SECOND MURRAY RIVER CROSSING AT ECHUCA-MOAMA

DETAILED FLORA AND FAUNA ASSESSMENT

VicRoads

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1. EXECUTIVE SUMMARY

Brett Lane and Associates Pty Ltd were engaged by VicRoads to conduct a Flora and Fauna Assessment of the proposed alignment of the second Murray River Crossing at Echuca - Moama.

The existing relevant literature and databases were reviewed and a field assessment incorporating targeted surveys for threatened flora (Slender Darling-pea, Silky Swainson-pea and Western Water-starwort) and threatened fauna (Bush Stone-Curlew and Squirrel Glider) was conducted to identify any significant environmental issues that may arise as a result of the proposed river crossing.

The assessment found that approximately 55 hectares of the study area supported indigenous vegetation in the form of Riverine Chenopod Woodland, Grassy Riverine Forest and Riverine Grassy Woodland across 27 habitat zones.

The assessment identifies the impacts of two separate development layouts including the "Initial" proposed works, and the "Ultimate" works on native vegetation and threatened flora and fauna species in the study area.

Vegetation Removal - Victoria

The Initial and Ultimate development footprints propose to remove between 14.07 to 16.92 hectares (4.182 and 5.092 habitat hectares) of native vegetation in Victoria. It is to be noted that approval is required from the Minister for Environment and Climate Change for the removal of native vegetation of very high conservation significance.

The proposed construction of six replacement tennis courts will also remove 0.2 hectares (0.057 habitat hectares) of native vegetation from Habitat Zone Q. Impacts to native vegetation through the construction of the tennis courts has been considered separately from the Initial and Ultimate development options as this is a consequential, rather than a direct, outcome of the proposed road corridor.

Net gain targets are provided separately below for the two road corridor development footprints and the replacement tennis courts.

- Initial Option: Proposes the removal of 4.182 habitat hectares, resulting in an offset target of 7.528 habitat hectares (equating to approximately 37.64 hectares of native vegetation required to compensate for this loss). This development footprint also proposes the removal of 224 large old trees from habitat zones in Victoria;
- Ultimate Option: Proposes the removal of 5.092 habitat hectares, resulting in an offset target of 9.11 habitat hectares (equating to approximately 45.55 hectares of native vegetation required to compensate for this loss). This development footprint also proposes the removal of 278 large old trees from habitat zones in Victoria.
- Replacement Tennis Courts: Proposes the removal of 0.057 habitat hectares, resulting in an offset target of 0.086 habitat hectares (equating to approximately 0.43 hectares of native vegetation required to compensate for this loss). This development footprint also proposes the removal of two large old trees from Habitat Zone Q.

Vegetation Removal – New South Wales

The area of vegetation removed is provided below for the two development footprints:

- **Initial Option:** Requires the removal of 4.63 hectares of native vegetation from Habitat Zone T and 0.04 hectares from Habitat Zone Y.
- **Ultimate Option:** Requires the removal of 5.34 hectares of native vegetation from Habitat Zone T and 0.04 hectares from Habitat Zone Y.

Threatened Species

No flora species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) or New South Wales *Threatened Species Conservation Act 1995* (TSC Act) were recorded in the study area. Three threatened flora species are considered to have the potential to occur in various parts of the study area due to the presence of suitable habitat. These species include the Slender Darling-pea, Silky Swainson-pea and Western Water-starwort. Due to the limited area of suitable habitat, poor quality of understorey vegetation in these areas and the absence of these species during the field surveys, there is a low likelihood that these species would occur in the study area. Any presence that may not have been detected would be minimal and therefore it is considered that the proposed development would not have a significant impact on these species.

Rainbow Bee-eater, listed as migratory under the EPBC Act, was observed during the field assessment. No additional listed EPBC Act fauna species are considered likely to occur in the study area regularly.

One threatened fauna species listed under the FFG Act, the Brown Treecreeper was recorded during the current assessments. Additionally, the Squirrel Glider is considered highly likely to occur in the study area due to the presence of suitable habitat. On the New South Wales side of the study area, only the Bush Stone-curlew is considered likely to occur. Other threatened species listed under the FFG Act may occur on the Victorian side of the study area, including Barking Owl, Brush-tailed Phascogale, Carpet Python and Bandy Bandy.

Targeted fauna surveys were recommended for the Bush-stone Curlew and the Squirrel Glider, which were considered likely to occur in the study area due to the presence of suitable habitat. These surveys were conducted in early January 2009, between Warren Road near the Campaspe River and the Moama side of the Murray River, in the northern part of the study area. None of these two fauna species were detected.

Recommendations provided in this report should be implemented to minimise and mitigate potential impacts on threatened species.

2. INTRODUCTION

VicRoads engaged Brett Lane and Associates Pty Ltd to conduct a detailed flora and fauna assessment of the proposed site of the second Murray River crossing at Echuca - Moama.

This investigation was commissioned to provide information on the extent and condition of native vegetation and fauna habitat in the study area and outline any implications under various national, state and local legislation and policy. Of particular focus are any implications of the proposal under Victoria's Native Vegetation Management – a Framework for Action (DNRE 2002), referred to herein as the 'Framework' as well as New South Wales' *Threatened Species Conservation Act 1995*.

Specifically, the scope of the investigation included:

- A review of existing information (e.g. Department of Environment and Conservation (DEC) Atlas of NSW Wildlife, the Department of Sustainability and Environment (DSE) Atlas of Victorian Wildlife and Flora Information System, and the Commonwealth EPBC Act Protected Matters Search Tool);
- Liaison with relevant government departments (including DSE, Parks Victoria (PV), Murray Catchment Management Authority, North Central Catchment Management Authority, Department of Primary Industries (DPI), Department of Environment and Climate Change (DECC), Road Traffic Authority (RTA) and environmental interest groups (including Field Naturalists of Victoria, Victorian National Parks Association) where appropriate;
- Undertaking of a site survey to determine the impact of the crossing point of the Murray River and Campaspe River in relation to flora and fauna species and habitat involving:
    - Compilation of detailed flora and fauna species lists;
    - Habitat hectare and scattered tree assessments (in Victoria);
    - Inspection of trees for hollows actively used by fauna;
    - Assessment of suitable habitat for threatened flora and fauna;
    - Assessment of the condition of fauna habitat and potential of the area to provide a wildlife corridor;
    - Assessment of the value of waterways for fish and aquatic mammals;
    - Photographing representative parts of the study area; and
    - Targeted surveys for any rare or threatened flora and fauna determined to potentially occur within the proposed development footprint;
- Preparation of a map of the study area including vegetation communities, significant fauna habitat and any threatened species located using a hand held GPS (accuracy +/- 1-5m) in GDA 94 and provided in ESRI shape file format;
- Preparation of this report that includes the following:

- A statement of the methods used and sources of information for the investigation, including any limitations, where applicable;
- The results of the survey and review of existing information, documenting the flora and fauna of the site;
- Assessment of the proposed alignment option against the objective: To minimise impacts on biodiversity and provide appropriate mitigation measures to the extent practicable.
- Discussion of the implications of the findings specifically addressing relevant legislative and policy requirements including reference to matters of national environmental significance, the NSW Seven Part Test and referral requirements under the EE Act;
- A net gain analysis for one alignment option and three vertical variations based on Victorian and NSW requirements including information on the extent, condition, habitat hectare score and Conservation Significance of the vegetation proposed for removal in tabular format;
- Recommendations for avoidance, mitigation and management strategies, as well as any further investigation, if required. This included an assessment of the likely impacts if mitigation actions are implemented; and
- A list of suitable flora species for revegetation/landscape works.

This report is divided into the following sections:

Section 3 describes the sources of information, including the methods used for the field assessment.

Section 4 provides an overview of the characteristics of the study area.

Section 5 presents the investigation results, describing the flora and fauna of the study area.

Section 6 discusses the implications of the findings under relevant Victorian legislation and policies.

Section 7 discusses the implications of the findings under relevant New South Wales legislation and policies.

Section 8 discusses the implications of the findings under relevant Commonwealth legislation and policies.

Section 9 discusses the overall impacts of the project.

Section 10 provides recommendations to inform the design process, and highlights opportunities to avoid and mitigate any impacts of the project.

Section 11 presents the main conclusions of the assessment.

This investigation was undertaken by a team from Brett Lane & Associates Pty Ltd, comprising Justin Sullivan (Botanist and Project Manager), Bill Wallach (Botanist), Inka Veltheim (Senior Zoologist), Davide Coppolino (Botanist), Teisha Sloane (Zoologist), Jennifer Prior (Zoologist), Bram Mason (Senior Ecologist and Project Manager) and Brett Lane (Principal Consultant).

3. SOURCES OF INFORMATION

This section identifies the sources of information and methodologies used to assess flora and fauna in this assessment. Only terrestrial vertebrate fauna and vascular plants were considered during this assessment.

3.1. Existing information

Existing information regarding flora and fauna utilised as part of this investigation is described below. Note that 'study area' encompasses the corridor of the second Murray River Crossing from the Murray Valley Highway intersection with Warren Street at Echuca in Victoria, to the Cobb Highway intersection with Perricoota Road and Meninya Street at Moama in New South Wales. This corridor is shown in Figure 1 with a red line. The proposed Initial and Ultimate road alignments occur within this boundary and are presented in Figures 14 and 18 respectively.

Existing information has been obtained from a wider area, termed the 'search region' defined for this assessment as an area with a radius 10 kilometres from the approximate centre point of the study area of coordinates: latitude 36˚ 06' 47" S and longitude 144˚44' 36" E.

Additional existing information was provided during a meeting with Echuca Bridge Community Consultative Group (CCG), attended by Brett Lane in early 2009. Information provided from bird observers within the Echuca Bridge CCG was reviewed and responses have been provided in the results and impacts section of this report.

3.1.1. Flora

Flora records from the Viridans Flora Information System (FIS), a database administered by the Victorian Department of Sustainability and Environment (DSE) were obtained. This database search listed all plant species, including rare and threatened plants found in the search region. In addition, The Atlas of NSW Wildlife (DEC 2005) was used to identify flora within the search region listed under the *Threatened Species Conservation Act 1995*.

The likelihood of suitable habitat in the study area for nationally threatened flora species was ascertained through a search of the online *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters Search Tool (DEWHA 2008) using the same search region.

Plant taxonomy used throughout this report follows the FIS standards.

3.1.2. Ecological Vegetation Classes

Pre-1750 (pre-European settlement) vegetation mapping was reviewed to determine the type of native vegetation likely to occur in the study area. Information on Ecological Vegetation Classes was obtained from published EVC benchmarks. These sources included:

- Previous Flora & Fauna Desktop Assessment (Brett Lane and Associates, 2009);
- Previous Flora & Fauna Desktop Assessment (Biosis Research, 2008);

- Relevant EVC benchmarks for the Victorian Riverina and Murray Fans bioregions[1] (DSE 2008a); and
- Biodiversity Interactive Maps (DSE 2008b).

3.1.3. Fauna

A list of the fauna species recorded in the search region was obtained from the Viridans Victorian Fauna Database (VFD), a database administered by the Victorian Department of Sustainability and Environment (DSE) and the Atlas of New South Wales Wildlife (ANSWW), a database administered by the New South Wales Parks and Wildlife Service.

Fauna taxonomy used throughout this report follows the VFD and ANSWW nomenclature, and Christidis and Boles (2008) where appropriate.

The presence or likelihood of occurrence in the study area of nationally threatened fauna species was obtained through the *Environment Protection and Biodiversity Conservation* Act Protected Matters Search Tool (DEWHA 2008).

3.2. Field methodology

The field assessment was conducted from the 13th to 15th of October 2008. During the field assessment, the study area was inspected in detail on foot.

Targeted flora and fauna surveys were conducted from the 6th to 8th of January 2009. Fauna surveys were conducted for the Bush-stone Curlew and Squirrel Glider. Suitable habitat was identified by site visits on foot.

An additional botanical field assessment was undertaken on the 21st and 22nd July 2010 to assess additional areas within an updated development layout for the project.

3.2.1. Flora species

Incidental records of flora species were made based on intuitive sampling methods within all vegetation types and landforms throughout the proposed alignment. Species lists, areas of potential habitat for threatened flora and general site descriptions were recorded throughout the entire study area. Habitat hectare and scattered tree assessments were carried out within all areas of the Victorian part of the study area. Locations and measurements of all Large Old Trees (LOT's) in Habitat Zones were recorded, except for one extensive area of Black Box dominated woodland in which a 50 x 50 metre quadrat was used for sampling purposes.

Specimens requiring identification using laboratory techniques were collected.

Targeted surveying for threatened species, in particular the River Swamp Wallaby-grass, Small Scurf-pea, Chariot Wheels, Western Water-starwort, Slender Darling-pea and Silky Swainson-pea was undertaken in early January for a total of 32 working hours. During this survey, areas identified to support suitable habitat for

[1] A bioregion is defined as "a geographic region that captures the patterns of ecological characteristics in the landscape, providing a natural framework for recognising and responding to biodiversity values". In general bioregions reflect underlying environmental features of the landscape (DNRE 1997).

these species were inspected thoroughly along transects spaced approximately ten metres apart. This transect spacing was considered to be appropriate due to the open structure of the ground layer vegetation which the targeted flora species would occupy.

3.2.2. Defining and assessing native vegetation

Native vegetation in Victoria has been defined by the DSE as belonging to three categories. These are:

- Remnant patch;
- Scattered trees; and
- Degraded treeless vegetation.

In NSW such definitions have not been developed. The Victorian vegetation definitions have been used to describe the NSW vegetation observed along the alignment. The use of Victorian definitions in the NSW component of the alignment allows for direct comparison between vegetation types and for comparison of impact assessments in Victoria and NSW.

These categories are described in detail below, together with the method DSE prescribes for their assessment.

Remnant Patch

Remnant patches of remnant native vegetation are composed of indigenous plant species considered part of a clearly definable Ecological Vegetation Class (EVC). Such vegetation includes remnant vegetation with the following attributes:

- Proportion of indigenous understorey species being greater than 25% total understorey cover (excluding bare ground); and/or
- Indigenous canopy trees with at least 20% projected foliage canopy cover (DSE 2007a).

Assessment of remnant patch vegetation involves the habitat scoring or habitat hectare method (Parkes *et al*. 2003; DSE 2004). This entails assessing the components of native vegetation (e.g. tree canopy, understorey and ground cover) against a DSE-issued EVC benchmark (see appendices) that described the notional pre-European condition of that EVC. The score effectively measures the percentage resemblance of the vegetation to its original condition.

The habitat hectare score assists in defining the value of remnant native vegetation for assessing its conservation significance and for calculating offsets if removal of native vegetation is approved.

Scattered trees

Scattered trees comprise indigenous trees with projected foliage canopy cover less than 20% and total cover of indigenous species (excluding bare ground) is less than 25% (DSE 2007a).

Scattered trees are counted and their diameter recorded at 1.3 metres above ground level (diameter at breast height or DBH). The size class of scattered trees (based on DBH) is determined based on the large tree DBH in the relevant benchmark for the EVC to which it once belonged.

Degraded treeless vegetation

Degraded treeless vegetation comprises all other vegetation (DSE 2007a). This category includes the following:

- Treeless vegetation with less than 25% total cover of indigenous species (excluding bare ground); or
- Treeless vegetation that has greater than 25% total cover of indigenous species (excluding bare ground) but is dominated by a small number of opportunistic native species which were unlikely to have been dominant prior to a disturbance event (e.g. cropping).

3.2.3. Fauna

A number of techniques were used to detect fauna species inhabiting the study area, they included:

- Incidental searches were undertaken for mammal scats, tracks and signs (e.g. diggings, signs of feeding and nests/burrows);
- Turning over logs and other ground debris for reptiles, frogs and mammals;
- Bird observation during the day and on the morning of the 15th October 2008;
- General searches for reptiles and frogs; including an evening frog survey in seasonally wet areas;
- Spotlighting was undertaken on the evening of the 14th October 2008 along the entire length of Warren Street, in a patch of woodland between Warren Street and Campaspe River, and in the Black Box woodland between Campaspe River and Murray River. A total of five person hours was spent spotlighting;
- Call playback for owls was undertaken in a patch of woodland between Warren Street and the Campaspe River. The call of Barking Owl and Masked Owl was played twice within a 15 minute period, interspersed with listening;
- Call playback for the Growling Grass Frog was undertaken at a billabong in River Red-gum woodland on the Moama side of the study area; and
- Inspection of hollows and canopies of River Red-gums was undertaken for signs of active nesting, using binoculars.

Details of additional techniques utilized during targeted surveys in early January 2009 are provided below.

- Call playback for Bush-stone Curlew was undertaken in suitable patches of woodland, near billabongs and the Campaspe and Murray Rivers. Call playback was carried out at dusk to early evening to maximise the detection of calling individuals. Calls were played for 30 seconds followed by a 4.5 minutes of listening and spotlighting around the area. A total of 5.5 hours was spent playing calls, listening and spotlighting in the study area.
- A diurnal survey was conducted for the Bush-stone curlew throughout the site by walking transects 10 m apart to flush birds. A total of nine hours was spent listening, observing and walking the study area in search of this species.

- Spotlighting was undertaken for the Squirrel Glider during the evenings. Searches for Squirrel Glider included habitat in the Black Box woodland and riparian vegetation along the Campaspe and Murray Rivers. Large trees with hollows and wattle understorey were mainly found on the NSW side of the Murray River. A total of eight hours was spent spotlighting the study area in search of this species.

Fauna habitat types were characterised in the study area and are described in Section 5.1.7. The quality of fauna habitat was assessed based on the criteria detailed below.

High: Fauna habitat components are usually all present (i.e. vegetation intact) and habitat linkages to other remnant ecosystems in the landscape are intact.

Moderate: Some fauna habitat components are often missing (i.e. old-growth trees, fallen timber, leaf litter, surface rocks), although linkages with other remnant habitats in the landscape are usually intact.

Low: Many fauna habitat elements in low quality remnants have been lost (e.g. old-growth trees, fallen timber) and tree canopies are often highly fragmented. Remnants may be severely weed-invaded and possess few native structural and floristic components. Habitat linkages with other remnant ecosystems in the landscape have usually been removed by extensive past clearing.

3.3. Limitations of field assessment

Flora and fauna field surveys usually fail to record all species present for various reasons, including the seasonal absence of some species and short survey duration. Rare or cryptic species are often missed in short surveys.

Initial flora surveying was carried out in the middle of spring (October 2008), when most annual plant species would have been detectable. The timing of the survey and condition of vegetation was therefore considered suitable to ascertain the extent and quality of native vegetation.

The targeted flora survey was conducted in early January 2009, during the optimal survey period for River Swamp Wallaby grass, Chariot Wheels, and Small Scurf Pea. The targeted survey occurred outside the optimal survey period for the Western Water-starwort, Slender Darling-pea and Silky Swainson-pea, which are considered detectable in spring. Some areas of suitable threatened flora habitat were partially inundated during the targeted flora survey, making access difficult and potentially limiting plant observation due to them being under water.

The fauna assessment was undertaken during warm, dry and sunny weather conditions. Evening surveys were undertaken during cool to mild, calm, clear and full moon conditions. These conditions were considered suitable for detecting the majority of the vertebrate species likely to occur in the study area. However, it is possible that full moon may have reduced the activity of nocturnal mammals.

Targeted fauna surveys for the Squirrel Glider and Bush-stone Curlew were undertaken on warm – hot and dry conditions from the 6th to 8th of January 2009. These conditions were considered suitable for the detection of these species. However, the study area was heavily visited during the peak of the holiday season, for recreational purposes. This may have impacted on the nocturnal and diurnal behaviour of both of these species.

The combination of the original fauna survey, together with the time spent in the area undertaking targeted surveys for threatened fauna, is considered adequate to detect the regular occurrence of any significant population of the region's threatened fauna species.

Wherever appropriate, a precautionary approach has been adopted in the discussion of implications. That is, where insufficient evidence is available on the occurrence or likelihood of occurrence of a species, it is assumed that it could be in an area of habitat, if suitable, and the implications under legislation and policy are considered accordingly.

4. SITE DESCRIPTION

The study area encompasses the corridor of the second Murray River Crossing from the Murray Valley Highway intersection with Warren Street at Echuca in Victoria, to the Cobb Highway intersection with Perricoota Road and Meninya Street at Moama in New South Wales (Figure 1). A large proportion of the study area supported native vegetation including a large contiguous area of woodland vegetation between the Campaspe and Murray River. The remainder of the study area supported existing roads, Echuca Secondary College and recreation areas (tennis courts, sports oval).

The native vegetation within the study area was continuous with adjacent River Red-gum and Black Box woodland to the north, and provided habitat linkage to areas of woodland vegetation along the Murray River. Housing and residential developments also occurred adjacent to the study area at the north eastern end of Warren Street and east of the Cobb Highway.

The study area was composed of fertile to heavy clay soils on a mostly flat landscape. Observed vegetation in the Victorian part of the study area consisted of River Red-gum and Black Box dominated woodland with several large old trees, predominantly River Red-gums close to the edges of the Campaspe and Murray River. Native shrubs and grasses including Pale-fruit Ballart Rough, spear grasses and common wallaby grass species were common in these areas, though the understorey layer was mostly degraded with a high cover of introduced flora including Barley Grass, Wild Oat and Great Brome and several other ground cover weeds. Large areas of Black Box woodland occurred at the eastern end of Warren Street as well as between Echuca Secondary College and the Murray River. These areas supported various native shrub and herb species and presented a low cover of introduced flora.

Observed vegetation on the New South Wales side of the study area consisted of several various age cohorts of River Red-gum's with the oldest occurring adjacent to the Murray River. Distinct patches of River Red-gum regrowth occurred within this area, possibly due to previous flooding events. A large area which had been excavated for mining of sand occurred within the study area. This area supported some young River Red-gum's and native shrub species at the time of inspection. Several small billabongs surrounded by wetland vegetation occurred within the eastern part of the study area within NSW.

The study area occurs across the boundary of the Victorian Riverina and Murray Fans bioregions in Victoria and falls within the North Central Catchment Management Authority (CMA) area in Victoria. The New South Wales part of the study area is located within the Murray CMA and falls within the Murray Fans CMA sub-region.

5. FLORA AND FAUNA OF THE STUDY AREA

5.1. Vegetation Assessment

5.1.1. Ecological Vegetation Classes

Pre–European EVC mapping (DSE 2008a) indicated that the study area and surrounds would have supported a range of Ecological Vegetation Classes prior to European settlement based on modelling of factors including rainfall, aspect, soils and remaining vegetation. These EVCs included:

- Riverine Chenopod Woodland (EVC 103);
- Grassy Riverine Forest (EVC 106);
- Riverine Grassy Woodland (EVC 295);
- Sedgy Riverine Forest (EVC 816); and
- Floodway Pond Herbland/Riverine Swamp Forest Complex (EVC 945).

Evidence on site, including floristic composition and soil characteristics, suggested that Riverine Chenopod Woodland (EVC 103), Grassy Riverine Forest (EVC 106) and Riverine Grassy Woodland (EVC 295) were present within the study area. Descriptions of these EVCs as provided from the published EVC benchmarks are documented below (DSE 2008b). The conservation status of each EVC in the bioregion is also provided. The conservation status of an EVC is determined by the current extent of the EVC in the bioregion compared to its former range. This is maintained by DSE.

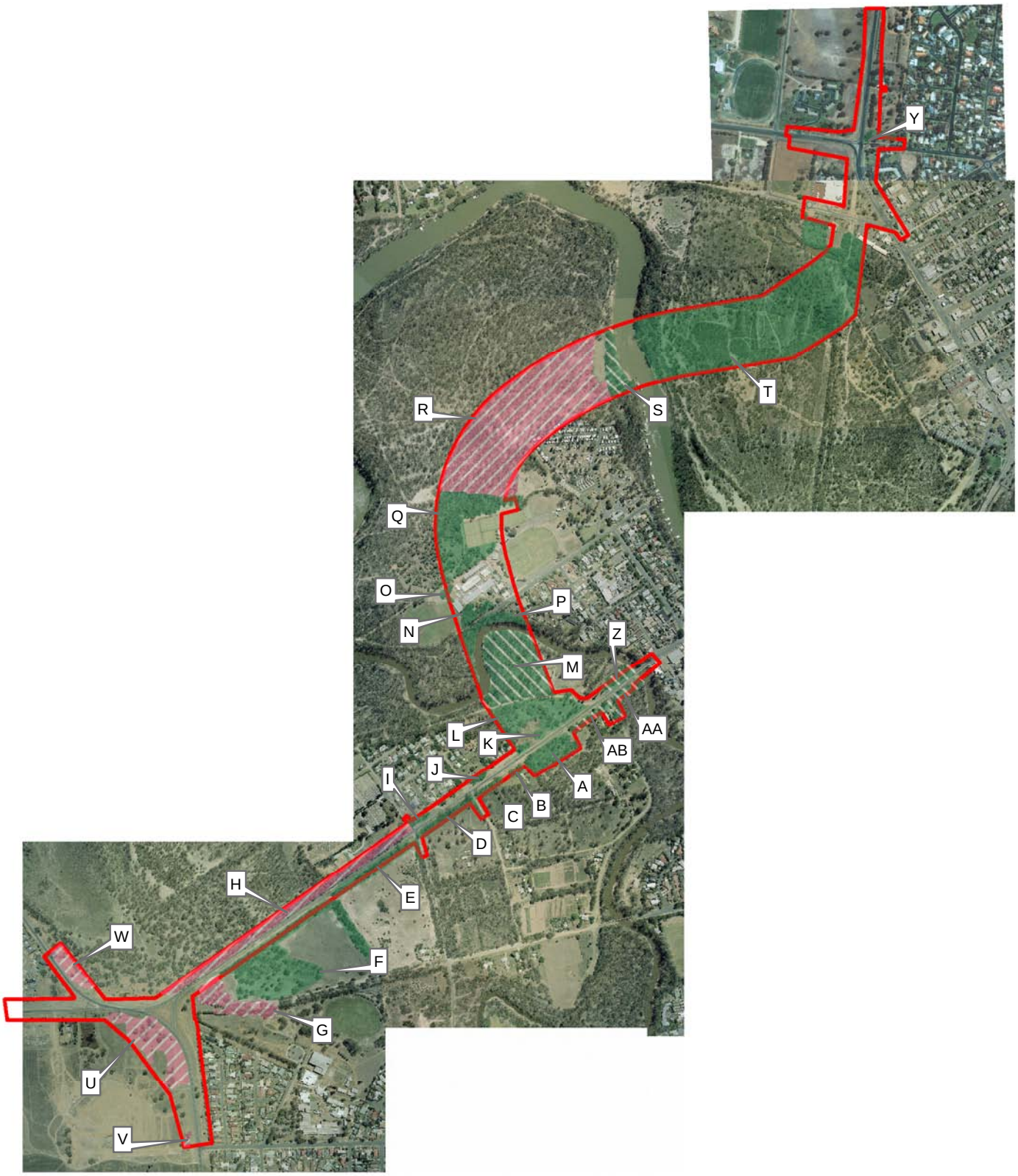
Riverine Chenopod Woodland (EVC 103) has a vulnerable conservation status in the Victorian Riverine bioregion and an endangered conservation status in the Murray Fans bioregion. The benchmark for this EVC describes it as "Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded" (Refer to Appendix 6).

Grassy Riverine Forest (EVC 106) has a Depleted conservation status in the Victorian Riverine and Murray Fans bioregion. The benchmark for this EVC describes it as "Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red-gum forest to 25 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present" (Refer to Appendix 6).

Riverine Grassy Woodland (EVC 295) has a vulnerable conservation status in the Victorian Riverine and Murray Fans bioregion. The benchmark for this EVC describes it as "Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present" (Refer to Appendix 6).

A total of 27 remnant patches (referred to herein as habitat zones) comprising the above mentioned EVCs were identified in the study area. These habitat zones are shown in Figure 1 and described in Table 1.

The vegetation within the New South Wales part of the study area has been classified according to the Victorian EVC classification method for the purpose of this investigation.



