

Appendix A

Supplementary flora assessment

Hume Highway Upgrade Woomargama Bypass

ADDENDUM REPORT – SPRING FLORA SURVEY

- Final
- November 2009



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1. Introduction

1.1. Background

As part of the upgrade of the Hume Highway, the NSW Roads and Traffic Authority (RTA) proposes to bypass the township of Woomargama north of Albury. A preferred route has been recommended following the investigation of a number of route options. An Environmental Assessment for the Woomargama Bypass has been prepared by Parsons Brinckerhoff (2009), however due to access constraints at the time detailed flora surveys could not be undertaken. As a condition of the Environmental Assessment a statement of commitment was agreed to by the Department of Environment, Climate Change and Water (DECCW) to undertake targeted flora surveys during spring. This addendum report documents the results of the spring flora surveys and associated ecological constraints of the proposal which is approximately 9 km in length located to the west of the existing Hume Highway.

1.2. Aims

The aims of the study were to assess the presence of threatened flora species, populations and communities listed under the schedules of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (EPBC Act) and the NSW *Threatened Species Conservation Act*, 1995 (TSC Act).

The objectives of this study were to:

- Investigate the presence, extent and quality of threatened ecological communities potentially impacted by the preferred bypass route, in particular White Box-Yellow Box-Blakely's Red Gum Woodland (Box-Gum Woodland).
- Identify areas of Box-Gum Woodland which are consistent with descriptions of the Critically Endangered Ecological Community (CEEC) as listed under the EPBC Act and the Endangered Ecological Community (EEC) listed under the TSC Act.
- Undertake targeted surveys for threatened flora species potentially occurring in the study area.
- Identify the quality and extent of potential habitat for threatened flora species in the study area.
- Identify the potential impacts of the proposal on listed vegetation communities and species and compare this with the predicted impacts presented in the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009).
- Review the statement of commitments with regard to the findings of the current ecological survey.



2. Methods

Field surveys for the flora assessment were conducted in the spring season of 2009 (21-24 September). The survey concentrated on the proposal area including the road footprint and proposed site compound/office areas.

The survey aimed to identify the presence of threatened flora species, populations and listed communities in the study area and provide data to be used as a basis for the prediction of impacts and refinement of the concept design and/or management and mitigation measures provided in the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) where feasible. The flora surveys utilised a combination of general traverses or transects, plot-based quadrat assessments and targeted surveys for threatened flora species.

2.1. Vegetation Communities

The distribution and extent of vegetation communities in the local area was initially identified from digital mapping undertaken as part of the route selection process and the preliminary ecological assessment for the Woomargama Bypass (nghenvironmental 2007). This vegetation map was ground-truthed and the verification data used to refine the distribution of vegetation communities within the study area. Transect sampling was conducted to identify species composition, vegetation community boundaries and habitat condition. A hand-held GPS unit was used to record the location of vegetation community boundaries and any other items of interest. Vegetation communities were compared with communities listed as occurring in the Murray Catchment Management Authority area in the BioMetric database (DECC 2008).

Digital mapping of vegetation community boundaries was conducted using the ArcGIS software package. A combination of field data, aerial photograph interpretation and biophysical data such as elevation and soil type were used to map the boundaries of vegetation communities. Vegetation communities were compared with final determination advice and identification guidelines for endangered ecological communities, in particular Box-Gum Woodland (NPWS 2002; DEH 2005; NSW Fisheries 2002).

Quantitative data on species richness were collected from plots replicated across each vegetation association. Quadrat sampling was used to determine the floristic composition and structure of vegetation associations, and the ecological condition of the vegetation including disturbances and weed abundance. Quadrat size was 20 m x 50 m (0.1 ha) to be consistent with assessment of vegetation patches under the EPBC Act guidelines and determine areas that meet the criteria for the critically endangered Box-Gum Woodland. A total of 12 quadrats were surveyed throughout the study area. Quadrats were positioned to represent the diversity of habitats occurring in the study area, such as riparian zones, rocky outcrops, woodland patches of varying condition, stockpiles, isolated trees and open fields.



Data collected in each quadrat included:

- Dominant species in each structural layer.
- Heights of structural layers (i.e. canopy, sub-canopy, shrub and groundcovers).
- A cover abundance score of each layer (based on a modified Braun Blanquet cover scale).
- Landscape features (i.e. slope, gully, aspect etc).
- Soil features (soil type, rocks, organic matter etc).
- Geographical coordinates and a photographic record.
- Species richness and abundance.
- The presence and abundance of weed species.
- The condition of the vegetation including past and present disturbances such as fire, grazing, logging, etc.

Additional to these quadrat assessments and general traverses, rapid plot-based assessments were undertaken recording dominant floristic species, and vegetation structure and condition to aid vegetation mapping. Any species which could not be identified in the field were collected for later identification or for lodgement with the Royal Botanic Gardens.

2.2. Vegetation Condition Assessment

The condition of individual patches within the study area was ranked relative to each other. Quadrats and general meanders were used to investigate and document the vegetation condition within patches of vegetation across the study area.

Condition was determined through several factors including: the size of the patch, the density of mature trees, current disturbance regimes; the amount of native and exotic vegetation cover in the understorey, and the potential for the patch to regenerate. One of three condition scores (low, moderate and high) were assigned to each patch within proximity to the road corridor and mapped. Vegetation condition scores comprise the following rankings listed in **Table 2-1**.

■ **Table 2-1: Vegetation Condition scores used in this assessment**

Condition Score	Vegetation Attributes	Meets criteria under identification guidelines	
		TSC Act	EPBC Act
High	■ Greater than 20 trees per hectare. ■ Relatively intact understorey with a mix of native and exotic species, including native shrubs, herbs and grasses. ■ Exotic species cover consists mostly of annual grass species. ■ Native species in the understorey occur as a low-moderate cover of perennial species.	Yes. Listed as EEC	Yes. Listed as CEEC



Condition Score	Vegetation Attributes	Meets criteria under identification guidelines	
		TSC Act	EPBC Act
	Likely to respond to assisted natural regeneration.		
Moderate	- Larger patches (>2ha) with a moderate canopy cover. - Understorey highly disturbed comprising improved pasture that is heavily grazed supporting a very low (<5%) native species cover. - Could potentially respond to assisted natural regeneration given sufficient time and resources.	Yes. Listed as EEC	No. Not listed as CEEC
Low	- Isolated trees - Understorey highly disturbed comprising improved pasture that is heavily grazed supporting a very low (<5%) native species cover. - Unlikely to respond to assisted natural regeneration given sufficient time and resources.	No. Not listed as EEC	No. Not listed as CEEC

It is evident that the national listing excludes patches that are included within the State-recognised communities on the basis of a cover of predominantly exotic understorey species. Such areas are identified in this study as “Low” and “Moderate” quality remnants. The excluded areas are heavily degraded and do not retain sufficient values to merit protection under the EPBC Act (DEH 2006). However, under the TSC Act, such areas, especially those in which the vegetation could respond to assisted regeneration, are classified under the listing advice and are considered important areas of partial native vegetation with potential to assist the recovery of the community.

This methodology coupled with GIS analysis provides for identification of Box-Gum Woodland under the TSC Act and EPBC Act identification guidelines. This is achieved through the identification of the proportion of cover for the shrubs and native and exotic species in the understorey, and determining the species composition, patch size, tree density and vegetation structure within each patch (refer to Section 2.3).

2.3. Identification of Box-Gum Woodland

Preliminary investigations identified the presence of Box-Gum Woodland. This community is listed under both the State (TSC Act) and Commonwealth (EPBC Act) legislation, both of which provide separate guidelines for identifying and managing Box-Gum Woodland remnants. The approach addresses each of the guidelines as shown below.



2.3.1. Identification Guidelines under the TSC Act

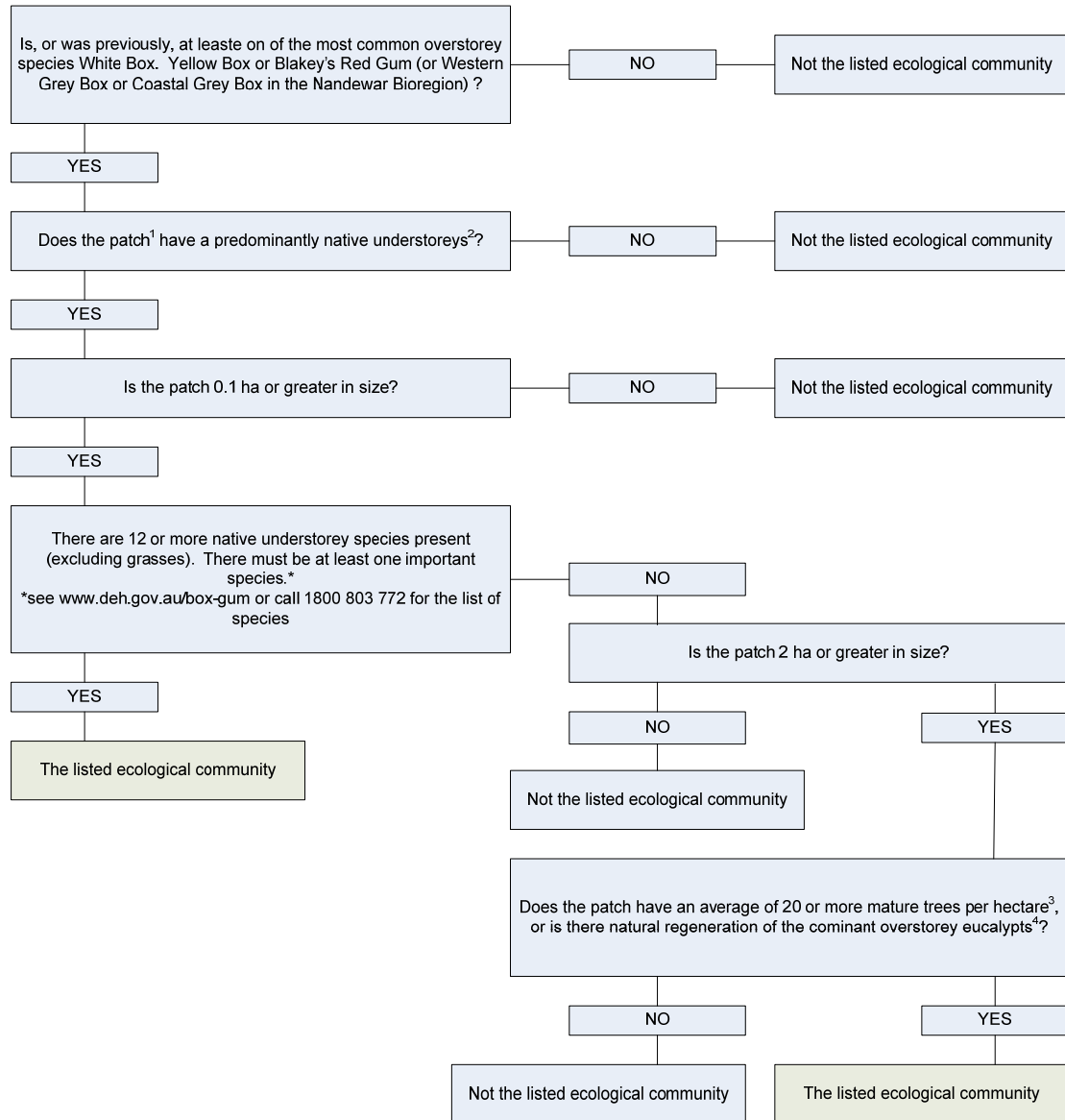
The following is a key used in determining whether Box-Gum woodland exists on a site and should be classified as an Endangered Ecological Community (EEC) under the TSC Act (NPWS 2002).

