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Ecological Research & Management

ECHUCA-MOAMA BRIDGE PROJECT BIODIVERSITY AND HABITAT IMPACT ASSESSMENT EES REPORT



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Glossary of Terms

Term	Definition
1 in 100 year flood	A flood which results from a storm which has a statistical probability of occurring once in every 100 years.
Access	The location by which vehicles and / or pedestrians enter and / or leave property adjacent to a road.
Afflux	A rise in upstream water level caused by introducing a constriction such as a bridge, into a stream, channel or floodplain.
Alignment Option	The location and geometric form of a carriageway in both the horizontal and vertical directions. For this Project the Alignment Option being assessed is the Mid-West Option.
Arterial Road	The nominated traffic routes (such as Murray Valley Highway or Cohuna-Echuca Road / Warren Street), for longer distance travel and larger vehicles.
At grade intersection	An intersection where all roads cross at the same level usually controlled by traffic signals or Stop or Give Way signs.
Attenuation	The reduction in the magnitude of sound pressure level during transmission over a distance or around a barrier.
Axel load limit	Restrictions on how much load can be carried on an axel, single or dual tyres, and on the vehicle or vehicle combinations.
Australian Height Datum (AHD)	The Australian standard height datum for calculating levels.
B-double	A twin trailer articulated vehicle with the second trailer pivoting on the back of the first.
Batter	<p>In road construction, an artificial uniform slope created on the sides of fills or cuts. The proposed batters for the Project have a slope of 2:1 (vertical to horizontal).</p> <p>A batter is also known as an embankment.</p>
Benefit Cost Ratio (BCR)	The ratio of the discounted benefits over the life of a project to the discounted capital costs, or the project's discounted total agency costs.

Term	Definition
Bored pile	A steel or reinforced concrete post that is inserted vertically into the ground by drilling, or formed in the ground in a pre-bored hole, to support a load.
Bridge	A bridge is a structure built to cross an obstacle in the road network. The Project comprises bridges across the Campaspe River, the Murray River and some bridging components over the Campaspe/Murray River floodplains.
Carriageway	That portion of a road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes, such as the two-lane, two-way carriageway in the Initial Alignment.
Chainage	The distance of a point along a control line, measured from a datum point.
Clear Zones	An area within the recovery area which is ideally kept clear of hazards (or within which unmovable hazards are shielded). The width of the clear zone reflects the probability of an accident occurring at that location and the cost-effectiveness of removing hazards. The clear zone width is dependent on traffic speeds, road geometry and traffic volume.
Concept Design	Initial high-level functional layout of a concept, such as a road or road system, to provide a level of understanding to later establish detailed design parameters.
Construction Environmental Management Framework (CEMP)	A site or project specific plan developed to ensure that appropriate environmental management practices are followed during the construction and/or operation of a Project.
Construction Area	The area defined for the Project within the Right of Way that would be directly impacted by construction activities.
Corridor	An area of travel between two points. It may include more than one major route and more than one form of transport. Two corridors were investigated prior to the development of the EES. These corridors were identified as the Mid-West 2 Corridor (which included the Mid-West 2A and Mid-West 2B options) and the Mid-West Corridor, (which included the Mid-West Option).

Term	Definition
Culvert	One or more subsurface adjacent pipes or enclosed channels for conveying surface water or a stream below road formation level.
Cut	The depth below the natural surface of the ground to the construction level.
dB(A)	The human ear is not equally sensitive to all parts of the sound frequency range and the scale most commonly used is the A-weighted decibel or dB(A). This unit most accurately reflects human perception of the frequency range normally associated with road traffic noise.
Deceleration lane	An auxiliary traffic lane provided to allow vehicles to decrease speed on the approach to an intersection.
Design speed	A speed fixed for the design and correlation of those geometric features of a carriageway that influence vehicle operation. The Mid-West Option alignment option has been designed to 90 kilometres per hour, for a posted speed limit of 80 kilometres per hour.
Earthworks	All operations involved in loosening, removing, depositing, shaping and compacting soil or rock.
EES Scoping Requirements	The Scoping Requirements under the Victorian <i>Environmental Effects Act 1978</i> entitled "The Second Crossing of the Murray River at Echuca Moama dated June 2014"
Environmental Management Framework (EMF)	Outlines the environmental measures recommended to be adopted as part of the EES.
Environment	For the purpose of the EES, environment incorporates physical, biological, heritage, cultural, economic and social aspects.
Environment Effects Statement (EES)	A statement prepared at the request of the Victorian Minister for Planning, pursuant to the Victorian <i>Environmental Effects Act 1978</i> , on the potential environment impact of a proposed development.
Fill	One or more of the following: 1. The depth from the subgrade level to the natural surface. 2. That portion of road where the formation is above the natural

Term	Definition
	surface. 3. The material placed in an embankment.
Floodway	Land that is identified as carrying active flood flows associated with waterways and open drainage systems.
Freehold land	Privately owned land.
Gradeline	The level and gradient of a road carriageway along the centreline.
High Productivity Freight Vehicles (HPFV)	Larger combination vehicles such as B triples and super B doubles that are restricted to specific arterial routes
Higher Mass Limits (HML)	Allows for higher axle loading for various axle groups in compliance with National accreditation and restricted to specific routes
Highway	A principal road in the road network with direct property access, such as the Murray Valley Highway.
Initial Alignment	For the purpose of this EES, the Initial Alignment comprises the construction of a two lane, two-way carriageway road including a single lane bridge across the Campaspe and Murray Rivers.
Intersection	The place at which two or more roads meet or cross.
Investigation Area	A corridor defined for the Project encompassing the Right-of-Way sufficient for the ultimate duplication and the construction area of the alignment.
Land use	The type of development permitted in an area: industrial, commercial, residential, recreational or a combination of some or all of these different uses.
Local access path	Minor path generally located in a local or residential area that links road and/or off road cycling routes, and off road pedestrian path, such as those paths within Victoria Park.
Major Road	A road to which is assigned a permanent priority for traffic movement over that of other roads.
Mid-West Option (Preferred Alignment)	The Mid-West Option extends from the Murray Valley Highway along Warren Street before diverting to the northwest where it crosses Campaspe Esplanade and the Campaspe River, then turns north-east to cross the Murray River north of the Victoria Park Boat

Term	Definition
	Ramp. This option then extends north in New South Wales to cross Boundary Road in Moama and connect with the Cobb Highway at Meninya Street.
Mid-West 2A Option	The Mid-West 2A Option extends north/northwest on a new alignment from the intersection of the Murray Valley Highway and Warren Street crosses the Campaspe River north of the Echuca Cemetery, before turning northeast towards Reflection Bend on the Murray River. This option then passes immediately south of Reflection Bend and crosses the Murray River north of the Victoria Park Boat Ramp, then extends north in New South Wales to cross Boundary Road in Moama and connect with the Cobb Highway at Meninya Street.
Mid-West 2B Option	The Mid-West 2B Option extends north/northwest on a new alignment from the intersection of the Murray River Highway and Warren Street, crosses the Campaspe River northeast of the Echuca Cemetery, before turning north towards the Echuca Sports and Recreation Reserve. This option crosses the Murray River north of the Victoria Park Boat Ramp, then extends north in New South Wales to cross Boundary Road in Moama and connect with the Cobb Highway at Meninya Street.
Mitigation Measures	Measures which are implemented to reduce an adverse impact caused by road construction and operation.
No Project Option	This assumes no additional bridge crossing of the Murray River and assumes existing road conditions and networks remain unchanged.
Preferred Alignment	The preferred alignment is the Mid-West Option.
Property	A property is land owned by a single or more landowners. It may include multiple contiguous titles owned by the same registered proprietor.
Recovery Area	The area beside the traffic lane required for a run-off-road vehicle to stop safely or be brought under control before rejoining the traffic lane.
Review of Environmental	A report prepared to satisfy the planning approval requirements of the Environmental Planning and Assessment Act 1979.