Legend

Study Area

Native Vegetation

EVC 295

EVC 106

EVC 103

Metres

0 250 500 1,000

Figure 1: Native Vegetation

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

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Table 1: Description of habitat zones in the study area

Habitat Zones (See Fig 1)	Bioregion	EVC	Bioregional Conservation Status	Description
A, B, C, D, E, F, I, J, K	Victorian Riverina	295	Vulnerable	Roadside remnants, dominated by large River Red-gum and Black Box. Understorey layer consisting of some native shrubs (Pale-fruit Ballart) and grasses (Wallaby Grass and Spear Grass), with high cover of introduced species including introduced pasture grasses (Wild Oat, Barley Grass) and ground cover weeds (Fog fruit).
G, H	Victorian Riverina	103	Vulnerable	Roadside remnants continuous with adjacent vegetation, dominated by Black Box. Dry understorey layer consisting of native chenopod shrubs and herbs (Grey Roly-poly, Wingless Bluebush). High litter and low weed cover.
L	Victorian Riverina	295	Vulnerable	Triangular shaped patch with continuous canopy dominated by River Red-gum and Black Box. Highly degraded understorey dominated by introduced pasture grasses (Barley Grass, Wild Oat) and other invasive weeds (Patterson's Curse).
M	Victorian Riverina	106	Depleted	Large patch dominated by River Red-gum. High number of large old trees, mostly occurring close to the river. Somewhat degraded understorey consisting of some native shrubs (Pale-fruit Ballart) with high cover of introduced species including introduced pasture grasses (Wild Oat, Barley Grass) and invasive weeds (Terracina Spurge).
N, O	Victorian Riverina	295	Vulnerable	Small remnant patches with continuous River Red-gum canopy within Echuca Secondary College. Introduced understorey.
P	Victorian Riverina	295	Vulnerable	Degraded patch dominated by River Red-gum along the northern edge of the Campaspe River. Some native shrubs (Pale-fruit Ballart) with high cover of introduced species including high threat weeds such as Bridal Creeper and Sweet Pittosporum.
Q	Murray Fans	295	Vulnerable	Degraded patch dominated by River Red-gum and Black Box. A number of mature and immature Murray Pines were also recorded in this habitat zone (See Section 6.2.6 for further details regarding this species). Some native shrubs (Pale-fruit Ballart, Yarran Wattle) with high cover of introduced species including planted trees (Radiata Pine) and high threat weeds (Bridal Creeper, Sweet Pittosporum).
R	Murray Fans	103	Endangered	Large continuous patch, dominated by Black Box with high number of large trees. Dry understorey layer consisting of native shrubs and herbs (Grey Roly-poly, Wooly New Holland Daisy). High litter and low weed cover.
S	Murray Fans	106	Depleted	Linear patch along the southern edge of the Murray River dominated by large River Red-gums. Understorey layer consisting of some native shrubs (Pale-fruit Ballart) and grasses (Wallaby Grass and Spear Grass), with moderate cover of introduced species including Wild Oat and Great Brome.
T	Murray Fans sub-region	295	N/A	Large patch dominated by River Red-gum and Black Box in various age cohorts. Large River Red-gums occur close to the river while younger cohorts occur scattered throughout. Large excavated area occurs in the centre of the patch and a small number of swampy depressions occur to the north.
U, V, W	Victorian Riverina	103	Vulnerable	Roadside remnants, dominated by Black Box. Dry understorey layer consisting of native chenopod shrubs and herbs (Grey Roly-poly, Wingless Bluebush, Dwarf Bluebush). Low weed cover.
Y	Murray Fans sub-region	295	N/A	Small patch with continual Yellow Box canopy. Introduced understorey.
Z, AA, AB	Victorian Riverina	106	Depleted	Roadside remnants, dominated by large River Red-gum and Black Box. Understorey layer consisting of some native shrubs (Pale-fruit Ballart) and grasses (Wallaby Grass and Spear Grass), with high cover of introduced species including introduced pasture grasses (Wild Oat, Barley Grass) and ground cover weeds (Fog fruit).

The habitat hectare assessment results for these habitat zones are provided in Table 2, including any large and very large trees in habitat zones. More detailed habitat scoring results are presented in Appendix 3.

Initially no impact was to occur on native vegetation north of Warren Street. Therefore, as instructed by the proponent, detailed habitat hectare assessments were not carried out in Habitat Zones H, I, J or K. As impacts are now to occur in these habitat zones, the default habitat score of 0.6 (60 out of 100) has been applied (DSE 2007a).

Table 2: Summary of Habitat Hectare assessment results and conservation significance for native vegetation in the study area

Habitat Zone	EVC no.	Area (ha)	Habitat score (out of 100)	Conservation significance	No. large and very large trees in habitat zone
A	295	1.03	34	High	13
B	295	0.11	25	High	1
C	295	0.23	30	High	4
D	295	0.63	22	High	3
E	295	1.01	34	High	8
F	295	4.71	46	High	5
G	103	1.33	33	High	2
H*	103	2.56	60	Very High	N/A
I*	295	0.15	60	Very High	N/A
J*	295	0.12	60	Very High	N/A
K*	295	0.1	60	Very High	N/A
L	295	2.25	36	High	11
M	106	3.64	36	High	44
N	295	0.38	28	High	9
O	295	0.13	32	High	4
P	295	0.85	40	High	10
Q	295	3.46	29	High	10
R**	103	11.31	54	Very high	533
S	106	0.93	33	High	9
T^	295	15.19	N/A	N/A	N/A
U	103	2.21	44	High	8
V	103	0.08	29	High	4
W	103	0.66	33	High	2
Y^	295	0.19	N/A	N/A	N/A
Z	106	0.41	27	High	0
AA	106	0.43	30	High	2
AB	106	0.32	42	High	1
Totals					

* Habitat Zones H, I, J and K – default score of 0.6 (60 out of 100) applied (see note above Table 2). ^ Habitat Zones T and Y – Areas of Native vegetation in New South Wales – not subjected to Habitat hectare assessment as the Framework has no implications under New South Wales legislation, ** Based on scaling up from 12 large trees within 50 x 50 metre quadrat in Habitat Zone R.

5.1.2. Scattered trees

A total of 53 scattered trees occurred in the study area, of which 16 were very large, nine were large, three were medium and 25 were small compared to the benchmark large tree diameter at breast height (DBH) for the relevant EVCs (Appendix 6). A full list of scattered trees recorded within the study area is presented in Appendix 4.

5.1.3. Conservation significance

Conservation Significance of Habitat Zones

The conservation significance of habitat zones in the study area according to the Framework are summarised in Table 2. The conservation significance of habitat zones provided in Table 2 is based on the highest result for conservation significance from the following:

- A combination of the bioregional conservation status of the EVC and habitat score of the vegetation;
- The assessment of best and remaining 50% of habitat for rare and threatened species; and
- Any significant site attributes.

Best/Remaining 50%

An assessment has been undertaken to determine whether the habitat zones within the study area support the “best” or “remaining” 50% of habitat for each rare or threatened flora and fauna species that has been recorded or is likely to occur. Species that share preferred habitat types have been considered together. The results of this assessment are detailed in Table 3.

Other site attributes

No other site attributes are considered to occur within the study area and therefore do not affect the conservation significance of habitat zones.

Conservation of Scattered trees

Very large, large and medium scattered trees in the study area are assigned a conservation significance based on the bioregional conservation status of the EVC to which they once belonged (Appendix 6). Small scattered trees are defined as having low conservation significance according to the Framework.

Table 3: Assessment of Best/Remaining 50% of habitat for rare and threatened species recorded or likely to occur

Species and Conservation Status (DSE)	Habitat Zones	Assessment Process	Outcome	Conservation significance	Justification
Silky Swainson-pea (v) Slender Darling-pea (e)	A, B, C, D, E, F, G, H, I, J, K, W, U, V, Z AA, AB	A, D, No	No further consideration	N/A	Roadside remnants provide some suitable habitat components but are not considered likely to support the species due to disturbance.
	O, N	A, D, No	No further consideration	N/A	School grounds supporting native canopy only. No habitat for listed flora species.
	L, M, P, S	A, D, F, No	Remaining 50%	High	Woodland vegetation around the Campaspe River and Murray River provides some suitable habitat for these species. Considered to be of low quality due to disturbance to understorey and high level of introduced species in ground layer.
	Q	A, D, No	No further consideration	N/A	This habitat zone is highly disturbed and is infested with a high cover of Bridal Creeper. No suitable habitat for threatened flora.
	R	A, D, F, No	Remaining 50%	High	This habitat zone supports a high quality remnant of Black Box Woodland with intact canopy layer. While there is a low potential for the occurrence of Silky Swainson-pea and Slender Darling-pea in this habitat zone, this area is considered to support a below average condition of this EVC due to the sparse cover of indigenous flora in the understorey.
Western Water-starwort (v)	L, M, P, S	A, D, F, No	Remaining 50%	High	These habitat zones provide the main potential habitat for this species as they are within close proximity of either the Campaspe or Murray Rivers. This area is considered to support a below average condition of this EVC due to the high cover of introduced species in the understorey.
		A, D, No	No further consideration	N/A	The remainder of the habitat zones do support suitable habitat for this species.
Squirrel Glider	A, B, C, D, E, F, G, H, I, J, K, N, O, Q, R, U, V, W, Z, AA, AB	A, D, F, No	Remaining 50%	High	The habitat is not above-average condition in the landscape context.
	L, M, P	A, D, F, No	Remaining 50%	High	The habitat is not above-average condition in the landscape context.
	Q	A, D, F, No	Remaining 50%	High	The habitat is not above-average condition in the landscape context.
	R	A, D, F, Yes	Best 50%	Very High	The habitat is considered to be above-average quality in the landscape context.
	S	A, D, F, No	Remaining 50%	High	Considering the connectivity to the higher quality habitat and the patch is located adjacent to water, the habitat quality in the local context provides suitable habitat.
Carpet Python and Bandy Bandy	A, B, C, D, E, F, G, H, I, J, K, N, O, Q, R, U, V, W, Z, AA, AB	A, D, No	No further consideration	-	-
	Z	A, D, F, No	No further consideration	-	-
	LMP	A, D, F, No	No further consideration	-	-
	Q	A, D, F, No	No further consideration	-	-
	R	A, D, F, Yes	Best 50%	Very High	The habitat is considered to be above-average quality in the landscape context.
	S	A, D, F, No	Remaining 50%	High	The habitat is not considered to be above-average quality in the landscape context.

5.1.4. Flora species

The field assessment recorded 68 species of plants, 36 (53%) of which were indigenous and 32 (47%) of which were introduced (including non-indigenous native) in origin. These plant species are listed in Appendix 1.

Victorian FIS records and the EPBC Protected Matters Search Tool indicated that within the search region there were records of 29 rare or threatened flora species. A search of the New South Wales Department of Environment and Climate Change (DEC 2005) records indicated that within the Murray Fans CMA Sub-region there were records of 15 species listed under the TSC Act. No rare or threatened flora species were detected during the current field survey.

The likelihood of occurrence in the study area of rare or threatened species listed under the state *Flora and Fauna Guarantee Act 1988* and the federal *Environment Protection and Biodiversity Conservation Act 1999* are addressed in Table 4. These species are either known to occur in the broader search region or suitable habitat has been identified in the broader search region in the Protected Matters Search Tool (DEWHA 2008).

The analysis of the likelihood of occurrence of flora species listed under the FFG Act, EPBC Act and TSC Act indicates that limited suitable habitat occurs on site for Silky Swainson-pea (FFG and TSC), Slender Darling-pea (EPBC, FFG and TSC) and Western Water-starwort (EPBC, FFG and TSC) (Table 4). These species were not detected during either of the two surveys conducted to date. Due to the limited area of suitable habitat, poor quality of understorey vegetation in these areas and the absence of these species during the field surveys, there is a low likelihood that these species would occur in the study area. Any presence that may not have been detected would be minimal and therefore it is considered that the proposed development would not have a significant impact on these species.

Based on the FIS search results, 26 species of rare or threatened plants listed on the DSE advisory list occur in the search region. No such species were recorded in the study area. As this list does not have a legal status it has not been included in detail within the impact assessment.

5.1.5. Noxious weeds

Several weed species were recorded in the study area (Appendix 1). Weeds classified as noxious were recorded in the study area as follows:

Victoria (North Central CMA):

- African Box-thorn;
- Horehound; and
- Patterson's Curse.

New South Wales (Murray CMA):

- Bridal Creeper; and
- Soursob.

Table 4: EPBC Act, FFG Act and TSC Act listed flora species and likelihood of occurrence

EPBC	FFG	TSC	Common Name	Scientific Name	Habitat	Potential to occur in study area
		E	Bitter Quandong	*Santalum murrayanum*	Sites are restricted to the Euston and Pooncarie districts. Generally grows in gravely and sandy loam soils on dunes, in open woodland and tall shrubland (DEC 2005).	Outside of known distribution - **unlikely to occur.**
	f		Buloke	*Allocasuarina luehmannii*	Woodlands on non-calcareous soils. Commonly grows with Grey Box (Entwisle 1996).	No suitable habitat recorded. Grey Box not recorded in Victorian part of study area – **unlikely to occur.**
V		V	Chariot Wheels	*Maireana cheelii*	Usually found on heavier, grey clay soils with Bladder Saltbush (DEC 2005).	Not recorded during current targeted survey during flowering/fruiting period – **unlikely to occur.**
		V	Claypan Daisy	*Brachycome muelleroides*	Grows in damp areas on the margins of claypans in moist grassland (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
	f		Hairy Tails	*Ptilotus erubescens*	Fertile soils with grassland and woodland communities (Walsh 1996).	No suitable habitat recorded. Woodland understorey mostly degraded– **unlikely to occur.**
		V	Narrow Goodenia	*Goodenia macbarronii*	Moist, shaded, sandy sites on soils with impeded drainage (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
V	f	V	Red Swainson-pea	*Swainsona plagiotropis*	Grows on flat grassland and in heavy red soil. Occurs in the upper Murray River valley in the south-western plains of NSW and into Victoria (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
V		V	River Swamp Wallaby-grass	*Amphibromus fluitans*	Wetlands and permanent swamps (Walsh 1994).	Not recorded during current targeted survey during peak flowering period – **unlikely to occur.**
		E	Round-leafed Wilsonia	*Wilsonia rotundifolia*	Grows in mud in coastal salt marsh and inland saline lakes (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
	f	V	Silky Swainson-pea	*Swainsona sericea*	Rare in Victoria, of disjunct occurrence in north of state where usually found in grassland and grassy woodland (Jeanes, 1996).	Some suitable habitat recorded in woodland EVCs – **low potential to occur.**
V	f	V	Slender Darling-pea	*Swainsona murrayana*	In black box and grassland on level plains, floodplains and depressions (DEC 2005). Seasonally inundated flats and around lakes (Jeanes, 1996).	Some suitable habitat recorded in woodland EVCs - **low potential to occur.**
	f	E	Small Scurf-pea	*Cullen parvum*	Seasonally wet areas with heavy soils in Grasslands and Grassy (River Red-gum) Woodlands (Jeanes, 1996).	Not recorded during current targeted survey during peak flowering period – **unlikely to occur.**
		V	Spear grass	*Austrostipa metatoris*	Sandy areas of the Murray Valley (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
		E	Spear grass	*Austrostipa wakoolica*	Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW (DEC 2005).	Outside of known distribution - **unlikely to occur.**
C	f		Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	Grasslands or open shrublands on basalt derived soils (Entwisle 1996).	No suitable habitat recorded – **unlikely to occur.**
E	f	E	Turnip Copperburr	*Sclerolaena napiformis*	Grasslands on clay-loam soils (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
V	f	V	Western Water-starwort	*Callitriche cyclocarpa*	NSW and Victoria in thick patches in floodwaters (DEC 2005). Mostly aquatic, in damp, swampy places (Jeanes, 1999).	Suitable habitat along edges of Campaspe and Murray River, as well as billabongs– **low potential to occur.**
		E	Winged Peppercress	*Lepidium monoplocoides*	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils. Widespread in the semi-arid western plains regions of NSW (DEC 2005).	No suitable habitat recorded – **unlikely to occur.**
	f		Yarran Wattle	*Acacia omalophylla*	Widespread in New South Wales but just crossing the Murray River into Victoria where present as mainly remnant populations in paddocks and roadsides (Entwisle, *et. al* 1996).	No suitable habitat recorded – **unlikely to occur.**
		V	Yellow Gum	*Eucalyptus leucoxylon subsp. pruinosa*	Restricted to several small areas between Barham and Euston (DEC 2005).	Outside of known distribution - **unlikely to occur.**
	f		Yellow-tongue Daisy	*Brachyscome chrysoglossa*	In Victoria occurring as far west as Jeparit and Horsham, extending eastward to Strathmerton and Ulupna Island. Commonly on clay soils subject to inundation (Short 1999).	No suitable habitat recorded – **unlikely to occur.**

Key to abbreviations: EPBC – Status under EPBC Act; **C** – Critically Endangered; **E** – Endangered; **V** – Vulnerable; **FFG (f)** – Listed as threatened under FFG Act; **TSC** – Status under TSC Act; **E –** Endangered; **V** – Vulnerable.

5.1.6. Fauna

This section describes the fauna habitat features of the site and the fauna recorded or likely to occur.

5.1.7. Fauna Habitat assessment

The land under investigation supports three main habitat types described below. These include:

- River Red-gum woodland/forest;
- Black Box woodland
- Aquatic habitat (Murray River, Campaspe River and billabongs); and

River Red-gum woodland/forest

River Red-gum woodland/forest occurred along the entire length of Warren Street, between Warren Street and the Campaspe River, and north east of the Murray River on the New South Wales side. This habitat type also occurred on the banks of both the Campaspe and Murray Rivers (Figure 9 and Figure 10). These areas are described in more detail below.

Large River Red-gums (including some dead trees), many with hollows, were located along Warren Street (Figure 2). The majority of the ground cover in this area was dominated by exotic weeds. Acacias and regenerating River Red-gums were present in the understorey, and logs were present with moderate cover. Connectivity is high, as the vegetation links to woodland habitat along the Campaspe River and to large areas of intact native vegetation north west of Warren Street.

Tree hollows are likely to be utilised by a number of native mammals and birds, such as Brush-tailed Possums and Galahs, which were found to be common during the current assessment. Threatened species considered in the initial assessment to potentially utilise this area included the Squirrel Glider, Barking Owl, Swift Parrot, Brush-tailed Phascogale and Grey-crowned Babbler. This roadside vegetation is considered to be of moderate to high quality for native fauna. No threatened species were detected during the targeted field survey, however further information from the Murray Shire indicated that recent reports of Grey-crowned Babbler exist from near the alignment.

Figure 2: Warren Street roadside vegetation

Figure 3: River Red-gum woodland/forest between Warren Street and Campaspe River

Large River Red-gums, including some with hollows, were present between Warren Street and the Campaspe River. The understorey in this area was dominated by exotic weeds and garden escapees (Figure 3). This vegetation is contiguous with that along the Campaspe River and also connects with roadside vegetation along Warren Street. This part of the study area is considered to be moderate quality for native fauna and to support a similar suite of fauna species to the previous area, although the dominance of exotic species in the understorey makes it unlikely that some of the ground-dwelling threatened fauna species occur in this area.

River Red-gum woodland/forest is dominant in the New South Wales part of the study area, although scattered Black Box was present in the vicinity of the Murray River. This area has previously been logged, as evidenced by large tree stumps and a lack of large old trees. Evidence of cattle grazing was also found during the assessment. Along the edge of Murray River the ground cover was dominated by exotic weeds (Figure 4). There were few hollows in River Red-gums and further away from the river there were dense patches of regenerating River Red-gum (Figure 5). Leaf litter cover was moderate and log cover was low. Further away from the river, the ground had more native grass cover. An old sand mine was located in the middle of the alignment on the New South Wales side (Figure 6). This area was being used for nesting by pardalotes and possibly bee-eaters, as well as by foxes, evidenced by tracks at the entrance of burrows.

Figure 4: River Red-gum woodland along Murray River in New South Wales

Disturbance, lack of hollows, logs, large old trees and native ground cover make it unlikely that many threatened species would occur in this part of the study area. However, native vegetation remains and connectivity with adjacent intact habitat was high. The Swift Parrot may occasionally utilise River Red-gums and Bush Stone-curlew may occur away from the river in the more open areas where native grasses are present. Overall, this part of the study area is considered to be of moderate habitat quality for native fauna.

Figure 5: Regenerating River Red-gum, New South Wales side of study area

Black Box woodland

Black Box woodland was present between the Campaspe and Murray Rivers in the Victorian part of the study area. This area had many large trees with hollows and varying ground layer vegetation cover and quality, including wallaby grasses and herbs. In some areas, exotic weeds dominated the ground cover. Much of this habitat was relatively open with little understorey vegetation, although a shrub layer of Pale-fruit Ballart, wattle and regenerating Black Box was present in places. The area had a moderate cover of leaf litter and a low cover of logs (Figure 7 and Figure 8). The area nearest to the tennis courts had a high level of weed invasion. This habitat has high connectivity with intact adjacent native vegetation and habitat along the Murray and Campaspe Rivers.

Figure 6: Old sand mine in River Red-gum woodland/forest, New South Wales

Figure 7: Black Box woodland habitat (a)

Dominant fauna species present included a suite of dry woodland bird species, including thornbills, Weebill and Brown Treecreeper, the last a state threatened species in Victoria. Bush-stone Curlew is considered unlikely to occur in the proposed alignment in this habitat, based on information from the Community Consultative Group and the lack of recent records. Carpet Python, Barking Owl and Speckled Warbler may occur, but these were not recorded during the targeted threatened fauna surveys in January 2009.

Figure 8: Black Box woodland habitat (b)

habitat

Aquatic habitat in the study area consists of the Campaspe and Murray Rivers and billabongs on the New South Wales side of the Murray River. There is little bank side aquatic vegetation along either of the rivers within the study area, although sedges and *Common Reed* were present on the north eastern bank of the Murray River (Figure 10). The rivers provide continuity in habitat, and are therefore high value habitat corridors, mostly for fish. Common species of frogs and potentially the nationally threatened Growling Grass Frog may also utilise the rivers for movement, in particular during the non-breeding season. Neither river within the study area is considered to provide breeding opportunities for wetland birds or frogs.

Both the Campaspe and Murray Rivers are likely to provide habitat for a number of native fish species, including threatened species such as Silver Perch, Golden Perch and Murray Cod. The last species is more common upstream nearer Yarrawonga and is unlikely to occur in significant numbers near the proposed alignment.

Several billabongs were located in the north eastern part of the River Red-gum woodland in the New South Wales part of the study area. Some of these had a moderate cover of fringing vegetation, which is likely to provide cover and breeding habitat for a number of common native frog species (Figure 11). The water quality was found to be poor and carp were present in at least one of the billabongs. There was no floating aquatic vegetation, which is required by Growling Grass Frogs as calling sites, mating sites, attachment sites for egg masses and cover for tadpoles. These habitats are considered too limited in extent to support significant numbers of any threatened wetland bird species on a regular basis.

habitat

Other habitat in the study area consists of modified and highly disturbed areas. These areas are unlikely to support threatened species, although scattered trees will provide some habitat for locally common native fauna species.

Figure 9: Campaspe River

Figure 10: Murray River

Figure 11: Billabong habitat in north eastern part of the New South Wales study area

5.1.8. Fauna species

Based on the field assessment and the review of existing information, the study area is known or likely to support 253 species of fauna, including 27 species of mammals (five introduced), 178 species of birds (eight introduced), 24 species of reptile, nine species of frog and 14 species of fish. These species are listed in Appendix 2 with their scientific names. Fauna recorded during the field assessments are indicated in this Appendix.

In the search region, the VFD, ANSWW and the EPBC Act Protected Matters Search Tool lists a total of 77 threatened species of vertebrates, including 51 species of birds, 14 species of mammals, four species of reptile, one species of frog and five species of fish. Of these, suitable habitat exists in the study area for 47 species, however many of these species are unlikely to regularly occur in the study area. Threatened species are summarised in Table 5 and those for which suitable habitat occurs in the study area are discussed in more detail in the following sub-sections. Where suitable habitat is present, it is considered that there is some potential for the species to occur.

Species for which suitable habitat does not occur in the study area or for which the study area lies well outside their usual range, are considered unlikely to occur and are not discussed further.

Table 5: Threatened fauna identified as occurring or potentially occurring in the study area (excluding fish)

Common name	Scientific name	EPBC Cons. Status	Victoria Cons. Status		NSW Cons. Status	Suitable habitat
			FFG	DSE	TSC/FM	
Birds						
Australasian Bittern	*Botaurus poiciloptilus*		L	EN	V	Absent
Australasian Shoveler	*Anas rhynchotis*			VU		Present
Australian Bustard	*Ardeotis australis*				E1	Absent
Australian Painted Snipe	*Rostratula australis*	VU	L	CE	E1	Absent
Azure Kingfisher	*Alcedo azurea*			NT		Present
Barking Owl	*Ninox connivens*		L	EN	V	Present
Black-chinned Honeyeater	*Melothreptus gularis gularis*			NT	V	Present
Black Falcon	*Falco subniger*			VU		Present
Black-tailed Godwit	*Limosa limosa*			VU	V	Absent
Blue-billed Duck	*Oxyura australis*		L	EN	V	Absent
Brolga	*Grus rubicunda*		L	VU	V	Absent
Brown Quail	*Coturnix ypsilophora*			NT		Present
Brown Treecreeper (south-eastern ssp.)	*Climacteris picumnus victoriae*			NT	V	Present
Bush Stone-curlew	*Burhinus grallarius*		L	EN	E1	Present
Chestnut Quail-thrush	*Cinclosoma castanotus*			NT	V	Absent
Diamond Dove	*Geopelia cuneata*		L	NT		Present
Diamond Firetail	*Stagonopleura guttata*		L	VU	V	Present
Eastern Great Egret	*Ardea modesta*		L	VU		Present
Freckled Duck	*Stictonetta naevosa*		L	EN	V	Absent
Gilbert's Whistler	*Pachycephala inornata*				V	Present
Great Knot	*Calidris tenuirostris*		L	EN	V	Absent
Grey-crowned Babbler	*Pomatostomus temporalis temporalis*		L	EN	V	Present
Grey Goshawk	*Accipiter novaehollandiae*		L	VU		Absent
Hardhead	*Aythya australis*			VU		Present
Hooded Robin	*Melanodryas cucullata*		L	NT	V	Present
Intermediate Egret	*Ardea intermedia*		L	CE		Present
Magpie Goose	*Anseranas semipalmata*		L	NT	V	Absent
Major Mitchell's Cockatoo	*Cacatua leadbeateri*		L	VU	V	Absent
Masked Owl	*Tyto novaehollandiae*		L	EN	V	Present
Musk Duck	*Biziura lobata*			VU		Present
Nankeen Night Heron	*Nycticorax caledonicus*			NT		Present
Olive Whistler	*Pachycephala olivacea*				V	Absent
Painted Honeyeater	*Grantiella picta*		L	VU	V	Present
Pied Cormorant	*Phalacrocorax varius*			NT		Present
Pied Honeyeater	*Certhonyx variegatus*				V	Present
Pink Robin	*Petroica rodinogaster*				V	Absent
Plains-wanderer	*Pedionomus torquatus*	VU	L	CE	E1	Absent
Purple-gaped Honeyeater	*Lichenostomus cratitius*			VU	V	Absent

Common name	Scientific name	EPBC Cons. Status	Victoria Cons. Status		NSW Cons. Status	Suitable habitat
Red-tailed Black Cockatoo	*Calyptorhynchus banksii*	EN	L	EN	V	Absent
Regent Honeyeater	*Xanthomyza phrygia*	EN	L	CE	V	Present
Regent Parrot	*Polytelis anthopeplus morchoides*	VU	L	VU	E1	Absent
Royal Spoonbill	*Platalea regia*			VU		Present
Shy Heathwren	*Hylacola cauta*				V	Absent
Speckled Warbler	*Pyrrholaemus saggitatus*		L	VU	V	Present
Square-tailed Kite	*Lophoictinia isura*		L	VU	V	Present
Superb Parrot	*Polytelis swainsonii*	VU	L	EN	V	Present
Swift Parrot	*Lathamus discolor*	EN	L	EN	E1	Present
Turquoise Parrot	*Neophema pulchella*		L	NT	V	Present
Whiskered Tern	*Chlidonias hybridus*			NT		Present
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		L	VU		Present
Mammals						
Brush-tailed Phascogale	*Phascogale tapoatafa*		L	VU	V	Present
Eastern Long-eared Bat	*Nyctophilus timoriensis*	VU	L	VU	V	Present
Koala	*Phascolarctos cinereus*				V	Absent
Large-footed Myotis	*Myotis adversus*				V	Present
Little Pied Bat	*Chalinolobus picatus*				V	Present
Spot-tailed Quoll	*Dasyurus maculatus maculatus*	EN	L	EN		Absent
Squirrel Glider	*Petaurus norfolcensis*		L	EN	V	Present
Yellow-tailed Sheathtail-bat	*Saccolaimus flaviventris*				V	Absent
Reptiles						
Bandy Bandy	*Vermicella annulata*		L	NT		Present
Carpet Python	*Morelia spilota metcalfei*		L	EN		Present
Murray River Turtle	*Emydura macquarii*			DD		Present
Striped Legless Lizard	*Delma impar*	VU	L	EN	V	Absent
Amphibians						
Growling Grass Frog	*Litoria raniformis*	VU	L	EN	E1	Present

DSE – Status from DSE Advisory List; **EPBC** – Status under EPBC Act; **FFG** – Status under FFG Act; **CE** – Critically endangered; **EN** – Endangered; **VU**– Vulnerable; **NT** – Lower risk near threatened; **DD** = data deficient; **L** – Listed on FFG Act; **TSC** – Status from Threatened Species Conservation Act (NSW); **E1**– Endangered; **E4** – Presumed extinct; **V** – Vulnerable; **FM –** Status from Fisheries Management Act; **FCE** – Critically Endangered; **FE** – Fish Endangered; **FV** – Fish Vulnerable

Birds

A total of 171 species of birds occurs or is likely to occur within the study area based on the VFD records from the search region, the suitability of habitats and birds recorded in the study area. This total includes eight introduced species. During the field assessment, a total of 52 species were recorded (Appendix 2).

Potentially suitable habitat occurs for 33 threatened species of bird, however, the study area was considered most likely regularly to support five of these species: Brown Treecreeper, Bush Stone-curlew, Brown Quail, Barking Owl and Grey-crowned Babbler. These are discussed in more detail below. These species were also the subject of targeted fauna surveys in January 2009.

Woodland birds

The **Brown Treecreeper** is listed as vulnerable in NSW (DEC 2005a) and considered near threatened in Victoria (DSE 2007). This species occurs mostly in eucalypt dominated woodlands, often with open grassy understorey. It is absent in habitats with a dense shrub layer. It has been recorded in River Red-gum and Black Box woodlands and requires hollows for breeding (Higgins *et al.* 2001). The Brown Treecreeper was recorded during the assessment in the Black Box woodland in Victoria (Habitat Zone R) and it is likely to nest there. It was not recorded in the River Red-gum woodland elsewhere in the study area, although it may occasionally occur in this habitat. The dense regenerating River Red-gum shrub layer on the New South Wales side is likely to provide sub-optimal habitat for the Brown Treecreeper (Figure 5).

The **Bush Stone-curlew** is listed as endangered in both NSW (DECC 2005a) and Victoria (DSE 2007). It occurs in lightly timbered open forests and woodlands, as well as cleared land with patches of remnant trees, usually with a sparse cover of grasses and often with fallen timber for cover (Marchant and Higgins 1993). There are three records of this species within close proximity to the study area, including one record within one kilometre and another record within two kilometres. One of the records is from 2006 from Echuca Secondary College. This species was considered likely to occur in the Black Box and River Red-gum woodland habitats within the study area but was not detected during the targeted fauna survey work in January 2009.