1	The site is in the NSW North coast, New England Tableland, Nandewar, Brigalow Belt south, Sydney Basin, south Eastern Highlands or NSW South Western Slopes Bioregions	2.
1*	The site is outside the above bioregions	The site is not Box-Gum Woodland
2	There are no native species in the understorey, and the site is unlikely to respond to assisted natural regeneration	The site is not Box-Gum Woodland
2*	The understorey is otherwise	3
3	The site has trees	3
3*	The site is treeless, but is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing:	5
4	White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or were present	5
4*	White Box, Yellow Box or Blakely's Red Gum, have never been present	The site is not Box-Gum Woodland
5	The site is predominantly grassy	The site is Box-Gum Woodland
5*	The understorey of the site is dominated by shrubs excluding pioneers species	The site is not Box-Gum Woodland

Under these guidelines it is important to note that the size or ages of the remnant are not determining factors as to whether it constitutes the listed EEC or not. Similarly the definition of the Box-Gum Woodland recognises that some remnants are degraded and have few native species in the understorey, although are considered to have high assisted natural regeneration potential.

2.3.2. Identification Guidelines under the EPBC Act

The following flowchart represents the lowest condition at which vegetation patches are included in the listed Critically Endangered Ecological Community (CEEC) under the EPBC Act.



¹ Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch. In determining patch size it is important to know what is and is not, included within any individual patch. The patch is the larger of:

- an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
- the area over which the understorey is predominantly native.

Patches must be assessed at a scale of 0.1 ha or greater

² A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine that is late autumn when the annual species have died back and have not yet started to regrow

³ Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground

⁴ Natural regeneration of the dominant overstorey eucalypts when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

(DEH 2006)



2.3.3. Targeted Surveys

Threatened flora species which potentially occur in the study area were targeted in the survey by random meanders through areas of suitable habitat, which allows for greater coverage than plot-based techniques. Targeted surveys for threatened flora were concentrated within areas of Box-Gum Woodland with a partially intact understorey, as these areas have the greatest potential to support these species, and areas with an improved pasture understorey have a very low potential to support these species. Targeted searches were also conducted within creeks and farm dams for threatened aquatic flora species. Random meanders were conducted along all remnants within the road easement of the Hume Highway, comprising a total effort of 16 person hours. Several random meanders were also conducted within Box-Gum Woodland areas with a highly disturbed improved pasture understorey, comprising a total effort of 6 person hours.

Targeted threatened species searches were focussed on but not limited to the species listed in **Table 2-2**. There is currently a preliminary proposal to delist Pine Donkey Orchid (*Diuris tricolor*) from the EPBC Act.

■ **Table 2-2: Targeted threatened species**

Species	Conservation significance		Habitat within the flora and fauna assessment area	Flowering period	Likelihood of occurrence*
	TSC Act	EPBC Act			
Silky Swainson-pea (<i>Swainsona sericea</i>)	V		Box-Gum Woodland	Spring	Moderate
Pine Donkey Orchid (<i>Diuris tricolor</i>)	V	V	Box-Gum Woodland	September to November	Moderate
River Swamp Wallaby-grass (<i>Amphibromus fluitans</i>)	V	V	Creeks and dams	Spring to autumn or November to March	Moderate
Austral Pilwort (<i>Pilularia novae-hollandiae</i>)	V		Creeks and dams	N/A	Moderate
Small scurf-pea (<i>Cullen parvum</i>)	E		River Red Gum Woodland	Summer	Moderate
Mountain Swainson-pea (<i>Swainsona recta</i>)	E	E	Box-Gum Woodland	Late September-early December	Moderate

* Likelihood of Occurrence

Moderate: Species have been recorded from the wider locality (DECCW 2009) and have suitable habitat attributes in the study area, although habitat generally in a poor or modified condition.



3. Results

3.1. Floristic Diversity

A total of 178 flora species were recorded within the study area. This total consisted of 2 species of fern, 2 conifer species, 113 species of dicotyledons and 61 species of monocotyledons. Of the total species recorded, 86 species of introduced flora were identified, representing approximately 48% of the total, and an additional 9 species are non-indigenous native flora species which have been planted in the study area. Of the 86 species of introduced flora present, 7 are listed as being noxious weeds in the Greater Hume local government area. A comprehensive list of the flora species present within the study area has been included as **Appendix A**.

3.2. Vegetation Communities

Two broad vegetation community types were identified in the study area, comprising Box-Gum Woodland and River Red Gum Woodland in riparian areas. Areas of Box-Gum Woodland were delineated into areas where the understory is partially intact, areas with an improved pasture understorey where the native understorey has been removed, and areas of isolated trees with an improved pasture understorey. The distribution of vegetation communities is illustrated in **Figure 3-1, 3-2 and 3-3** and a description summarised below. The remainder of the study area comprises improved pasture which has little or no remnant native flora species presence.

Box-Gum Woodland communities in the study area are consistent with Grassy White Box - Blakely's Red Gum - Yellow Box woodland of the NSW South Western Slopes Bioregion (Benson 282) as described in the BioMetric database (DECC 2008). River Red Gum Woodland in the study area is consistent with River Red Gum very tall open forest of the NSW South Western Slopes Bioregion (Benson 79) as described in the BioMetric database (DECC 2008).

Box-Gum Woodland – Disturbed Understorey

Refers to remnant vegetation in the road easements of the existing Hume Highway which support a partially intact native understorey, however during the survey period exotic annual species were generally dominant (**Plate 1 & 2**). The canopy is dominated by White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*Eucalyptus blakelyi*), with several other trees occurring in lower abundance including Apple Box (*Eucalyptus bridgesiana*), Red Stringybark (*Eucalyptus macrorhyncha*) and Large-leaved Box (*Eucalyptus goniacalyx*). The abundance of mature trees in these areas is greater than 20 trees / hectare. These areas support a mix of native and exotic understorey species including shrubs such as Silver Wattle (*Acacia dealbata*), Golden Wattle (*Acacia pycnantha*) and Wedge-leaved Wattle (*Acacia pravissima*).

The understorey was dominated by exotic annual species including grasses such as Barley Grass (*Hordeum leporinum*), Wild Oats (*Avena fatua*) and Annual Veldtgrass (*Ehrharta longiflora*). A



low-moderate cover of native species is present including native grasses such as Plains Grass Speargrass (*Austrostipa scabra*), Wallaby Grasses (*Austrodanthonia* spp.), Common Wheatgrass (*Elymus scaber* var. *scaber*) and several native herbs including Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*), *Oxalis* spp., *Acaena ovina*, Native Geranium (*Geranium solanderi* var. *solanderi*) and Tall Sedge (*Carex appressa*). Several areas on embankments elevated above the existing highway support better quality areas of understorey including forb species that are vulnerable to disturbance such as Sun-orchid (*Thelymitra* spp.), Chocolate Lily (*Dichopogon strictus*) and Native Leek (*Bulbine bulbosa*).

This community is consistent with White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the EPBC Act and White Box-Yellow-Box Blakely's-Red Gum Woodland as listed under the TSC Act.

Although the understorey of these areas is generally dominated by exotic flora, the presence of some native species in the understorey suggests the natural soil and associated seed bank are mostly intact and these areas would respond to assisted natural regeneration. Such areas provide potential habitat for threatened flora species, however only marginally so considering the high competition from exotic grasses and herbs.



Plate 1: Box-Gum woodland with a disturbed understorey supporting a mix of native and exotic species (southern end).



Plate 2: Box-Gum woodland with a disturbed understorey supporting a mix of native and exotic species (northern end).