Term	Definition
Factors (REF)	
Right-of-Way	<p>The Right-of-Way is a strip of land that is reserved through a planning scheme amendment for the public purpose of a road (road reserve) and encompasses sufficient land to construct and maintain the Project. The Right-of-Way for the Project comprises the sealed road surfaces (including shoulders / verges) and a 5m to 10m wide strip of land on either side of the road formation of the ultimate duplication.</p> <p>Note: In NSW, a Right-of-Way is known as a Road Reserve.</p>
Right-turn lane	Right-turn lanes are used to provide space for the deceleration and storage of turning vehicles.
Risk Assessment	The processes of reaching a decision or recommendation on whether risks are tolerable and current risk control measures are adequate, and if not, whether alternative risk control measures are justified or would be implemented.
Roads and Maritime Services (Roads and Maritime)	Roads and Maritime Services are the co-proponent for the Echuca-Moama Bridge Project. Roads and Maritime Services are the NSW state government department responsible for the environmental assessment on the NSW component of the Project.
Roundabout	A channelised intersection at which all traffic moves clockwise around a central traffic island. The roundabouts proposed as part of the Project are located at the Murray Valley Highway/Warren Street intersection and on Warren Street. Both three-leg roundabouts.
Scoping Requirements	The Scoping Requirements for the EES under the Victorian Environment Effects Act 1978 entitled 'The Second Crossing of the Murray River at Echuca-Moama', dated June 2014.
Search Region	Existing information has been obtained from a wider area, termed the 'search region' defined for this assessment as an area with radius ten kilometres from the approximate centre point of the Study Area of coordinates: latitude 36° 06' 47" S and longitude 144° 44' 36" E.
Service Road	A road designed or developed to be used, wholly or mainly, by traffic servicing adjacent land along the north west side of Warren

Term	Definition
	Street as part of the Mid-West Option only.
Shared Path	A paved area particularly designed (with appropriate dimensions, alignment and signing) for the movement of cyclists and pedestrians.
Spill Basins	Engineered basins designed to contain spills on the new carriageway, preventing contaminants from entering the floodplain.
Staged Construction	A construction sequence in which the initial alignment comprising a single traffic lane in each direction is constructed and then, should traffic demand warrant an increase in road capacity, the road and bridge structures are duplicated, providing two traffic lanes in each direction.
Study Area	The area identified by individual specialists to determine potential impacts for the Project relating to a specific discipline. The Study Area may be different to the Project Area for some studies, whilst other assessments may limit their Study Area to the Right-of-Way.
Super "T"	A load-bearing structure (usually reinforced concrete) with a T-shaped cross-section.
The Project	The Echuca-Moama Bridge EES (the Project) involves the construction and operation of a second road bridge crossing of the Murray and Campaspe Rivers at Echuca-Moama.
Title	A title is an official record of who owns a parcel of land. Adjoining titles in the same ownership are considered and assessed as a 'property' in the impact assessment.
Turning lanes	An auxiliary lane reserved for turning traffic, providing deceleration length and storage for turning vehicles.
Two Way Carriageway	A carriageway with two traffic lanes allotted for use by traffic in opposing directions.
Ultimate Duplication	For the EES, the ultimate duplication comprises the construction of a duplicated roadway and bridges. The ultimate duplication will be constructed when future traffic demand warrants an increase in road capacity. The EES considers the potential impacts of the ultimate duplication.

Term	Definition
VicRoads	VicRoads (Roads Corporation) is the co-proponent for the Echuca-Moama Bridge Project. VicRoads is responsible for project management of the planning and will manage the construction of the Project.
Work Hours	'Work' is defined as any activity other than office bound duties, including the starting up of plant and machinery. Work for the Project would not be undertaken outside the hours of 7am or sunrise, whichever is the later, and 6pm or sunset, whichever is earlier. Work outside these hours requires prior consent.

Executive Summary

VicRoads, in partnership with New South Wales Roads and Maritime Services (Roads and Maritime), is undertaking planning activities for a second Murray River crossing at Echuca Moama. The second crossing, known as the 'Echuca-Moama Bridge Project' (the Project) would alleviate congestion on the existing bridge, provide an alternate access for traffic between the two towns and cater for road freight, including vehicles with Higher Mass Limits (HML) and High Productivity Freight Vehicles (HPFV).

On 14 June 2013, the Minister for Planning determined that an Environment Effects Statement (EES) would be required to assess the potential environmental effects of the Project within Victoria. As the Project extends into NSW, a Review of Environmental Factors (REF) would be required to assess impacts within New South Wales. This impact assessment has been prepared to inform the EES only and a separate report will be prepared to inform the REF.

As part of the EES options assessment, the Mid-West Option was determined to be the better performing option when considering a balance between environmental, social and economic considerations and was selected as the preferred alignment for detailed risk and impact assessment. The Mid-West Option utilises existing road reserves for part of its length, has the least impact on biodiversity and habitat values, cultural heritage values and satisfies the Project objectives. This report considers the biodiversity and habitat impacts of the Mid-West Option and supports its selection as the Preferred Alignment.

This Biodiversity Impact Assessment Report has been prepared in response to the EES Scoping Requirements for the Project. The assessment included review of previous investigations, consideration of the existing conditions, an options assessment, environmental risk assessment and impact assessment. It should be noted that Aquatic Flora and Fauna are addressed separately in the Aquatic Flora and Fauna report.

The Preferred Alignment would result in the removal of a total of 18.735 hectares of native vegetation (comprising 13.655 hectares in Victoria and 5.080 hectares in NSW) and a total of 14 scattered trees (comprising 7 scattered trees in Victoria and 7 scattered trees in NSW).

A total of 230 hollow bearing trees will require removal (comprising 221 hollow bearing trees in Victoria and 9 hollow bearing trees in NSW).

One threatened flora species — Pale Flax-lily plants (DELWP-listed) — will be impacted by the project (an unknown number of plants will be removed). One rare flora species — Blue Burr-daisy (DELWP-listed) — will be impacted by the project (two plants will be removed).

No ecological community will be impacted by the project.

Furthermore, the project is unlikely to have a significant impact on any threatened terrestrial fauna species.

Based on the analysis of calls recorded during the bat surveys, it was initially determined that the EPBC Act-listed South-eastern Long-eared Bat was present within the study area. However, a subsequent peer review of these findings found that the habitat present was not suitable and that the recorded calls could not be attributed to South-eastern Long-eared Bat — as such, this species was not likely to occur within the study area (Gration 2015).

Based on the initial findings in relation to South-eastern Long-eared Bat, a Referral under the *Environment Protection and Biodiversity Conservation Act 1999* was undertaken in respect of potential impacts upon this bat. Given the information provided, the Project was determined by the Commonwealth Department of Environment to be a 'controlled action' that would require assessment by Preliminary Documentation.

Preliminary Documentation is currently being prepared based on the current understanding that South-eastern Long-eared Bat is not likely to occur within the study area and therefore the project is highly unlikely to have a significant impact on this species.