A diurnal survey and evening spotlighting and call playback was undertaken in an attempt to locate this species in all potential habitats along the alignment. This thorough survey failed to detect the Bush-stone Curlew. Personal communications with local land owners indicated that the bird has been known to nest on land within the study area in previous years. Information obtained via the project Community Consultative Group indicated that it occurs regularly further north and south of the study area but that it is unlikely to occur in the vicinity of the proposed alignment.

The **Barking Owl** is listed under the FFG Act and considered endangered in Victoria. It is also listed as vulnerable under the New South Wales TSC Act. The Barking Owl occurs in dry forests and woodlands dominated by eucalypts and is known to inhabit riparian vegetation dominated by species such as River Red-gum and Black Box. The species requires large trees for roosting and hollows for nesting. The Barking Owl has not been recorded in the VFD search region,

however suitable habitat occurs and it has been recorded nine times within the ANSWW search region. The study area contains numerous large and hollow trees, in particular on the Victorian side of the Murray River (Figure 2). Therefore the Barking Owl was considered likely to occur during the initial fauna assessment. No signs of active use of the alignment route were recorded during the targeted field survey in January 2009. Due to the presence of suitable habitat, the Barking Owl has a low potential to occur within the study area.

The **Grey-crowned Babbler** is listed as vulnerable on the TSC Act, threatened under the FFG Act and is considered endangered under the DSE Advisory List. This species inhabits dry woodlands and forests with an open sapling and shrub layer and a groundcover of leaf litter and fallen timber (Higgins and Peter 2002). It occurs in woodlands of Black Box, Grey Box, Yellow Box and Cypress-pine, and in open forest dominated by River Red-gum, sometimes with a mid-storey of Black Wattle and groundcover with abundant leaf litter and sparse cover of grasses.

The Grey-crowned Babbler is a territorial, co-operatively breeding species. It lives together in groups comprising an adult pair and three to four helpers or auxilliaries being young of the year or a previous year. The species roosts communally at night in nests known as dormitory nests, comprising sticks externally in a domed form and lined with softer materials such as grass, feathers or wool. Dormitory nests usually number several (usually a minimum of four) in a small area and if used, house up to 14 birds. Grey-crowned Babbler is an active, gregarious species and members of a group often draw attention to themselves by their noisy chattering calls and other group behaviours such as chasing and mobbing (Higgins and Peter 2002),

Five records of the Grey-crowned Babbler were located within the ANSWW search region. These records are from 2004 and 2005. The highest quality potential habitat is considered to occur in the Black Box woodland. Warren Street roadside vegetation is likely to have too dense a ground cover to support the species (Figure 2). Given that potential habitat exists within the study area, this species was considered to have potential to occur in woodland habitat within the study area during the initial fauna assessment.

During the targeted diurnal surveys of the study area, no evidence was found for the occurrence of this species. No nests were located and no birds were found. Information obtained from the Murray Shire indicated that this species is occasionally observed along the proposed alignment on the New South Wales side of the Murray River. Such occurrences appear to be dispersing individuals, in the absence of nests that would suggest a permanent presence in the study area. It is therefore unlikely that a breeding population of Grey-crowned Babblers occur in the vicinity of the proposed alignment, although they may occur elsewhere along the Murray River nearby.

The **Brown Quail** is considered to be near threatened under the DSE Advisory List (DSE 2007). This species inhabits a range of habitat types, including woodland. It prefers damp and swampy habitats with a cover of ground vegetation and may move into ephemeral grasslands after flooding (Marchant and Higgins 1993). There are two records of Brown Quail within the VFD search region and one record in the ANSWW search region. The habitat is currently very dry and unlikely to support this species, apart from possibly near the billabongs on the New South Wales side of the study area (Figure 11). Although this species may occasionally

occur in the study area, it is unlikely to be a resident or occur in significant numbers on a regular basis.

Two nationally threatened bird species, the endangered **Swift Parrot** and **Regent Honeyeater** were identified under the EPBC Act as occurring or having potential habitat within the search region. These species are also considered endangered under the TSC Act (DEC 2005).

The Swift Parrot migrates to Victoria from Tasmania in winter to feed on the flowering eucalypts of the inland slopes of the Great Divide. The Regent Honeyeater is mainly an inhabitant of the Box-Ironbark forests. Both are considered nomadic in Victoria, with movements being determined by flowering eucalypts (Emison *et al.* 1987; Higgins *et al.* 2001). Both species may also occur in urban areas and farmlands with remnant eucalypt trees, especially during migration (Higgins 1999).

Although these two woodland birds may occasionally pass through the study area, it is highly unlikely they would occur regularly or in significant numbers. There are no records of either species in VFD or ANSWW, and although the study area contains potential foraging habitat, the preferred food trees of the species, such as Red Ironbark, Grey Box, Yellow Gum and White Box, are absent.

The **Superb Parrot** is considered nationally vulnerable (EPBC Act), vulnerable on the TSC Act and considered endangered under the FFG Act. In Riverina districts, they occur mainly in mature healthy River Red-gums in forest growing on river flats along with Yellow Box, Black Box and Cypress Pine (Higgins 1999). Forest and woodlands often contain an open mid-storey of wattles and ballart. The species nests in the hollows of large trees (dead or alive), mainly in tall, riparian River Red-gum forest or woodland.

This species' range includes Barmah-Millewa Forest, within approximately 20km of the study area. It is possible this species may occasionally occur in the study area due to the presence of suitable foraging habitat; however numbers are unlikely to be significant due to their preference for the Barmah-Millewa State Forest and adjacent areas further east.

The **Turquoise Parrot** occurs in eucalypt forests and woodlands with grassy ground cover and sometimes with a shrubby understorey. The species has been recorded mostly from box/ironbark eucalypt associations although it may also occur in riparian woodlands dominated by River Red-gum (Higgins 1999). It feeds on seeds of grasses and shrubs. There are no records of this species from the VFD or ANSWW and although this species may occur in the study area as suitable habitat is present, it is unlikely to regularly occur there.

Potentially suitable habitat also occurs for several other woodland species such as the **Diamond Dove**, **Diamond Firetail**, **Speckled Warbler** and **Painted Honeyeater.** However, the VFD and ANSWW contain one record for each of the Diamond Dove (2001) and Diamond Firetail (1984), and no records of the latter three species within 10 km of the study area. Therefore, although these species may occasionally utilise the habitats in the study area, they are unlikely to occur regularly or in significant numbers.

Grassland species

The study area lacks extensive, sparse, native grasslands required by the **Plains-wanderer**, a species predicted to occur in the region by the EPBC Protected Matters Search Tool. In addition, the only two records of this species in the search region are both from 1954. The study area ground layer is dominated by a fairly dense sward of introduced pasture grasses. The Plains-wanderer is therefore considered unlikely to occur in the study area.

Migratory Birds

The EPBC Act identified suitable habitat for nine migratory bird species including four terrestrial birds and five wetland birds.

As described in the sections above, the review of existing information and site inspection identified suitable habitat in the study area for two migratory bird species. The **Rainbow Bee-eater,** a summer visitor to the region, was recorded in several locations in both the NSW and Victorian sections of the study area during the field assessment, and is likely to pass through the study area during migration. Recent information from local submitters provided to VicRoads indicates that it has been recorded breeding near the proposed alignment.

The **White-bellied Sea-eagle**, listed as threatened under the FFG Act and vulnerable on the DSE Advisory List, may occur and forage along the Murray River. One record of this species occurs in the search region from 1999. It is mostly a coastal species, but is also known to occur along the Murray River (Emison *et al.* 1987). The species is known to build its nests in River Red-gum trees, and as suitable habitat is present, it is likely to occur in the study area. No nests of this species were found during the assessment and it is unlikely to be a resident in the area.

The remaining migratory species have not been recorded in the search region and habitat for them (wetter forests and gullies) is absent. Therefore it is expected they would not occur regularly in the study area and are unlikely to be significantly impacted upon by the proposed development.

Waterbirds

The VFD and ANSWW list a number of threatened waterbird species from the search regions. These species include the **Australasian Shoveler** (3 records between 1953 and 1999), **Blue-billed Duck** (6 records between 1989 and 1999), **Eastern Great Egret** (7 records between 1984 and 2001), **Hardhead** (8 records between 1982 and 1999), **Intermediate Egret** (5 records between 1994 and 2001), **Musk Duck** (11 records between 1989 and 1999), **Royal Spoonbill** (3 records between 1989 and 1994), **Nankeen Night Heron** (1 record in 1984), **Azure Kingfisher** (3 records between 1986 and 2001), **Pied Cormorant** (no records in the search region) and **Whiskered Tern** (2 records between 1982 and 1994). There is very limited habitat for waterbirds, although some of them may occasionally utilise the billabongs on the New South Wales side of the river for foraging, loafing and roosting. However, none of these habitats is likely to support breeding habitat.

Birds of Prey

One open country species listed in Victoria as vulnerable, the **Black Falcon**, was recorded in the search region in 1994 (single record). These species may rarely occur over farmland areas within the study area, but the frequency of records to date suggests it would not be a regular component of the study area's fauna. In addition, this species is more common to arid regions of Australia.

The **Square-tailed Kite** is listed as threatened under the FFG Act, vulnerable under the TSC Act and vulnerable on the DSE Advisory List. It inhabits a range of eucalypt open forest and woodland and has been recorded to utilise River Red-gum and requires large tracts of intact woodland or forest habitat for breeding (Marchant and Higgins 1993). No records of this species occur within the search region. This species may occur in the study area but it is unlikely to occur regularly or in significant numbers.

Mammals

A total of 26 species of mammals occurs or are likely to occur within the study area based on VFD records from the search region and the current site assessment. This total includes five introduced species and 10 species of bats. Three native species, Brush-tailed Possum (16 individuals), Ring-tailed Possum (6 individuals) and White-striped Free-tail Bat, were directly recorded during the field surveys (Appendix 2). In addition, evidence of Black Wallabies was recorded on the New South Wales side of the study area (scats and tracks at burrow entrances).

The study area was considered to provide potential habitat for five threatened mammals, although only one was considered likely to occur. These are discussed in more detail below.

The **Squirrel Glider** is listed as threatened under the FFG Act, vulnerable under the TSC Act and endangered under the DSE Advisory List. It occurs in dry forests and woodland and utilises habitats with mature and mixed-age trees, including those dominated by River Red-gum and with Silver Wattle and Black Wattle in the understorey (Menkhorst 1995). Golden Wattle or Lightwood may also be present in the understorey where this species occurs (van der Ree 2003). The species requires hollows for denning and a range of hollow types can be utilised (Menkhorst 1995). Squirrel Gliders are known to utilise linear road reserves with suitable habitat and in many rural areas of Victoria depend on such habitat, particularly the large trees (van der Ree 2002, van der Ree and Bennett 2003).

There are 27 VFD records of this species within the search region ranging from 1980 to 2000. Two of these locations are close to the study area. This species is considered to be highly likely to occur within the study area, with the highest quality habitat being along Warren Street, and between Warren Street and the Campaspe River (See Figure 13).

The **Brush-tailed Phascogale** is listed as vulnerable in New South Wales under the TSC Act and it is also listed under the FFG Act in Victoria. There are no records within 10 km of the study area, however ANSWW has two records from approximately 40 km away from near Cohuna and Deniliquin. The species occurs in dry forests and woodlands dominated with box and ironbark eucalypt species.

Brush-tailed Phascogale has been recorded denning and foraging in River Red-gum, in particular mature and large trees (Rodney van der Ree pers. comm.)

There is potentially suitable habitat for the species in the study area, but as there are very few records in the surrounding region and as it is outside of the current known range of the Brush-tailed Phascogale, it is unlikely to occur.

The **Large-footed Myotis** and **Little Pied Bat** are listed as vulnerable under the TSC Act. The Large-Footed Myotis occurs in habitats where vegetation is associated with water. It has been recorded from the Riverina, upstream from Echuca (Menkhorst 1995). This species is infrequently recorded but it may occur in the study area, as potential foraging and roosting habitat occurs. The Little Pied Bat has been recorded in River Red-gum forest and riparian woodlands but has not been recorded south of the Murray River. This species may occur in the study area but is unlikely to be there on a regular basis or in significant numbers, due to its current known distribution.

The **Spot-tailed Quoll** occurs in a range of forest and woodland habitats including River Red-gum Forest and riparian habitats in drier areas (Menkhorst 1995). It is unlikely to occur in the study area due to the lack of recent nearby records and the lack of extensive forested habitats in or near the study area.

Reptiles

A total of 22 species of reptiles occurs or is likely to occur within the study area based on VFD or ANSWW records from the search region and the current site assessment. Three species were directly recorded during the assessment (Appendix 2).

The study area was considered to support three threatened reptiles. These are discussed in more detail below.

The **Carpet Python** is listed as threatened under the FFG Act and endangered under the DSE Advisory List, and there is one historical record of this species in the VFD from 1951. This species occupies a range of habitats; however, the Victorian subspecies *Morelia spilota metcalfei* is associated with large River Red-gums and box woodlands along watercourses (Wilson and Swan 2003). The species requires hollow logs or hollows for sheltering (Mirtschin and Davis 1992). It is considered most likely to occur in the Black Box woodland habitat, although it may also be present in the River Red-gum habitat on the Victorian side of the study area.

The **Bandy Bandy** is considered near threatened in Victoria and is listed under the FFG Act. There are two records in the VFD from 1951 from the same location as the Carpet Python record. The Bandy Bandy is nocturnal and feeds mainly on blind snakes. It occurs in a range of habitats and shelters under rocks, logs and cracks in the soil (Mirtschin and Davis 1992). It is considered likely to occur in the same habitats as the Carpet Python within the study area.

The **Murray River Turtle** is not threatened but DSE (2005) lists this species as being data deficient, meaning that there is inadequate information for assessing extinction risk. This species may occur in the Murray River.

Frogs

A total of seven species of frogs occurs or is likely to occur within the study area based on VFD records from the search region and the current site assessment. Three species were directly recorded during the assessment (Appendix 2).

The study area was considered to support one threatened frog. This is discussed in more detail below.

The EPBC Act Protected Matters Search Tool identified the nationally threatened **Growling Grass Frog** as potentially having habitat in the search region. This species is listed as vulnerable under the EPBC Act, threatened under the FFG Act, endangered under the TSC Act and endangered under the DSE Advisory List. The species is usually associated with permanent water bodies supporting large areas of fringing and aquatic vegetation such as Common Reed (*Phragmites australis*), Bulrush (*Typha spp.*) and Water Ribbon (*Triglochin procera*) (Organ 2002). It is considered unlikely that this species would occur in the study area due to lack of records from the region, although some potential habitat occurs on the banks of some of the billabongs and along the New South Wales bank of the Murray River.

Invertebrates

The Protected Matters Search Tool identified the potential for the **Golden Sun Moth** or its habitat to be present within the search area. This species is listed as critically endangered under the EPBC Act, threatened under the FFG Act and endangered under the DSE Advisory list. Habitat for this species is limited to secondary Wallaby-grass grassland along the road reserve of the Murray Valley Highway. There are no records of this species in nearby parts of the Riverina, with most records being closer to or south of the Great Dividing Range. As the potential habitat is derived from original woodland habitat and this species is a grassland specialist, it is considered unlikely to occur in the study area.

5.2. Fauna conservation significance

The fauna conservation significance for the study area was broken down to each of the habitat types and is discussed in more detail below. (See Figure 12 and Appendix 5).

5.2.1. River Red-gum woodland/forest

The River Red-gum woodland/forest habitat along Warren Street and between Warren Street and Campaspe River is likely to support Squirrel Gliders (Figure 13). Due to the high likelihood of a population of Squirrel Gliders being present it is considered to be of **potential state conservation significance**. Although the other threatened fauna species for which habitat occurs may occur there, they are considered unlikely to occur regularly or in significant numbers.

The River Red-gum woodland/forest habitat on the New South Wales was of lower quality than elsewhere in the study area due to disturbance and modification of native vegetation. Suitable habitat was noted on the NSW side of the Murray River for Bush Stone Curlew. This area is therefore considered to be of **potential state conservation significance**.

5.2.2. Black Box woodland

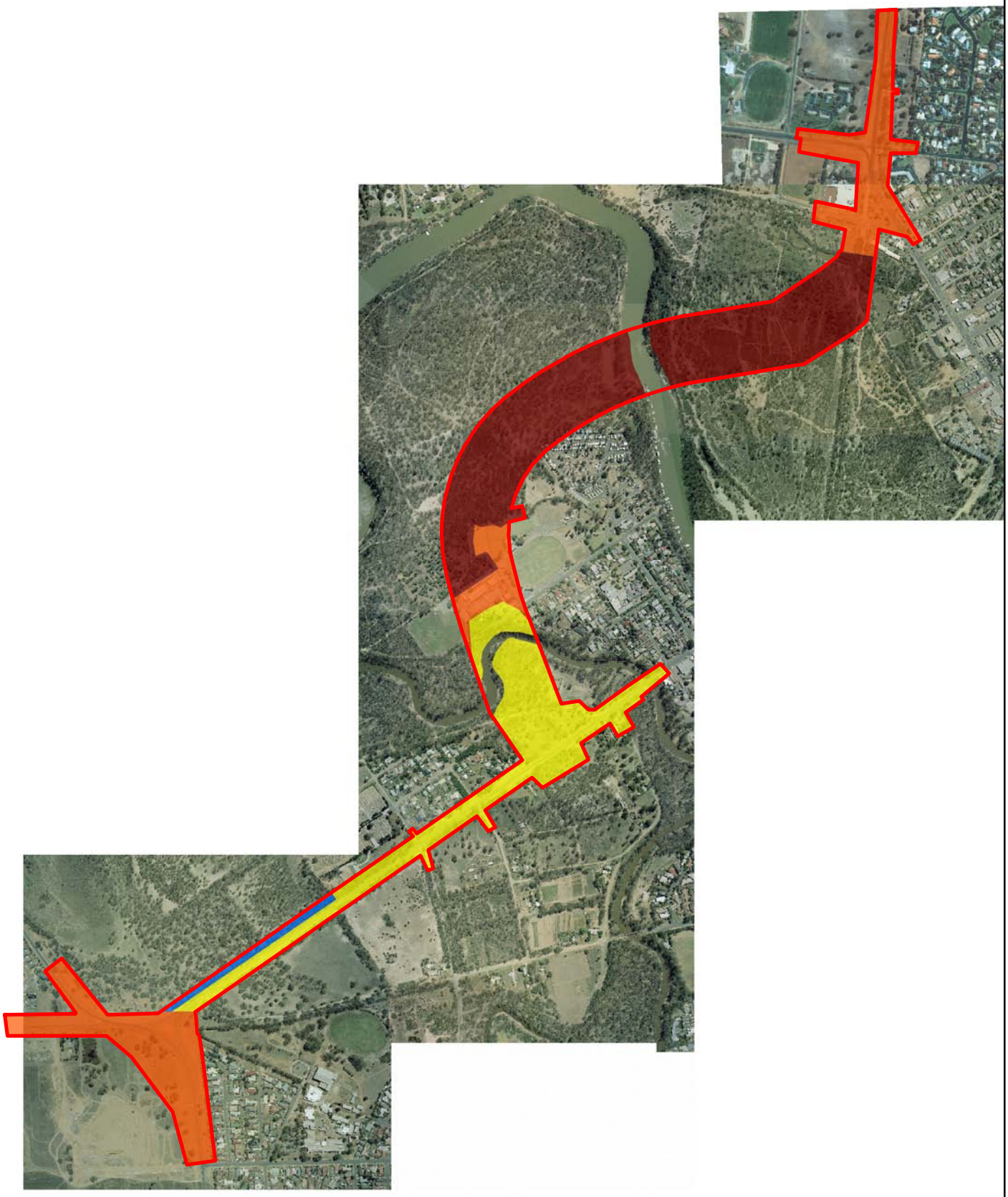
The Black Box woodland retains a lot of habitat features, such as hollow trees, native ground cover and logs that are important for native fauna including threatened species. The Brown Treecreeper was recorded throughout this habitat and is also likely to nest there. This habitat is therefore of **state conservation significance**. Other threatened species that may occur there include the Squirrel Glider, Carpet Python, Bandy Bandy, Barking Owl and a number of threatened woodland birds. A targeted fauna survey in early January 2009 failed to locate any threatened species and most are considered unlikely to occur there regularly.

5.2.3. Aquatic habitat

The **Growling Grass Frog** may potentially occur in the billabongs within the River Red-gum woodland/forest habitat on the New South Wales side of the study area, although this habitat is considered to be sub-optimal for the species. These billabongs are likely to be of local conservation significance, although due to the potential of the Growling Grass Frog occurring there, it is considered to be of **potential national conservation significance**.

5.2.4. Other habitat

Other habitat in the study area consists of modified and highly disturbed areas and is likely to support locally common species and unlikely to support threatened species. Therefore these areas are considered to be of **local conservation significance**.



Legend

- Study Area

Conservation Significance of Fauna Habitat

- Local
- Potentially National
- Potentially State
- State

Metres

0 250 500 1,000

Figure 12: Conservation Significance of Fauna Habitat

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 28/07/2010	Created By: J. Sullivan / L. Braun

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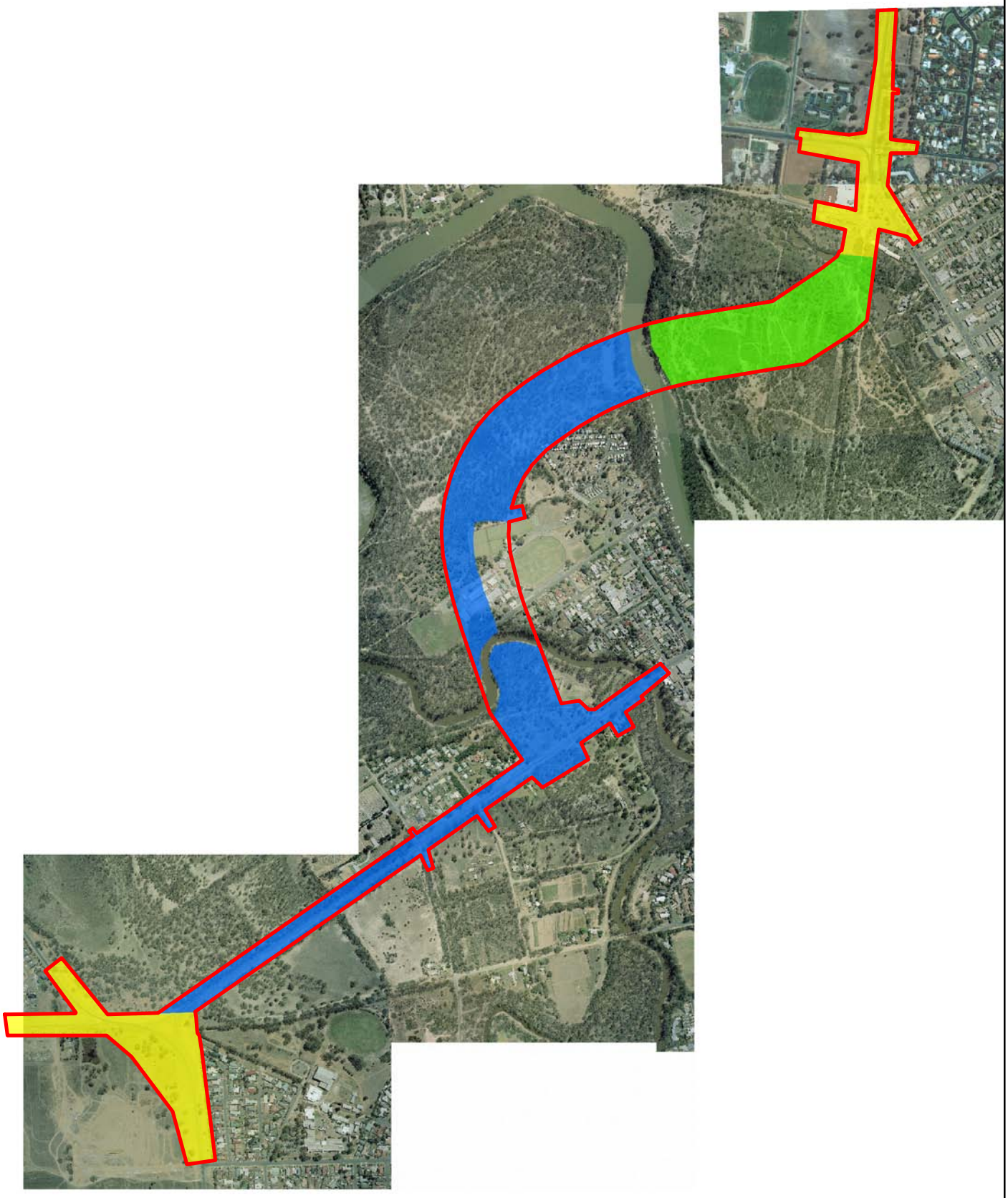

Legend

Study Area

Squirrel Glider Habitat Quality

- High
- Moderate
- Low

Metres

0 250 500 1,000

Figure 13: Habitat Likely to Support Squirrel Glider

Project: Murray River Crossing Echuca-Moama

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6. VICTORIAN IMPACTS AND REGULATORY IMPLICATIONS

This section provides an outline of the regulatory issues related to the flora, fauna and native vegetation present in the Victorian study area. Impacts and implications in this section of the report are discussed with reference to Victorian Planning Controls, the FFG Act and the EE Act.

6.1. Planning Controls

Removal of native vegetation on allotments of 0.4 hectares or more requires a planning permit under Clause 52.17 of all Victorian Planning Schemes. Before issuing a planning permit, Responsible Authorities are obligated to refer to Clause 12.01 (Biodiversity) in the Planning Scheme. This refers in turn to Victoria's Native Vegetation Management – a Framework for Action, discussed in the following section.

6.2. Victoria's Native Vegetation Management - a Framework for Action

This part of the report describes the Framework and applies its provisions to the proposed development. The Framework is a state-wide policy, separate from local planning overlays that may also require a permit for the removal of trees or vegetation. In the latter case, different criteria and controls may apply to those described below.

6.2.1. How the Framework operates

Any proposal to remove native vegetation from the study area must demonstrate that the three-step approach of 'Net Gain' outlined in the Framework has been applied. This approach is hierarchical and includes the following steps:

- Step 1: As a priority, ***avoid*** adverse impacts on native vegetation, particularly through clearance;

If the removal of native vegetation cannot be avoided:

- Step 2: ***Minimise*** impacts through appropriate consideration in the planning process and expert input to project design or management; and
- Step 3: Identify appropriate ***offset*** options.

A combination of project design and offsetting should aim to achieve a net gain in the area and quality of native vegetation across Victoria.

Responses to planning permit applications to remove native vegetation vary depending on the conservation significance of the vegetation proposed for removal. Conservation significance determines both the likelihood of approval and, importantly, the scale of the required offset. This is summarised in Table 6.

Table 6: Likely response to applications for removal of intact native vegetation

Framework conservation significance	Likely response to application for clearing	Likely offset requirements
VERY HIGH	Clearing not permitted unless exceptional circumstances apply. Offset Management Plan to be submitted with application. Approval required from the Minister for Environment and Climate Change.	Substantial Net Gain At least 2 X calculated loss in habitat hectares plus a large tree protection and replacement offset if any large trees are removed
HIGH	Clearing generally not permitted	Net Gain At least 1.5 X calculated loss in habitat hectares plus a large tree protection and replacement offset if any large trees are removed
MEDIUM	Clearing generally not permitted	Equivalent Gain At least 1 X calculated loss in habitat hectares plus a large tree protection and replacement offset if any large trees are removed
LOW	Clearing may be permitted but only as part of an appropriate sustainable use response	Equivalent Gain At least 1 X calculated loss in habitat hectares

Offset targets are directly related to the habitat hectare value of the removed vegetation. They can comprise indigenous vegetation retained for conservation purposes within the study area, or vegetation elsewhere, secured on a case-by-case basis by the proponent or through the DSE Bush Broker scheme.

Clause 66.02 of all Victorian Planning Scheme's determines the role of the DSE in the assessment of indigenous vegetation removal planning permit applications. If an application is referred to the DSE then the Responsible Authority must follow that department's recommendation in relation to that permit application. The criteria presented in Table 7 indicate when the DSE becomes a referral authority.

Table 7: Application referral criteria

Applications will be referred to the Department of Sustainability and Environment under the following circumstances:
Scattered Trees ▪ To remove more than 15 trees of DBH less than 40 centimetres ▪ To remove more than 5 trees of DBH 40 centimetres or greater (DBH = diameter at 1.3 metres above ground)
Remnant Patch Vegetation (may include trees) ▪ To remove more than 0.5 hectares of vegetation in an EVC with Bioregional Conservation Status of Endangered, Vulnerable or Rare. ▪ To remove more than 1 hectare of vegetation in an EVC with Bioregional Conservation Status of Depleted or Least Concern.

A referral to DSE would be triggered for both the initial and ultimate works as:

- **Initial Option:** More than 0.5 hectares of vegetation is proposed for removal from Habitat Zones with a bioregional conservation status of vulnerable or endangered; AND more than 1.0 hectare of vegetation is proposed for removal from Habitat Zones with a depleted bioregional conservation status.
- **Ultimate Option:** More than 0.5 hectares of vegetation is proposed for removal from Habitat Zones with a bioregional conservation status of vulnerable or endangered; AND more than 1.0 hectare of vegetation is proposed for removal from Habitat Zones with a depleted bioregional conservation status.