Box-Gum Woodland – Improved Pasture Understorey

Larger clusters (> 1 ha) of remnant trees within private property areas are characteristic of Box-Gum Woodland being dominated by White Box, Yellow Box, Blakely's Red Gum and Large-leaved Box. The understorey is highly disturbed supporting improved pasture dominated by several exotic species (**Plate 3**) including Barley Grass, Phalaris (*Phalaris aquatica*), Capeweed



(*Arctotheca calendula*), Clover (*Trifolium* spp), Sorrel (*Acetosella vulgaris*) and Onion Grass (*Romulea rosea* var. *australis*). Native species are generally absent from areas of improved pasture being limited to sporadic occurrences of Swamp Dock (*Rumex brownii*), Stonecrop (*Crassula* spp.) and Plains Grass (*Austrostipa aristiglumis*) mostly around rocky outcrops. Tall Sedge is present in the understorey surrounding depressions and minor drainage lines and is co-dominant with exotic species in areas within the study area (**Plate 4**).

These areas have a lower density of mature trees (generally less than 20 mature trees / hectare) and there is no or very little evidence of regenerating canopy species. The presence of native understorey species during the survey period is very sporadic suggesting the natural soil and associated seed bank are highly depleted and are therefore unlikely to provide potential habitat for threatened flora species.

Although such areas exhibited minimal native flora species in the understorey, there is potential for native species to be present in higher abundance during autumn/winter or drier periods when annual grasses are less abundant. With the removal of livestock and pasture improvement activities from these areas there is likely to be the eventual regeneration of canopy species, and potentially, with significant time there will be recruitment of native understorey species. Therefore larger patches of these woodland areas are considered to be consistent with White Box-Yellow Box-Blakely's Red Gum Woodland as listed under the TSC Act. These areas are not consistent with the CEEC listed under the EPBC Act due to the understorey being predominantly dominated by exotic flora species cover and/or the low density of tree cover (less than 20 mature trees / ha).

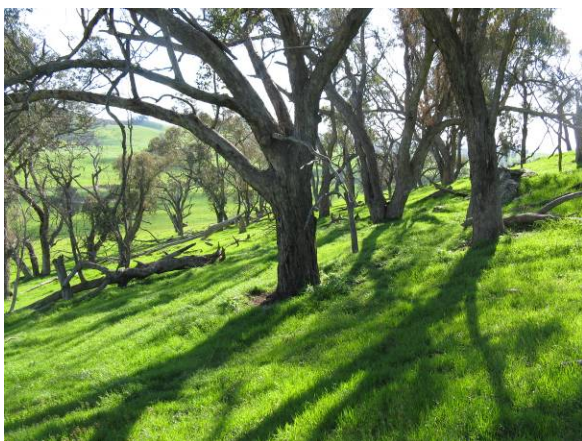


Plate 3: Box-Gum woodland with improved pasture understorey supporting dense pasture grasses and weeds.



Plate 4: Box-Gum woodland with improved pasture understorey and clumps of Tall Sedge (*Carex appressa*)



Box-Gum Woodland – Isolated Trees

Isolated trees within private property areas include tree species that are characteristic of Box-Gum Woodland such as White Box, Yellow Box, Blakely's Red Gum and Large-leaved Box. The understorey is highly disturbed supporting improved pasture, with little or no native species present.

Considering the highly fragmented and isolated occurrence of mature trees and the high degree of modification in the understorey from pasture improvement, these areas are considered unlikely to respond to assisted natural regeneration and therefore are not consistent with White Box-Yellow Box-Blakely's Red Gum Woodland as listed under the TSC Act. Similarly, these areas are not consistent with the CEEC listed under the EPBC Act due the understorey being predominantly dominated by exotic flora species cover.

River Red Gum Woodland

This community is present along Mountain Creek and is dominated by River Red Gum (*Eucalyptus camaldulensis*), with Weeping Willow (*Salix babylonica*) occurring on creek banks (**Plate 5**). There are also several billabongs on the river flats surrounding Mountain Creek supporting some native aquatic plant species. Minor occurrences of River Red Gum are also present along Sandy Creek (**Plate 6**). The understorey is highly disturbed supporting similar species to the surrounding areas of improved pasture with livestock having direct access to this area. The understorey is dominated by Phalaris, Barley Grass and other exotic pasture species. Shrub cover is limited to several Silver Wattle and wild fruit trees (*Prunus* spp.) along the edges of the creek. Cover of native macrophytes within the creek line and surrounding billabongs is sporadic including Common Rush (*Juncus usitatus*), Common Reed (*Phragmites australis*), Hyssop Loosestrife (*Lythrum hyssopifolia*), Star-fruit (*Damasonium minus*) and Broad-leaf Cumbungi (*Typha orientalis*).

The aquatic habitats of the creek and billabong supports potential habitat for the threatened flora species River Swamp Wallaby-grass (*Amphibromus fluitans*). However this species was not identified in this area despite targeted searches, and considering the highly disturbed nature of the understorey from livestock grazing, trampling and eutrophication of the aquatic environment this species is unlikely to occur (**Plate 5 & 6**).

Aquatic habitats within this community support the Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment as listed under the FM Act.



Plate 5: Mountain Creek with surrounding improved pasture and River Red Gum (*Eucalyptus camaldulensis*).



Plate 6: Sandy Creek with a scattered River Red Gums and dense pasture grasses surrounding the creek.

Non-indigenous Vegetation

Several areas of planted trees are present in the study area including exotic species and non-indigenous native species. These trees have been planted as part of wind-breaks on farms, roadside plantings adjacent to the existing Hume Highway and as part of rehabilitation activities along Sandy Creek.

Figure 3.1 : Vegetation Communities



Figure 3.2 : Vegetation Communities

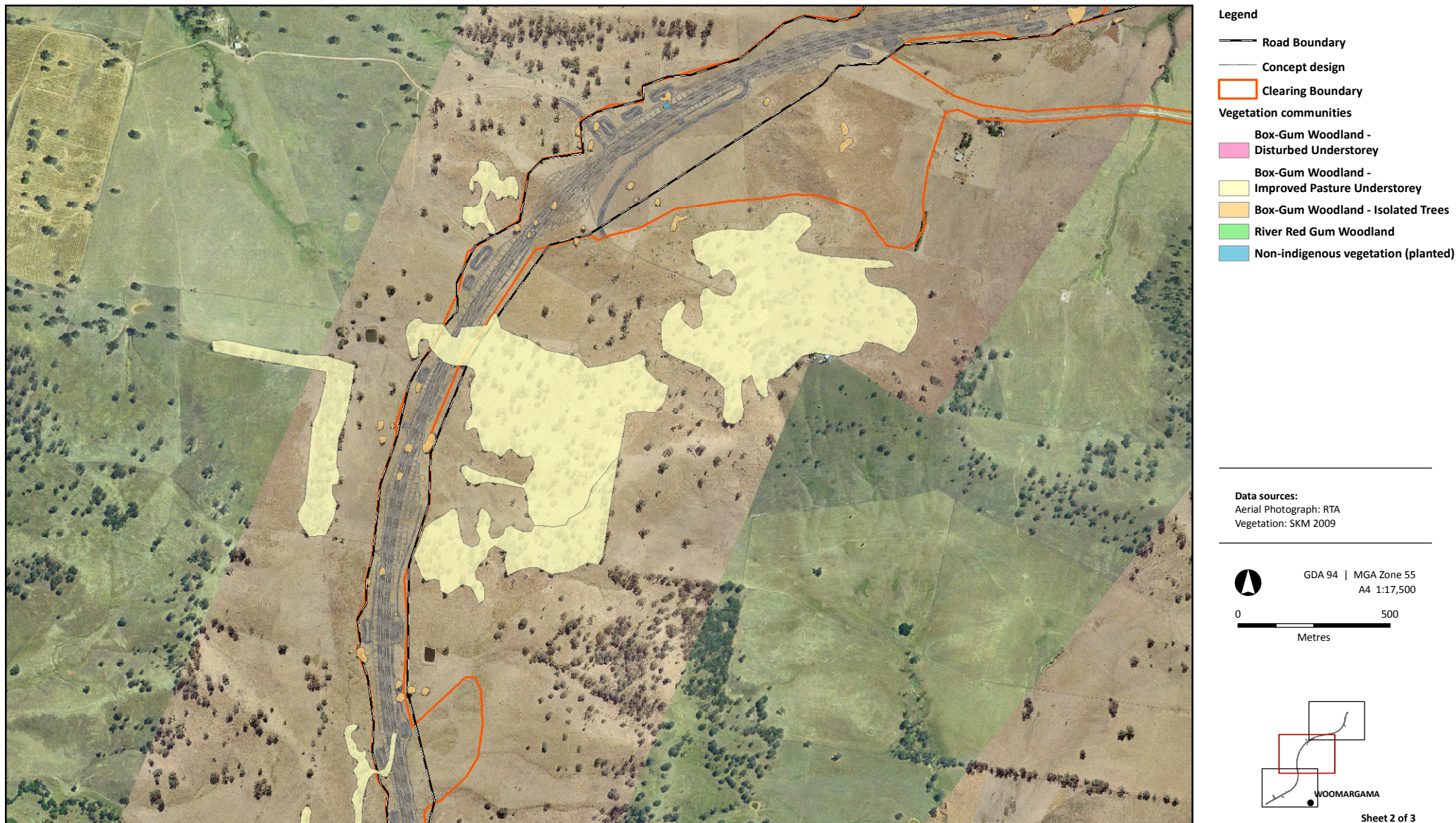
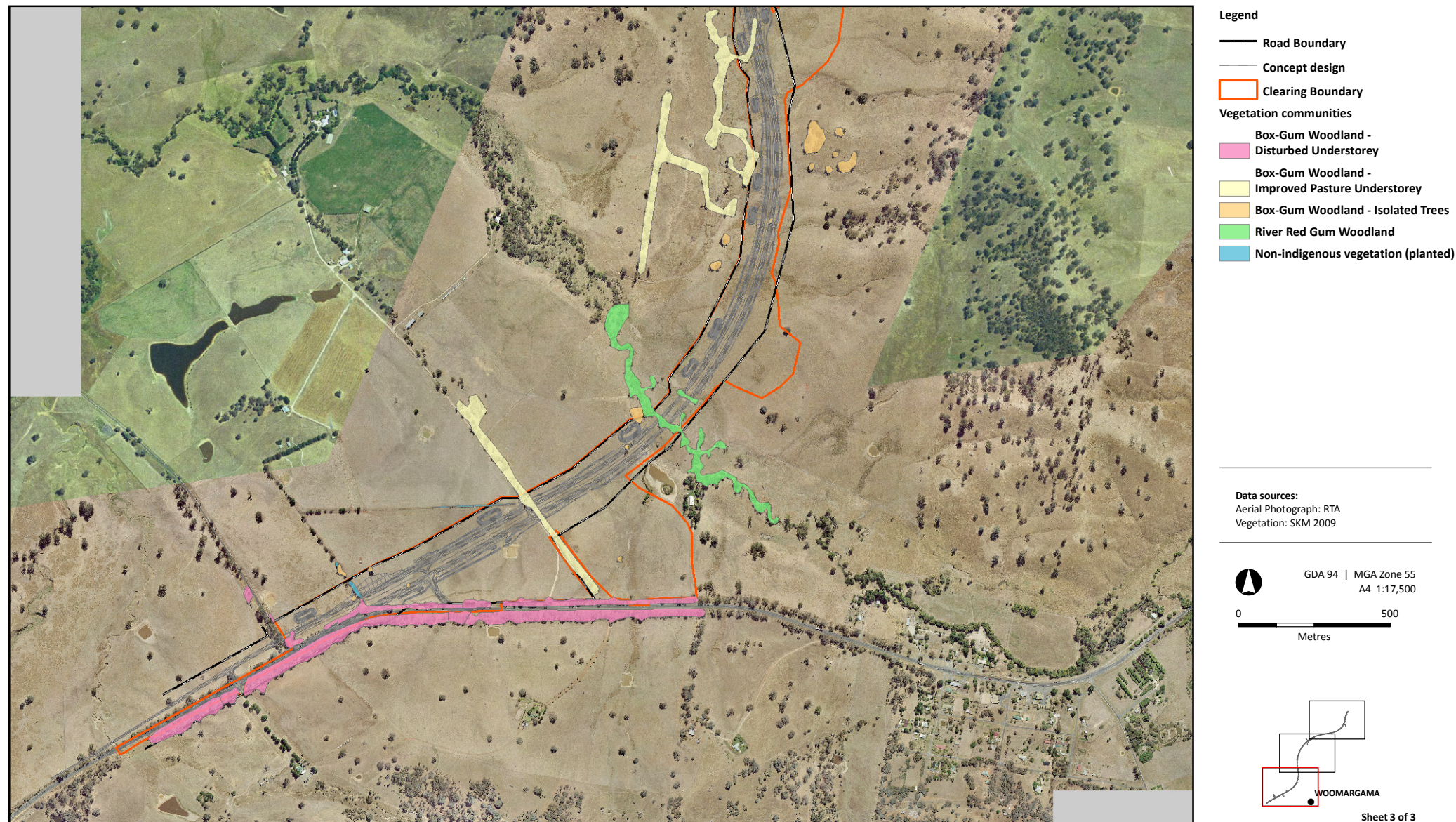