1. Introduction

1.1 Project Overview

VicRoads, in partnership with New South Wales Roads and Maritime Services (Roads and Maritime), is undertaking planning activities for a second Murray River crossing at Echuca Moama. The Project, known as the Echuca-Moama Bridge Project would alleviate congestion on the existing bridge and provide an alternate access for residents and improved security of access for the local community, as well as catering for freight and agricultural machinery.

As part of the assessment and approvals processes, the Project was referred to the Victorian Minister for Planning for a decision on whether an assessment under the *Environment Effects Act 1978* was needed to determine the Project's potential for significant effects on the environment. On 14th June 2013, the Minister determined that an Environment Effects Statement (EES) was required.

This Biodiversity Impact Assessment has been prepared to inform the EES. The EES is required to consider the potential effects of the Project on the environment, inform the public and other stakeholders and enable a Ministerial Assessment of the Project to inform decision makers.

The EES for the Project has considered three alignment options. As part of the options assessment for the EES, the Mid-West Option was identified as the better performing option and this impact assessment has been prepared based on the Mid-West Option (the Preferred Alignment).

1.2 Purpose of this document

The purpose of this report is to document the existing conditions, the impacts on biodiversity and habitat and to outline the methodology, risks and proposed mitigation for the Project within Victoria.

2. Project Description

2.1 Project Background

Echuca and Moama are currently linked by a single road bridge across the Murray River with a single carriageway in either direction. The existing bridge was built in 1878 and originally operated as a combined road/rail bridge until 1989, whereby a separate rail bridge was constructed. The nearest alternative road crossings of the Murray River are at Barham, 86 km to the west, Barmah 36 km to the east, or Tocumwal 120 km to the east.

The existing road bridge and its approaches have inherent safety and operational limitations including its inability to carry over-width loads and higher mass limited vehicles used by an increasing proportion of the freight transport industry. Rehabilitation works to upgrade the operational capacity of the existing bridge would require lengthy road closures and would be further complicated by heritage considerations.

The existing bridge does not provide a suitable level of service for the increased volume of light vehicle traffic experienced during peak summer tourist events. Extensive delays are commonly experienced at these times which are easily exacerbated by any minor traffic incidents. This results in sizeable delays and in particular restricts the movement of emergency services vehicles from one town to the other.

Early investigations to provide for a second Murray River Crossing at Echuca-Moama commenced in 1965. Since then, VicRoads has undertaken extensive planning investigations including route options development and environmental impact assessments. Over the past 15 years, five corridors have been considered for an additional Murray River crossing. These investigations have included:

- An Environment Effects Statement (EES) / Environmental Impact Statement (EIS) study in 2000/2001 whereby a Western Corridor was approved by the Planning Panel;
- Preparation of an Environmental Report in 2010 for a Mid-West corridor (this process was superseded in late 2010 following a change in Government); and
- The current EES process which formally commenced in 2013.

As a result of the investigations completed and stakeholder consultation conducted, VicRoads has amassed significant knowledge of existing environmental, social and economic conditions and community values in the Echuca-Moama region.

2.2 The Project

The Project involves the construction and operation of a second road bridge crossing of the Murray and Campaspe Rivers at Echuca-Moama. The Project extends between Echuca (within Victoria) and Moama (in New South Wales) and is therefore subject to the provisions of the Victorian and New South Wales approvals processes. As part of the EES (within Victoria), the proposed alignment is assessed against a 'No Project' option, whereby it is assumed that the existing road conditions and networks remain unchanged and in NSW a Review of Environmental Factors (REF) is being prepared to consider the construction impacts of the Project.

The Project comprises a Right-of-Way sufficient to build a four lane road and duplicated bridges across both Rivers. The Project includes an elevated roadway and extensive bridging across the Campaspe River and Murray River floodplains, as well as changes to existing approach roads.

Construction of the Project will be staged to meet traffic demands and includes the Initial Alignment and an Ultimate Duplication. The Initial Alignment comprises two lanes (a single carriageway in either direction) and the Ultimate Duplication, which comprises the two lanes in both directions and duplicated bridges next to the bridges built during the Initial Alignment.

2.2.1 Project Objectives

The Project objectives are:

- To improve accessibility and connectivity for the community of Echuca-Moama and the wider region;
- To provide security of access with a second flood free crossing between Echuca and Moama;
- To enable cross border access for high productivity vehicles and oversized vehicles;
- To improve emergency services access between Echuca and Moama during emergency situations and major tourist and flood events;
- To provide road infrastructure that supports:
 - the state (Vic and NSW) and national economies through improved connectivity of goods and services; and
 - the local and regional economy of Echuca-Moama.

2.2.2 Preferred Alignment

VicRoads undertook an assessment of alignment options based upon the information from previous assessments and existing conditions in the area. The result was the selection of a Preferred Alignment option for consideration by specialists. The alignment, known as the "Mid-West"

Option was determined to be a better performing option when considering a balance between environmental, social and economic considerations. The Preferred Alignment is approximately 4.1km in length and utilises existing road infrastructure along part of Warren Street (Echuca-Cohuna Road), has the least amount of vegetation removal and least amount of raised road formation and bridging, impacting on the overall cost of the Project. Refer to the Echuca-Moama Project EES Main Report for more details on the assessment of the alignment options to support the selection of the Preferred Alignment.

The Preferred Alignment extends from the Murray Valley Highway along Warren Street before diverting to the northwest where it extends to the west of Victoria Park Oval. The Preferred Alignment then turns north-east to cross the Murray River before extending north to connect with the Cobb Highway (Figure 1).

More specifically, the Preferred Alignment comprises:

- A new roundabout at the intersection of the Murray Valley Highway;
- Upgrade works along Warren Street, including widening of the road pavement, shoulder sealing, upgrading flood relief structures, line marking and intersection upgrades at Homan Street and Redman Street;
- Construction of a new service road on the western side of Warren Street between Homan Street and Redman Street;
- Line marking for a dedicated right-turn lane for traffic turning into Homan Street;
- Construction of a new 'three-leg' roundabout approximately 120 m south of Campaspe Esplanade;
- Construction of a new road extending north-west from Warren Street and construction of a new bridge across the Campaspe River and Crofton Street;
- Construction of a new road extending north over part of the former Echuca College site and construction of a new road over a slab on the edge of an existing sand hill;
- A new road extending north-east over the western and northern tennis court Victoria Park and to the north of the Echuca Caravan Park;
- Construction of a new bridge over the Murray River near the existing boat ramp;
- Construction of an elevated road east of the Murray River to connect a realigned Meninya Street (the existing Cobb Highway) at a new signalised intersection; and
- Signalising of the intersections at Cobb Highway and Perricoota Road and Cobb Highway and Francis Street.

The main construction activities associated with the Project would comprise:

- Civil and structural works associated with the construction of new elevated roadway and bridges across the Murray River and the Campaspe River;
- Construction of earthworks and flood relief structures (including spill basins) for the new road across the Murray River and Campaspe River floodplains; and
- Improvements to existing roads and intersections on approaches in Victoria and New South Wales, including the construction of a large diameter roundabout at the Murray Valley Highway / Warren Street intersection and traffic signals with Meninya Street and Perricoota Road in Moama.



Figure 1: Project Alignment

2.3 Project Investigation Area

The Project Investigation Area, shown in Figure 2, is 'search region' encompassing a zone 10 kilometres in radius from all route options considered during project feasibility and design studies. This area was searched for existing flora and fauna information (records).