6.2.2. Design recommendations

Consideration should be given to including the design recommendations described below to illustrate the "avoid" and "minimise" principles of the Framework:

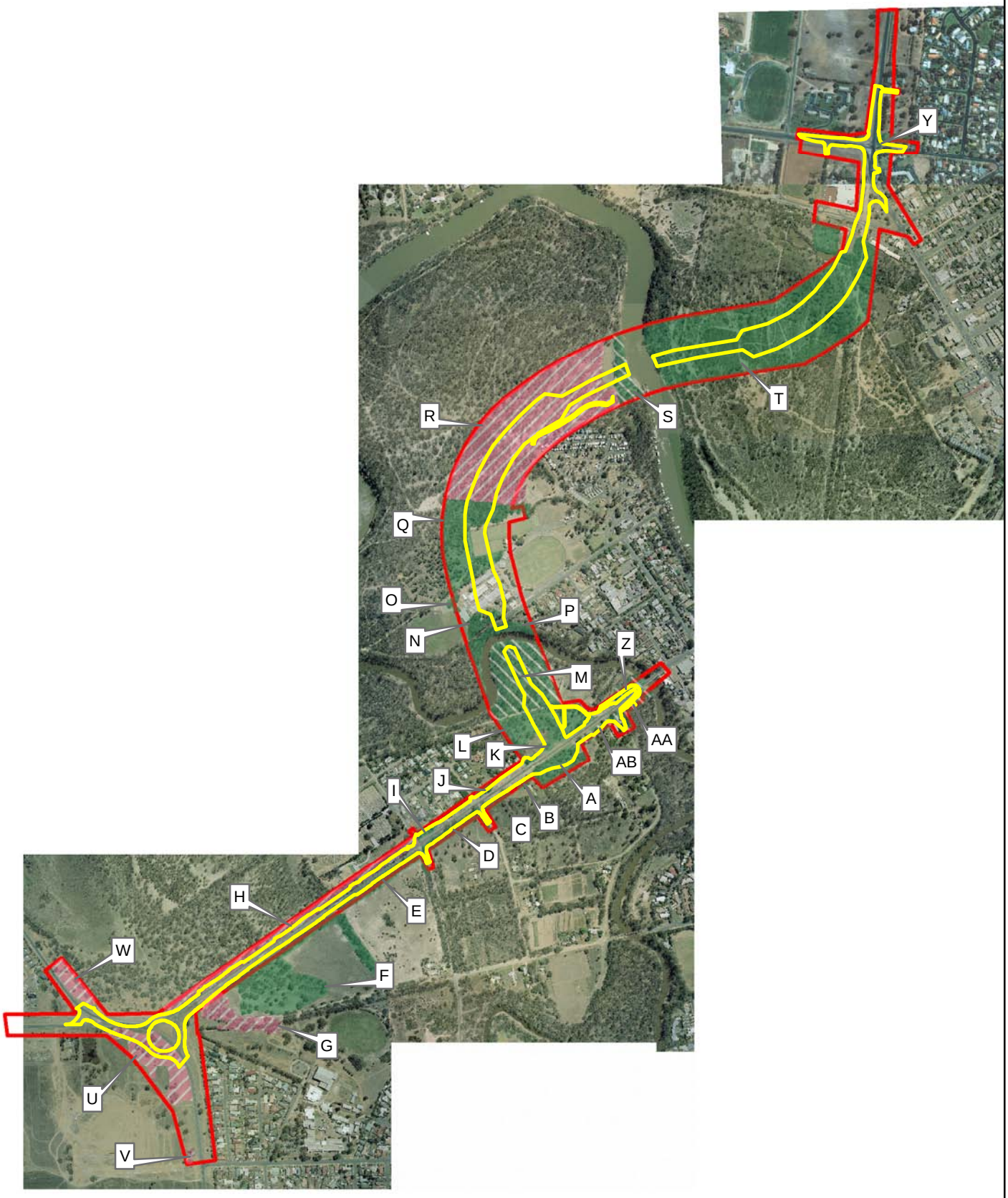
- If possible, the alignment should be sited as close to the already disturbed and built up areas as possible to avoid impacting on high quality fauna habitat;
- Loss of large old trees and hollow bearing trees along Warren Street and between Warren Street and Campaspe River should be avoided. If avoidance is not possible, the removal of such trees should be minimised;
- It is recommended that hollow trees within the Black Box woodland are avoided. If removal of such habitat trees is unavoidable, pre-construction surveys to determine the presence of fauna in the hollows should be undertaken.

Where impacts to native vegetation cannot be avoided or minimised, offsets are required to compensate for their loss. Detailed offset targets for the proposed loss of native vegetation are provided in the following sections.

Detailed mitigation recommendations are provided in Chapter 10 to further compensate for the proposed loss of native vegetation.

6.2.3. Offset targets for removal of native vegetation from Initial Option

Offset targets for the proposed removal of intact native vegetation within the 'Initial Option' development footprint is outlined in this section. Offsets in habitat hectares are presented in Table 8 and offset targets for large tree removal from habitat zones are presented in Table 9. This table is based on the clearance of native vegetation within the proposed 'Initial Option' development footprint provided by the proponent (Figures 14 to 17).



Legend

- Study Area
- Initial Boundary

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

Metres

0 260 520 1,040

Figure 14: Native Vegetation Removed by the Initial Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 28/07/2010	Created By: J. Sullivan / L. Braun

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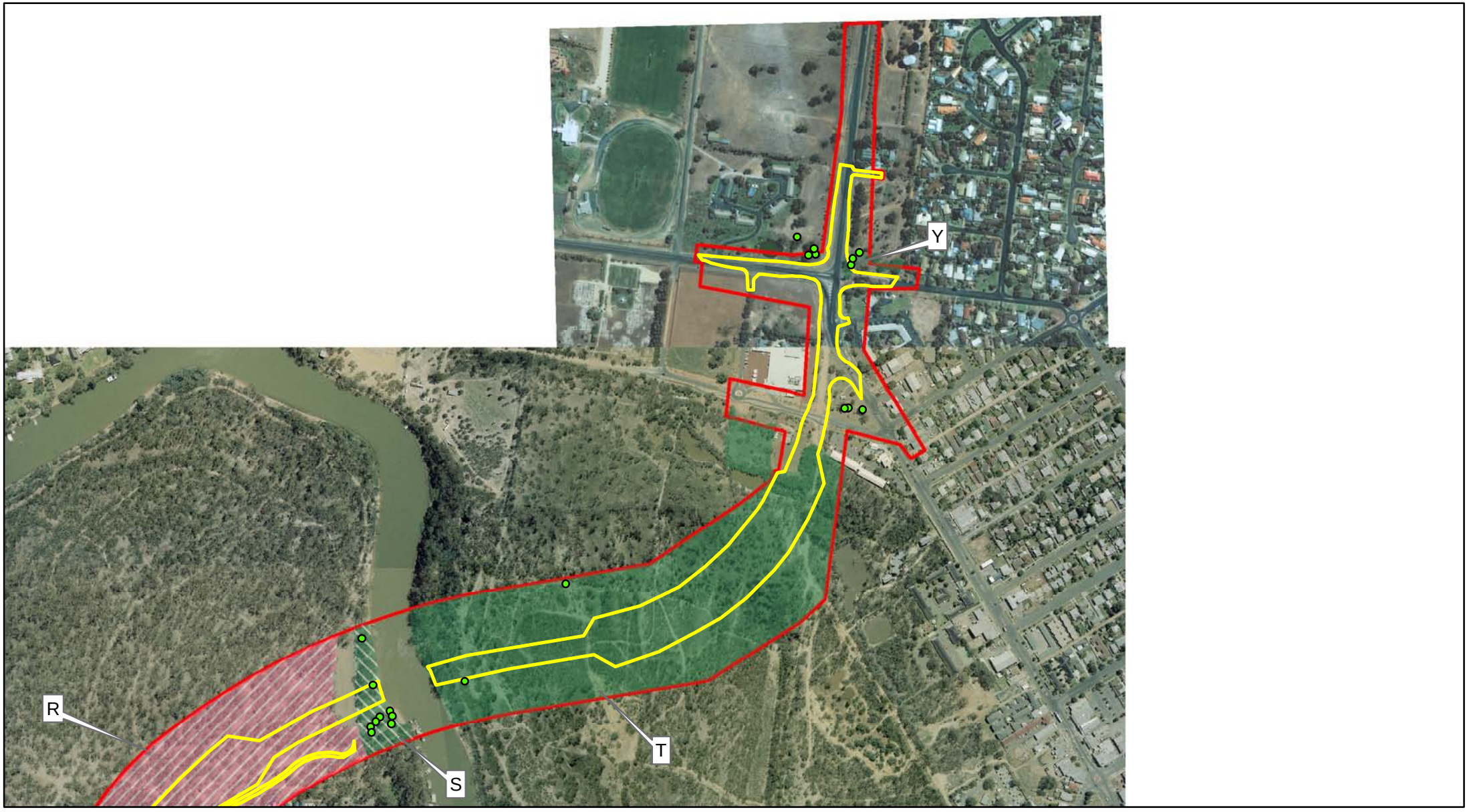

Legend

- Study Area
- Initial Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 15: Native Vegetation Removed by the Initial Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

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Legend

- Study Area
- Initial Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 16: Native Vegetation Removed by the Initial Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

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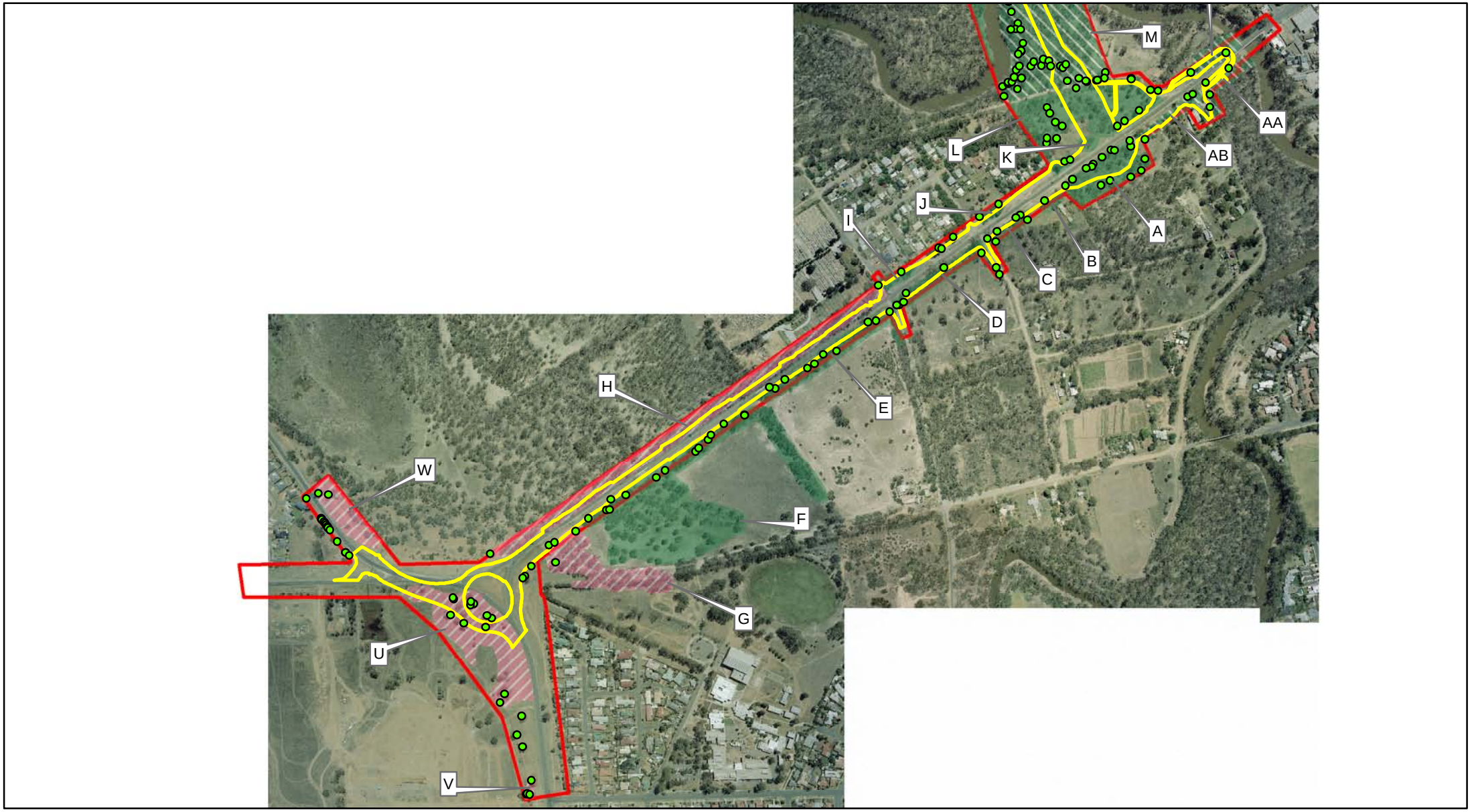

Legend

- Study Area
- Initial Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 17: Native Vegetation Removed by the Initial Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 29/07/2010	Created By: J. Sullivan / L. Braun

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Table 8: Offset targets for removal of native vegetation – Initial Option

Habitat Zone	Area in alignment (ha)	Habitat Hectares	Framework Conservation Significance	Net Gain Multiplier	Offset Target (*habitat hectares*)
A	0.51	0.172	High	1.5 x	0.258
B	0.01	0.002	High	1.5 x	0.002
C	0.06	0.018	High	1.5 x	0.026
D	0.25	0.056	High	1.5 x	0.084
E	0.20	0.067	High	1.5 x	0.100
F	0.03	0.012	High	1.5 x	0.017
G	0.03	0.010	High	1.5 x	0.015
H	0.71	0.424	Very High	2 x	0.848
I	0.10	0.062	Very High	2 x	0.124
J	0.05	0.029	Very High	2 x	0.057
K	0.08	0.049	Very High	2 x	0.099
L	0.81	0.288	High	1.5 x	0.432
M	0.83	0.296	High	1.5 x	0.444
N	0.07	0.019	High	1.5 x	0.029
O	0.00	0.000	High	1.5 x	0.000
P	0.04	0.017	High	1.5 x	0.026
Q	1.05	0.309	High	1.5 x	0.463
R	3.58	1.946	Very high	2 x	3.892
S	0.14	0.047	High	1.5 x	0.070
T	4.63	na	na	na	na
U	0.56	0.246	High	1.5 x	0.369
V	0.00	0.000	High	1.5 x	0.000
W	0.00	0.000	High	1.5 x	0.000
Y	0.04	na	na	na	na
Z	0.05	0.014	High	1.5 x	0.021
AA	0.05	0.016	High	1.5 x	0.024
AB	0.20	0.085	High	1.5 x	0.128
Total	14.07	4.182			7.528

* Habitat Zones H, I, J and K – default score of 0.6 (60 out of 100) applied (see note above Table 2), ^ Habitat Zones T and Y Areas of Native vegetation in New South Wales – not subjected to Habitat hectare assessment as the Framework has no implications under New South Wales legislation.

Offsets are commensurate with the conservation significance of the removed vegetation and are subject to like-for-like criteria. These may include the permanent protection (e.g. Section 173 agreement under the *Planning and Environment Act 1987*) for conservation purposes of other existing remnant vegetation. Offsets may be located within the study area or offsite, and maintained for up to 10 years. Offsite offsets may be identified on a case-by-case

basis by the proponent or through the DSE Bush Broker scheme. Offsets must be of a like-for-like nature as outlined in the Framework.

As a rule of thumb, (five times the habitat hectare value), approximately 37.64 hectares of Riverine Chenopod Woodland, Grassy Riverine Forest and Riverine Grassy Woodland may be required to achieve this 'Initial' offset target, based on a potential 20% improvement of the offset site. It should be noted that this is an approximation only. This offset target may not be achieved within the study area. An appropriate third party offset site (i.e. site located on another property) would need to be identified through discussions with the Responsible Authority or with the DSE Bush Broker coordinator.

Additional offset targets for removal of large and very large trees from habitat zones apply to any such approved removal under the Framework and the North Central Native Vegetation Plan (NCCMA, 2005) and are presented in Table 9. These offsets contain both a protection and recruitment component, whereby a prescribed number of existing trees must be protected for conservation purposes, and a prescribed number of new indigenous plants must be successfully recruited through planting and/or assisted natural regeneration.

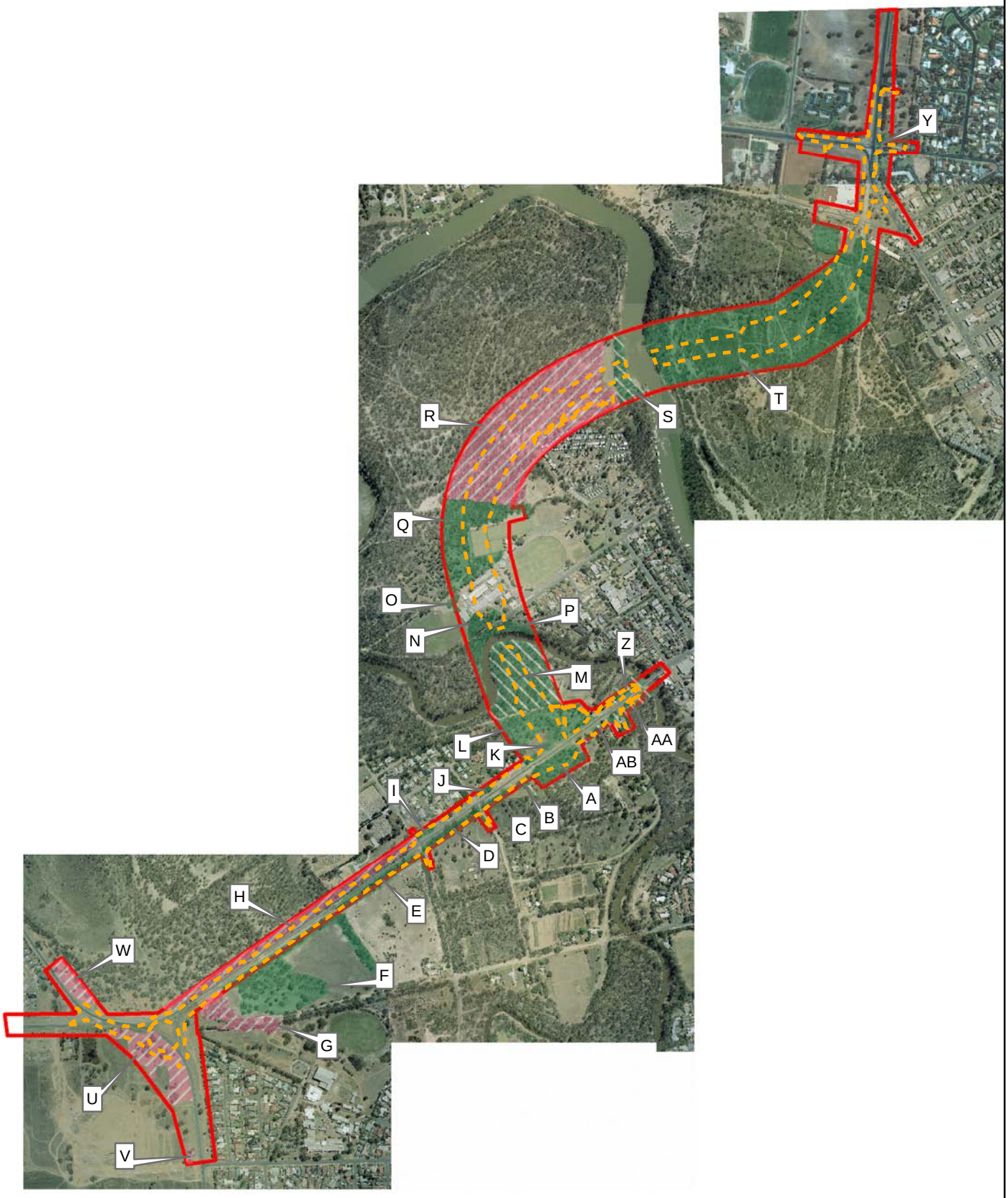
Table 9: Offset targets for removal of large and very large trees from habitat zones – Initial Option

Habitat Zone	No. of large and very large trees to be removed	Protect		Recruit	
		Multiplier	No. of trees	Multiplier	No. of plants*
A	10	4	40	20	200
B	1	4	4	20	20
C	4	4	16	20	80
D	3	4	12	20	60
E	3	4	12	20	60
F	1	4	4	20	20
G	2	4	8	20	40
J	2	8	16	40	80
M	7	4	28	20	140
N	2	4	8	20	40
P	3	4	12	20	60
Q	8	4	32	20	160
R#	172	8	1376	40	6880
S	1	4	4	20	20
U	3	4	12	20	60
AB	2	4	8	20	40
Totals	**224**		**1592**		**7960**

* Note that it is assumed that by protecting a medium or large tree, either scattered or in a patch, five recruits will be generated naturally. To be considered protected, twice the canopy diameter of the tree must be fenced and protected from adverse impacts; # Number of trees based on 12 large old trees per 50 x 50m within area of 3.58 ha (area within alignment).

6.2.4. Offset targets for removal of native vegetation from Ultimate Option

Offset targets for the proposed removal of intact native vegetation within the Ultimate Option development footprint is outlined in this section. Offsets in habitat hectares are presented in Table 10 and offset targets for large tree removal from habitat zones is presented in Table 11. This is based on the clearance of native vegetation within the proposed 'Ultimate Option' development footprint provided by the proponent (Figures 18 to 21).



Legend

- Study Area
- Ultimate Boundary

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

Metres
0 250 500 1,000

Figure 18: Native Vegetation Removed by the Ultimate Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 28/07/2010	Created By: J. Sullivan / L. Braun

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Legend

- Study Area
- Ultimate Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 19: Native Vegetation Removed by the Ultimate Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 29/07/2010	Created By: J. Sullivan / L. Braun

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Legend

- Study Area
- Ultimate Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 20: Native Vegetation Removed by the Ultimate Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 29/07/2010	Created By: J. Sullivan / L. Braun

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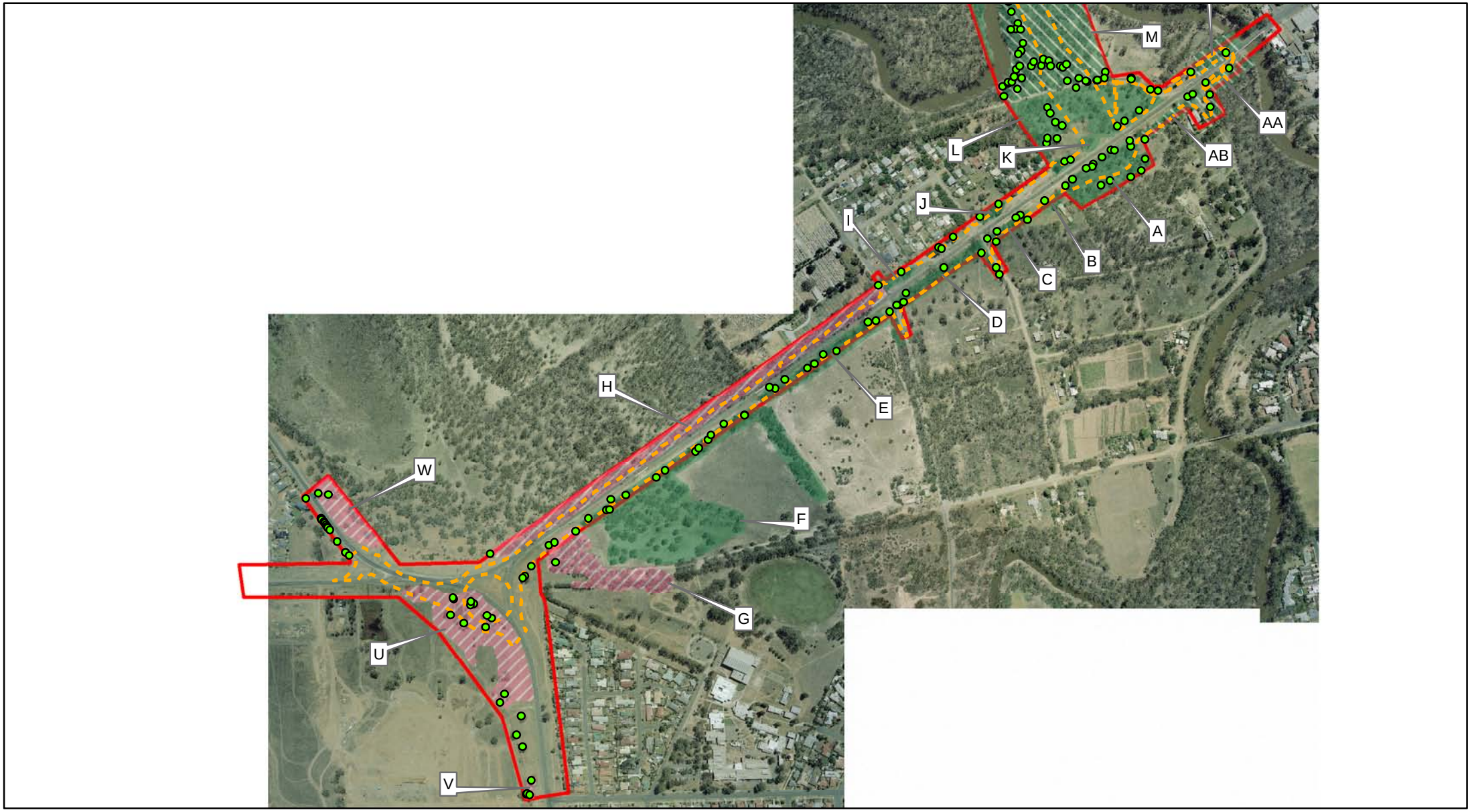

Legend

- Study Area
- Ultimate Boundary
- Large Trees in patches and Scattered Trees

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 100 200 400 Meters

Figure 21: Native Vegetation Removed by the Ultimate Proposed Works

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194.4	Date: 29/07/2010	Created By: J. Sullivan / L. Braun

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Table 10: Offset targets for removal of native vegetation – Ultimate Option

Habitat Zone	Area in alignment (ha)	Habitat Hectares	Framework Conservation Significance	Net Gain Multiplier	Offset Target (*habitat hectares*)
A	0.51	0.174	High	1.5 x	0.262
B	0.01	0.003	High	1.5 x	0.004
C	0.12	0.037	High	1.5 x	0.056
D	0.41	0.091	High	1.5 x	0.136
E	0.44	0.150	High	1.5 x	0.226
F	0.27	0.126	High	1.5 x	0.188
G	0.04	0.014	High	1.5 x	0.022
H*	0.71	0.424	Very High	2 x	0.848
I*	0.10	0.062	Very High	2 x	0.124
J*	0.05	0.029	Very High	2 x	0.057
K*	0.09	0.054	Very High	2 x	0.107
L	0.89	0.318	High	1.5 x	0.476
M	1.12	0.399	High	1.5 x	0.599
N	0.11	0.031	High	1.5 x	0.046
P	0.06	0.025	High	1.5 x	0.038
Q	1.21	0.355	High	1.5 x	0.533
R	4.37	2.375	Very high	2 x	4.750
S	0.20	0.066	High	1.5 x	0.100
T	5.34	0.000	na	na	0.000
U	0.56	0.246	High	1.5 x	0.369
W	0.04	0.013	High	1.5 x	0.019
AA	0.05	0.016	High	1.5 x	0.024
AB	0.20	0.085	High	1.5 x	0.128
Total	16.92	5.092			9.110

* Habitat Zones K – default score of 0.6 (60 out of 100) applied (see note above Table 2), ^ Habitat Zones T – Areas of Native vegetation in New South Wales – not subjected to Habitat hectare assessment as the Framework has no implications under New South Wales legislation.

As a rule of thumb, (five times the habitat hectare value), approximately 45.55 hectares of Riverine Chenopod Woodland, Grassy Riverine Forest and Riverine Grassy Woodland may be required to achieve this offset target, based on a potential 20% improvement of the offset site. It should be noted that this is an approximation only. This offset target may not be achieved within the study area. An appropriate third party offset site (i.e. site located on another property) would need to be identified through discussions with the Responsible Authority or with the DSE Bush Broker coordinator.

Additional offset targets for removal of large and very large trees from habitat zones apply to any such approved removal under the Framework and the North Central Native Vegetation Plan (NCCMA 2005) and are presented in Table 11.

Table 11: Offset targets for removal of large and very large trees from habitat zones – Ultimate Option

Habitat Zone	No. of large and very large trees to be removed	Protect		Recruit	
		Multiplier	No. of trees	Multiplier	No. of plants*
A	10	4	40	20	200
B	1	4	4	20	20
C	4	4	16	20	80
D	5	4	20	20	100
E	9	4	36	20	180
F	4	4	16	20	80
G	2	4	8	20	40
L	2	4	8	20	40
M	11	4	44	20	220
N	2	4	8	20	40
P	3	4	12	20	60
Q	9	4	36	20	180
R#	210	8	1680	40	8400
S	1	4	4	20	20
U	3	4	12	20	60
AB	2	4	8	20	40
Totals	**278**		**1952**		**9760**

* Note that it is assumed that by protecting a medium or large tree, either scattered or in a patch, five recruits will be generated naturally. To be considered protected, twice the canopy diameter of the tree must be fenced and protected from adverse impacts; # Number of trees based on 12 large old trees per 50 x 50m within area of 4.37 ha (area within alignment).

6.2.5. Offset targets for removal of scattered trees from the Initial and Ultimate Option

Any approved removal of scattered trees will attract an offset target comprising protection and recruitment components, whereby a prescribed number of trees of the same size class must be protected and recruitment (planting or assisted regeneration) of indigenous plants undertaken. The scale of the offset is determined by the size class of the trees proposed to be removed. Alternatively, in the event that the protection of existing trees is considered not to be feasible, a 'recruit only' offset for tree removal may apply, subject to negotiation with the Responsible Authority.

Offset targets for the removal of two scattered trees within the development footprints (Initial and Ultimate), as determined by the Framework and the North Central Native Vegetation Plan (NCCMA 2005), are presented in Appendix 4. A summary of the required offsets is provided below in Table 12.