Figure 3.3 : Vegetation Communities



Hume Highway - Woomargama Bypass





3.3. Threatened Ecological Communities

Some areas of Box-Gum Woodland in the study area are consistent with White Box-Yellow Box-Blakely's Red Gum Woodland as listed under the TSC Act and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the EPBC Act. The condition assessment was used to determine the conservation status of remnant patches of Box-Gum Woodland (refer to **Table 2-1**). The condition of the Box-Gum Woodland remnants in the study area are illustrated in **Figure 3-4, 3-5 and 3-6** including the distribution of state and federal listed Box-Gum Woodland communities.

The federal listing excludes patches that are included within the State-recognised communities on the basis of a cover of predominantly exotic understorey species. Therefore all of the remnants which are not within the road easement of the existing Hume Highway have been excluded from the federal listing, as these areas support little or native understorey species and have been subject to repeated improved pasture activities and heavy grazing. Isolated trees which are characteristic of Box-Gum Woodland within an improved pasture landscape have been excluded from the state listed EEC on the basis that these areas are unlikely to respond to assisted natural regeneration.

Each of the major patches of Box-Gum Woodland within the study area as illustrated in **Figure 3-4, 3-5 and 3-6** (survey sites), have been assessed under the identification guidelines and the results are summarised in **Table 3-1**. Refer to **Appendix A** for list of species recorded at each survey site.

■ **Table 3-1: Assessment of Box-Gum Woodland in the study area**

Survey Site (refer to Figure 3-4, 3-5 and 3-6)	Consistency with legislation		Attributes
	TSC Act	EPBC Act	
1, 12	Yes	Yes	Larger than 2 ha and greater than 20 mature trees / ha, understorey partially intact and significant regeneration evident (includes all patches within the road easement). These areas support a moderate diversity of native species including several identified important species.
6	Yes	No	Patch 7 ha in area and greater than 20 mature trees / ha, however understorey highly disturbed comprising improved pasture dominated by exotics, no regeneration evident.
9, 10	Yes	No	Larger than 2 ha, less than 20 mature trees / ha, understorey highly disturbed, however cover of Tall Sedge (<i>Carex appressa</i>) is present with exotic pasture species, no regeneration evident.
5, 11	Yes	No	Larger than 2 ha, less than 20 mature trees / ha, understorey highly disturbed comprising improved pasture dominated by exotics, no regeneration evident.
2, 3, 4, 7, 8	No	No	Isolated trees with a highly modified improved pasture understorey dominated by exotics, no regeneration evident.

Figure 3.4 : Threatened Ecological Communities



Figure 3.5 : Threatened Ecological Communities

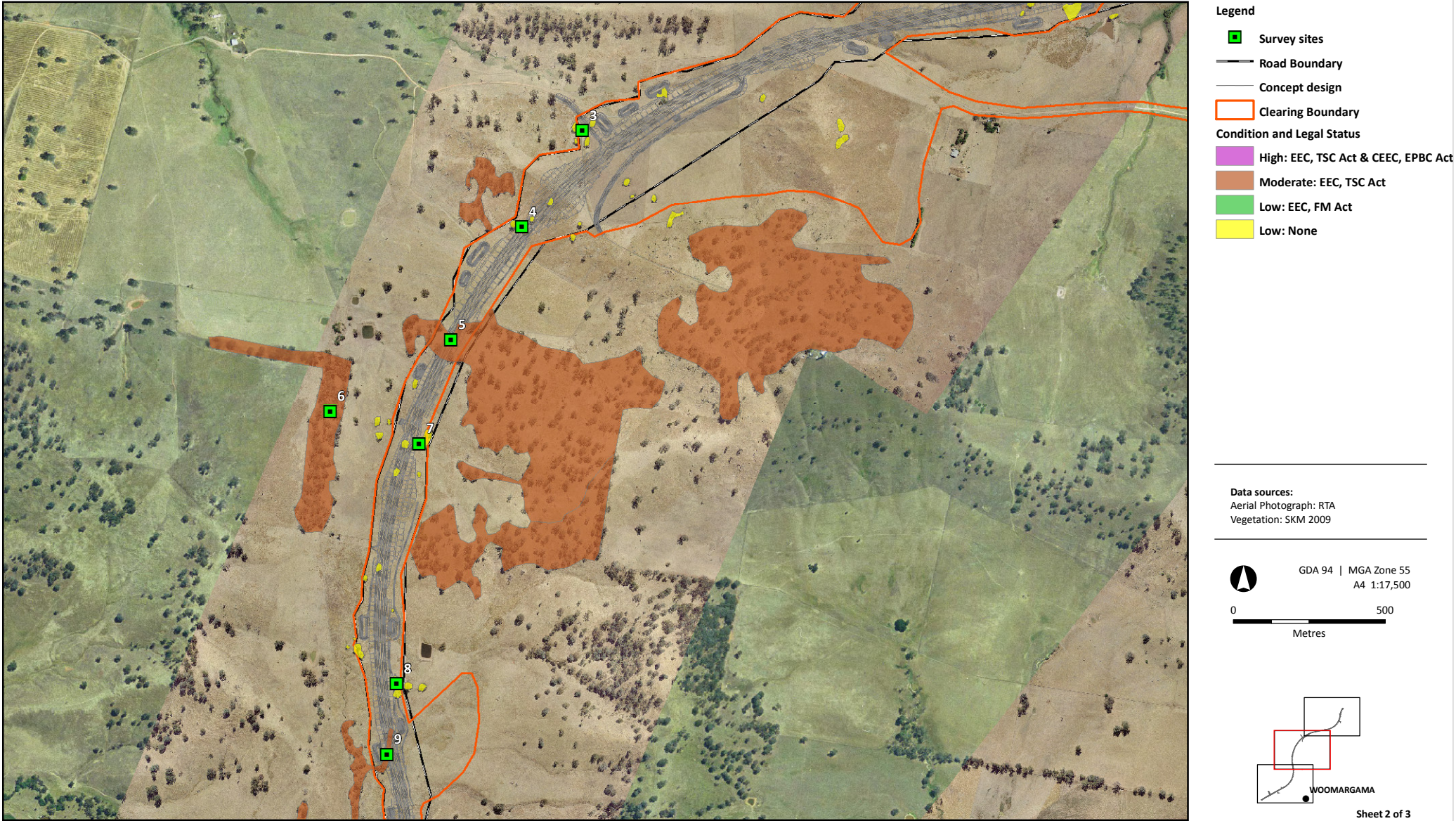
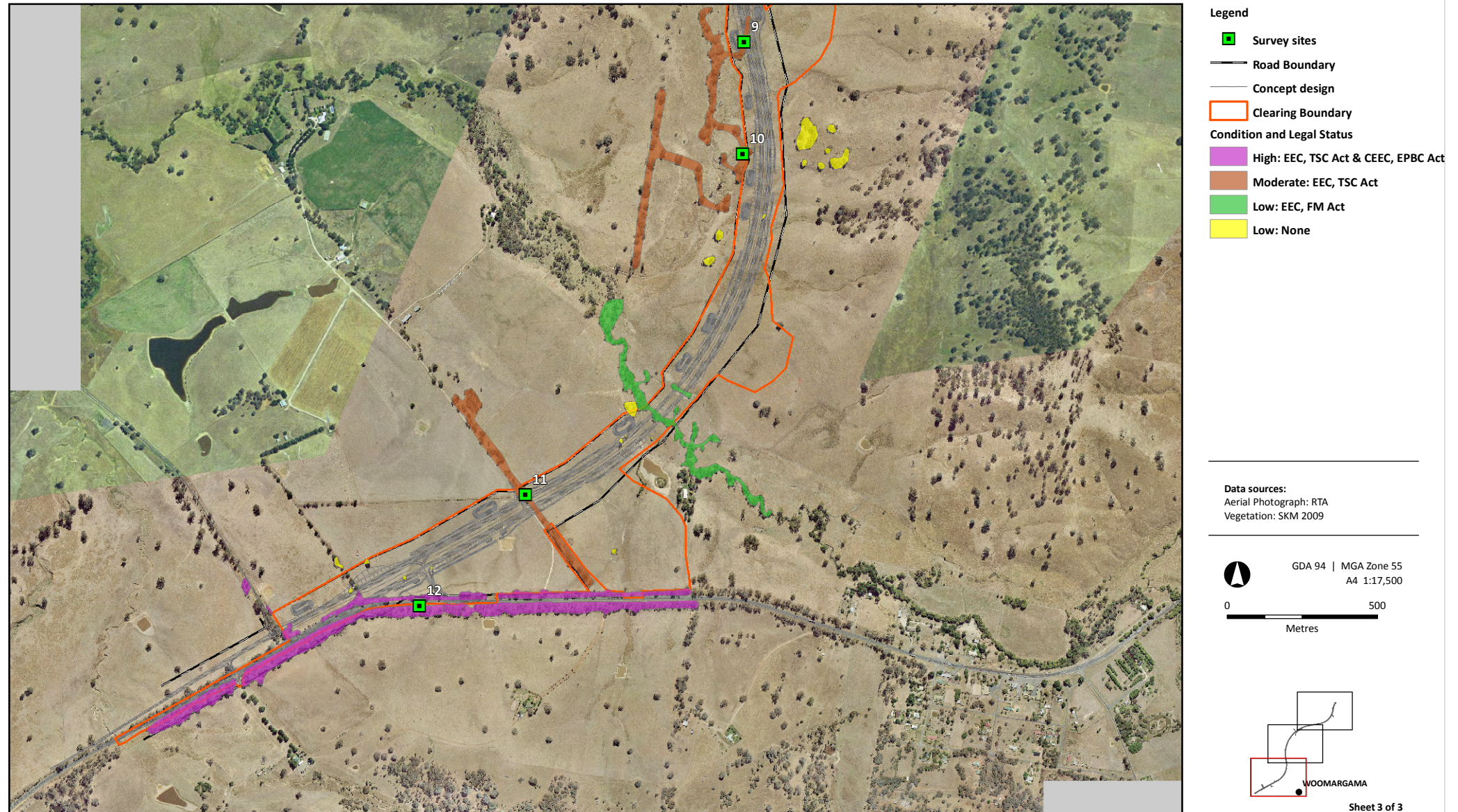