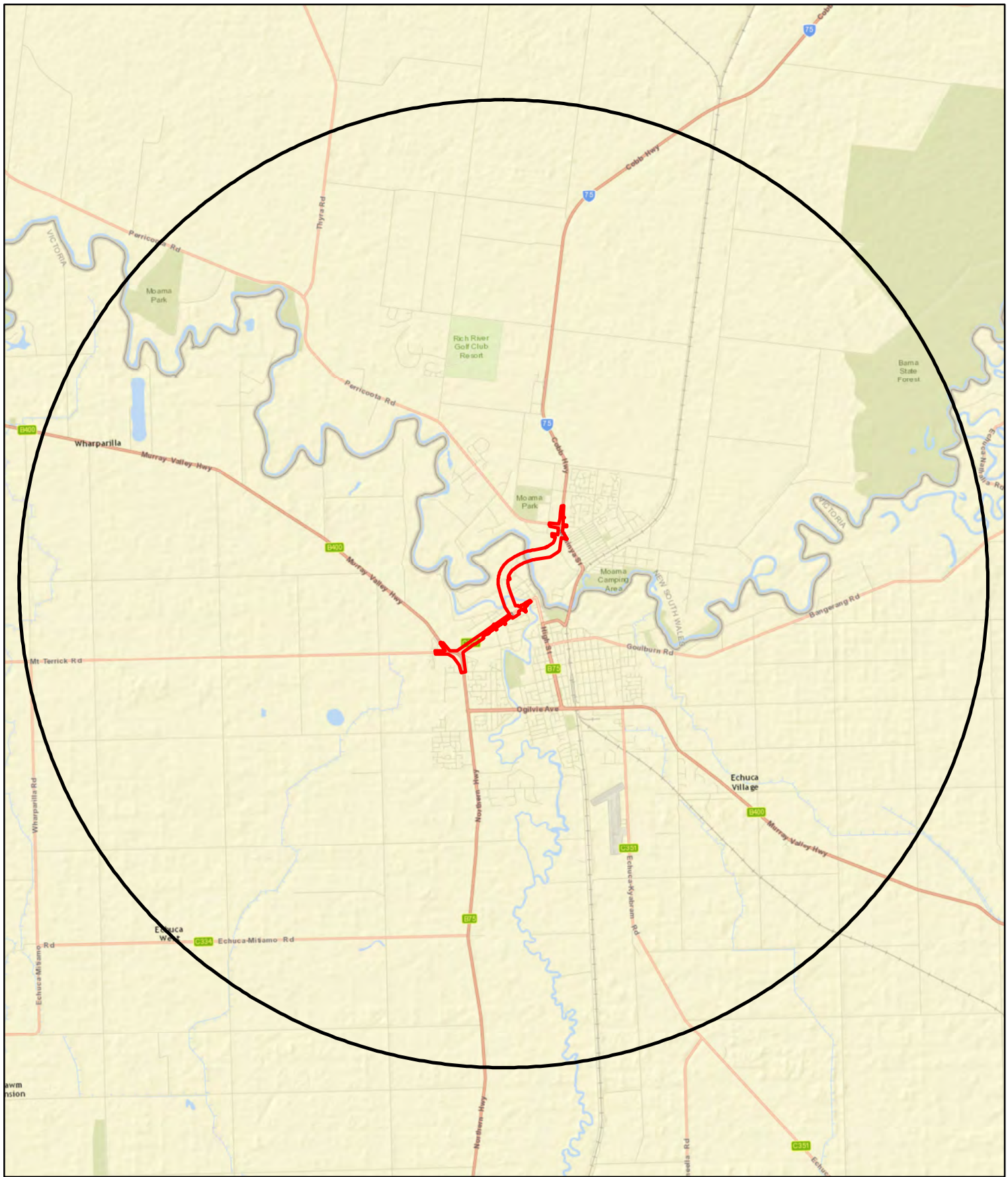
2.4 Study Area

The study area for the purposes of this biodiversity assessment, being the area subject to detailed field surveys and impact assessment, comprises the Right-of-Way as shown in Figure 3.

An additional investigation area, as shown in Figure 3, was also subject to detailed field surveys and impact assessment. This additional investigation area was assessed to provide context for the impact assessment given that many fauna species readily move over larger areas than just the Right-of-Way.

2.5 Construction Area

The Construction Area is the area defined for the Project that would be directly impacted by construction activities. It is located within the within the Right-of-Way. The Construction Area, as shown in Figure 12, is the area for which the extent of direct impacts was assumed when assessing native vegetation and habitat removal for the Mid-West Option.



Legend

- Study Area
- Project Investigation Area

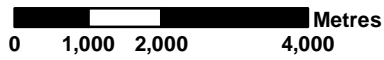


Figure 2: Project Investigation Area		
Project: Murray River Crossing Echuca		
Client: VicRoads		
Project No.: 8194	Date: 12/03/2015	Created By: A. Brennan / M. Ghasemi
Brett Lane & Associates Pty. Ltd. Ecological Research & Management		
<ul style="list-style-type: none"> Experience Knowledge Solutions 	Suite 5, 61 - 63 Camberwell Road Hawthorn East, VIC 3123 PO Box 337, Camberwell, VIC 3124, Australia	Ph (03) 9815 2111 / Fax (03) 9815 2688 enquiries@ecologicalresearch.com.au www.ecologicalresearch.com.au

3. Existing Conditions

3.1 Methodology

3.1.1 Existing Information

Existing information used for this investigation is described below.

Existing information has been obtained from a wider area, termed the 'search region' defined for this assessment as an area with radius ten kilometres from the approximate centre point of the Study Area of coordinates: latitude 36° 06' 47" S and longitude 144° 44' 36" E. This provided an indication of threatened species and communities that have the potential to occur in the Study Area and in the Construction Area. The following reports relating to the Study Area were also reviewed:

- Echuca Bridge Planning Study - Mid West 2 Option Aquatic Flora and Fauna Assessment (GHD 2012). GHD Melbourne.
- Second Murray River Crossing at Echuca-Moama, Detailed Flora and Fauna Assessment, Brett Lane and Associates (BL&A 2011);
- Mid-West 2 Murray River Crossing at Echuca-Moama, Matters of National Environmental Significance, Brett Lane and Associates (BL&A 2013a); and
- Mid-West 2 Murray River Crossing at Echuca-Moama, Detailed Flora, Fauna, Native Vegetation and Net Gain Assessment, Brett Lane and Associates (BL&A 2013b).