Table 12: Summary of offset targets for scattered tree removal

Common Name	Size Class	Conservation Significance	No. trees to be removed	Protect and Recruit Option		Recruit Only Option*
				Protect	Recruit*	
Black Box^	Very Large	Medium	1	N/A	N/A	N/A
Black Box	Small	Low	1	N/A	60	60
Total			**2**	**N/A**	**60**	**60**

* 15% must be canopy trees; ^ Scattered tree recorded in NSW and therefore has no offset obligations under the Central Native Vegetation Plan (NCCMA 2005).

Removal of one very large and one small Black Box is required by the Initial and Ultimate layout. To offset these trees, 60 plants must be recruited. No protect and recruit option is available for small scattered trees. One of the scattered trees proposed to be removed occurred in NSW and therefore has no offset obligations under the Central Native Vegetation Plan (NCCMA 2005).

6.2.6. Offset targets for the removal of Murray Pines recorded in Habitat Zone Q

The Murray Pine (*Callitris gracilis subsp. murrayensis*) or otherwise known as Slender Cypress-pine is a native tree, growing up to 20 metres tall. It commonly grows on low-nutrient sandy soils and is widely distributed. It occurs from Mildura, Yarrawonga and Horsham, an outlying population has also been recorded approximately 70 kilometres north west of Melbourne. The species is locally significant, but is not listed as threatened under the EPBC Act, FFG Act or DSE Advisory List.

A large stand of Murray Pines occurs north of Echuca High School, the extent of which is represented by a blue line in Figure 22. This area is covered by a Heritage Overlay – Schedule HO79 which requires a permit for the removal of any Murray Pines in the affected area (Figure 22). The area for which this overlay applies occurs within the project study area. A permit is therefore required under HO79 for the removal of Murray Pines for the project.

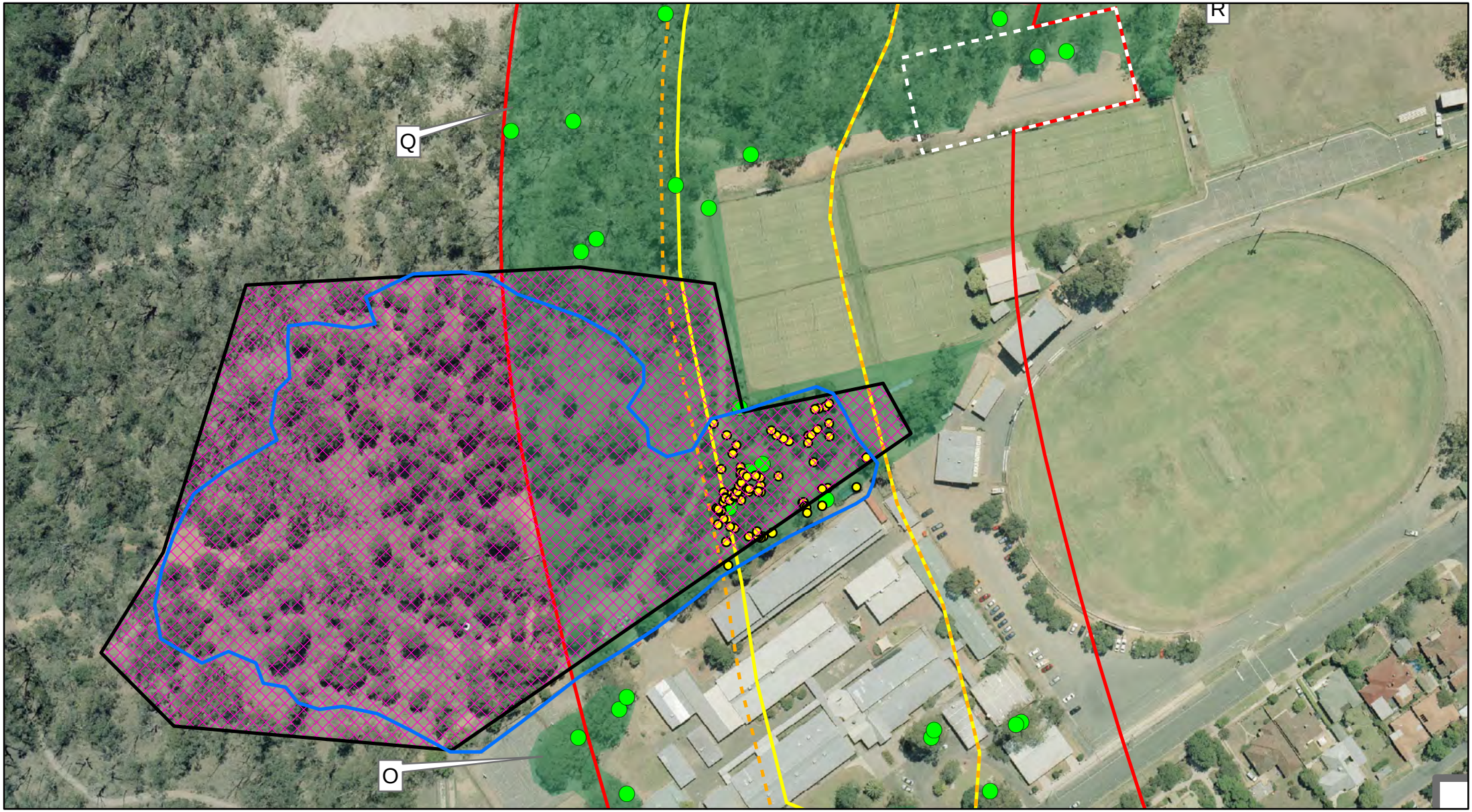
The Initial development layout proposes the removal of 71 Murray Pines, while the Ultimate works propose the removal of 82 Murray Pines from Habitat Zone Q. A large proportion of the trees proposed for removal are young trees of less than 10 cm DBH. The locations of the Murray Pines within the alignment are shown in Figure 22. The removal of Murray Pines will be compensated primarily by the offset targets as presented for Habitat Zone Q in Tables 8 to 11.

The proponent has indicated that re-planting of additional Murray Pines in the area to the west of the alignment would be undertaken to compensate for the removal of these locally significant species. Two trees are proposed to be planted for every one being removed.

6.2.7. Offset targets for consequential removal of native vegetation from the proposed replacement tennis courts

The proposed road corridor will also impact on several existing tennis courts north of Echuca Secondary School. To compensate for this, six replacement tennis courts have been proposed to be developed to the north of the existing tennis courts, adjacent to the proposed road corridor. This development will result in the consequential removal of an additional area of native vegetation.

Offset targets for the proposed removal of intact native vegetation within the development footprint for the six replacement tennis courts is outlined in this section. Offsets in habitat hectares are presented in Table 13 and offset targets for large tree removal from habitat zones is presented in Table 14. The area of vegetation to be removed for the development of the replacement tennis courts is shown in Figure 22.



Legend

- Study Area
- Initial Boundary
- Ultimate Boundary
- Replacement Tennis Courts
- Large Old Trees
- Murray Pines in alignment
- Extent of Murray Pines (mapped by BL&A)
- Area where Heritage Overlay (HO79) applies

Native Vegetation

- EVC 295
- EVC 106
- EVC 103

0 25 50 100 Meters

Figure 22: Replacement Tennis Courts and Murray Pines

Project: Murray River Crossing Echuca-Moama

Client: VicRoads

Project No.: 8194	Date: 15/02/2011	Created By: J. Sullivan / M.Ghasemi

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Table 13: Offset targets for removal of native vegetation – Ultimate Option

Habitat Zone	Area in alignment (ha)	Habitat Hectares	Framework Conservation Significance	Net Gain Multiplier	Offset Target (*habitat hectares*)
Q	0.20	0.057	High	1.5 x	0.086
Total	0.20	0.057			0.086

* Habitat Zones K – default score of 0.6 (60 out of 100) applied (see note above Table 2), ^ Habitat Zones T – Areas of Native vegetation in New South Wales – not subjected to Habitat hectare assessment as the Framework has no implications under New South Wales legislation.

As a rule of thumb, (five times the habitat hectare value), approximately 0.43 hectares of Riverine Grassy Woodland may be required to achieve this offset target, based on a potential 20% improvement of the offset site. It should be noted that this is an approximation only. This offset target may not be achieved within the study area. An appropriate third party offset site (i.e. site located on another property) would need to be identified through discussions with the Responsible Authority or with the DSE Bush Broker coordinator.

Additional offset targets for removal of large and very large trees from habitat zones apply to any such approved removal under the Framework and the North Central Native Vegetation Plan (NCCMA 2005) and are presented in Table 14.

Table 14: Offset targets for removal of large and very large trees from habitat zones – Tennis Courts

Habitat Zone	No. of large and very large trees to be removed	Protect		Recruit	
		Multiplier	No. of trees	Multiplier	No. of plants*
Q	2	4	8	20	40
Totals	**2**		**8**		**40**

* Note that it is assumed that by protecting a medium or large tree, either scattered or in a patch, five recruits will be generated naturally. To be considered protected, twice the canopy diameter of the tree must be fenced and protected from adverse impacts.

6.3. Flora and Fauna Guarantee Act 1988

The Victorian *Flora and Fauna Guarantee Act 1988* lists threatened flora and fauna species to provide for their protection and management. The FFG Act has limited direct application to private land. However, Clause 12.01 of the Campaspe Planning Scheme makes reference to this Act. The local planning authority is likely to consider impacts on FFG Act-listed species and communities when deciding on planning permit applications. The removal of threatened species or communities, or protected flora under the FFG Act from public land requires a permit under the Act. This permit is obtained from the Department of Sustainability and Environment. Any impacts on FFG Act listed threatened flora or fauna are likely to be taken into consideration by the Department of Sustainability and Environment.

6.3.1. Threatened communities

No communities listed as threatened under the FFG Act were observed during the current assessment.

6.3.2. Threatened flora species

No flora species listed as threatened under the FFG Act were observed during the current assessment. Three flora species have the potential to occur in the Victorian part of the study area due to the presence of suitable habitat. These species include the Slender Darling-pea and Silky Swainson-pea which have low potential to occur in areas of grassy woodland vegetation along Warren Street and south of the Campaspe River. Western Water-starwort shows low potential to occur in wet areas along the edges of the Campaspe and Murray Rivers. Due to the limited area of suitable habitat, poor quality of understorey vegetation in these areas and the absence of these species during the field surveys, there is a low likelihood that these species would occur in the study area. Any presence that may not have been detected would be minimal and therefore it is considered that the proposed development would not have a significant impact on these species.

Species of the family Asteraceae (daisy), protected under the FFG Act, were observed within the road reserve (public land) along Warren Street. A permit is required from DSE to remove protected flora from the road reserve.

6.3.3. Threatened fauna species

No fauna species listed as threatened under the FFG Act were observed during the current assessment. The Squirrel Glider is considered highly likely to occur in the study area due to the presence of suitable habitat and the regularity and proximity of records in the region. However, a targeted survey for this species was undertaken in January 2009 without detecting it.

The Barking Owl, Carpet Python and Bandy Bandy may occur due to the presence of suitable habitat. Other FFG Act listed species that may occasionally utilise the habitats in the study area include seven woodland bird species (Swift Parrot, Superb Parrot, Regent Honeyeater, Turquoise Parrot, Diamond Dove, Diamond Firetail, Speckled Warbler and Painted Honeyeater), one reptile (Murray River Turtle), one frog (Growling Grass Frog) and three fish (Macquarie Perch, Murray Cod and Silver Perch). The project is likely to affect the potential for these species to occur in the area due to the impacts on suitable habitat.

A number of bird species, listed above, that form part of the Victorian Temperate Woodland Bird community listed as threatened under the FFG Act may occur but their consistent presence is unlikely given the lack of records during the current surveys.

River Red-gums along Warren Street and between Warren Street and the Campaspe River and Black Box between Campaspe and Murray Rivers are likely to be removed or impacted upon by the development. These areas contain numerous hollows in live and dead River Red-gum and Black Box trees that are likely to provide habitat for the Squirrel Glider and potentially the Carpet Python.

Mitigation measures that minimise the area of vegetation and number of trees to be removed and incorporate habitat linkages will assist in mitigating impacts on

these species. In areas where vegetation removal/tree removal can be minimised, it is considered that direct impacts on these species will be reduced.

Provided impacts on the river do not prejudice movement opportunities for native fish then impacts are considered to be temporary and not significant for these aquatic fauna.

6.3.4. Threatening processes

Relevant threatening processes listed under the FFG Act which pertain to the proposed development include:

- Infection of amphibians with Chytrid Fungus, resulting in chytridiomyosis.
- Loss of woody debris from Victorian native forests and woodlands.
- Loss of hollow-bearing trees from Victorian native forests.

Infection of amphibians with Chytrid Fungus, resulting in chytridiomyosis.

Areas susceptible to this threatening process include along the Murray River and the Goulburn-Broken River. Although these areas are unlikely to support any listed threatened species, other amphibian species are likely to be present. Contamination would be avoided by ensuring machinery is cleaned before and after construction activities at a particular site. With these management measures in place, this threatening process is unlikely to result on a significant impact on the local amphibian population.

Loss of woody debris from Victorian native forests and woodlands.

As part of the mitigation measures proposed in Section 10.1, loss of woody debris in the forested areas and woodlands would be minimised. Where it is not possible to avoid this would be relocated to an adjacent similar habitat. Therefore, impacts from this threatening process are unlikely to result in a significant impact on the local flora or fauna populations.

Loss of hollow-bearing trees from Victorian native forests.

Section 10.1 stipulates that hollow trees within the Black Box woodland are retained. Where the removal of hollow-bearing trees cannot be avoided, pre-construction surveys would be undertaken to determine the presence of fauna in the hollows. Any identified fauna will be removed by a qualified zoologist and relocated to an adjacent area of suitable habitat. The loss of hollow-bearing trees will be mitigated by the installation of suitable nest boxes. With the implementation of these mitigation measures impacts from this threatening process are considered unlikely to occur.

6.4. Environment Effects Act 1978

Under the *Environment Effects Act 1978*, proponents are required to prepare a Referral to the State Minister for Planning, who will determine if an Environment Effects Statement (EES) is required for the project. Criteria related to flora and fauna are:

- Potential clearing of 10 hectares or more of native vegetation from an area with endangered Ecological Vegetation Class (EVC), or vegetation that is or is

likely to be, of very high conservation significance according to Victoria's Native Vegetation Management - a Framework for Action, except where authorised under an approved Forest Management Plan or Fire Protection Plan;

- Potential long-term loss of a significant proportion (1 to 5% depending upon conservation status of species concerned) of known remaining habitat or population of a threatened species in Victoria;
- Potential long-term change to a wetland's ecological character, where that wetland is Ramsar listed, or listed in 'A Directory of Important Wetlands in Australia';
- Potential major effects upon the biodiversity of aquatic ecosystems over the long term;
- Potential significant effects on matters listed under the *Flora and Fauna Guarantee Act 1988*.

One or a combination of these criteria may trigger a requirement for a Referral to the Victorian Minister for Planning who will determine if an EES is required.

There is potential for an impact on the Squirrel Glider, a threatened species listed under the FFG Act, although this is unlikely to be significant, especially if mitigation measures are put in place. Therefore it is not likely that a referral is required under the EE Act.

6.5. DSE threatened species advisory lists

Rare and threatened species advisory lists administered by the Department of Sustainability and Environment include flora and fauna species known to be rare or threatened throughout the state. Although the advisory list has no statutory status, the Responsible Authority will consider impacts on any species on the list when assessing a planning application.

No flora species from the *Advisory List of Rare and Threatened Plants in Victoria* (DSE 2005) were recorded from the study area during the current investigation.

One fauna species from the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2007b) was recorded during the current survey – the Brown Treecreeper. The VFD and ANSWW included another 15 species from the search regions. Of these, the Golden Perch is likely to be present. Provided impacts on the river do not prejudice movement opportunities for native fish then any impacts are considered to be temporary and not significant. The other 14 species are not likely to be regularly present, or in significant numbers, in the study area.

7. NSW IMPACTS AND REGULATORY IMPLICATIONS

7.1. Impacts to Native Vegetation

A large area of River Red-gum dominated woodland occurs within the New South Wales section of the proposed alignment. This vegetation includes a small number of large trees close to the Murray River and various age cohorts of River Red-gum regrowth throughout Habitat Zone T. While this area is currently disturbed with various tracks through it and an excavated area nearby, a large amount of native vegetation is required for removal. The 'Initial Option' development footprint proposes the removal of 4.63 hectares of native vegetation, whereas, the 'Ultimate Option' development footprint requires the removal of 5.34 hectares of vegetation from Habitat Zone T.

One further patch of native vegetation occurs in the north eastern end of the study area. Habitat Zone Y supports a small patch of remnant Yellow Box (0.19 hectares). Habitat Zone Y occurs as remnant trees in parks and gardens and therefore does not classify as an endangered ecological community. Both the Initial and Ultimate works propose would result in the removal of 0.04 hectares of native vegetation from Habitat Zone Y.

Two additional scattered trees occur in the north eastern end of the study area. One of these trees will be removed under the Initial and Ultimate alignments.

7.2. Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EPA Act) sets out a Seven Part Test that determines whether a Species Impact Statement should be prepared under the *Threatened Species Conservation Act 1995* (TSC Act) for a development. The aim of the Seven Part Test is to ascertain whether a proposed project is likely to lead to a significant impact on a threatened species or community that requires more detailed assessment under the TSC Act.

This test should be undertaken whenever the presence of a threatened species listed on the TSC Act in an affected area is confirmed or likely. If any of the Seven Part Test criteria are met, a Species Impact Statement is required. The criteria for the Seven Part Test are addressed for all TSC Act listed species recorded or deemed likely to occur in the study area in the following sub-section.

7.2.1. Seven Part-Test Criteria

(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;

Flora

The **Slender Darling-pea** and **Silky Swainson-pea** are both considered to have low potential to occur in areas of grassy woodland vegetation within the study area. However, the species was not detected during both preliminary and targeted surveys conducted. Some suitable habitat occurs in the River Red-gum grassy woodland vegetation on the New South Wales side of the Murray River, despite this area having a high cover of introduced pasture grasses in the understorey layer. As the potential for the occurrence of this species is low and any occurring

local populations of this species are expected to span beyond the study area, it is considered that the proposed action will not have an adverse effect on this species.

The **Western Water-starwort** is considered to have low potential to occur in and around the areas of permanent water in the New South Wales part of the study area. However, the species was not detected during both preliminary and targeted surveys conducted. Areas of potential habitat include a small area adjacent to the Murray River as well as the area surrounding the billabongs at the eastern end of the study area. Dense stands of native Rush was the only vegetation occurring along the edge of the Murray River, providing low potential for the occurrence of this species. Wetland vegetation adjacent to the billabongs in the eastern part of the study area was also disturbed, resulting in low potential for the occurrence of this listed species. Therefore it is considered the proposed action will not have an adverse effect on the local populations of this species.

Fauna

The **Bush-stone Curlew** is considered likely to utilise the River Red-gum woodland/forest habitat. The species has been confirmed to occur within 10 km of the study area and this habitat is considered to be suitable for it. The ANSWW contains 549 records of this species with one record from approximately 30 km east of Moama. In, addition, there is a record from the Victorian side of Murray River, within 5 km, from 2006 and it is therefore considered that a small population of the Bush-stone Curlew may be present. However, no individual of this species or its nests was found during both preliminary and targeted searches for the species. Therefore, it is considered unlikely that the proposal will have a significant impact on the local population of this species. The **Squirrel Glider** may utilise some of the large River Red-gums and wattles in the understorey in the River Red-gum woodland/forest habitat. However, due to the lack of potential denning and nesting trees in this habitat, a significant population of this species is unlikely to occur within the study area on the New South Wales side. Therefore it is unlikely that the proposed bridge construction would have an adverse effect on the life cycle of this species.

The **Brown Treecreeper** may occur in River Red-gum woodland/forest habitat. However, during the assessment this part of the study area was found to contain very few hollow trees suitable for nesting. Brown Treecreeper was observed nesting during the assessment on the Victorian side in Black Box, but none were recorded on the New South Wales side of the study area. The proposed bridge could impact this species through disturbance during construction activities. However, this disturbance would be of short duration and would result in a temporary impact. Concurrently, the Brown Treecreeper is a mobile species which would be able to move away from the source of disturbance. Therefore potential impacts would not significantly affect this species.

Potentially suitable habitat for the **Growling Grass Frog** is located in the north eastern part of the River Red-gum woodland/forest habitat. However, this habitat is limited, with poor water quality, presence of potential predators of eggs and tadpoles (Common Carp) and little fringing aquatic vegetation. Therefore the species is unlikely to breed successfully in these billabongs, although some

individuals may occasionally occur there. Therefore it is unlikely that the proposed bridge construction would have an adverse effect on the life cycle of this species.

The **Grey-crowned Babbler** inhabits dry woodlands and forests with a shrub layer and a groundcover of leaf litter and fallen timber (Higgins and Peter 2002). Five recent records of the Grey-crowned Babbler were located within the ANSWW search region. These records are from 2004 and 2005. During the site survey no evidence was found of its occurrence, in particular no nests were located and no birds were found. Therefore the species is considered to be most likely an occasional visitor in the study area and it is unlikely that the proposed bridge construction would have an adverse effect on the life cycle of this species.

The **Superb Parrot** may occasionally utilise the few large and hollow-bearing trees for roosting and wattles and *Exocarpos* sp. The proposed development is unlikely to have an adverse impact on this species as the study area would not support core habitat for the regional population as suitable habitat is limited.

The **Swift Parrot** and **Regent Honeyeater** may occasionally occur in River Red-gum woodland/forest habitat in small numbers. There are no records of either species in VFD or ANSWW, and although the study area contains potential foraging habitat, the preferred food trees of the species, such as Red Ironbark, Grey Box, Yellow Gum and White Box, are absent.

The Swift Parrot is considered to be most likely an occasional visitor to the study area when searching for flowering Eucalypts during migration. It is unlikely that the proposed bridge construction would have an adverse effect on the life cycle of this species. Likewise, the study area is not considered to be core habitat for Regent Honeyeater and impacts to this species from the proposed development are considered to be negligible.

(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.

No endangered populations of flora or fauna currently listed under Schedule 1 Part 2 of the TSC Act occur in the vicinity of the study area. Therefore, none will be affected by the proposed development.

(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.

No endangered ecological communities listed under Schedule 1 Part 3, or critically endangered ecological communities listed under Schedule 1A Part 2 of the TSC Act occur within the study area. Therefore, no impact on such communities is anticipated.

(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;

The main area of suitable habitat for the **Slender Darling-pea** and **Silky Swainson-pea** in New South Wales occurs in the River Red-gum grassy woodland vegetation along the Murray River. This habitat occurs widely along the Murray River and only a small proportion of this habitat falls within the alignment and is proposed for removal. The main area of suitable habitat for the **Western Water-starwort** in New South Wales occurs along the edges of the Murray River and around adjacent billabongs. A very small proportion of this habitat is to be removed under the current proposal.

Potential Bush-stone Curlew habitat is likely to be removed within the proposed bridge construction alignment. Sub-optimal habitat for the Squirrel Glider, Brown Treecreeper, Growling Grass Frog, Grey-crowned Babbler, Regent Honeyeater, Swift Parrot and Superb Parrot will be removed. No Murray Hardyhead or Macquarie Perch habitat will be removed.

(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;

Potential habitat for the **Slender Darling-pea** and **Silky Swainson-pea** may become fragmented if native vegetation is removed within the proposed alignment. Areas of aquatic habitat for the **Western Water-starwort** including the small amount of vegetation fringing the Murray River, is not likely to become fragmented.

Potential threatened fauna habitat is likely to become fragmented where native vegetation is proposed for removal within the alignment. Although potential habitat will become fragmented, no core or breeding habitat will be fragmented or isolated.

Habitat for the Murray Hardyhead and Macquarie Perch will not become fragmented or isolated as a result of the proposed action.

(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.

There is a very limited area of potential habitat for threatened flora species within the New South Wales part of the study area. Therefore the removal or modification of this habitat is not considered to have a long-term effect on the survival of the species in the local area.

There is limited overall potential habitat for the Bush-stone Curlew in the study area due to the absence of individuals during both preliminary and targeted surveys. Therefore this area of native vegetation is unlikely to provide important habitat for a local population of the species.

The area to be affected is unlikely to provide core breeding, nesting or denning habitat for other threatened species due to the lack of recent VFD and ANSWW records, and for some of the species the study area is out of their known range. These species include Squirrel Glider, Brown Treecreeper, Growling Grass Frog, Grey-crowned Babbler, Swift Parrot, Regent Honeyeater and Superb Parrot.

Habitat for the Murray Hardyhead and Macquarie Perch will not be removed or fragmented and is unlikely to be modified if mitigation measures to prevent run-off into the Murray River are implemented.

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

The study area is not listed as Critical Habitat in the Register of Critical Habitat under the TSC Act. No such habitat is therefore affected by the proposal.

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

No recovery plan exists for the Slender Darling-pea and Western Water-starwort. Recovery actions for the Silky Swainson-pea include monitoring and mapping of known populations, and propagation. These actions do not apply to the study area, as no populations of the Silky Swainson-pea have been recorded.

A recovery plan exists for the Swift Parrot (Swift Parrot Recovery Team 2001). The proposed action can meet Action 1 of this recovery plan:

Action 1: Identify the extent and quality of foraging habitat.

The preferred feeding trees of this species were limited in the study area. It is unlikely to be present regularly or in significant numbers during migration. Therefore potential threats to the species within the study area have been identified as part of the flora and fauna assessment.

A recovery plan exists for the Bush-stone Curlew (DEC 2006). The proposed action can fulfil and meet Objective 6 of this recovery plan:

Objective 6: Ensure that impacts on Bush-stone Curlews and their habitat are accurately assessed during planning and environmental processes.

Recommended surveys for this species were carried out in early January 2009 to gain a more detailed understanding of the occurrence of this species in the study area. As a result of this additional survey, the Bush-stone Curlew is considered unlikely to regularly utilise the study area.

A draft recovery plan exists for the Growling Grass Frog (DECC 2005). The proposed action can meet Objective 3 of this recovery plan:

Objective 3: identify and alleviate, where possible, any current or potential threats to the species.

As limited habitat for this species occurs in the study area, it is unlikely to be present regularly, or breed there. Therefore potential threats to the species within the study area have been identified as part of the flora and fauna assessment.

There is no recovery plan for the Superb Parrot, Regent Honeyeater, Squirrel Glider, Brown Treecreeper and Grey-crowned Babbler.

(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 as listed under Schedule 3 of the TSC Act (1995) relevant to the development proposal include the following:

- Clearing of native vegetation;
- Loss of hollow-bearing trees; and
- Removal of dead wood and dead trees.

All of the above key threatening processes are likely to occur under the proposed action. The extent to which these processes affect threatened species are described above under the relevant part of the test.

Conclusion

Responses to the criteria in the Seven Part Test are summarised in Table 15 for all species of flora and fauna listed on the TSC Act with potential to occur in the study area. Only the criteria relevant to threatened species (i.e. Criteria a, d and f see above) are provided in Table 15 as these are the only potential impacts relevant in the current circumstances, there being no listed endangered populations, communities or critical habitats in the study area. Part g of the test is dealt with in terms of species impacts under the other parts of the test in the table.