Figure 3.6 : Threatened Ecological Communities



Hume Highway - Woomargama Bypass





As the field surveys were conducted in the spring season there was an abundance of annual exotic grass species, which potentially obscured the abundance of native species in the understorey. There is potential for native species cover to be greater within these roadside remnants following die-off of exotic annuals during autumn/winter, therefore a precautionary approach has been taken and all remnants within the road easement have been identified as the federally listed community.

Given that the estimated proportion of Box-Gum Woodland remaining across the south-west slopes bioregion is approximately 5%, Priday and Mulvaney (2005) suggest that all regional remnants are considered of conservation significance. Considering this and the high subjectivity involved in determining the ability of remnants to respond to assisted natural regeneration, a precautionary approach was taken when assessing Box-Gum Woodland remnants within improved pasture areas under State legislation. Therefore all larger remnants within the study area are included under the state listed EEC as there is potential for assisted natural regeneration given sufficient time and resources, however isolated trees in improved pasture areas have been excluded on the basis that these areas are unlikely to respond to assisted natural regeneration.

Aquatic habitats along Mountain Creek and Sandy Creek support the Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment as listed under the FM Act. These habitats are currently subject to a high level of disturbance from livestock grazing and trampling, eutrophication, weed invasion and pasture improvement. Removal of riparian vegetation will constitute a key threatening process under the FM Act and will potentially have indirect and direct impacts to the aquatic ecological community.

3.4. Threatened Flora Species

No threatened flora species were recorded within the study area from the targeted search. Although potential habitat was identified for several threatened flora species in the study area the current disturbance regimes within these habitats suggest there is a small likelihood of them being present. Threatened species with identified potential habitat in the study area and considered to potentially occur are listed in **Table 2-2** and habitat for each of these species in the study area is illustrated in **Figure 3-7, 3-8 and 3-9**.

The condition scores used to rate the habitat quality for threatened flora species are defined in Table 3-2. Areas of predominantly native understorey within Box-Gum Woodland are limited to several small patches which are elevated above the existing Hume Highway within the road easement such as on top of embankments which are not subject to stormwater run-off (Plate 7 & 8). These areas provide the best quality habitat attributes for Silky Swainson-pea (*Swainsona sericea*), Pine Donkey Orchid (*Diuris tricolor*), Small scurf-pea (*Cullen parvum*) and Mountain Swainson-pea (*Swainsona recta*).



Other areas of habitat within the road easement are partially intact and provide moderate habitat quality as they support a high abundance of exotic annual species. Areas of Box-Gum Woodland in the study area on private properties are subject to pasture improvement and therefore provide lower quality habitat for these species. The condition classes used to rank the quality of threatened flora habitat are detailed in **Table 3-2**.

■ **Table 3-2: Habitat condition scores for threatened flora species**

Condition Score	Attributes
High	Patches of Box-Gum Woodland with a relatively high abundance and diversity of native species in the understorey.
Moderate	Patches of Box-Gum Woodland with a partially intact understorey dominated by annual exotic species, and aquatic/riparian habitats along creeks in the study area.
Low	Areas of Box-Gum Woodland with an improved pasture understorey with little/no native understorey species, and aquatic habitats within farm dams.

Habitat for River Swamp Wallaby-grass (*Amphibromus fluitans*) and Austral Pilwort (*Pilularia novae-hollandiae*) is limited to aquatic habitats along Mountain Creek, Sandy Creek and within farm dams (**Figure 3-7, 3-8 and 3-9**). However these areas provide moderate habitat quality for this species and are subject to disturbances from livestock grazing and trampling, eutrophication, weed invasion and pasture improvement. Aquatic habitats are generally of moderate quality along creeks within the study area, supporting a low abundance of macrophytes and riparian vegetation. Several dams in the study area provide relatively low condition habitats with little/no macrophytes, and these areas are subject to a high degree of trampling from livestock.



Plate 7: Box-Gum woodland supporting higher condition understorey and potential threatened flora species habitat (southern end).



Plate 8: Box-Gum woodland supporting higher condition understorey and potential threatened flora species habitat (northern end).

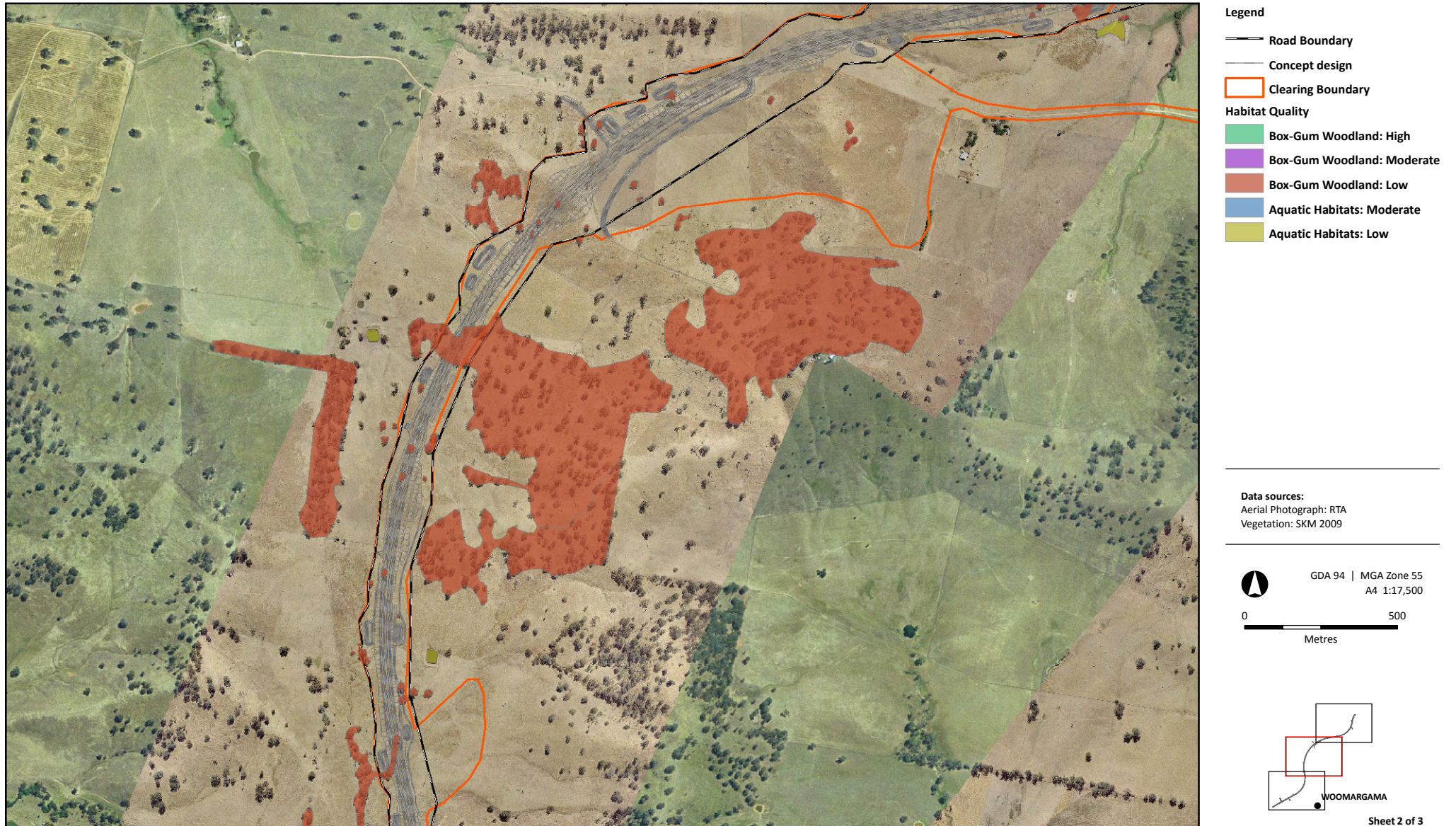
Figure 3.7 : Threatened Flora Species Habitat Quality