3.1.1.1 National level

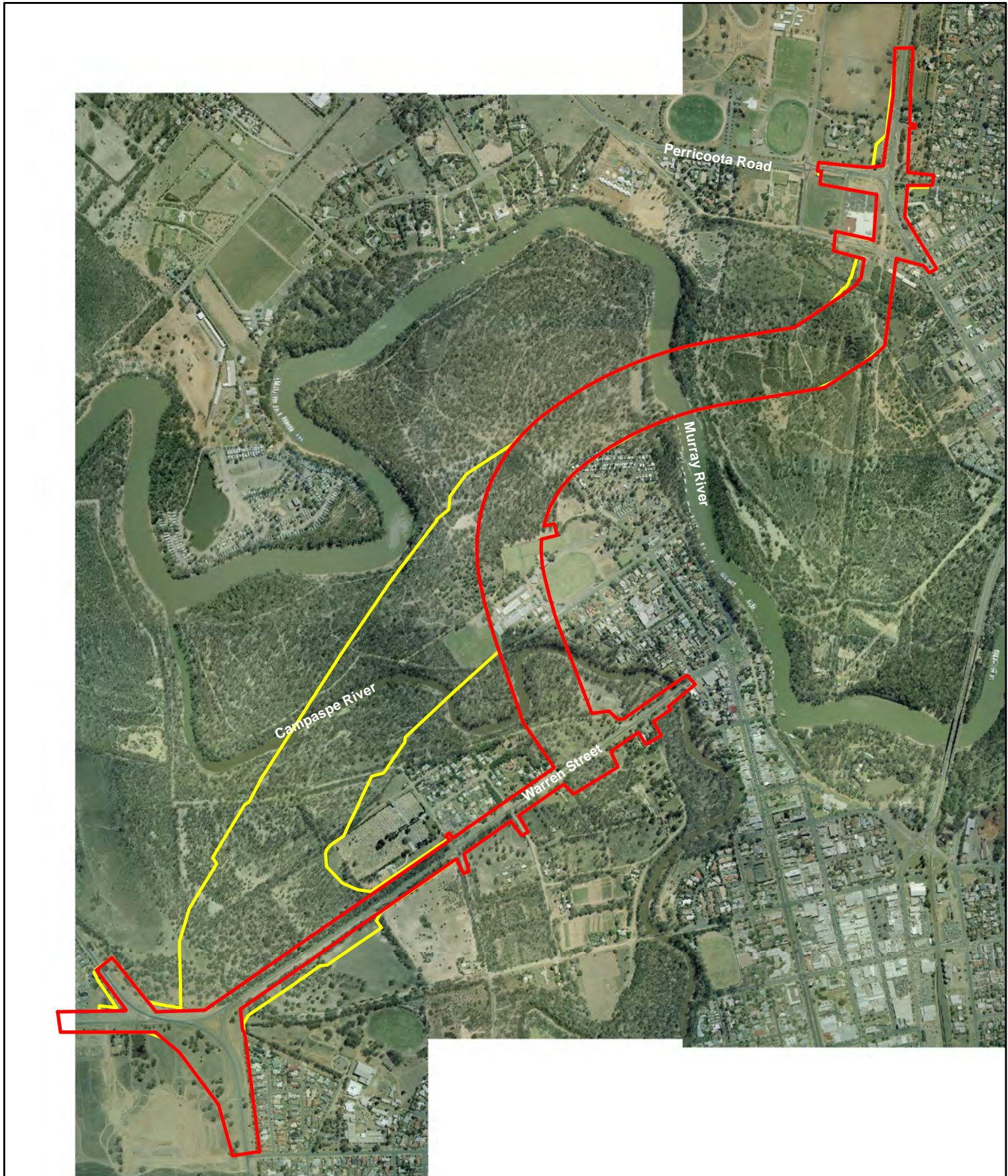
The likelihood of suitable habitat in the Study Area for nationally threatened ecological communities, flora and fauna species (including migratory species) was ascertained on the 6 August 2014 through a search of the online *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (DSEWPC 2012) using the search region defined above (see Appendix 10 in BL&A 2013b for the full list of species recorded in the search region).

3.1.1.2 State level — Victorian portion of the Study Area

3.1.1.2.1 Location and extent risk

The likely risk-based pathway for assessment of any proposed vegetation removal relies on the 'location risk' and 'extent risk' determined with the assistance of the online Native Vegetation Information Management system (NVIM) administered by the Department of Environment, Land, Water and Planning (DELWP 2014a).

NVIM online mapping was viewed to determine the mapped location risk of the Study Area and to gain a preliminary indication of the extent risk.



Legend

- Study Area
- Additional investigation area

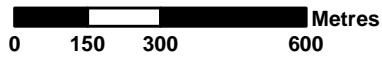


Figure 3: Study area and additional investigation area		
Project: Murray River Crossing Echuca		
Client: VicRoads		
Project No.: 8194	Date: 16/09/2014	Created By: J. Sullivan / M. Ghasemi
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;"> <p>BL&A Brett Laue & Associates Pty. Ltd. Ecological Research & Management</p> </div> <div style="font-size: 0.8em;"> <p>Experience Suite 5, 61 - 63 Camberwell Road Ph (03) 9815 2111 / Fax (03) 9815 2685</p> <p>Knowledge Hawthorn East, VIC 3123 enquiries@ecologicalresearch.com.au</p> <p>Solutions PO Box 337, Camberwell, VIC 3124, Australia www.ecologicalresearch.com.au</p> </div> <div style="text-align: right;"> </div> </div>		

3.1.1.2.2 *Native Vegetation*

Pre-1750 (pre-European settlement) vegetation mapping was reviewed to determine the type of native vegetation likely to occur in the Study Area. Ultimately, the impact assessment for native vegetation focussed on the Construction Area. Information on Ecological Vegetation Classes was obtained from published EVC benchmarks. These sources included:

- Relevant EVC benchmarks for the Victorian Riverina and Murray Fans bioregions¹ (DSE 2011a) viewed on the 22nd September 2011 and
- Biodiversity Interactive Maps (DSE 2011b) viewed on the 22nd September 2011.

3.1.1.2.3 *Flora*

A list of the flora species recorded in the Victorian section of the search region was obtained from the Viridans Flora Information System (FIS) on the 6th October 2011, a database administered by the then Department of Sustainability and Environment (DSE) (Viridans Biological Databases 2011a). This database search listed all plant species, including rare and threatened plants found in the Victorian search region (see Appendix 11 in BL&A 2013b for the full list of species recorded in the search region).

A follow-up database search for listed threatened flora species in the Victorian section of the search region was carried out using the Victorian Biodiversity Atlas (VBA) on the 1st December 2014 (see Appendix 10 of this report).

Plant taxonomy used throughout this report follows the FIS standards.

3.1.1.2.4 *Fauna*

A list of the fauna species recorded in the Victorian portion of the search region was obtained from the following sources:

- Atlas of Victorian Wildlife (AVW) on the 5th October 2011, a database administered by the then DSE (Viridans Biological Databases 2011b) (see Appendix 13 in BL&A 2013b for the full list of species recorded in the search region) — since been replaced by the database below;
- The Victorian Biodiversity Atlas (VBA) on the 1st December 2014 (see Appendix 10 of this report for a full list of listed threatened species recorded in the search region); and
- The New Atlas of Australian Birds viewed on the 22nd September 2011, administered by Birds Australia (see Appendix 15 in BL&A 2013b for the full list of species recorded in the search region).

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).

Fauna taxonomy used throughout this report follows the Victorian nomenclature. In particular, the common name for *Nyctophilus corbeni* adopted for this report is that used in the Commonwealth EPBC Act listing advice for the species: South-eastern Long-eared Bat.

3.1.1.2.5 *Listed threatened ecological communities*

The list of threatened ecological communities on the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) Threatened List (DEPI 2014a) was reviewed to ascertain whether any Victorian listed threatened ecological communities were likely to occur in the Study Area.

3.1.1.3 **State level — NSW portion of the Study Area**

3.1.1.3.1 *Native Vegetation*

Existing information regarding native vegetation types which occur in NSW within the Murray CMA was sourced from various databases incorporated in BioMetric 2.0, a tool that facilitates preparation of Property Vegetation Plans (PVPs) under the NSW *Native Vegetation Act 2003* (NV Act). This tool works alongside separate tools for assessing threatened species, soils, water quality, salinity and invasive native scrub.