Table 15: Summary of responses to the criteria in the Seven Part Test

Species listed under the TSC Act with potential to occur within the study area	(a) 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,	(d) (i) the extent to which habitat is likely to be removed or modified (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species.	(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
Slender Darling-pea	Some suitable habitat present, though high cover of introduced species in ground layer. Not recorded during targeted surveys. Low potential to occur, any local populations are expected to span beyond the study area. The proposed action is not likely to have an adverse impact.	River Red-gum grassy woodland occurs widely along the Murray River and only a small proportion of this habitat falls within the alignment and is proposed for removal. Potential habitat for the Slender Darling-pea may become fragmented if native vegetation is removed within the proposed alignment. Due to the very limited area of potential habitat, the removal or modification of this habitat is not considered to have a long-term effect on the survival of the species in the local area.	No recovery plan exists for the Slender Darling-pea.
Silky Swainson-pea	Some suitable habitat present, though high cover of introduced species in ground layer. Not recorded during targeted surveys. Low potential to occur, any local populations are expected to span beyond the study area. The proposed action is not likely to have an adverse impact.	River Red-gum grassy woodland occurs widely along the Murray River and only a small proportion of this habitat falls within the alignment and is proposed for removal. Potential habitat for the Silky Swainson-pea may become fragmented if native vegetation is removed within the proposed alignment. Due to the very limited area of potential habitat, the removal or modification of this habitat is not considered to have a long-term effect on the survival of the species in the local area.	The recovery actions for the Silky Swainson-pea do not apply to the study area as as no populations of the Silky Swainson-pea have been recorded or are known to occur.
Western Water-starwort	Potential habitat in wet areas. Edges of the Murray River and billabongs to the east disturbed. Not recorded during targeted surveys. Low potential to occur. The proposed action is not likely to have an adverse impact.	A very small proportion of river edge and wet habitat is to be removed under the current proposal. Areas of such habitat including the small amount of vegetation fringing the Murray River, is not likely to become fragmented. Due to the very limited area of potential habitat, the removal or modification of this habitat is not considered to have a long-term effect on the survival of the species in the local area.	No recovery plan exists for the Western Water-starwort.
Bush-stone Curlew	A small population of the Bush-stone Curlew may be present in River Red-gum woodland/forest habitat. No individuals or its nests were found during targeted searches for the species. The proposed action is not likely to have an adverse impact.	Potential Bush-stone Curlew habitat is likely to be removed within the proposed bridge construction alignment. Potential threatened fauna habitat is likely to become fragmented where native vegetation is proposed for removal within the alignment. Although potential habitat will become fragmented, no core or breeding habitat will be fragmented or isolated. There is limited overall potential habitat for the Bush-stone Curlew in the study area due to the absence of individuals during both preliminary and targeted surveys. Therefore this area of native vegetation is unlikely to provide important habitat for a local population of the species.	A recovery plan exists for the Bush-stone Curlew (DEC 2006). The proposed action meets Objective 6 of this recovery plan: (ensure that impacts on Bush-stone Curlews and their habitat are accurately assessed during planning and environmental processes). Recommended surveys for this species were carried out in early January 2009. As a result of this survey, the Bush-stone Curlew is considered unlikely to regularly utilise the study area.
Black-chinned Honeyeater	Potential to occur in River Red-gum or Black Box woodlands. Any population present is likely to be affected minimally due to the available corridors of similar habitat that would allow recolonisation.	Some potential habitat of the Black-chinned Honeyeater is proposed to be removed. This would result in some habitat fragmentation, however this would have negligible effect due to the species' mobility and available habitat along riparian zones beyond the study area.	No recovery plan exists for the Black-chinned Honeyeater
Brown Treecreeper	Brown Treecreeper was observed nesting on the Victorian side in Black Box, but none were recorded in the New South Wales. The proposed bridge could impact this species through disturbance during construction activities. However, this disturbance would be of short duration and would result in a temporary impact. Concurrently, the Brown Treecreeper is a mobile species which would be able to move away from the source of disturbance.	Sub-optimal habitat for the Brown Treecreeper will be removed within the proposed bridge construction alignment. Some potential threatened fauna habitat is likely to become fragmented where native vegetation is proposed for removal within the alignment. No core or breeding habitat will be fragmented or isolated. The area to be affected is unlikely to provide core breeding habitat for Brown Treecreeper.	No recovery plan exists for the Brown Treecreeper

Species listed under the TSC Act with potential to occur within the study area	(a) 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,	(d) (i) the extent to which habitat is likely to be removed or modified (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species.	(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
	Therefore potential impacts would not significantly affect this species.		
Eastern Long-eared Bat	Potential habitat exists in the form of Black Box and River Red-gum woodland. Generally occurs in habitats with a dense understorey and therefore is not expected to be in significant numbers in the study area. Any impacts on this mobile species, if present, are expected to be minimal.	Some fragmentation of habitat is likely to occur as a result of this proposal. This is likely to result is a small impact on this species if present, however it is unlikely to be sufficient to result in local extinction because of the large corridors of similar habitat available to the Bat.	No recovery plan exists for the Eastern Long-eared Bat
Gilbert's Whistler	Potentially occurs in Black Box woodland. However, not observed during survey work and any population if present in the study area is likely very small.	A small area of potential habitat is to be removed. Minor fragmentation of this habitat is expected, however this is considered unlikely to impact significantly on the Gilbert's Whistler if present.	No recovery plan exists for the Gilbert's Whistler
Grey-crowned Babbler	During surveys no evidence was found of its occurrence, in particular no nests were located and no birds were found. Therefore the species is considered to be most likely an occasional visitor in the study area and it is unlikely that the proposed action would have an adverse effect on the life cycle of this species.	Sub-optimal habitat for the Grey-crowned Babbler will be removed within the proposed bridge construction alignment, leading to minor fragmentation in the vicinity of the alignment. No core or breeding habitat will be fragmented or isolated. The area to be affected is unlikely to provide core nesting habitat for Grey-crowned Babbler, since none of their distinctive nests were found despite active searching.	No recovery plan exists for the Grey-crowned Babbler
Growling Grass Frog	Potentially suitable habitat in the north eastern part of the River Red-gum woodland/forest habitat. However, this habitat is limited, with poor water quality, presence of potential predators of eggs and tadpoles (Common Carp) and little fringing aquatic vegetation. Therefore unlikely to breed successfully in these billabongs, although some individuals may occasionally occur there. Unlikely that the proposed action would have an adverse effect on the life cycle of this species	A very small area of sub-optimal habitat for the Growling Grass Frog will be removed within the proposed bridge construction alignment. The area to be affected is unlikely to provide core or breeding habitat for Growling Grass Frog and the species is unlikely to be affected.	A draft recovery plan exists for the Growling Grass Frog (DECC 2005). The proposed action can meet Objective 3 of this recovery plan: Objective 3: (identify and alleviate, where possible, any current or potential threats to the species). As limited habitat for this species occurs in the study area, it is unlikely to be present regularly, or breed there. Therefore potential threats to the species within the study area have been identified as part of the flora and fauna assessment.
Hooded Robin	Potentially suitable habitat exists in River Red-gum and Black Box woodland.	A small area of potential habitat is to be removed. Minor fragmentation of this habitat is expected, however this is considered unlikely to impact significantly on the Hooded Robin if present.	No recovery plan exists for the Hooded Robin
Masked Owl	Potentially occurs in large River Red-gums. The paucity of such trees on the NSW side, together with absence of response by this species to the call playback survey conducted, suggests it is unlikely to be present and unlikely to be affected.	Some potential habitat of the Masked Owl is proposed to be removed. This would result in some habitat fragmentation, however this would have negligible effect due to the species' low density and current paucity of hollows in which it could nest.	A recovery plan exists for the large forest owls including Masked Owl. The proposed action contributes to the recovery effort by carrying out field surveys to validate models and mapping of habitat/lack of habitat.
Pied Honeyeater	Potentially suitable habitat in Black Box woodland. However a paucity of suitable flowering shrub layer preferred by this species (e.g. Emu-bushes *Eremophila* spp.) suggests it is unlikely to occur regularly and therefore unlikely to be affected by the bridge proposal.	Some potential sub-optimal habitat is to be removed. Given the dispersive habits of this widespread arid-zone species any fragmentation at the site would have no measurable impact on its local or overall population.	No recovery plan exists for the Pied Honeyeater

Species listed under the TSC Act with potential to occur within the study area	(a) 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,	(d) (i) the extent to which habitat is likely to be removed or modified (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species.	(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
Squirrel Glider	May utilise the large River Red-gums and wattles in the River Red-gum woodland/forest habitat. However, due to the lack of potential denning and nesting trees in this habitat, a significant population is unlikely to occur. The proposed action is not likely to have an adverse impact.	Sub-optimal habitat for the Squirrel Glider will be removed within the proposed bridge construction alignment. Better quality habitat was identified on the Victorian side of the Murray River. Potential Squirrel Glider habitat is likely to become fragmented where native vegetation is proposed for removal within the alignment. Although potential habitat will become fragmented, no core or breeding habitat will be fragmented or isolated, due to a paucity of hollow-bearing trees required by the species for denning.	No recovery plan exists for the Squirrel Glider
Superb Parrot	May occasionally utilise the few large and hollow-bearing trees for roosting and wattles and *Exocarpos* sp. The proposed action is unlikely to have an adverse impact on this species as the study area would not support core habitat for the regional population as suitable habitat is limited.	Sub-optimal habitat for the Superb Parrot will be removed within the proposed bridge construction alignment. Since the habitat is at present not known to regularly support Superb Parrot, there is not expected to be significant impact from this proposal.	No recovery plan exists for the Superb Parrot
Regent Honeyeater	May occasionally pass through the study area to forage on flowering Eucalypts. The proposed action is unlikely to have an adverse impact on this species as the study area would not support core habitat for the regional population as suitable habitat is limited.	Sub-optimal habitat for the regent Honeyeater will be removed within the proposed bridge construction alignment. Since the habitat is at present not known to regularly support Regent Honeyeater, there is not expected to be a significant impact from this proposal.	No recovery plan exists for the Regent Honeyeater
Swift Parrot	May occasionally occur in River Red-gum woodland/forest habitat in small numbers. Although the study area contains potential foraging habitat, the preferred food trees of the species, such as Red Ironbark, Grey Box, Yellow Gum and White Box, are absent. Therefore the species is considered to be most likely an occasional visitor when searching for flowering Eucalypts during migration. It is unlikely that the proposed bridge construction would have an adverse effect on the life cycle of this species.	Sub-optimal habitat for the Swift Parrot will be removed within the proposed bridge construction alignment. Since the habitat is at present not known to regularly support Swift Parrot, there is not expected to be a significant impact from this proposal.	A recovery plan exists for the Swift Parrot (Swift Parrot Recovery Parrot 2001). The proposed action can meet Action Plan 1 of this recovery plan: Action 1. Identify the extent and quality of foraging habitat. As limited foraging habitat for this species occurs in the study area, it is unlikely to be present regularly or in significant numbers during migration. Therefore potential threats to the species within the study area have been identified as part of the flora and fauna assessment.

The Seven Part Tests concluded that the proposed development would not have a significant impact upon threatened flora species including the Slender Darling-pea, Silky Swainson-pea and Western Water-starwort.

The Seven Part Tests concluded that the proposed development would not have a significant impact upon the Bush-stone Curlew, as this species was not found to be present in the study area during preliminary and recommended targeted searches.

The test also indicated that due to the modification of the habitat and loss of many key habitat features, other threatened species that may occasionally utilise the habitat are unlikely to be adversely impacted upon. These species include the Squirrel Glider, Brown Treecreeper, Growling Grass Frog, Grey-crowned Babbler, Swift Parrot, Regent Honeyeater and Superb Parrot.

Accordingly, it is concluded that a Species Impact Statement is not required for this proposal.

8. COMMONWEALTH IMPACTS AND REGULATORY IMPLICATIONS

8.1. Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* contains a list of threatened species and ecological communities that are considered to be of national conservation significance. Any impacts on these species considered significant requires the approval of the Australian Minister for the Environment. If there is a possibility of a significant impact on nationally threatened species or communities or listed migratory species, a Referral under the EPBC Act should be considered. The Minister will decide after 20 business days whether the project will be a 'controlled action' under the EPBC Act, in which case it cannot be undertaken without the approval of the Minister. This approval depends on a further assessment and approval process.

Species of flora and fauna listed as threatened under the EPBC Act with potential to occur in the study area have been assessed in Tables 16 and 17 according to the significant impact criteria.

8.1.1. Threatened ecological communities

No ecological communities listed as threatened under the EPBC Act were observed during the assessment.

8.1.2. Threatened flora species

No flora species listed as threatened under the EPBC Act were observed during the assessment. Two flora species, Slender Darling-pea and Western Water-starwort showed low potential to occur in the study area due to the presence of limited suitable habitat. Due to the limited area of suitable habitat, poor quality of understorey vegetation in these areas and the absence of these species during the field surveys, there is a low likelihood that these species would occur in the study area. Any presence that may not have been detected would be minimal and therefore it is considered that the proposed development would not have a significant impact on these species.

8.1.3. Threatened fauna species

No fauna species listed as threatened under the EPBC Act were observed during the assessment. The Golden Sun Moth may occur on the Victorian side of the study area along the Murray Valley Highway, as potentially suitable habitat exists and as the extent of habitat within and outside the study area is considered to potentially support a population of this species. Given the small habitat area along the roadside it is unlikely that the proposed development would have a significant impact on the Golden Sun Moth.

No other EPBC Act listed fauna species are considered to occur regularly or in significant numbers in the study area, although the Swift Parrot and Superb Parrot may occasionally utilise the habitats there whilst moving between core habitat areas. There is a low likelihood of the Growling Grass Frog occurring in the study area, in the billabongs due to limited habitat in the study area.

8.1.4. Migratory species

The Rainbow Bee-eater, a listed migratory species, was recorded in the study area and is likely to occur regularly in the warmer months due to the presence of suitable habitat. This species is a common, widespread species in inland Australia including along the River Murray valley, and the removal of a small proportion of its habitat, is not considered to be a significant impact. A potential breeding habitat in a quarry near the alignment will not be removed, so potential breeding habitat will not be affected significantly. Rainbow Bee-eater is a mobile species which would be able to move away from disturbance to nearby extensive, suitable habitat along the River Murray. Therefore potential impacts would not significantly affect this species. Based on the foregoing discussion, the impacts of the project against the criteria for significant impacts in EPBC Act Policy Statement 1.1 are summarised below.

An area of 'important habitat' for a migratory species is defined in the policy statement as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The small area of habitat (14 hectares) affected by the proposed new road does not meet any of the foregoing criteria as an important habitat for a listed migratory species in the case of the Rainbow Bee-eater. Therefore, the proposed new road will not substantially modify habitat, result in invasive species altering or destroying habitat, or disrupt the life cycle of an ecologically significant proportion of the population of the species. A significant impact on the Rainbow Bea-eater is therefore not expected from the project.

A Referral under the EPBC Act is therefore not required for the project.

Table 16: Assessment of threatened species against the EPBC Act significant impact criteria – Critically endangered or endangered species

Species	Long-term decrease in the size of a population	Reduce the area of the species	Fragment an existing population	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of a population	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in the establishment of invasive species	Introduce disease that may cause the species to decline	Interfere with the recovery of the species
Regent Honeyeater	No historical records in region, therefore unlikely to be an important population present	Not recorded during targeted survey - unlikely to be an important population present.	No population recorded within study area	No optimal habitat present. Likely to be restricted to Box-Ironbark habitats,	The study area does not form part of its core habitat distribution.	Small loss of sub-optimal habitat; unlikely to lead to a decline.	The project is unlikely to result in invasive species becoming established as best practice methods are proposed to be implemented during, and post construction.	Mitigation measures should be put in place to ensure this does not occur.	Not recorded in the study area so unlikely to be an important population present.
Swift Parrot	The study area is unlikely to support significant number of Swift Parrots on a regular basis due to the lack of preferred flowering Eucalypts.	Unlikely that the Swift Parrot occurs on the site regularly or in high numbers and therefore the project is unlikely to reduce the area of occupancy of the species.	The range and distribution of the Swift Parrot population on mainland Australia is variable and therefore not considered to fragment an existing population into two or more populations.	The study area is not considered to provide over-wintering habitat critical to the survival of the species.	The Swift Parrot breeds in Tasmania and over-winters on mainland Australia. The proposed bridge will therefore not disrupt the breeding cycle of the population.	The study area contains no critical habitat for this species and the project will not remove a substantial area of important Swift Parrot habitat. There may be a small loss of sub-optimal habitat. .	The project is unlikely to result in invasive species becoming established in the Swift Parrot habitat in the study area as no critical habitat is present.	Mitigation measures should be put in place to ensure this does not occur.	Not recorded in the study area so unlikely to be an important population present.
Golden Sun Moth	The impact on this species at a population level is considered to be minor and at a wider population scale. It is unlikely to be significant or lead to a decline in the size of the species' population.	The likely removal of a small proportion of the habitat at the site will reduce the area of occupancy by a very small percentage	Due to the only suitable grassland habitat being present on roadsides, it is therefore unlikely to fragment an existing population.	Due to the lack of extensive grasslands in the study area, the proposed development is unlikely to effect a population of the moth in the long term.	To disrupt breeding cycle as there are no records of this species in nearby parts of the Riverina, with most records being closer to or south of the Great Dividing Range.	Very small loss of potentially sub-optimal habitat; unlikely to lead to a decline.	The project is unlikely to result in invasive species becoming established in the grassland habitat, as best practice methods of weed control are proposed to be implemented during and after construction.	Mitigation measures should be put in place to ensure this does not occur.	Not recorded in the study area so unlikely to be an important population present.

Table 17: Assessment of threatened species against the EPBC Act significant impact criteria – Vulnerable species

Species	Lead to a long-term decrease in the size of an important population	Reduce the area of occupancy of an important population	Fragment an existing population	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in the establishment of an invasive species	Introduce disease that may cause the species to decline	Interfere substantially with the recovery of the species
Slender Darling-pea	Not recorded during targeted survey - unlikely to be an important population present	Not recorded during targeted survey - unlikely to be an important population present	No population recorded within study area	No optimal habitat present. Introduced understorey species dominate ground layer.	Not recorded during targeted survey - unlikely to be an important population present	The proposed action is likely to remove sub-optimal habitat only.	Weed control should be undertaken to mitigate any potential weed outbreaks along disturbed areas	Mitigation measures should be put in place to ensure this does not occur	Not recorded during targeted survey - unlikely to be an important population present
Western Water-starwort	Not recorded during targeted survey - unlikely to be an important population present	Not recorded during targeted survey - unlikely to be an important population present	No population recorded within study area	No optimal habitat present. Aquatic habitat disturbed.	Not recorded during targeted survey - unlikely to be an important population present	The proposed action is likely to remove sub-optimal habitat only.	Weed control should be undertaken to mitigate any potential weed outbreaks along disturbed areas.	Mitigation measures should be put in place to ensure this does not occur	Not recorded during targeted survey - unlikely to be an important population present
Eastern Long-eared Bat	Any impacts on this mobile species, if present, are expected to be minimal.	Generally occurs in habitats with a dense understorey and therefore is not expected to be in significant numbers in the study area.	Not recorded during targeted survey - unlikely to be an important population present	No optimal habitat present.	No population recorded within study area	Some fragmentation of habitat is likely to occur as a result of this proposal. This is likely to result is a small impact on this species if present, however it is unlikely to be sufficient to result in local extinction because of the large corridors of similar habitat available to the Bat.	The project is unlikely to result in invasive species becoming established as best practice methods are proposed to be implemented during, and post construction.	Mitigation measures should be put in place to ensure this does not occur	Not recorded in the study area so unlikely to be an important population present.
Superb Parrot	Lack of historical suggests that it is unlikely that an important population is present in the study area.	No historical records within 10km for study area - unlikely to be an important population present	Not recorded within study area. Species occur regularly between Barmah and Numurkah, east of the study area.	Some foraging trees may be affected by proposed bridge, but unlikely to affect core habitat critical to species.	Core breeding habitat is located east of the study area at Barmah - Millewa Forest. Therefore proposed bridge works unlikely to interrupt breeding cycle.	Some foraging habitat may be affected by proposed bridge, but unlikely to affect core habitat to the extent of population decline.	The project is unlikely to result in invasive species becoming established in Superb Parrot habitat as no critical habitat is present.	Mitigation measures should be put in place to ensure this does not occur	Not recorded regularly in the study area so unlikely to be an important population present.
Growling Grass Frog	Although suitable habitat exists, the lack of historical records in the region suggests that the species is unlikely to occur	Not recorded during targeted survey - unlikely to be an important population present	Not recorded within study area. Unlikely to be an important population present.	Avoid run-off near waterways and streams during construction.	Core breeding habitat is absent and proposed works largely avoids potential habitats.	Could cause temporary disturbance but unlikely to lead to long tern population decline.	Best practice methods are proposed to be implemented during and after construction to avoid establishment of invasive species into waterways.	Mitigation measures should be put in place to ensure this does not occur	Not recorded regularly in the study area so unlikely to be a significant population present.

9. OVERALL PROJECT IMPACTS

9.1. Project Objectives

The project objective as defined in the project brief provided by VicRoads is "To minimise impacts on biodiversity and provide appropriate mitigation measures to the extent practicable." A rating scale as determined by VicRoads has been used here and includes the following categories:

- Meets the objective very well;
- Meets the objective well;
- Meets objective;
- Meets objective poorly;
- Meets objective very poorly.

Recommended mitigation measures include the avoidance of large old trees, avoidance of important habitat areas for the threatened species, pre-clearing and construction fauna survey and salvage protocols, revegetation, rehabilitation and management of similar habitat in the local region and provision of nest boxes for hollow dependant fauna. The incorporation of these mitigation measures would be likely to result in the project objective being met.

Without implementation of any mitigation measures, the project would meet the above objective very poorly, as there would be potential impacts on a number of threatened species.

9.2. Potential for wildlife corridors

The study area has high value wildlife corridors. Warren Street has a high density of hollow bearing live and dead trees. Large old trees and hollow trees were also abundant in the Black Box Woodland. The majority of fauna habitat, including habitat suitable for threatened species of fauna, is limited in the local region and is mostly confined to roadsides, strips of riparian vegetation and floodplain associated woodlands dominated by River Red-gum and Black Box. Therefore the habitats throughout the study area are likely to be utilised as corridors for movement by birds, mammals and reptiles between other habitats in the local region. The Campaspe River and Murray River provide aquatic wildlife corridors for fish and frogs.

9.3. Impacts on regional biodiversity

Potential direct impacts on regional biodiversity as a result of proposed road construction comprise death/injury caused by vehicle collision and vegetation clearance. Indirect impacts include loss of habitat and food sources, noise, lighting and air pollution, invasion of weeds, and habitat fragmentation. Impacts on regional biodiversity will depend largely on the mitigation measures adopted to reduce impacts on individual threatened species and native vegetation.

Given that a number of threatened species may occur in the study area, there is a potential impact on regional biodiversity due to loss of habitat, which may result in reduced numbers of species and individuals foraging and breeding in the local

area. Where mitigation measures are applied, it is considered that the impact on individual threatened species and native vegetation will be reduced.

9.4. Summary of required permits and approvals

The following is a list of the permits required in relation to flora and fauna for the proposed development:

- Planning permit under Clause 52.17 of the Campaspe Planning Scheme for the removal of native vegetation in Victoria;
- A referral to DSE will be triggered as current development proposal triggers a number of the criteria, including scattered tree removal and the removal of remnant patch vegetation;
- A permit under HO79 for the removal of Murray Pines in the study area;
- Licence under the Victorian FFG Act for the removal of protected flora from public land. This licence is obtained from the Department of Sustainability and Environment; and
- Preparation of a referral under the Victorian EE Act to the State Minister for Planning, which will determine if an Environment Effects Statement (EES) is required for the project.

10. RECOMMENDATIONS

The following section outlines recommendations and mitigations measures to address ecological constraints and issues identified on the site.

10.1. Opportunities to avoid and mitigate potential impacts

Consideration should be given to including the mitigation measures described below in a construction and operational environmental management plan for the project:

- If possible, the alignment should be sited as close to the already disturbed and built up areas as possible to avoid impacting on high quality fauna habitat;
- Loss of large old trees and hollow bearing trees along Warren Street and between Warren Street and Campaspe River should be avoided. If avoidance is not possible, the removal of such trees should be minimised;
- It is recommended that hollow trees within the Black Box woodland are mapped to establish the location of potential Brown Treecreeper, Carpet Python and Squirrel Glider habitat;
- Once locations of habitat trees are established, it is recommended that these areas be avoided and that the trees not be removed;
- If removal of such habitat trees is unavoidable, pre-construction surveys to determine the presence of fauna in the hollows should be undertaken;
- Any fauna found during pre-construction surveys should be removed by qualified wildlife handler and translocated to similar nearby habitat;
- Any loss of hollow trees should be mitigated against by the implementation of nest boxes. Nest boxes should be designed to prevent colonisation by feral bees and exotic bird species;
- Any logs to be removed should be relocated to similar adjacent habitat;
- Any trees to be felled should be relocated to similar adjacent habitat to provide habitat for ground-dwelling fauna;
- Potential for building wildlife underpasses or crossing structures overhead to avoid road kill;
- The use of specific road lighting to avoid impacts on surrounding fauna;
- Erosion, sediment and run-off controls should be implemented to prevent impact on Campaspe River and Murray River.
- In accordance with the *Catchment and Land Protection Act 1994*, the noxious weed species listed below, which were recorded in the Victorian section of the study area, must be controlled using precision methods that minimise off-target kills (e.g. spot spraying). This method of control will be implemented throughout the project.
    - African Box-thorn;
    - Horehound; and
    - Patterson's Curse.

10.2. Opportunities and conditions for future roadside management

Revegetation of disturbed roadside areas will reduce long term weed control requirements. This will require sourcing of indigenous species seed, propagation by a suitable nursery, and incorporation of plants into the landscaped area during early July. Suitable species include those indicated in Section 10.3.

Weed control works should also be undertaken along areas of works to avoid weed spread into adjacent areas of bushland. Weed control should focus on high threat weeds, as well as all noxious weeds as listed in Section 5.1.5.

Future roadside fauna management should include;

- Installing nest boxes if hollow trees are to be removed;
- Monitoring of threatened species if they are located during threatened species surveys to determine impacts of construction and operation of the proposed development;
- Revegetation of disturbed and cleared areas to re-establish fauna habitat links;
- Provision of suitable fauna crossing structures and underpasses if required.
- Impacts of roadside lighting on fauna species could be minimised by using lights that would specifically light the roads only.

10.3. Fauna Salvage and Relocation Program

A salvage and relocation program will be developed for EPBC Act and FFG Act listed fauna species, namely the Squirrel Glider. Suitable habitat was recorded for this species within River Red-gum dominated woodland along Warren Street and around the Campaspe River and within Black Box Woodland between the Campaspe and the Murray Rivers. A qualified zoologist should undertake a pre-construction survey to identify and mark all hollow bearing trees within these parts of the alignment. A zoologist should then be present during any removal of these identified hollow trees during construction as per DSE guidelines.

Further discussion is required between VicRoads and DSE to discuss the appropriate implementation of the fauna salvage and relocation program.

10.4. Potential flora species for use in landscaping works

The following table provides a list of flora species useful for landscaping works throughout the study area (Table 18). Flora species have been taken from the benchmarks of relevant EVCs identified in the study area (Appendix 6).

Table 18: Landscaping guide

Category	Lifeform density per hectare*	Common Name	Scientific Name
Tree	250/ha	River Red-gum	*Eucalyptus camaldulensis*
		Black Box	*Eucalyptus largiflorens*
		River Coobah	*Acacia stenophylla*
Medium Shrub	1,000/ha	Old-man Saltbush	*Atriplex nummularia*
		Spreading Emu-bush	*Eremophila divaricata ssp. divaricata*
Small Shrub	2,500/ha	Grey Roly-poly	*Sclerolaena muricata var. villosa*
		Black Cotton-bush	*Maireana decalvans*
Large Tufted Graminoids	1,250/ha	Hollow Sedge	*Carex tereticaulis*
Medium Tufted Graminoids	7500/ha	Rough Spear-grass	*Austrostipa scabra*
		Bristly Wallaby-grass	*Austrodanthonia setacea*
Large Herbs	250/ha	Cotton Fireweed	*Senecio quadridentatus*

11. CONCLUSIONS

A detailed review of existing information, in combination with the current field assessment, determined that approximately 55 hectares of the study area supported indigenous vegetation in the form of Riverine Chenopod Woodland, Grassy Riverine Forest and Riverine Grassy Woodland across 27 habitat zones.

Consideration should be given to including the design recommendations described below to illustrate the "avoid" and "minimise" principles of the Framework:

- If possible, the alignment should be sited as close to the already disturbed and built up areas as possible to avoid impacting on high quality fauna habitat;
- Loss of large old trees and hollow bearing trees along Warren Street and between Warren Street and Campaspe River should be avoided. If avoidance is not possible, the removal of such trees should be minimised;
- It is recommended that hollow trees within the Black Box woodland are avoided. If removal of such habitat trees is unavoidable, pre-construction surveys to determine the presence of fauna in the hollows should be undertaken.

Where impacts to native vegetation cannot be avoided or minimised, offsets are required to compensate for their loss. A summary of the proposed removal of native vegetation is provided below.

11.1. Vegetation Removal - Victoria

The Initial and Ultimate development footprints propose to remove between 14.07 to 16.92 hectares (4.182 and 5.092 habitat hectares) of native vegetation in Victoria. It is to be noted that approval is required from the Minister for Environment and Climate Change for the removal of native vegetation of very high conservation significance.

The proposed construction of six replacement tennis courts will also remove 0.2 hectares (0.057 habitat hectares) of native vegetation from Habitat Zone Q. Impacts to native vegetation through the construction of the tennis courts has been considered separately from the Initial and Ultimate development options as this is a consequential, rather than a direct, outcome of the proposed road corridor.

Net gain targets are provided separately below for the two road corridor development footprints and the replacement tennis courts.

- **Initial Option:** Proposes the removal of 4.182 habitat hectares, resulting in an offset target of 7.528 habitat hectares (equating to approximately 37.64 hectares of native vegetation required to compensate for this loss). This development footprint also proposes the removal of 224 large old trees from habitat zones in Victoria;
- **Ultimate Option:** Proposes the removal of 5.092 habitat hectares, resulting in an offset target of 9.11 habitat hectares (equating to approximately 45.55 hectares of native vegetation required to compensate for this loss). This

development footprint also proposes the removal of 278 large old trees from habitat zones in Victoria.

- **Replacement Tennis Courts:** Proposes the removal of 0.057 habitat hectares, resulting in an offset target of 0.086 habitat hectares (equating to approximately 0.43 hectares of native vegetation required to compensate for this loss). This development footprint also proposes the removal of two large old trees from Habitat Zone Q.

11.2. Vegetation Removal – New South Wales

The area of vegetation removed is provided below for the two road corridor development footprints:

- **Initial Option:** Requires the removal of 4.63 hectares of native vegetation from Habitat Zone T and 0.04 hectares from Habitat Zone Y.
- **Ultimate Option:** Requires the removal of 5.34 hectares of native vegetation from Habitat Zone T and 0.04 hectares from Habitat Zone Y.

11.3. Threatened species

No flora species listed under the EPBC Act, FFG Act or TSC Act were recorded in the study area. Three species of flora are considered to have low potential to occur in various parts of the study area due to the presence of limited suitable habitat. These species include the Slender Darling-pea, Silky Swainson-pea and Western Water-starwort. Due to the limited area of suitable habitat, poor quality of understorey vegetation in these areas and the absence of these species during the field surveys, there is a low likelihood that these species would occur in the study area. Any presence that may not have been detected would be minimal and therefore it is considered that the proposed development would not have a significant impact on these species.

The study area contains modified, albeit intact, native vegetation and provides some high and moderate quality habitat for a range of native fauna. One state threatened species, the Brown Treecreeper was recorded during the assessment. The Squirrel Glider is considered highly likely to occur in the study area due to the presence of suitable habitat. Other state threatened species may also occur on the Victorian side of the study area, including Barking Owl, Carpet Python and Bandy Bandy.

Listed migratory species Rainbow Bee-eater was recorded in the study area and is likely to regularly occur in the warmer months due to the presence of suitable habitat. Rainbow Bee-eater is a mobile species which would be able to move away from the source of disturbance. Therefore potential impacts would not significantly affect this species.