Hume Highway - Woomargama Bypass



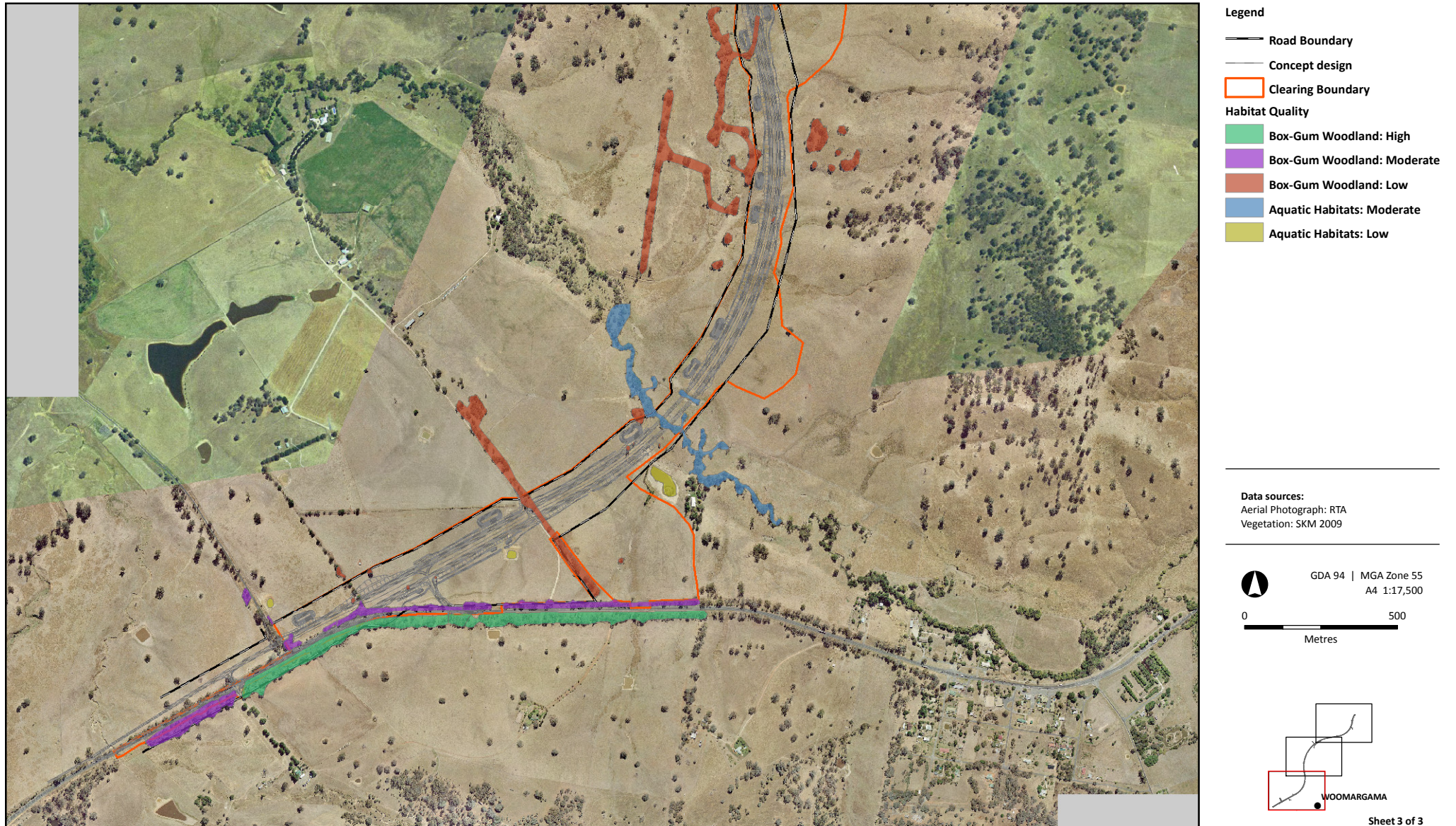
Figure 3.8 : Threatened Flora Species Habitat Quality



Hume Highway - Woomargama Bypass



Figure 3.9 : Threatened Flora Species Habitat Quality



Hume Highway - Woomargama Bypass





4. Assessment of Impacts

The impacts on state and federally listed threatened ecological communities have been calculated based on the results of the spring flora survey. The calculations are based on the area of mapped vegetation intersected by the clearing boundary. **Table 4-1** compares the impact areas determined from ground-truthing with the predicted impacts noted in the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) which were determined by aerial photograph interpretation.

■ **Table 4-1: Potential ecological impacts**

Community / Species	Conservation significance			Potential Impacts - Current Study September 2009 (ha)*	Potential Impacts – Section 5-1; Parsons Brinckerhoff 2009 (ha)
	TSC Act	EPBC Act	FM Act		
Threatened Ecological Communities					
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	-	CE	-	4	6 (Box-gum woodland)
White Box-Yellow Box-Blakely's Red Gum Woodland	E	-	-	6	6 (Box-gum woodland)
Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment	-	-	E	1	1 (Riparian vegetation)
Threatened Flora Species Habitat					
Silky Swainson-pea (<i>Swainsona sericea</i>)	V	-	-	4 (high-mod quality)	7
Pine Donkey Orchid (<i>Diuris tricolor</i>)	V	V	-	4 (high-mod quality)	7
Small scurf-pea (<i>Cullen parvum</i>)	E			4 (high-mod quality)	7
Mountain Swainson-pea (<i>Swainsona recta</i>)	E	E		4 (high-mod quality)	7
River Swamp Wallaby-grass (<i>Amphibromus fluitans</i>)	V	V	-	1 (moderate quality)	1
Austral Pilwort (<i>Pilularia novae-hollandiae</i>)	V			1 (moderate quality)	1

* Note – the total area of threatened ecological communities potentially impacted by the proposal is 7 ha because the 6 ha of TSC Act listed EEC incorporates the 4 ha of EPBC Act CEEC.



Assessments of significance were conducted under the TSC Act and/or the EPBC Act for each of the threatened ecological communities identified and potential threatened flora species listed in **Table 4-1** (Parsons Brinckerhoff 2009). The current surveys have identified the presence of a similar or smaller area of threatened ecological communities and threatened species habitat in the study area. As can be seen in **Table 4-1** the Environmental Assessment (Parsons Brinckerhoff 2009) including the assessments of significance for threatened communities were based on a greater area of habitat removal for the EPBC Act listed CEEC and a similar area for the TSC Act listed EEC. Similarly for threatened species habitat removal, the area of potential habitat identified in the current surveys comprises a smaller area for those species potentially occurring in Box-Gum Woodland, and a similar area for threatened species potentially occurring in aquatic habitats. Therefore the conclusions of the assessment with respect to non-significance are supported by the results of the current targeted field surveys.

The total area of each of the vegetation communities potentially removed including non-indigenous vegetation and isolated paddock trees is detailed in **Table 4-2**. The terrestrial fauna survey report for the Woomargama Bypass (EnviroKey 2009) identifies a greater area of habitat potentially impacted as this is based on fauna habitats rather than vegetation communities.

■ **Table 4-2: Potential removal of vegetation communities**

Species	Potential Removal - Current Study September 2009 (ha)
Box-Gum Woodland – Disturbed Understorey	4
Box-Gum Woodland – Improved Pasture Understorey	2
Box-Gum Woodland – Isolated Trees	1
River Red Gum Woodland	1
Non-indigenous vegetation (planted)	1
Total Vegetation Removal	9



5. Conclusions

The following conclusions have been established regarding the quality and extent of vegetation communities and threatened flora habitat within the Woomargama Bypass study area.