3.1.1.3.2 *Flora*

A list of flora species recorded in the NSW section of the search region was obtained from the Atlas of New South Wales Wildlife (ANSWW) viewed on the 22nd November 2011, a database administered by the Office of Environment and Heritage (OEH). This database search listed all plant species, including rare and threatened plants found in the NSW search region (see Appendix 12 in BL&A 2013b for the full list of species recorded in the search region).

A follow up search of the ANSWW was carried out on the 6th August 2014 to determine the validity of the 2011 search (see Appendix 2 in BL&A 2014 for the full list of species recorded in the search region).

A search of the NSW DPI Noxious Weeds database was also undertaken for this assessment (see Appendix 9 for the full list of species in this database).

3.1.1.3.3 *Fauna*

A list of the fauna species recorded in the NSW portion of the search region was obtained from the following sources:

- ANSWW viewed on the 3rd November 2011, administered by the OEH (see Appendix 14 in BL&A 2013b), and then reviewed on the 6th August 2014 (see Appendix 4 in BL&A 2014 for the full list of species recorded in the search region);

- The New Atlas of Australian Birds viewed on the 22nd September 2011, administered by Birds Australia (see Appendix 15 in BL&A 2013b for the full list of species recorded in the search region); and

3.1.1.3.4 *Listed threatened ecological communities*

A list of endangered ecological communities recorded in the search region was obtained from the ANSWW on the 6th August 2014 (see Appendix 5 in BL&A 2014 for the full list of communities recorded in the search region).

3.1.2 Field methodology

The field assessment timing and methodology for all project assessments carried out by BL&A is presented in this section. It should be noted that field assessments carried out at the following times were conducted in the current Study Area:

- October 2008;
- January 2009; and
- July 2010.

Other field assessments carried out were conducted in the Mid-West 2 alignments envelope which shares a significant amount of common area with the current Study Area (Figure 3)

- September 2011;
- November 2011;
- February – March 2012; and
- October 2012.

Limitations of, and assumptions made during field assessments are detailed in Section 13.

3.1.2.1 *General methods*

The following field methods satisfied the various National, Victorian and NSW survey guidelines.

3.1.2.1.1 *Flora and Fauna Field Surveys*

An initial flora and fauna field assessment of the entire Study Area was conducted between the 13th and 15th October, 2008, followed by an additional botanical field assessment undertaken on the 21st and 22nd July 2010 to assess additional areas within an updated development layout.

A further detailed flora and fauna assessment was conducted within the Mid-West 2 alignment envelope between 26th and 30th September, 2011.

During all field assessments, the entire Study Area was inspected in detail on foot. Sites in the Study Area found to support native vegetation and/or habitat for rare or threatened flora and/or fauna were mapped. Mapping

was undertaken through a combination of aerial photograph interpretation and ground-truthing using a hand held GPS (accurate to approximately five metres).

3.1.2.2 Flora

Incidental records of flora species within vegetation types and landforms were made whilst conducting field work. Specimens requiring identification using laboratory techniques were collected by botanists of BL&A.

3.1.2.3 Native vegetation assessment

Native vegetation assessment was undertaken in accordance with the relevant state assessment guidelines. This is summarised below.

3.1.2.3.1 Native vegetation assessment in Victoria

Native vegetation was originally assessed against criteria set out in the prevailing native vegetation permitted clearing regulations – the Native Vegetation Management Framework (DNRE 2002), referred to herein as ‘the Framework’.

The native vegetation assessment guidelines set out under the Framework and associated practice notes categorised native vegetation into the following relevant categories:

- Remnant patch;
- Scattered trees;
- Degraded treeless vegetation;
- Artificial Substrate; or
- Modified Wetlands.

Under the current *Biodiversity Assessment Guidelines* (DEPI 2013a) (Guidelines) native vegetation is defined as either ‘remnant patch’ or ‘scattered tree’ only. The definitions of these categories under the Guidelines are provided below, along with the prescribed Department of Environment, Land, Water and Planning (DELWP) methods to assess them. Also provided below is a comparison of the current definitions under the Guidelines and former definitions under the Framework.

3.1.2.3.2 Remnant patch

A remnant patch of native vegetation is either:

- An area of native vegetation where at least 25 per cent of the total perennial understorey plant cover is native; and/or
- Any area with three or more native canopy trees² where the canopy foliage cover³ is at least 20 per cent of the area.

² A canopy tree is a reproductively mature tree that is greater than 3 metres in height and is normally found in the upper layer of the relevant vegetation type.

The Framework required the assessment of remnant patches using the *habitat hectare* assessment method (Parkes *et al.* 2003; DSE 2004), which remains unchanged under the Guidelines. Under the Framework, this definition did not refer to “perennial” plant cover. However, following a review of the previous site assessment results it is considered that this change would not affect the identification of remnant patches in the Study Area.

Under the habitat hectare method, components of native vegetation (e.g. tree canopy, understorey and ground cover) are assessed against an EVC benchmark. The score effectively measures the percentage resemblance of the vegetation to its original condition.

3.1.2.3.3 *Scattered trees*

The Guidelines define scattered trees as a native canopy tree² that does not form part of a remnant patch of native vegetation. The definition of a canopy tree remains substantially unchanged between the Framework and the Guidelines.

Scattered trees are counted, the species identified and their DBH (diameter at breast height or 1.3 metres above ground) measured or estimated.

3.1.2.3.4 *Flora species and habitats*

Records of flora species were made in conjunction with sampling methods used to undertake habitat hectare assessments of native vegetation, described above. Specimens requiring identification using laboratory techniques were collected.

The potential for habitats to support listed flora species was assessed based on the criteria outlined below:

- The presence of suitable habitat for flora species such as soil type, floristic associations and landscape context; and
- The level of disturbance of suitable habitats by anthropogenic disturbances and invasions by pest plants and animals.

3.1.3 **Native vegetation assessment in New South Wales**

Native vegetation in New South Wales is classified using three hierarchical levels:

- Formations – Broad classification of vegetation (e.g. Rainforest, Grassland, Grassy Woodland).

³ Foliage cover is the proportion of the ground that is shaded by vegetation foliage when lit from directly above.

- Classes – Detailed classification of vegetation based on geographical range and indicative species (e.g. Northern Warm Temperate Rainforest, Western Slopes Grassland, New England Grassy Woodlands).
- Types – Further classification of vegetation classes based on the dominant canopy species, characteristic mid- and understorey species and landscape position (e.g. Norton's Box - Red Box - White Box grassy open forest of the southern section of the NSW South Western Slopes Bioregion).

Vegetation formations and classes are outlined in Keith (2006). Information on vegetation types was sourced from the BioMetric Vegetation Type tool.

During the site inspection, existing vegetation was classified to type and mapped (using aerial photograph interpretation and ground-truthing) within the Study Area as per the criteria outlined in the Environmental Outcomes Assessment Methodology (DNR 2005).

According to the NV Act, native vegetation in New South Wales is classified as follows:

- Remnant vegetation is any vegetation that is not regrowth.
- Regrowth is all native vegetation that has regrown since January 1st 1990. However, regrowth does not include native vegetation that has grown following:
 - Unlawful clearing of remnant native vegetation; or
 - Clearing of remnant native vegetation caused by natural events such as bushfires, floods and droughts (NSW Government 2005).