There is unlikely to be a significant impact on the Macquarie Perch and Murray Cod, provided that mitigation measures, such as sediment and pollution control, are implemented, to prevent impacts on river habitat.

The proposed bridge construction is likely to result in the removal of some threatened species habitat. River Red-gums along Warren Street and between Warren Street and the Campaspe River and Black Box between Campaspe and Murray Rivers are likely to be removed or impacted upon by the development.

These areas contain numerous hollows in live and dead River Red-gum and Black Box trees that are likely to provide habitat for the Squirrel Glider and Carpet Python. If logs and other ground cover and debris are disturbed, this is likely to have a potential impact on Carpet Python and Bandy Bandy.

No fauna species were detected during the targeted surveys although potential habitat is present for the Squirrel Glider. The proposed removal of native vegetation and large old trees within the study area would result in a reduction in the potential habitat for the species. If fauna species are detected during a pre-clearing and construction fauna survey a salvage protocol should be utilised.

Recommendations provided in this report should be implemented to minimise and mitigate potential impacts on threatened species.

12. REFERENCES

Biosis Research Pty. Ltd., 2008, Project 6926: *Echuca-Moama Murray River Crossing (Downstream of Warren Street): Flora and Fauna Desktop Assessment*, Biosis Research Pty. Ltd.

Brett Lane and Associates, 2009, Project 8194: *Second Murray River Crossing at Echuca-Moama*: *Detailed Flora and Fauna Assessment*, Brett Lane and Associates Pty. Ltd., North Carlton.

Christidis, L, & Boles, W 2008, *Systematics and taxonomy of Australian Birds*, CSIRO Publishing, Collingwood, Victoria.

Department of Environment and Conservation 2005a, *Threatened Species Conservation Act 1995,* Threatened Species, Department of Environment and Conservation, New South Wales, viewed 30 July 2008, <http://www.threatenedspecies.environment.nsw.gov.au>.

Department of Environment and Conservation 2005b, *Threatened Species Conservation Act 1995,* Threatened Species, Department of Environment and Conservation, New South Wales, viewed 30 July 2008, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile

Department of Environment and Conservation 2005, Draft recovery plan. Southern Bell Frog *Litoria raniformis*.

Department of Environment and Conservation 2006, Approved recovery plan. Recovery plan for the Bush Stone-curlew *Burhinus grallarius*.

Department of Natural Resources and Environment 1997, *Victoria's Biodiversity – Our Living Wealth*. Department of Natural Resources and Environment, Victoria.

Department of Natural Resources and Environment 2002, *Victoria's Native Vegetation Management – a Framework for Action*, Department of Natural Resources and Environment, Victoria.

Department of Sustainability and Environment 2004, *Native Vegetation: sustaining a living landscape, Vegetation Quality Assessment Manual – guidelines for applying the Habitat Hectare scoring method (Version 1.3)*. Department of Sustainability and Environment, East Melbourne, Victoria.

Department of Sustainability and Environment 2005, *Advisory List of Rare or Threatened Plants in Victoria*. Department of Sustainability and Environment, East Melbourne, Victoria.

Department of Sustainability and Environment 2007a, *Native Vegetation: Guide for assessment of Referred Planning Permit Applications*. Department of Sustainability and Environment, East Melbourne, Victoria.

Department of Sustainability and Environment 2007b, *Advisory List of Threatened Vertebrate Fauna in Victoria*. Department of Sustainability and Environment, East Melbourne, Victoria.

Department of Sustainability and Environment 2008a, *Ecological Vegetation Class (EVC) Benchmarks by Bioregion*, Department of Sustainability and

Environment, East Melbourne, Victoria, viewed 6th October 2008, <http://www.dse.vic.gov.au>.

Department of Sustainability and Environment 2008b, *Biodiversity Interactive Map 2.0*. Department of Sustainability and Environment, East Melbourne, Victoria, viewed 6th October 2008, <http://www.dse.vic.gov.au>.

Edwards, T. 1993. Golden Sun Moth. *Australian Natural History* **24** (16) 16-17.

Emison, WB, Beardsell, CM, Norman, FI Loyn, RH, & Bennett, SC 1987, *Atlas of Victorian Birds*. Department of Conservation, Forests and Lands & Royal Australasian Ornithologists Union, Melbourne.

Entwisle, TJ 1996, 'Casuarinaceae', in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 3: Dicotyledons Winteraceae to Myrtaceae*, Inkata Press, Melbourne, pp. 90-101.

Entwisle, TJ, Maslin, BR, Cowan, RS & Court, AB 1996, 'Mimosaceae', in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 3: Dicotyledons Winteraceae to Myrtaceae*, Inkata Press, Melbourne, pp. 585-658.

Entwisle, TJ 1996, 'Thymelaceae', in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 3: Dicotyledons Winteraceae to Myrtaceae*, Inkata Press, Melbourne, pp. 912-930.

Higgins, PJ (ed) 1999, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ & Peter, JM (eds) 2002, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM & Steele, WK (eds) 2001, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 5: Tyrant-flycatchers to Chats, Oxford University Press, Melbourne.

Jeanes, J.A, 1996 Fabaceae, In Walsh, N.G. and Entwisle, T.J. (eds) Flora of Victoria: Dicotyledons: Winteraceae to Myrtaceae, V.3, Inkata Press, Melbourne, pp 663-829.

Jeanes, J.A, 1999 Callitrichaceae, In Walsh, N.G. and Entwisle, T.J. (eds) Flora of Victoria: Dicotyledons: Cornaceae to Asteraceae, V.4, Inkata Press, Melbourne, pp 459-463.

Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds, Volume 2*, Raptors to Lapwings, Oxford University Press, Melbourne.

Mirtschin, P and Davis, R 1992. Snakes of Australia – dangerous and harmless. Hill of Content Publishing, Australia.

North Central Catchment Management Authority 2005, North Central *Native Vegetation Plan*, North Central Catchment Management Authority, Huntly, Victoria.

O'Dwyer, C. and Attiwill, P. M. 1999. A comparative study of habitats of the Golden Sun Moth *Synemon plana* Walker (Lepidoptera; Castniidae): implications for restoration. *Biological Conservation* 89: 131-141.

Organ, A 2002, *Survey for the Warty Bell Frog Litoria raniformis, at the Western Treatment Plant, Werribee, Victoria*. Biosis Research, Port Melbourne.

Parkes, D, Newell, G, & Cheal, D 2003, 'Assessing the Quality of Native Vegetation: The 'habitat hectares' approach'. *Ecological Management and Restoration*, vol. 4, supplement, pp. 29-38.

Short PS 1999, 'Brachyscome' in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 4: Dicotyledons - Cornaceae to Asteraceae*, Inkata Press, Melbourne, pp. 835-859.

van der Ree, R 2002. The population ecology of the squirrel glider (*Petaurus norfolcensis*) within a network of remnant linear habitats. Wildlife Research 29: 329-340.

van der Ree, R and Bennett, A 2003. Home range of the Squirrel Glider (*Petaurus norfolcensis*) in a network of remnant linear habitats. Journal of Zoology (London) 259: 327-336.

van der Ree, R 2003. Flora and Fauna Guarantee Act 1988. Action statement. Squirrel Glider *Petarus norfolcensis*. Department of Sustainability and Environment.

Van Praagh, B. D. 2004. New sightings of the Golden Sun Moth *Synemon plana* (Lepidoptera; Castniidae) at Craigieburn and Cooper St Grasslands, Melbourne Victoria 2003/2004. Unpublished report to the Department of Sustainability and Environment.

Walsh, NG 1994, 'Poaceae', in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 2: Ferns and Allied Plants, Conifers and Monocotyledons*, Inkata Press, Melbourne, pp. 356-627.

Walsh, NG 1996, 'Amaranthaceae", in NG Walsh & TJ Entwisle (eds), *Flora of Victoria - Volume 3: Dicotyledons Winteraceae to Myrtaceae*, Inkata Press, Melbourne, pp. 199-215.

Wilson, S & Swan G 2003, *A Complete Guide to Reptiles of Australia*. Reed New Holland, Sydney.

Appendix 1: Flora species recorded in the study area and threatened species known (or with the potential) to occur in the search region

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Recorded
				FFG	EPBC	DSE	TSC	
*	African Box-thorn	*Lycium ferocissimum*	Solanaceae					X
*	Annual Meadow-grass	*Poa annua*	Poaceae					X
*	Annual Veldt-grass	*Ehrharta longiflora*	Poaceae					X
	Ausfeld's Wattle	*Acacia ausfeldii*	Mimosaceae			v		
*	Barley-grass	*Hordeum murinum s.l.*	Poaceae					X
	Basalt Podolepis	*Podolepis sp. 1*	Asteraceae			e		
	Berry Saltbush	*Atriplex semibaccata*	Chenopodiaceae					X
	Bitter Quandong	*Santalum murrayanum*	Santalaceae				E	
	Black Box	*Eucalyptus largiflorens*	Myrtaceae					X
	Black Cotton-bush	*Maireana decalvans*	Chenopodiaceae					X
	Black Wattle	*Acacia mearnsii*	Mimosaceae					X
	Black-anther Flax-lily	*Dianella revoluta s.l.*	Hemerocallidaceae					X
	Blue Burr-daisy	*Calotis cuneifolia*	Asteraceae			r		
	Bluish Raspwort	*Haloragis glauca f. glauca*	Haloragaceae			k		
*	Bridal Creeper	*Asparagus asparagoides*	Asparagaceae					X
	Buloke	*Allocasuarina luehmannii*	Casuarinaceae	f				
	Buloke Mistletoe	*Amyema linophylla subsp. orientale*	Loranthaceae			v		
*	Cape Weed	*Arctotheca calendula*	Asteraceae					X
	Chariot Wheels	*Maireana cheelii*	Chenopodiaceae				V	
	Claypan Daisy	*Brachycome muelleroides*	Asteraceae				V	
*	Common Olive	*Olea europaea ssp. Europaea*	Oleaceae					X
*	Common Peppercress	*Lepidium africanum*	Brassicaceae					X
*	Common Sow-thistle	*Sonchus oleraceus*	Asteraceae					X
*	Common Vetch	*Vicia sativa*	Fabaceae					X
	Common Wallaby-grass	*Austrodanthonia caespitosa*	Poaceae					X
	Common Woodruff	*Asperula conferta*	Rubiaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Recorded
				FFG	EPBC	DSE	TSC	
*	Couch	*Cynodon dactylon var. dactylon*	Poaceae					X
*	Cypress	*Cupressus spp.*	Cupressaceae					X
	Cypress Pine	*Callitris sp.*	Cupressaceae					X
	Dark Roly-poly	*Sclerolaena muricata var. semiglabra*	Chenopodiaceae			k		
	Drooping Cassinia	*Cassinia arcuata*	Asteraceae					X
	Dwarf Amaranth	*Amaranthus macrocarpus var. macrocarpus*	Amaranthaceae			v		
	Dwarf Bitter-cress	*Rorippa eustylis*	Brassicaceae			r		
	Dwarf Bluebush	*Maireana humillima*	Chenopodiaceae					X
	Everlasting	*Ozothamnus sp.*	Asteraceae					X
	Fireweed	*Senecio*	Asteraceae					X
*	Fog-fruit	*Phyla canescens*	Verbenaceae					X
	Frosted Goosefoot	*Chenopodium desertorum subsp. virosum*	Chenopodiaceae			k		
	Fuzzy New Holland Daisy	*Vittadinia cuneata var. morrisii*	Asteraceae			r		
	Galvanized Burr	*Sclerolaena birchii*	Chenopodiaceae			k		
*	Gazania	*Gazania linearis*	Asteraceae					X
	Gold-dust Wattle	*Acacia acinacea s.l.*	Mimosaceae					X
	Golden Wattle	*Acacia pycnantha*	Mimosaceae					X
*	Great Brome	*Bromus diandrus*	Poaceae					X
	Grey Box	*Eucalyptus microcarpa*	Myrtaceae					X
	Grey Roly-poly	*Sclerolaena muricata var. villosa*	Chenopodiaceae					X
	Hairy Tails	*Ptilotus erubescens*	Amaranthaceae	f				
*	Horehound	*Marrubium vulgare*	Lamiaceae					X
	Jersey Cudweed	*Pseudognaphalium luteoalbum*	Asteraceae					X
	Long Eryngium	*Eryngium paludosum*	Apiaceae			v		
*	Mallow	*Malva sp.*	Malvaceae					X
*	Montpellier Broom	*Genista monspessulana*	Fabaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Recorded
				FFG	EPBC	DSE	TSC	
	Narrow Goodenia	*Goodenia macbarronii*	Goodeniaceae				V	
*	Narrow-leaf Vetch	*Vicia sativa subsp. nigra*	Fabaceae					X
	Nodding Saltbush	*Einadia nutans subsp. nutans*	Chenopodiaceae					X
*	Oat	*Avena spp.*	Poaceae					X
	Pale Flax-lily	*Dianella longifolia var. longifolia s.l.*	Hemerocallidaceae					X
	Pale-fruit Ballart	*Exocarpos strictus*	Santalaceae					X
	Panic	*Panicum spp.*	Poaceae					X
*	Paterson's Curse	*Echium plantagineum*	Boraginaceae					X
*	Pepper Tree	*Schinus molle*	Anacardiaceae					X
*	Perennial Rye-grass	*Lolium perenne*	Poaceae					X
*	Radiata Pine	*Pinus radiata*	Pinaceae					X
	Red Swainson-pea	*Swainsona plagiotropis*	Fabaceae	f	V	e	V	
*	Ribwort	*Plantago lanceolata*	Veronicaceae					X
	River Coobah	*Acacia stenophylla*	Mimosaceae					X
	River Red-gum	*Eucalyptus camaldulensis*	Myrtaceae					X
	River Swamp Wallaby-grass	*Amphibromus fluitans*	Poaceae		V		V	
	Rough Spear-grass	*Austrostipa scabra*	Poaceae					X
	Round-leafed Wilsonia	*Wilsonia rotundifolia*	Convolvulaceae				E	
	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	Chenopodiaceae					X
	Rush	*Juncus spp.*	Juncaceae					X
	Sand Brome	*Bromus arenarius*	Poaceae			r		
	Silky Swainson-pea	*Swainsona sericea*	Fabaceae	f		v	V	
	Silver Wattle	*Acacia dealbata*	Mimosaceae					X
	Slender Cypress-pine	Callitris gracilis subsp. murrayensis	Cupressaceae					X
	Slender Darling-pea	*Swainsona murrayana*	Fabaceae	f	V	e	V	

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Recorded
				FFG	EPBC	DSE	TSC	
	Slender Dock	*Rumex brownii*	Polygonaceae					X
	Small Scurf-pea	*Cullen parvum*	Fabaceae	f		e	E	
	Small-leaf Swainson-pea	*Swainsona microphylla*	Fabaceae			r		
	Smooth Minuria	*Minuria integerrima*	Asteraceae			r		
*	Soursob	*Oxalis pes-caprae*	Oxalidaceae					X
	Southern Swainson-pea	*Swainsona behriana*	Fabaceae			r		
	Spear grass	*Austrostipa metatoris*	Poaceae				V	
	Spear grass	*Austrostipa wakoolica*	Poaceae				E	
*	Spear Thistle	*Cirsium vulgare*	Asteraceae					X
	Spiny Rice-flower	*Pimelea spinescens*	Thymelaeaceae	f		e		
	Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	Thymelaeaceae		C	e		
	Spreading Crassula	*Crassula decumbens var. decumbens*	Crassulaceae					X
*	Sugar Gum	*Eucalyptus cladocalyx*	Myrtaceae					X
	Sunray	*Hyalosperma spp.*	Asteraceae					X
#	Sweet Pittosporum	*Pittosporum undulatum*	Pittosporaceae					X
*	Tall Fleabane	*Conyza sumatrensis*	Asteraceae					X
	Tangled Lignum	*Muehlenbeckia florulenta*	Polygonaceae					X
*	Terracina Spurge	*Euphorbia terracina*	Euphorbiaceae					X
	Turnip Copperburr	*Sclerolaena napiformis*	Chenopodiaceae	f	E	e	E	
	Wallaby Grass	*Austrodanthonia spp.*	Poaceae					X
	Western Water-starwort	*Callitriche cyclocarpa*	Veronicaceae	f	V	v	V	
*	White Fumitory	*Fumaria capreolata*	Fumariaceae					X
	Winged Peppercress	*Lepidium monoplocoides*	Brassicaceae				E	
	Wingless Bluebush	*Maireana enchylaenoides*	Chenopodiaceae					X
	Woolly New Holland Daisy	*Vittadinia gracilis*	Asteraceae					X
	Yarran Wattle	*Acacia omalophylla*	Mimosaceae	f		e		
	Yellow Box	*Eucalyptus melliodora*	Myrtaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Recorded
				FFG	EPBC	DSE	TSC	
	Yellow Gum	*Eucalyptus leucoxylon subsp. pruinosa*	Myrtaceae				V	
	Yellow-tongue Daisy	*Brachyscome chrysoglossa*	Asteraceae	f		v		

***** = introduced species; **#** = native species occurring outside of natural range; **FFG (f)** = Listed as threatened under FFG Act; **EPBC** = Status under EPBC Act; **DSE** = Status in DSE Advisory List; **C** = critically endangered; **E, e** = endangered; **V, v** = vulnerable; **R, r** = rare; **k** = insufficiently known; **TSC** – Status under TSC Act; **E** – Endangered; **V** – Vulnerable.

Appendix 2: Vertebrate terrestrial fauna species that occur or are likely to occur in the study area (Victorian Fauna Database, Atlas of New South Wales Wildlife, Biosis Research (2008), current assessment).

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
Birds								
	Australasian Grebe	*Tachybaptus novaehollandiae*						
	Australasian Pipit	*Anthus novaeseelandiae*						
	Australian Hobby	*Falco longipennis*						
	Australian Magpie	*Gymnorhina tibicen*					X	X
	Australian Owlet-nightjar	*Aegothles cristatus*						
	Australian Pelican	*Pelecanus conspicillatus*						
	Australian Raven	*Corvus coronoides*					X	
	Australian Shelduck	*Tadorna tadornoides*						
	Australian White Ibis	*Threskiornis molucca*						
	Australian Wood Duck	*Chenonetta jubata*						X
	Azure Kingfisher	*Alcedo azurea*			NT			
	Banded Lapwing	*Vanellus tricolor*						
	Barking Owl	*Ninox connivens*		L	EN	V		
	Black Falcon	*Falco subniger*			VU			
	Black Kite	*Milvus migrans*						
	Black Swan	*Cygnus atratus*						
	Black-eared Cuckoo	*Chalcites osculans*						
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*					X	
	Black-faced Woodswallow	*Artamus cinereus*						
	Black-fronted Dotterel	*Elseyornis melanops*						
	Black-shouldered Kite	*Elanus axillaris*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Black-tailed Native-hen	*Gallinula ventralis*						
	Blue-billed Duck	*Oxyura australis*		L	EN	V		
	Blue-faced Honeyeater	*Entomyzon cyanotis*						
	Brown Falcon	*Falco berigora*						
	Brown Goshawk	*Accipiter fasciatus*						
	Brown Quail	*Coturnix ypsilophora*			NT			
	Brown Songlark	*Cincloramphus cruralis*						
	Brown Thornbill	*Acanthiza pusilla*						
	Brown Treecreeper	*Climacteris picumnus victoriae*			NT	V	X	
	Brown-headed Honeyeater	*Melithreptus brevirostris*						
	Budgerigar	*Melopsittacus undulatus*						
	Buff-rumped Thornbill	*Acanthiza reguloides*					X	
	Cattle Egret	*Ardea ibis*						
	Chestnut Teal	*Anas castanea*						
	Clamorous Reed Warbler	*Acrocephalus stentoreus*						
	Cockatiel	*Nymphicus hollandicus*						
	Collared Sparrowhawk	*Accipiter cirrhocephalus*					X	
*	Common Blackbird	*Turdus merula*						
	Common Bronzewing	*Phaps chalcoptera*					X	
*	Common Myna	*Acridotheres tristis*						
*	Common Starling	*Sturnus vulgaris*						
	Crested Pigeon	*Ocyphaps lophotes*						X
	Crested Shrike-tit	*Falcunculus frontatus*						
	Crimson Rosella	*Platycercus elegans elegans*					X	

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Darter	*Anhinga novaehollandiae*						
	Diamond Dove	*Geopelia cuneata*		L	NT			
	Diamond Firetail	*Stagonopleura guttata*		L	VU	V		
	Dollarbird	*Eurystomus orientalis*						
*	Domestic Goose	*Anser sp.*						
	Dusky Moorhen	*Gallinula tenebrosa*						
	Dusky Woodswallow	*Artamus cyanopterus*					X	
	Eastern Great Egret	*Ardea modesta*		L	VU			
	Eastern Rosella	*Platycercus eximius*						
	Eastern Yellow Robin	*Eopsaltria australis*					X	
	Emu	*Droamius novaehollandiae*						
	Eurasian Coot	*Fulica atra*						
*	Eurasian Tree Sparrow	*Passer montanus*						
*	European Goldfinch	*Carduelis carduelis*						
	Fairy Martin	*Petrochelidon ariel*						
	Fan-tailed Cuckoo	*Cacomantis flabelliformis*						X
	Flame Robin	*Petroica phoenicea*						
	Galah	*Eolophus roseicapilla*					X	X
	Golden Whistler	*Pachycephala pectoralis*						
	Golden-headed Cisticola	*Cisticola exilis*						
	Great Cormorant	*Phalacrocorax carbo*						
	Grey Butcherbird	*Cracticus torquatus*						
	Grey Fantail	*Rhipidura albiscarpa*					X	
	Grey Shrike-thrush	*Colluricincla harmonica*					X	X

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Grey Teal	*Anas gracilis*						
	Ground Cuckoo-shrike	*Coracina maxima*						
	Hardhead	*Aythya australis*			VU			
	Hoary-headed Grebe	*Poliocephalus poliocephalus*						
	Hooded Robin	*Melanodryas cucullata*		L	NT	V		
	Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*					X	
*	House Sparrow	*Passer domesticus*						
	Intermediate Egret	*Ardea intermedia*		L	CE			
	Jacky Winter	*Microeca fascinans*					X	
	Laughing Kookaburra	*Dacelo novaeguineae*					X	
	Little Black Cormorant	*Phalacrocorax sulcirostris*						
	Little Corella	*Cacatua sanguinea*						
	Little Crow	*Corvus bennetti*						X
	Little Eagle	*Hieraaetus morphnoides*						
	Little Egret	*Egretta garzetta*						
	Little Friarbird	*Philemon citreogularis*						
	Little Grassbird	*Megalurus gramineus*						
	Little Pied Cormorant	*Microcarbo melanoleucos*						
	Little Raven	*Corvus mellori*					X	
	Long-billed Corella	*Cacatua tenuirostris*					X	X
	Magpie-lark	*Grallina cyanoleuca*					X	
	Masked Lapwing	*Vanellus miles*						
	Masked Woodswallow	*Artamus personatus*						
	Mistletoebird	*Dicaeum hirundinaceum*					X	

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Musk Duck	*Biziura lobata*			VU			
	Musk Lorikeet	*Glossopsitta concinna*						
	Nankeen Kestrel	*Falco cenchroides*						
	Nankeen Night Heron	*Nycticorax caledonicus*			NT			
	Barking Owl	*Ninox connivens*		L	EN	V		
	Noisy Friarbird	*Philemon corniculatus*					X	X
	Noisy Miner	*Manorina melanocephala*					X	
	Olive-backed Oriole	*Oriolus sagittatus*						
	Pacific Barn Owl	*Tyto javanica*						
	Pacific Black Duck	*Anas superciliosa*						X
	Painted Button-quail	*Turnix varia*						
	Pallid Cuckoo	*Cuculus pallidus*						
	Peaceful Dove	*Geopelia striata*						X
	Peregrine Falcon	*Falco peregrinus*						
	Pied Butcherbird	*Cracticus nigrogularis*						
	Pied Cormorant	*Phalacrocorax varius*			NT			
	Pied Currawong	*Strepera graculina*						
	Purple Swamphen	*Porphyrio porphyrio*						
	Rainbow Bee-eater	*Merops ornatus*					X	X
	Red Wattlebird	*Anthochaera carunculata*					X	
	Red-backed Kingfisher	*Todiramphus pyrrhopygia*						
	Red-browed Finch	*Neochmia temporalis*						
	Red-capped Robin	*Petroica goodenovii*					X	X
	Red-kneed Dotterel	*Erythrogonys cinctus*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Red-rumped Parrot	*Psephotus haematonotus*						
	Restless Flycatcher	*Myiagra inquieta*						
*	Rock Dove	*Columba livia*					X	
	Royal Spoonbill	*Platalea regia*			VU			
	Rufous Songlark	*Cincloramphus mathewsi*					X	
	Rufous Whistler	*Pachycephala rufiventris*					X	X
	Sacred Kingfisher	*Todiramphus sanctus*					X	
	Scarlet Robin	*Petroica boodang*						
	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*						
	Silver Gull	*Chroicocephalus novaehollandiae*						
	Silvereye	*Zosterops lateralis*						
	Southern Boobook	*Ninox novaeseelandiae*					X	X
	Southern Whiteface	*Aphelocephala leucopsis*						
	Speckled Warbler	*Pyrrholaemus saggitatus*		L	VU	V		
	Spotted Harrier	*Circus assimilis*						
	Spotted Pardalote	*Pardalotus punctatus*					X	X
	Square-tailed Kite	*Lophoicinia isura*		L	VU	V		
	Straw-necked Ibis	*Threskiornis spinicollis*						
	Striated Pardalote	*Pardalotus striatus*					X	X
	Striated Thornbill	*Acanthiza lineata*						
	Stubble Quail	*Coturnix pectoralis*						
	Sulphur-crested Cockatoo	*Cacatua galerita*					X	X
	Superb Fairy-wren	*Malurus cyaneus*					X	X
	Swift Parrot	*Lathamus discolor*		L	EN	E1		

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Tawny Frogmouth	*Podargus strigoides*						
	Tree Martin	*Hirundo nigricans*						
	Tree Martin	*Petrochelidon nigricans*						
	Turquoise Parrot	*Neophema pulchella*		L	NT	V		
	Varied Sittella	*Daphoenositta chrysoptera*					X	
	Wedge-tailed Eagle	*Aquila audax*						
	Weebill	*Smicrornis brevirostris*					X	X
	Welcome Swallow	*Hirundo neoxena*					X	X
	Western Gerygone	*Gerygone fusca*					X	
	Whiskered Tern	*Chlidonias hybridus*			NT			
	Whistling Kite	*Haliastur sphenurus*					X	X
	White-backed Swallow	*Cheramoeca leucosterna*						
	White-bellied Cuckoo-shrike	*Coracina papuensis*						
	White-bellied Sea-Eagle	*Haliaeetus leucogaster*		L	VU			
	White-breasted Woodswallow	*Artamus leucorynchus*						
	White-browed Babbler	*Pomatostomus superciliosus*						
	White-browed Scrubwren	*Sericornis frontalis*						
	White-browed Woodswallow	*Artamus superciliosus*						
	White-faced Heron	*Egretta novaehollandiae*						
	White-necked Heron	*Ardea pacifica*						
	White-plumed Honeyeater	*Lichenostomus penicillatus*					X	
	White-throated Treecreeper	*Cormobates leucophaeus*					X	X
	White-winged Chough	*Corcorax melanorhamphos*					X	X
	White-winged Triller	*Lalage tricolor*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Willie Wagtail	*Rhipidura leucophrys*					X	
	Yellow Rosella	*Platycercus elegans flaveolus*					X	X
	Yellow Thornbill	*Acanthiza nana*					X	
	Yellow-billed Spoonbill	*Platalea flavipes*						X
	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*						
	Zebra Finch	*Taeniopygia guttata*						
Mammals								
	Black Wallaby	*Wallabia bicolor*						X
*	Cat	*Felis catus*						
	Chocolate Wattled Bat	*Chalinolobus morio*						
	Common Brushtail Possum	*Trichosurus vulpecula*					X	
	Common Ringtail Possum	*Pseudocheirus peregrinus*					X	
	Dingo, domestic dog	*Canis lupus*						
	Eastern Grey Kangaroo	*Macropus giganteus*						X
*	European Hare	*Lepus europeaus*						
*	European Rabbit	*Oryctolagus cuniculus*					X	
	Feathertail Glider	*Acrobates pygmaeus*						
	Gould's Long-eared Bat	*Nyctophilus gouldi*						
	Gould's Wattled Bat	*Chalinolobus gouldii*						
*	House Mouse	*Mus musculus*						
	Inland Broad-nosed Bat	*Scotorepens balstoni*						
	Large Forest Bat	*Vespadelus darlingtoni*						
	Lesser Long-eared Bat	*Nyctophilus geoffroyi*						
	Little Forest Bat	*Vespadelus vulturnus*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Platypus	*Ornithorhynchus anatinus*						
*	Red Fox	*Vulpes vulpes*						X
	Short-beaked Echidna	*Tachyglossus aculeatus*						
	Southern Forest Bat	*Vespadelus regulus*						
	Southern Freetail Bat (long penis)	*Mormopterus sp. 1*						
	Squirrel Glider	*Petaurus norfolcensis*		L	EN	V		
	Sugar Glider	*Petaurus breviceps*						
	Water Rat	*Hydromys chrysogaster*						
	White-striped Freetail Bat	*Tadarida australis*					X	
	Yellow-footed Antechinus	*Antechinus flavipes*						
Reptiles								
	Bandy Bandy	*Vermicella annulata*		L	NT			
	Bearded Dragon	*Pogona barbarata*						
	Bougainville's Skink	*Lerista bougainvillii*					X	X
	Broad-shelled River Turtle	*Macrochelodina expansa*						
	Carpet Python	*Morelia spilota metcalfei*		L	EN			
	Common Dwarf Skink	*Menetia greyii*						
	Curl Snake	*Suta suta*						
	Eastern Blue-tongue	*Tiliqua scincoides*						
	Eastern Brown Snake	*Pseudonaja textilis*						
	Eastern Snake-necked Turtle	*Echelodina longicollis*						
	Garden Skink	*Lampropholis guichenoti*						
	Gould's Goanna	*Varanus gouldii*						
	Lace Monitor	*Varanus varius*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Large Striped Skink	*Ctenotus robustus*					X	
	Marbled Gecko	*Christinus marmoratus*						
	Murray River Turtle	*Emydura macquarii*			DD			
	Patternless Delma	*Delma inornata*						
	Prong-snouted Blind Snake	*Ramphotyphlops bituberculatus*						
	Pspiny-palmed Shinning-skink	*Cryptolepharus carnabyi*					X	
	Shingle-back	*Tiliqua rugosa*						
	South-eastern Morethia Skink	*Morethia boulengeri*						
	Tiger Snake	*Notechis scutatus*						
Amphibians								
	Common Froglet	*Crinia signifera*						X
	Long-thumbed Frog	*Limnodynastes fletcheri*						
	Peron's Tree Frog	*Litoria peronii*						
	Plains Froglet	*Crinia parinsignifera*						X
	Southern Bell Frog	*Litoria raniformis*	VU	L	EN	E1		
	Southern Bullfrog	*Limnodynastes dumerilii*						
	Spotted Marsh Frog	*Limnodynastes tasmaniensis*						X
Fish								
	Australian Smelt	*Retropinna semoni*						
	Bony Herring	*Nematalosa erebi*						
*	Common Carp	*Cyprinus carpio*						X
*	Eastern Gambusia	*Gambusia holbrooki*						
	Flathead Galaxias	*Galaxias rostratus*						
	Flat-headed Gudgeon	*Philypnodon grandiceps*						

Origin	Common Name	Scientific Name	Conservation status				Recorded	
			EPBC	FFG	DSE	TSC/FM	VIC	NSW
	Golden Perch	*Macquaria ambigua*			VU			
*	Goldfish	*Carassius auratus*						
	Macquarie Perch	*Macquaria australasica*	EN	L	EN	FE		
	Murray Cod	*Maccullochella peelii peelii*	VU	L	EN			
	Murray Hardyhead	*Craterocephalus fluviatilis*	L		CE	FCE		
*	Redfin Perch	*Perca fluviatilis*						
	Short-headed Lamprey	*Mordacia mordax*						
	Silver Perch	*Bidyanus bidyanus*		L	CE			
	Trout Cod	*Maccullochella maxquariensis*						
Insects								
	Golden Sun Moth	*Synemon plana*	CE	L	CE	E1		

DSE – Status from DSE Advisory List; **EPBC** – Status under EPBC Act; **FFG** – Status under FFG Act; **CE** – Critically endangered; **EN** – Endangered; **VU**– Vulnerable; **NT** – Lower risk near threatened; **DD** = data deficient; **L** – Listed on FFG Act; **TSC** – Status under the Threatened Species Conservation Act; **E1** – Endangered; **E4** – Presumed Extinct; **V** – Vulnerable; **FE** – Fish endangered; **FV** – Fish vulnerable; VIC – Victoria; NSW – New South Wales; ***** = introduced species; **X** = recorded.