Threatened Ecological Communities

- Areas of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed under the EPBC Act are restricted to areas within the road easement of the Hume Highway at the southern and northern end of the Woomargama Bypass where the understorey is at least partially intact. Approximately 4 ha of this CEEC will potentially be impacted by the proposal.
- Areas of vegetation within private property are highly disturbed comprising patches of mature trees from Box-Gum Woodland with an improved pasture understorey supporting little native vegetation cover. Larger clumps have been classed as White Box-Yellow Box-Blakely's Red Gum Woodland as listed under the TSC Act on the basis that these areas would potentially respond to assisted natural regeneration given sufficient time and resources. Approximately 6 ha of this EEC will potentially be impacted by the proposal (this includes the four hectares of CEEC as listed under the EPBC Act).
- Isolated trees which are characteristic of Box-Gum Woodland within an improved pasture landscape have been excluded from the TSC Act listed EEC on the basis that these areas are unlikely to respond to assisted natural regeneration.
- Aquatic habitats along Mountain Creek and Sandy Creek support the Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment as EEC listed under the FM Act. These habitats are currently subject to a high level of disturbance from livestock grazing and trampling, eutrophication, weed invasion and pasture improvement. Approximately 1 ha of riparian vegetation that supports this community will potentially be impacted by the proposal.

Threatened Flora Species

- No threatened flora species were identified in the study area during the spring flora surveys despite targeted searches within areas of suitable habitat.
- High quality potential habitat for Silky Swainson-pea (*Swainsona sericea*), Pine Donkey Orchid (*Diuris tricolor*), Small scurf-pea (*Cullen parvum*) and Mountain Swainson-pea (*Swainsona recta*) is restricted to a few small patches within the road easement of the Hume Highway at the southern and northern end of the study area. The remaining areas within the road easement comprise moderate quality habitat and Box-Gum Woodland within private property are low quality and generally unsuitable for these species.
- Habitat for River Swamp Wallaby-grass (*Amphibromus fluitans*) and Austral Pilwort (*Pilularia novae-hollandiae*) is limited to aquatic habitats along Mountain Creek, Sandy Creek



and within farm dams, however these areas provide marginal habitat quality for this species and are subject to a high level of disturbance.

- Additional threatened flora species were identified as potentially occurring based on the presence of suitable habitat, however none of these species were identified in the study area during the current surveys and considering the high level of disturbance within habitats of the study area it is unlikely any of these threatened flora species are present. No further assessment is required for these species.
- The majority of high quality Box-Gum Woodland habitats for threatened flora species are outside the clearing boundary and are unlikely to be impacted from the proposal.

Limitations

- The surveys were conducted in spring when there was a high abundance of annual exotic species, as stated in the EPBC Act identification guidelines the best time of year to determine native species cover within Box-Gum Woodland remnants is in autumn following die-back of exotic annual species, therefore a precautionary approach was taken when assessing the presence of the EPBC Act listed Box Gum Woodland community.
- There is potential that the Pine Donkey Orchid (*Diuris tricolor*) were not flowering (detectable) during the survey period, or at a stage of senescence where it was virtually undetectable. However the majority of the best quality Box-Gum Woodland habitats in the study area are outside the clearing boundary, and assessments of significance in the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) assesses a 7 ha of habitat removal as being insignificant.

Impact Assessment

- The Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) includes assessments of significance for the threatened communities and flora species listed in **Table 4-1**. These assessments of significance are based on a larger area of habitat/vegetation removal than has been identified in the study area from the current spring flora surveys (September 2009).
- Considering the above factors and the conclusions of the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) the results of the field survey support the original conclusions that the proposal is unlikely to result in a significant impact to threatened ecological communities or threatened flora species.

Mitigation Measures

- Critically endangered Box-Gum Woodland within the Hume Highway road easement at the southern and northern ends of the proposal should be avoided where possible, in particular areas on embankments on the eastern side of the highway which support high quality habitats for threatened flora should be avoided.
- Where possible isolated paddock trees and other native vegetation cover should be retained.



- Considering the conclusions of the current survey support the findings of the Woomargama Bypass Environmental Assessment (Parsons Brinckerhoff 2009) additional comprehensive mitigation measures are not necessary.



6. Bibliography

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7. Appendix A: Flora Species List

Classification/ Scientific name	Common Name	Survey Site													Riparian
		1	2	3	4	5	6	7	8	9	10	11	12		
Ferns															
ADIANTACEAE															
<i>Cheilanthes austrotenuifolia</i>	Rock Cloak-fern	x												x	
ASPLENIACEAE															
<i>Pleurosorus subglandulosus</i>															
Conifers															
CUPRESSACEAE															
<i>Callitris endlicheri</i>	Black Cypress Pine														
PINACEAE															
<i>Pinus spp.</i>	Pine	i													
Flowering Plants - Dicotyledons															
AMYGDALACEAE															
<i>Prunus spp.</i>		i													x
APIACEAE															
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort														x
<i>Lilaeopsis polyantha</i>	Lilaeopsis														x
ASTERACEAE															
<i>Arctotheca calendula</i>	Cape Dandelion	i	x	x	x	x	x	x	x	x	x	x		x	x
<i>Aster subulatus</i>	Wild Aster	i													x

Classification/ Scientific name		Common Name	Survey Site													
			1	2	3	4	5	6	7	8	9	10	11	12	Riparian	
	<i>Calotis hispidula</i>	Bogan Flea	x													
	<i>Carthamus lanatus</i>	Saffron Thistle	i	x	x											
	<i>Cassinia longifolia</i>													x		
	<i>Cirsium vulgare</i>	Spear Thistle	i		x											
	<i>Conyza spp.</i>	Fleabane	i											x		
	<i>Cotula australis</i>	Lawn Cotula												x		
	<i>Cotula bipinnata</i>	Ferny Cotula	i	x												
	<i>Hypochaeris radicata</i>	Catsear	i	x										x		
	<i>Lactuca serriola</i>	Prickly Lettuce	i											x		
	<i>Pseudognaphalium luteo-album</i>	Jersey Cudweed		x										x		
	<i>Silybum marianum</i>	Variegated Thistle	i				x	x		x	x					
	<i>Sonchus asper</i>	Toothed Sow-thistle	i													
	<i>Sonchus oleraceus</i>	Common Sow-thistle	i											x		
	<i>Xanthium occidentale</i>	Noogoora Burr	iw												x	
	<i>Xerochrysum viscosum</i>	Sticky Everlasting												x		
BORAGINACEAE																
	<i>Echium plantagineum</i>	Patterson's Curse	i	x	x	x		x		x	x			x		
	<i>Echium vulgare</i>	Vipers Bugloss	i							x	x			x		
BRASSICACEAE																
	<i>Brassica rapa</i> subsp. <i>sylvestris</i>	Wild Turnip	i				x									
	<i>Capsella bursa-pastoris</i>	Shepherds Purse	i													
	<i>Lepidium pseudohyssopifolium</i>	Peppercress		x										x		
	<i>Rapistrum rugosum</i>	Turnip Weed	i					x						x		
	<i>Sisymbrium irio</i>	London Rocket	i													
CAMPANULACEAE																
	<i>Wahlenbergia communis</i>	Tufted Bluebell												x		
CARYOPHYLLACEAE																
	<i>Cerastium glomeratum</i>	Mouse-ear Chickweed	i											x		
	<i>Moenchia erecta</i>	Erect Chickweed	i					x						x		

Classification/ Scientific name	Common Name	Survey Site												
		1	2	3	4	5	6	7	8	9	10	11	12	Riparian
<i>Petrorhagia velutina</i>	Pinks	i												
<i>Stellaria media</i>	Common Chickweed	i			x	x		x	x					
CHENOPODIACEAE														
<i>Einadia nutans</i> subsp. <i>nutans</i>	Climbing Berry-saltbush		x											
CLUSIACEAE														
<i>Hypericum perforatum</i>	St. Johns Wort	iw	x										x	
CONVOLVULACEAE														
<i>Convolvulus erubescens</i>	Pink Bindweed		x											
CRASSULACEAE														
<i>Crassula colorata</i>	Dense Stonecrop													
<i>Crassula decumbens</i>			x			x							x	
<i>Crassula sieberiana</i>	Australian Stonecrop													
DILLENIACEAE														
<i>Hibbertia obtusifolia</i>	Blunt-leaf Guinea-flower												x	
DROSERACEAE														
<i>Drosera peltata</i>	Rosette Sundew													
FABACEAE														
FABOIDEAE														
<i>Glycine tabacina</i> agg.														
<i>Hardenbergia violacea</i>	Purple Twining-pea		x											
<i>Medicago spp.</i>	Medic	i											x	
<i>Medicago sativa</i>	Alfalfa	i												
<i>Melilotus indicus</i>	Hexham Scent	i												
<i>Trifolium</i> spp.		i				x		x	x					
<i>Trifolium angustifolium</i>	Narrow-leaved Clover	i	x										x	
<i>Trifolium arvense</i>	Haresfoot Clover	i											x	
<i>Trifolium campestre</i>	Hop Clover	i												
<i>Trifolium repens</i>	White Clover	i		x								x	x	
<i>Vicia sativa</i> subsp. <i>sativa</i>	Common Vetch	i												
MIMOSOIDEAE														