3.1.3.1 Hollow-bearing tree survey

OEH guidelines require hollow-bearing tree surveying and mapping for any development proposal in NSW, as the loss of hollow-bearing trees is a key threatening process under the *Threatened Species Conservation Act 1995* (TSC Act). A systematic search was conducted on the 17th October 2012 for hollow-bearing trees in the NSW portion of the Study Area, along transects spaced approximately 15 metres apart. All identified hollow-bearing trees were mapped using a hand-held GPS unit (accuracy approximately +/- 5 metres), and the number, nature and size of the hollows was recorded.

3.1.4 Listed threatened ecological communities

The presence of listed threatened ecological communities in the Study Area was assessed against the relevant National and State qualifying criterion during the flora and fauna field surveys.

3.1.5 Fauna

The techniques below were used to detect fauna species inhabiting the Study Area

3.1.5.1 *Direct search and initial assessment*

This included traversing the Study Area during the day searching for and recording fauna species. This approach included the following:

- Bird observation during the day;
- The diurnal bird surveys concentrated on detecting or finding threatened species with emphasis on birds such as the Brown Treecreeper and the Bush Stone-Curlew;
- Incidental searches 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;
- General searches for reptiles and frogs; including identification of frog calls in seasonally wet areas;
- General searches for bat habitat including water bodies and potential roosting sites such as dead trees with hollows and underneath bark of trees;
- Inspection of hollows and canopies of River Red-gums using binoculars for signs of active nesting or occupation by arboreal mammals.

3.1.5.2 *Spotlighting*

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;

Further spotlighting was undertaken on the evenings of the 26th and the 27th September 2011 in the following areas;

- Within the River Red-gum forest, close to the Murray River in the NSW section of the Study Area corridor. A total of four person hours was spent spotlighting;
- Within the Black Box forest between Warren Street and the Campaspe River in Victoria. A total of four person hours was spent spotlighting.

Spotlighting was mainly targeted at finding nocturnal arboreal mammals likely to be present in the Study Area with particular emphasis on Squirrel Glider.

3.1.5.3 *Call playback*

Call playback for owls was undertaken on the 14th October 2008 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 periods.

Call playback for the Bush Stone-Curlew was undertaken on the evenings of the 26th and the 27th September 2011 in the two patches of woodland where spotlighting took place (described above). The call of the curlew was played several times, interspersed with listening periods.

Call playback for the Growling Grass Frog was undertaken during the October 2008 surveys at a billabong in River Red-gum woodland on the Moama side of the Study Area. Further call playback for the Growling Grass Frog was undertaken at three sites during the September 2011 surveys. The first site was at a billabong in River Red-gum woodland on the NSW side of the Study Area. The second site was at a small well vegetated wetland (large dam) located south of the Warren Street - Murray Valley Highway intersection within the Victorian side of the investigation corridor. The third site was at a billabong along the Campaspe River within the investigation corridor in Victoria.

Call playback was not undertaken for the threatened owls during the September 2011 surveys, as the time of the initial investigation was not appropriate for owls and might cause disruption of their breeding activities. This was delayed until November, after the most sensitive period of the breeding season had passed.

3.1.5.4 Trapping

Two types of mammal traps were employed from the 26th to 30th September 2011 as part of the initial survey work; Elliot traps and Hair Tube traps. Trapping was carried out mainly within the NSW section and as follows:

- A line of ten hair tubes placed at ten metre intervals within the River Red-gum woodland in NSW, mostly placed on the main tree trunks.
- A line of ten small Elliot traps placed at ten metre intervals within a small regrowth section of River red-gum in NSW close to the above hair tubes site;
- A line of ten large Elliot traps placed at ten metre intervals at another section of the River Red-gum woodland in NSW;
- Another line of five hair tubes placed on tree trunks close to the large Elliot traps in NSW;
- And finally a line of ten hair tubes placed on both tree trunks and ground within a mixed River Red-gum and Black Box woodland at a private property within the Victorian section of the investigation corridor.

3.1.5.5 *Habitat assessment*

Fauna habitat types were characterised in the Study Area. The quality of fauna habitat was assessed based on the criteria detailed below. These are based on habitat components which include old-growth trees, fallen timber, leaf litter, surface rocks. Three quality categories were used, as described below:

High: The majority of fauna habitat components are present and habitat linkages to other remnant ecosystems in the landscape are intact.

Moderate:

- The majority of fauna habitat components are present but habitat linkages to other remnant ecosystems in the landscape are absent; or
- The majority of habitat components are absent but habitat linkages to other remnant ecosystems in the landscape are intact.

Low: The majority of fauna habitat components are absent and habitat linkages to other remnant ecosystems in the landscape are absent.

3.1.6 Targeted Flora and Fauna Surveys

3.1.6.1 *Flora surveys*

Targeted surveying for threatened flora species was undertaken in the current Study Area between the 6th and 8th January 2009, for a total of 32 person hours. During this survey, areas identified to support suitable habitat for the targeted 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. Targeted species were:

- Chariot Wheels;
- River Swamp Wallaby-grass;
- Silky Swainson-pea;
- Slender Darling-pea;
- Small Scurf-pea; and
- Western Water-starwort.

Further targeted flora surveying was undertaken over three days from 21st to 23rd November 2011 in the Mid-West 2 alignments envelope. During the targeted flora assessment, areas of suitable habitat identified in the initial survey were walked by two botanists along transects spaced 5 metres apart throughout the entire Study Area. This methodology was applied in both the Victorian and NSW portions of the Study Area.

The November 2011 targeted flora survey was undertaken for the species that were initially considered likely to occur due to presence of suitable habitat and included the following:

- Hairy tails;
- River Swamp Wallaby-grass;
- Slender Darling-pea;
- Small Scurf-pea; and
- Western Water Starwort.

3.1.6.2 Fauna surveys

A large amount of additional targeted fauna surveying work was undertaken between 2009 and 2012. Threatened species that could potentially be impacted by the proposed development and that were considered likely to occur due to the presence of suitable habitat were targeted to gain more information on whether they utilise the Study Area or otherwise. Details of each of the targeted survey methods are provided below and locations of surveys are presented in **Figure 4**. Targeted fauna surveys comprised:

- Within current Study Area:
 - Spotlighting and call playback for Bush Stone-curlew and Squirrel Glider and Diurnal search for Bush Stone-curlew: 06/01/2009 to 08/01/2009 (uncertain which state survey was carried out in, though probably both)
- Within Mid-West 2 alignment corridors envelope:
 - Hair tube trapping for Squirrel Glider: 08/11/2011 to 22/11/2011 (Victoria and NSW);
 - Spotlighting and call playback for Bush Stone-curlew, Squirrel Glider and Barking Owl: 08/11/2011 to 17/11/2011 (Victoria and NSW);
 - First bat survey: 08/11/2011 to 22/11/2011 (Victoria and NSW);
 - Second bat survey: 24/02/2012 to 14/03/2012 (Victoria and NSW);
 - Growling Grass Frog survey: 17/10/2012 to 18/10/2012 (Victoria and NSW);
 - Arboreal cage trapping for Squirrel Glider: 15/10/2012 to 18/10/2012 (NSW only); and
 - Hollow-bearing tree survey, particularly for potential Squirrel Glider habitat: 17/10/2012 (NSW only).

Note that all targeted survey work was undertaken at the appropriate time of year for the relevant species. Surveying was undertaken under the following permits:

- Victorian Department of Sustainability and Environment: Wildlife Act 1975 and Flora and Fauna Guarantee Act 1988 – Research

Permit/Permit to take Protected Flora – Permit No. 10004726, File No. FF383118.