Appendix 3: Detailed Habitat Hectare assessment results

Habitat Zone			A	B	C	D	E	F
EVC Number			295	295	295	295	295	295
Total area of zone (Ha)			1.03	0.11	0.23	0.63	1.01	4.71
		Max' score						
Site Condition	Large Old Trees	10	6	4	8	2	4	2
	Tree Canopy Cover	5	3	1	1	1	1	2
	Lack of Weeds	15	6	7	7	7	6	11
	Understorey	25	5	5	5	5	5	15
	Recruitment	10	3	0	0	0	10	6
	Organic Matter	5	3	3	5	3	3	3
	Logs	5	2	0	0	0	0	0
	*Site Condition subtotal**		*28*	*20*	*26*	*18*	*29*	*39*
Landscape Context	Patch Size	10	1	1	1	1	1	2
	Neighborhood	10	2	1	0	0	1	2
	Distance to Core	5	3	3	3	3	3	3
Total Habitat Score		**100**	**34**	**25**	**30**	**22**	**34**	**46**
Habitat score out of 1.00			0.34	0.25	0.30	0.22	0.34	0.46
Habitat Hectares in zone#			0.350	0.027	0.069	0.140	0.343	2.167
EVC Bioregional Conservation Status			V	V	V	V	V	V
Conservation Significance	Conservation Status x Habitat Score		High	Medium	High	Medium	High	High
	Threatened Species Rating		High	High	High	High	High	High
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A
	Overall Conservation Significance (highest)**		**High**	**High**	**High**	**High**	**High**	**High**
No. Large Old trees in Habitat Zone			13	1	4	3	8	5

Habitat Zone			G	H	I	J	K	L
EVC Number			103	103	295	295	295	295
Total area of zone (Ha)			1.33	2.56	0.15	0.12	0.1	2.25
		Max' score						
Site Condition	Large Old Trees	10	3					2
	Tree Canopy Cover	5	2					4
	Lack of Weeds	15	11					6
	Understorey	25	5					5
	Recruitment	10	3					6
	Organic Matter	5	3					3
	Logs	5	0					2
	*Site Condition subtotal**		*27*					*28*
Landscape Context	Patch Size	10	1					2
	Neighborhood	10	2					3
	Distance to Core	5	3					3
Total Habitat Score		**100**	**33**	**60**	**60**	**60**	**60**	**36**
Habitat score out of 1.00			0.33	0.60	0.60	0.60	0.60	0.36
Habitat Hectares in zone#			0.439	1.536	0.090	0.072	0.060	0.806
EVC Bioregional Conservation Status			V	V	V	V	V	V
Conservation Significance	Conservation Status x Habitat Score		High	Very High	Very High	Very High	Very High	High
	Threatened Species Rating		High	High	High	High	High	High
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A
	Overall Conservation Significance (highest)**		**High**	**Very High**	**Very High**	**Very High**	**Very High**	**High**
No. Large Old trees in Habitat Zone			2	N/A	N/A	N/A	N/A	11

Habitat Zone			M	N	O	P	Q	R
EVC Number			106	295	295	295	295	103
Total area of zone (Ha)			3.64	0.38	0.13	0.85	3.46	11.31
		Max' score						
Site Condition	Large Old Trees	10	4	8	9	6	1	8
	Tree Canopy Cover	5	1	2	2	1	3	1
	Lack of Weeds	15	2	7	7	4	0	9
	Understorey	25	10	0	5	15	5	10
	Recruitment	10	6	0	0	3	6	6
	Organic Matter	5	5	5	3	3	3	3
	Logs	5	0	0	0	2	2	4
	*Site Condition subtotal**		*28*	*22*	*26*	*34*	*20*	*41*
Landscape Context	Patch Size	10	2	1	1	1	2	6
	Neighborhood	10	3	2	2	2	3	3
	Distance to Core	5	3	3	3	3	4	4
Total Habitat Score		**100**	**36**	**28**	**32**	**40**	**29**	**54**
Habitat score out of 1.00			0.36	0.28	0.32	0.40	0.29	0.54
Habitat Hectares in zone#			1.296	0.105	0.041	0.342	1.017	6.153
EVC Bioregional Conservation Status			D	V	V	V	V	E
Conservation Significance	Conservation Status x Habitat Score		Medium	Medium	High	High	Medium	Very high
	Threatened Species Rating		High	High	High	High	High	Very high
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A
	Overall Conservation Significance (highest)**		**High**	**High**	**High**	**High**	**High**	**Very high**
No. Large Old trees in Habitat Zone			44	9	4	10	10	533

Habitat Zone			S	T	U	V	W	Y
EVC Number			106	295	103	103	103	295
Total area of zone (Ha)			0.93	15.19	2.21	0.08	0.66	0.19
		Max' score						
Site Condition	Large Old Trees	10	4		7	9	5	
	Tree Canopy Cover	5	2		2	2	4	
	Lack of Weeds	15	11		9	6	11	
	Understorey	25	5		15	5	5	
	Recruitment	10	0		1	0	0	
	Organic Matter	5	3		3	3	3	
	Logs	5	0		2	0	0	
	*Site Condition subtotal**		*25*		*39*	*25*	*28*	
Landscape Context	Patch Size	10	1		2	1	1	
	Neighborhood	10	3		0	0	1	
	Distance to Core	5	4		3	3	3	
Total Habitat Score		**100**	**33**		**44**	**29**	**33**	
Habitat score out of 1.00			0.33		0.44	0.29	0.33	
Habitat Hectares in zone#			0.307	0.000	0.972	0.023	0.215	0.000
EVC Bioregional Conservation Status			D		V	V	V	
Conservation Significance	Conservation Status x Habitat Score		Medium		High	Medium	High	
	Threatened Species Rating		High	N/A	High	High	High	N/A
	Other Site Attribute Rating		N/A	N/A	N/A	N/A	N/A	N/A
	Overall Conservation Significance (highest)**		**High**		**High**	**High**	**High**	
No. Large Old trees in Habitat Zone			9	N/A	8	4	2	N/A

Habitat Zone			Z	AA	AB
EVC Number			106	106	106
Total area of zone (Ha)			0.41	0.43	0.32
		Max' score			
Site Condition	Large Old Trees	10	0	2	2
	Tree Canopy Cover	5	3	4	4
	Lack of Weeds	15	7	7	11
	Understorey	25	5	5	5
	Recruitment	10	0	0	10
	Organic Matter	5	5	5	3
	Logs	5	0	0	0
	*Site Condition subtotal**		*20*	*23*	*35*
Landscape Context	Patch Size	10	1	1	1
	Neighborhood	10	3	3	3
	Distance to Core	5	3	3	3
Total Habitat Score		**100**	**27**	**30**	**42**
Habitat score out of 1.00			0.27	0.30	0.42
Habitat Hectares in zone#			0.110	0.128	0.134
EVC Bioregional Conservation Status			D	D	D
Conservation Significance	Conservation Status x Habitat Score		Low	Medium	Medium
	Threatened Species Rating		High	N/A	High
	Other Site Attribute Rating		N/A	N/A	N/A
	Overall Conservation Significance (highest)**		**High**	**High**	**High**
No. Large Old trees in Habitat Zone			0	2	1

Habitat hectares = Total habitat score/100 X area in zone (ha), ** May increase following targeted searches for threatened species, * Habitat Zones H, I, J and K –default score of 0.6 (60 out of 100) applied (See note above Table 2), *** EVC Bioregional Conservation Status: E = Endangered, V = Vulnerable, D = Depleted, ^ Habitat Zones T, X and Y – Areas of Native vegetation in New South Wales – not subjected to Habitat hectare assessment as the Framework has no implications under New South Wales legislation.

Appendix 4: Scattered trees in the study area

Tree no.	Common Name	DBH (cm)	EVC	Size Class	Conservation Significance	Remove/Retain
1	River Red-gum	76	103	Very Large	Medium	Retain
2	Grey Box	117	103	Very Large	Medium	Retain
3	Grey Box	136	103	Very Large	Medium	Retain
4	Black Box	28	103	Small	Medium	Retain
5	River Red-gum	166	103	Very Large	Medium	Retain
11	River Red-gum	50	295	Small	Medium	Retain
12	River Red-gum	48	295	Small	Medium	Retain
14	River Red Gum	60	295	Medium	Medium	Retain
16	Black Box	116	103	Very Large	Medium	Retain
20	River Red-gum	120	106	Large	Low	Retain
21	River Red-gum	120	106	Large	Low	Retain
22	River Red-gum	103	106	Large	Low	Retain
116	Black Box	77	NSW	Medium	na	Retain
117	Black Box	129	NSW	Very Large	na	Retain
119	Black Box	36	NSW	Small	na	Retain
120	Black Box	51	NSW	Small	na	Retain
121	Black Box	116	NSW	Very Large	na	Remove
10a	Black Wattle	23	295	S3	Low	Retain
11a	River Red Gum	145	295	Very Large	Medium	Retain

Tree no.	Common Name	DBH (cm)	EVC	Size Class	Conservation	Remove/Retain
12a	Black Box	51	295	S1	Low	Retain
13a	Black Box	80	295	Large	Medium	Retain
15a	Black Box	133	103	Very Large	Medium	Retain
17a	River Red Gum	75	103	Very Large	Medium	Retain
18a	Black Box	25	103	SS2	Low	Retain
19a	Black Box	20	103	SS2	Low	Remove
1a	Black Box	89	103	Very Large	Medium	Retain
20a	Black Box	13	103	SS3	Low	Retain
21a	Black Box	15	103	SS3	Low	Retain
22a	Black Box	13	103	SS3	Low	Retain
23a	Black Box	18	103	SS3	Low	Retain
24a	Black Box	18	103	SS3	Low	Retain
25a	Black Box	14	103	SS3	Low	Retain
26a	Black Box	15	103	SS3	Low	Retain
27a	Black Box	16	103	SS3	Low	Retain
28a	Black Box	15	103	SS3	Low	Retain
29a	Black Box	19	103	SS3	Low	Retain
2a	Black Box	21	103	SS2	Low	Retain
30a	Black Box	10	103	SS3	Low	Retain
31a	Black Box	12	103	SS3	Low	Retain
32a	River Red Gum	26	NSW	S1	Low	Retain
33a	Grey Box	114	NSW	Large	Low	Retain
34a	Yellow Box	127	NSW	Very Large	Low	Retain
35a	Black Box	78	NSW	Medium	Low	Retain

Tree no.	Common Name	DBH (cm)	EVC	Size Class	Conservation	Remove/Retain
36a	Black Box	102	NSW	Large	Low	Retain
37a	River Red Gum	138	106	Very Large	Low	Retain
38a	River Red Gum	91	106	Large	Low	Retain
3a	Black Box	18	103	SS3	Low	Retain
4a	River Red Gum	138	295	Very Large	Medium	Retain
5a	River Red Gum	93	295	Large	Medium	Retain
6a	River Red Gum	35	295	S2	Low	Retain
7a	River Red Gum	155	295	Very Large	Medium	Retain
8a	River Red Gum	171	295	Very Large	Medium	Retain
9a	River Red Gum	95	295	Large	Medium	Retain

Appendix 5: Fauna conservation significance criteria

National fauna conservation significance applies to an area that supports one or more of the attributes described below.

- A population of one or more species listed as nationally threatened by Maxwell *et al.* (1996), Lee (1995), Duncan *et al.* (1999), Garnett and Crowley (2000), Cogger *et al.* (1993), Tyler (1997) or Wager and Jackson (1993), or listed on the schedules of the *Environment Protection and Biodiversity Conservation Act 1999*.
- A nationally threatened ecological community listed on the schedules of the EPBC Act.

State fauna conservation significance applies to an area when it supports one or more of the following attributes.

- A population of at least one fauna species threatened in Victoria, as listed by DSE (2007b), or on the schedules to the Victorian *Flora and Fauna Guarantee Act 1988*.
- An ecological community considered threatened in Victoria through its listing on the schedules of the FFG Act.

Regional fauna conservation significance applies to an area that supports one or more of the attributes described below.

- A population of a species considered depleted in a particular bioregion based on an authoritative regional analysis, such as the Regional Native Vegetation Plan, Environment Conservation Council Report or Comprehensive Regional Assessment documents.

Local fauna conservation significance applies to all 'other' native fauna that do not meet the above criteria.

As it is not always possible to confirm the presence of some fauna species, due to seasonal or behavioural difficulties in detection, the foregoing significance levels can be qualified by the word "**potential**" where habitat attributes are considered suitable for a species of a particular level of conservation significance.

Appendix 6: EVC benchmarks

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Murray Fans bioregion

EVC 103: Riverine Chenopod Woodland (*syn.* Black Box Chenopod Woodland)

Description:
Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus largiflorens	40 cm	5/ha

Tree Canopy Cover:

%cover	Character Species	Common Name
10%	*Eucalyptus largiflorens*	Black Box
	Acacia stenophylla	River Coobah

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Medium Shrub	3	30%	MS
Small Shrub	5	25%	SS
Prostrate Shrub	1	1%	PS
Medium Herb	5	5%	MH
Small or Prostrate Herb*	5	10%	SH
Medium to Small Tufted Graminoid	2	5%	MTG

* Largely seasonal life form

Total understorey projective foliage cover **50%**

LF Code	Species typical of at least part of EVC range	Common Name
MS	*Atriplex nummularia*	Old-man Saltbush
MS	*Chenopodium nitrariaceum*	Nitre Goosefoot
MS	*Eremophila divaricata* ssp. *divaricata*	Spreading Emu-bush
SS	*Sclerolaena tricuspis*	Streaked Copperburr
SS	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush
SS	*Atriplex lindleyi*	Flat-top Saltbush
SS	*Rhagodia spinescens*	Hedge Saltbush
PS	*Sclerochlamys brachyptera*	Short-wing Saltbush
MH	*Einadia nutans* ssp. *nutans*	Nodding Saltbush
MH	*Calocephalus sonderi*	Pale Beauty-heads
MH	*Senecio glossanthus*	Slender Groundsel
MH	*Brachyscome lineariloba*	Hard-head Daisy
SH	*Disphyma crassifolium* ssp. *clavellatum*	Rounded Noon-flower
SH	*Maireana pentagona*	Hairy Bluebush

Recruitment:
Continuous

Organic Litter:
5% cover

Logs:
5m/0.1 ha.

EVC 103: Riverine Chenopod Woodland (*syn.* Black Box Chenopod Woodland) - Murray Fans bioregion

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
T	*Olea europaea* subsp. *europaea*	Olive	low	high
MS	*Lycium ferocissimum*	Boxthorn	low	high
LH	*Sisymbrium erysimoides*	Smooth Mustard	high	high
LH	*Critesion* spp.	Barley-grass	high	low
LH	*Gazania linearis*	Gazania	high	high
LH	*Opuntia* spp.	Prickly Pear	low	high
LH	*Sisymbrium irio*	London Mustard	high	high
LH	*Psilocaulon granulicaule*	Noon-flower	high	high
MH	*Limonium sinuatum*	Notch-leaf Sea-lavender	high	high
MH	*Limonium lobatum*	Winged Sea-lavender	high	high
MH	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	high	low
MH	*Mesembryanthemum nodiflora*	Ice-plant	high	high
MH	*Carrichtera annua*	Ward's Weed	high	high
MH	*Marrubium vulgare*	Horehound	high	high
MH	*Carpobrotus aequilaterus*	Angled Pigface	low	high
MH	*Silene apetala* var. *apetala*	Sand Catchfly	high	low
MH	*Medicago* spp.	Medic	high	low
MH	*Oxalis pes-caprae*	Soursob	high	high
MH	*Silene gallica*	French Catchfly	high	low
MH	*Silene nocturna*	Mediterranean Catchfly	high	low
SH	*Mesembryanthemum crystallinum*	Common Ice-plant	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	high
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low
MTG	*Asphodelus fistulosus*	Onion Weed	high	high
MNG	*Bromus rubens*	Red Brome	high	high
MNG	*Vulpia myuros*	Rat's-tail Fescue	high	low
MNG	*Bromus* spp.	Brome	high	high
MNG	*Schismus barbatus*	Arabian Grass	high	low
SC	*Asparagus asparagoides*	Bridal Creeper	high	high

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Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Murray Fans bioregion

EVC 106: Grassy Riverine Forest

Description:
Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum forest to 25 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	90 cm	20 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
30%	*Eucalyptus camaldulensis*	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	10%	T
Large Herb	2	10%	LH
Medium Herb	3	10%	MH
Medium to Small Tufted Graminoid	3	25%	MTG
Medium to Tiny Non-tufted Graminoid	3	10%	MNG
Bryophytes/Lichens	na	10%	BL
Total understorey projective foliage cover		**75%**	

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia stenophylla*	Eumong
LH	*Wahlenbergia fluminalis*	River Bluebell
LH	*Senecio quadridentatus*	Cotton Fireweed
MH	*Goodenia fascicularis*	Silky Goodenia
MH	*Eclipta platyglossa*	Yellow Twin-heads
MTG	*Setaria jubiflora*	Warrego Summer-grass
MNG	*Eleocharis acuta*	Common Spike-sedge

Recruitment:
Continuous

Organic Litter:
40 % cover

Logs:
30 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Lactuca serriola*	Prickly Lettuce	high	low
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Centaurea melitensis*	Malta Thistle	high	low
MH	*Hypochoeris glabra*	Smooth Cat's-ear	high	low
MH	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	high	low
MH	*Reichardia tingitana*	False Sow-thistle	high	low
MH	*Phyla canescens*	Fog-fruit	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MNG	*Bromus rubens*	Red Brome	high	low

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EVC 106: Grassy Riverine Forest - Murray Fans bioregion

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Murray Fans bioregion

EVC 295: Riverine Grassy Woodland

Description:
Occurs on the floodplain of major rivers, in a slightly elevated position where floods are rare, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a groundlayer dominated by graminoids and sometimes lightly shrubby or with chenopod shrubs.

Large trees:

Species	DBH(cm)	# / ha
Eucalyptus spp.	80 cm	15 / ha

Tree Canopy Cover:

% cover	Character Species	Common Name
20%	*Eucalyptus camaldulensis*	River Red-gum
	Eucalyptus largiflorens	Black Box

Understorey:

Life form	# Spp	% Cover	LF code
Immature Canopy Tree		5%	IT
Small Shrub	4	10%	SS
Large Herb	4	10	LH
Medium Herb	2	10%	MH
Small or Prostrate Herb	5	10%	SH
Large Tufted Graminoid	1	1%	LTG
Medium to Small Tufted Graminoid	5	20%	MTG
Medium to Tiny Non-tufted Graminoid	2	5%	MNG
Bryophytes/Lichens	na	10%	BL
Total understorey projective foliage cover		**75%**	

LF Code	Species typical of at least part of EVC range	Common Name
SS	*Sclerolaena muricata* var. *villosa*	Grey Roly-poly
SS	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush
SS	*Maireana decalvans*	Black Cotton-bush
SS	*Chenopodium curvispicatum*	Cottony Saltbush
LH	*Wahlenbergia fuminalis*	River Bluebell
LH	*Rumex brownii*	Slender Dock
LH	*Senecio quadridentatus*	Cotton Fireweed
MH	*Einadia nutans* ssp. *nutans*	Nodding Saltbush
MH	*Atriplex semibaccata*	Berry Saltbush
MH	*Atriplex eardleyae*	Small Saltbush
MH	*Sida corrugata*	Variable Sida
MTG	*Austrodanthonia setacea*	Bristly Wallaby-grass
MTG	*Austrostipa scabra*	Rough Spear-grass
MTG	*Carex inversa*	Knob Sedge
MTG	*Juncus subsecundus*	Finger Rush

Recruitment:
Continuous

Organic Litter:
10 % cover

Logs:
20 m/0.1 ha.

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Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
MTG	*Bromus hordaceus* ssp. *hordaceus*	Soft Brome	high	high
MTG	*Critesion murinum* ssp. *leporinum*	Wall Barley-grass	high	high
MNG	*Bromus rubens*	Red Brome	high	high

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Riverina bioregion

EVC 103: Riverine Chenopod Woodland

Description:
Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	50 cm	5/ha

Tree Canopy Cover:

%cover	Character Species	Common Name
10%	*Eucalyptus largiflorens*	Black Box

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Medium Shrub	3	30%	MS
Small Shrub	5	25%	SS
Prostrate Shrub	1	1%	PS
Medium Herb	5	5%	MH
Small or Prostrate Herb*	5	10%	SH
Medium to Small Tufted Graminoid	2	5%	MTG
Soil Crust	na	10%	S/C

* Largely seasonal life form

Total understorey projective foliage cover **65%**

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia stenophylla*	River Coobah
MS	*Atriplex nummularia*	Old-man Saltbush
MS	*Chenopodium nitrariaceum*	Nitre Goosefoot
MS	*Eremophila divaricata* ssp. *divaricata*	Spreading Emu-bush
SS	*Sclerolaena tricuspis*	Streaked Copperburr
SS	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush
SS	*Atriplex lindleyi*	Flat-top Saltbush
SS	*Rhagodia spinescens*	Hedge Saltbush
PS	*Sclerochlamys brachyptera*	Short-wing Saltbush
MH	*Einadia nutans* ssp. *nutans*	Nodding Saltbush
MH	*Calocephalus sonderi*	Pale Beauty-heads
MH	*Senecio glossanthus*	Slender Groundsel
MH	*Brachyscome lineariloba*	Hard-head Daisy
SH	*Disphyma crassifolium* ssp. *clavellatum*	Rounded Noon-flower
SH	*Maireana pentagona*	Hairy Bluebush

Recruitment:
Continuous

Organic Litter:
5% cover

Logs:
5 m/0.1 ha.

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Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
T	*Olea europaea* subsp. *europaea*	Olive	low	high
MS	*Lycium ferocissimum*	Boxthorn	low	high
LH	*Sisymbrium erysimoides*	Smooth Mustard	high	high
LH	*Critesion* spp.	Barley-grass	high	low
LH	*Gazania linearis*	Gazania	high	high
LH	*Opuntia* spp.	Prickly Pear	low	high
LH	*Sisymbrium irio*	London Mustard	high	high
LH	*Psilocaulon granulicaule*	Noon-flower	high	high
MH	*Limonium sinuatum*	Notch-leaf Sea-lavender	high	high
MH	*Limonium lobatum*	Winged Sea-lavender	high	high
MH	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	high	low
MH	*Mesembryanthemum nodiflora*	Ice-plant	high	high
MH	*Carrichtera annua*	Ward's Weed	high	high
MH	*Marrubium vulgare*	Horehound	high	high
MH	*Carpobrotus aequilaterus*	Angled Pigface	low	high
MH	*Silene apetala* var. *apetala*	Sand Catchfly	high	low
MH	*Medicago* spp.	Medic	high	low
MH	*Oxalis pes-caprae*	Soursob	high	high
MH	*Silene gallica*	French Catchfly	high	low
MH	*Silene nocturna*	Mediterranean Catchfly	high	low
SH	*Mesembryanthemum crystallinum*	Common Ice-plant	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	high
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low
MTG	*Asphodelus fistulosus*	Onion Weed	high	high
MNG	*Bromus rubens*	Red Brome	high	high
MNG	*Vulpia myuros*	Rat's-tail Fescue	high	low
MNG	*Bromus* spp.	Brome	high	high
MNG	*Schismus barbatus*	Arabian Grass	high	low
SC	*Asparagus asparagoides*	Bridal Creeper	high	high

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Riverina bioregion

EVC 106: Grassy Riverine Forest

Description:
Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum forest to 25 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present.

Large trees:

Species	DBH(cm)	# / ha
Eucalyptus spp.	90 cm	20 / ha

Tree Canopy Cover:

% cover	Character Species	Common Name
30%	*Eucalyptus camaldulensis*	River Red-gum

Understorey:

Life form	# Spp	% Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	10%	T
Large Herb	2	10%	LH
Medium Herb	3	10%	MH
Medium to Small Tufted Graminoid	3	25%	MTG
Medium to Tiny Non-tufted Graminoid	3	10%	MNG
Bryophytes/Lichens	na	10%	BL
Total understorey projective foliage cover		**75%**	

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia stenophylla*	Eumong
LH	*Wahlenbergia fluminalis*	River Bluebell
LH	*Senecio quadridentatus*	Cotton Fireweed
MH	*Goodenia fascicularis*	Silky Goodenia
MH	*Eclipta platyglossa*	Yellow Twin-heads
MTG	*Setaria jubiflora*	Warrego Summer-grass
MNG	*Eleocharis acuta*	Common Spike-sedge

Recruitment:
Continuous

Organic Litter:
40 % cover

Logs:
30 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Lactuca serriola*	Prickly Lettuce	high	low
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Centaurea melitensis*	Malta Thistle	high	low
MH	*Hypochoeris glabra*	Smooth Cat's-ear	high	low
MH	*Trifolium arvense* var. *arvense*	Hare's-foot Clover	high	low
MH	*Reichardia tingitana*	False Sow-thistle	high	low
MH	*Phyla canescens*	Fog-fruit	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MNG	*Bromus rubens*	Red Brome	high	low

Victoria The Place To Be

EVC 106: Grassy Riverine Forest – Victorian Riverina bioregion

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Riverina bioregion

EVC 295: Riverine Grassy Woodland

Description:
Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a groundlayer dominated by graminoids. Occasional tall shrubs present.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	80 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	*Eucalyptus camaldulensis*	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Small Shrub	1	1%	SS
Medium Herb	2	1%	MH
Small or Prostrate Herb	2	1%	SH
Large Tufted Graminoid	2	5%	LTG
Medium to Small Tufted Graminoid	5	20%	MTG
Medium to Tiny Non-tufted Graminoid	2	20%	MNG
Bryophytes/Lichens	na	10%	BL
Total understorey projective foliage cover		**65%**	

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia dealbata*	Silver Wattle
MH	*Sida corrugata*	Variable Sida
MH	*Oxalis perennans*	Grassland Wood-sorrel
SH	*Chamaesyce drummondii*	Flat Spurge
SH	*Azolla filiculoides*	Pacific Azolla
LTG	*Austrostipa gibbosa*	Spurred Spear-grass
LTG	*Carex tereticaulis*	Hollow Sedge
MTG	*Chloris truncata*	Windmill Grass
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Aristida behriana*	Brush Wire-grass
MTG	*Elymus scaber var. scaber*	Common Wheat-grass
MNG	*Pseudoraphis spinescens*	Spiny Mud-grass
MNG	*Eleocharis acuta*	Common Spike-sedge

Recruitment:
Continuous

Organic Litter:
10 % cover

Logs:
20 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Cirsium vulgare*	Spear Thistle	high	high
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low

EVC 295: Riverine Grassy Woodland - Victorian Riverina bioregion

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For more information contact: Customer Service Centre, 136 186

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