Classification/ Scientific name		Common Name	Survey Site													Riparian
			1	2	3	4	5	6	7	8	9	10	11	12		
	<i>Acacia baileyana</i>	Cootamundra Wattle	n												x	
	<i>Acacia dealbata</i>	Silver Wattle		x											x	
	<i>Acacia decurrens</i>	Fine-leaf Green Wattle	n													
		Hickory													x	
	<i>Acacia implexa</i>															
	<i>Acacia longifolia</i>	Sydney Golden Wattle	n													
	<i>Acacia pravissima</i>	Wedge-leaved Wattle		x											x	
	<i>Acacia pycnantha</i>	Golden Wattle		x											x	
FUMARIACEAE																
	<i>Fumaria muralis</i> subsp. <i>muralis</i>	Wall Fumitory	i												x	
GERANIACEAE																
	<i>Erodium botrys</i>	Long Storksbill	i		x	x	x	x	x	x	x	x	x			
	<i>Erodium crinitum</i>	Blue Storksbill													x	
	<i>Erodium brachycarpum</i>	Herons Bill	i													
	<i>Erodium cicutarium</i>	Common Storksbill	i													
	<i>Geranium retrorsum</i>	Common Cranesbill														
	<i>Geranium solanderi</i> var. <i>solanderi</i>	Native Cranesbill		x			x								x	
GOODENIACEAE																
	<i>Goodenia cycloptera</i>														x	
	<i>Goodenia pinnatifida</i>														x	
HALORAGACEAE																
	<i>Gonocarpus tetragynus</i>	Poverty Raspwort		x												
LAMIACEAE																
	<i>Lamium amplexicaule</i>	Henbit	i	x												
	<i>Marrubium vulgare</i>	White Horehound	iw	x											x	
LORANTHACEAE																
	<i>Amyema miquelii</i>	Drooping Mistletoe														
	<i>Amyema pendulum</i> subsp. <i>pendulum</i>	Pendulous Mistletoe														
LYTHRACEAE																

Classification/ Scientific name		Common Name	Survey Site													Riparian	
			1	2	3	4	5	6	7	8	9	10	11	12			
	<i>Lythrum hyssopifolia</i>	Hyssop Loosestrife															x
MALVACEAE																	
	<i>Malva parviflora</i>	Small-flower Mallow	i			x		x		x							
	<i>Modiola caroliniana</i>	Red-flowered Mallow	i				x										
MYOPORACEAE																	
	<i>Myoporum montanum</i>	Western Boobialla															x
MYRSINACEAE																	
	<i>Anagallis arvensis</i>	Pimpernell	i														
MYRTACEAE																	
EUCALYPTS																	
	<i>Eucalyptus spp.</i>	A Planted Eucalypt	n														
	<i>Eucalyptus albens</i>	White Box		x			x		x	x	x						x
	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum		x	x	x			x		x	x	x	x			
	<i>Eucalyptus bicostata</i>	Southern Blue Gum	n														
	<i>Eucalyptus bridgesiana</i>	Apple Box		x			x										x
	<i>Eucalyptus camaldulensis</i>	River Red Gum															x
	<i>Eucalyptus cinerea</i>	Argyle Apple	n														
	<i>Eucalyptus goniocalyx</i>	Long-leaved Box					x										
	<i>Eucalyptus gracilis</i>	Yorrel	n														
	<i>Eucalyptus macrorhyncha</i>	Red Stringybark															x
	<i>Eucalyptus melliodora</i>	Yellow Box		x				x	x	x	x	x	x				x
	<i>Eucalyptus polyanthemus</i>	Red Box													x	x	
	<i>Eucalyptus sideroxylon</i>	Mugga Ironbark															
	<i>Melaleuca spp.</i>	Paperbark	n														
OLEACEAE																	
	<i>Fraxinus spp.</i>	Ash	i														
OXALIDACEAE																	
	<i>Oxalis corniculatum</i>	Creeping Oxalis	i			x											
	<i>Oxalis exilis</i>	Yellow Oxalis															
	<i>Oxalis perennans</i>			x													x

Classification/ Scientific name	Common Name	Survey Site												
		1	2	3	4	5	6	7	8	9	10	11	12	Riparian
PLANTAGINACEAE														
<i>Plantago spp.</i>	Plantain													
<i>Plantago coronopus subsp. commutata</i>	Buck's-horn Plantain	i											x	
<i>Plantago lanceolata</i>	Plantain	i	x										x	
POLYGONACEAE														
<i>Acetosella vulgaris</i>	Sheep Sorrel	i	x	x	x		x	x	x	x	x	x	x	
<i>Polygonum aviculare</i>	Variable-leaf Wireweed	i											x	
<i>Rumex brownii</i>	Swamp Dock				x	x								
<i>Rumex crispus</i>	Curled Dock	i	x			x								
ROSACEAE														
<i>Acaena ovina</i>			x										x	
<i>Rosa rubiginosa</i>	Sweet Briar	iw		x										
<i>Rubus parviflorus</i>	Small-leaf Bramble													x
RUBIACEAE														
<i>Asperula conferta</i>	Common Woodruff													
<i>Galium aparine</i>	Cleavers	i	x							x	x		x	
<i>Galium murale</i>	Small Bedstraw	i												
SALICACEAE														
<i>Populus nigra</i>	Lombardy Poplar	i												
<i>Salix babylonica</i>	Weeping Willow	i												
SCROPHULARIACEAE														
<i>Verbascum virgatum</i>	Twiggy Mullein	i												
ULMACEAE														
<i>Ulmus spp</i>	Elm	i												
URTICACEAE														
<i>Urtica incisa</i>	Scrub Stinging Nettle			x										

Flowering Plants - Monocotyledons

ALISMACEAE

Classification/ Scientific name	Common Name	Survey Site												
		1	2	3	4	5	6	7	8	9	10	11	12	Riparian
<i>Damasonium minus</i>	Star-fruit													x
ANTHERICACEAE														
<i>Caesia parviflora</i> var. <i>parviflora</i>	Pale Grass-lily												x	
<i>Dichopogon strictus</i>	Chocolate Lily												x	
<i>Tricoryne elatior</i>	Yellow Rush-lily													
ASPHODELACEAE														
<i>Bulbine bulbosa</i>	Native Leek												x	
CYPERACEAE														
<i>Carex appressa</i>	Tussock Tassel-sedge		x	x						x	x			x
<i>Carex inversa</i>	Knob Tassel-sedge												x	
<i>Cyperus eragrostis</i>	Umbrella Sedge	i												x
<i>Isolepis cernua</i>	Nodding Club-rush													x
IRIDACEAE														
<i>Romulea rosea</i> var. <i>australis</i>	Onion Grass	iw	x	x	x	x	x	x	x				x	
JUNCACEAE														
<i>Juncus</i> spp.														
<i>Juncus usitatus</i>	Common Rush													
LOMANDRACEAE														
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	Many-flowered Mat-rush		x										x	
ORCHIDACEAE														
<i>Thelymitra</i> spp.	Sun-orchid		x											
PHORMIACEAE														
<i>Dianella longifolia</i> var. <i>longifolia</i>	Long-leaf Flax Lily												x	
<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax Lily												x	
POACEAE														
<i>Aira caryophyllea</i>	Silvery Hairgrass	i	x	x	x								x	
<i>Andropogon virginicus</i>	Whisky Grass	i												
<i>Aristida ramosa</i>	Three-awned Spear Grass													
<i>Aristida vagans</i>	Three-awned Spear		x											

SINCLAIR KNIGHT MERZ

Classification/ Scientific name	Common Name	Survey Site													
		1	2	3	4	5	6	7	8	9	10	11	12	Riparian	
	Grass														
<i>Austrodanthonia</i> spp	Wallaby Grass														
<i>Austrodanthonia auriculata</i>	Lobed Wallaby Grass														
<i>Austrodanthonia caespitosa</i>	Wallaby Grass	x											x		
<i>Austrodanthonia eriantha</i>	Hill Wallaby Grass														
<i>Austrodanthonia racemosa</i>		x											x		
<i>Austrostipa aristiglumis</i>	Plains Grass	x			x								x		
<i>Austrostipa bigeniculata</i>	Yanganbil														
<i>Austrostipa scabra</i>	Speargrass	x											x		
<i>Avena fatua</i>	Common Oat	i	x									x	x		
<i>Briza maxima</i>	Quaking Grass	i	x										x		
<i>Briza minor</i>	Shivery Grass	i											x		
<i>Bromus catharticus</i>	Prarie Grass	i													
<i>Bromus diandrus</i>	Great Brome	i											x		
<i>Bromus hordeaceus</i>	Soft Brome	i													
<i>Bromus molliformis</i>	Soft Brome	iw													
<i>Cortaderia selloana</i>	Pampas Grass	i													
<i>Cynodon dactylon</i>	Common Couch	n													
<i>Cynosurus echinatus</i>	Rough Dog's Tail	i													
<i>Dactylis glomerata</i>	Cocksfoot	i	x												
<i>Deyeuxia quadriseta</i>	Reed Bent-grass														
<i>Ehrharta longiflora</i>	Annual Veldtgrass	i											x		
<i>Elymus scaber</i>	Common Wheatgrass		x										x		
<i>Eragrostis curvula</i>	African Lovegrass	i													
<i>Holcus lanatus</i>	Yorkshire Fog	i	x	x	x	x	x	x	x	x	x	x	x	x	
<i>Hordeum leporinum</i>	Barley Grass	i													
<i>Hyparrhenia hirta</i>	Coolatai Grass	iw													
<i>Lolium</i> spp.	Rye Grass	i				x	x	x	x						
<i>Panicum effusum</i>	Hairy Panic														
<i>Paspalidium</i> spp.	Paspalidium		x												

Classification/ Scientific name		Common Name	Survey Site												
			1	2	3	4	5	6	7	8	9	10	11	12	Riparian
	<i>Paspalum dilatatum</i>	Paspalum	i	x											
	<i>Phalaris aquatica</i>	Canary Grass	i	x		x					x	x		x	x
	<i>Phragmites australis</i>	Common Reed													x
	<i>Poa annua</i>	Winter Grass	i			x									
	<i>Poa bulbosa</i>	Bulbous Poa	i	x	x			x	x	x	x			x	
	<i>Poa siebriana</i>	Snowgrass												x	
	<i>Polypogon monspeliensis</i>	Annual Beardgrass	i												
	<i>Sporobolus africanus</i>	Parramatta Grass	i												
	<i>Vulpia bromoides</i>	Foxtail Grass	i	x											
	<i>Vulpia muralis</i>		i												
	<i>Vulpia myuros</i>	Rat's Tail Fescue	i											x	
TYPHACEAE															
	<i>Typha orientalis</i>	Broad-leaf Cumbungi													x