- New South Wales National Park and Wildlife Service: National Parks & Wildlife Act 1974, Section 132c – Scientific Licence – Document No. SL100136.

3.1.6.2.1 *Hair tube trapping survey*

Hair tube trapping was used to investigate, in more detail than previously used in the initial fauna survey (see above), the presence and use of the Study Area by Squirrel Glider. Hair tube trapping was carried out in November 2011 in both the Victorian and NSW sections of the Study Area, at a higher survey effort than employed during the initial field survey. For this purpose, hair tubes were used and set up on trees targeting arboreal mammals.

Hair tube traps were set up along six different transects as part of the additional targeted surveying. The central point of each of the 50 metre transects is shown in Figure 4. Please note that transects 3, 4 and 5 were set up outside of the current Study Area, in the Mid-West 2 alignments corridor.

Transects were set up in the following habitats:

- Transect 1 (T1): A line of ten hair tubes within River red-gum forest in the NSW section of the Study Area;
- Transect 2 (T2): A line of ten hair tubes in similar Red River-gum forest in NSW comprising larger and older trees;
- Transect 3 (T3): A line of ten hair tubes in the Black Box woodland in the southern section of the Victorian part of the Study Area;
- Transect 4 (T4): A line of ten hair tubes in another section of the Black Box woodland in Victoria.
- Transect 5 (T5): A line of ten hair tubes in River Red-gum dominated forest in the Victorian section of the Study Area;
- Transect 6 (T6): A line of 14 hair tubes in mixed River red-gum and Black box woodland in the northern part of the Victorian section of the Study Area.

Hair tube traps were set up on the trunks of trees spaced at five metre intervals and were located at least 1.5 metres above ground.

Hair tube traps were collected, and hair harvested during the survey was analysed by Hans Brunner, an internationally recognised expert on mammalian hair analysis.

3.1.6.2.2 *Call playback and night spotlighting*

3.1.6.2.2.1 Within the current Study Area

Detailed targeted surveys for Bush Stone–Curlew and Squirrel Glider were undertaken in early January 2009, as follows:

- 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 suitable habitat 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.

3.1.6.2.2.2 Within Mid-West 2 alignment corridors envelope

Detailed targeted surveys of the Bush Stone–Curlew and Barking Owl were undertaken on five different nights at five selected sites within the Study Area. The surveys were carried out between the 8th and 17th November, 2011. At each of the five survey nights, the threatened species were surveyed consecutively starting with the Bush Stone–Curlew and followed by Barking Owl. Surveys were undertaken following both DELWP (DSE 2010) and OEH (DEC 2004) Guidelines, except for the Bush Stone–Curlew for which such guidelines were not available. Survey methods used for the Plains Wanderer were adopted for this species. Spotlighting was also undertaken for Squirrel Glider.

Surveys were conducted from dusk to midnight during mild to warm weather conditions (DSE 2009). Under these conditions, threatened species were more likely to be active, making detection easier. All animals observed during the survey were identified and recorded. Methods followed in each of the surveys are outlined below.

3.1.6.2.2.3 Bush Stone–Curlew

On first arrival at each survey location the call of the Bush Stone–Curlew was played through a megaphone in an effort to elicit the response of this species. Following the ten minute call playback and listening time, each

survey location was systematically searched for the species using transects.

The surveyor walked the length of each transect, situated 40 metres apart with a search area of 10 metres either side of the transect line. Transect length depended on the size of native vegetation patch. Each transect was searched for Bush Stone-Curlew using a hand-held spotlight and binoculars.

3.1.6.2.2.4 Barking Owl

Consistent with both DELWP and OEH guidelines, the following steps were followed during the Barking Owl surveys:

- 5 minutes initial passive listening,
- 20 seconds call playback,
- 30 seconds silent listening for elicited response,
- 1 minute call-playback in different direction,
- 30 seconds listening for elicited response,
- 1 minute call-playback in different direction,
- 12 minutes silent listening.
- After call playback, a 30-minute spotlighting session was conducted within 200 metres to check trees for any owls while listening for a distant response.
- Spotlighting concentrated on large hollow-bearing trees that may also support tree-dwelling mammals, such as possums and gliders.
- A hand-held spotlight with powerful beam was used.

In addition to above, active diurnal searches were also made to locate evidence of whitewash or regurgitated pellets to determine owl presence in the Study Area and evaluation of the presence and abundance of suitable hollows that might provide suitable nesting habitat for the owls.

3.1.6.2.2.5 Squirrel Glider

Representative transects were searched for Squirrel Glider after dusk using spotlights. Transects were spaced at 50 metres apart through likely habitat, conducted for 30 minutes.

3.1.6.2.3 Bat surveys

Please note that both bat surveys were undertaken within the Mid-West 2 alignments envelope, some of which is common with the current Study Area.

Bats were surveyed using electronic detectors to record the ultrasonic echolocation calls of bats. Detectors offer several major advantages over trapping or other means of detection; they are non-invasive, can add significantly to the number of species detected at a particular site, allow detection of species not readily captured, and in many cases, do not need

to be attended constantly. In Australia, the Anabat system (Titley Electronics) is the most widely used system. Anabat detectors are especially well suited for unattended detector surveys, with several options available for storing recorded calls.

3.1.6.2.3.1 Automated Anabat Systems

Automated Anabat® (Titley Electronics, Ballina, NSW) bat detectors that record the species-specific echolocation calls of free-flying bats are used at a series of sampling points that are representative of the habitats in the proposed Study Area. The detectors are programmed to commence operation approximately 30 minutes before dusk, and to cease approximately 30 minutes after dawn.

Calls from the units are downloaded and sent to Dr. Greg Richards (Greg Richards and Associates Pty Ltd, Canberra), for identification.

Call identification is based on a key developed by comparing the characteristics of bat search calls within reference calls from known species recorded across Victoria. Identification is largely based on changes to frequency patterns over time, especially as the characteristic frequency changes. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific. However, not all species can be consistently or reliably identified. There is a large overlap in the call characteristics of some Victorian species and many calls are attributable only to species “complexes” and not to single species.

A significant limitation in the use of this technique is that it is not possible to census bats accurately. That is, the Anabat unit may record 10 calls of a particular species but it is not known if this represents 10 individuals or one individual flying past 10 times. Therefore, it is not possible to determine utilisation rates as it is for birds.

3.1.6.2.3.2 Sites and times of recording

Two bat surveys were undertaken within the Study Area, the first during November 2011 and the second survey across February and March 2012. Eight sites were selected for bat recordings and the same sites were used for both surveys. Sites were selected to reflect the various habitats existing in the Study Area.

3.1.6.2.3.3 First Bat Survey

During the first bat survey, Anabat recording was left for seven nights in the field for each of the sites. The first four sites were recorded between the 8th and 15th; and the second four sites between the 15th and the 22nd November, 2011.

The locations of the recording sites are shown Figure 4. Anabat recorders were located in the following habitats:

- Within the Mid-West 2 alignments envelope only (outside current Study Area):
 - Site 1 (B1): The Anabat recorder was set up in Black Box Woodland in the southern part of the Victorian section of the Study Area.
 - Site 2 (B2): Set up in a patch of old and mature River Red-gum adjacent to a small billabong, in the central part of the Victorian section.
 - Site 3 (B3): Set up on the banks of the Campaspe River among tall River Red-gum, in Victoria.
 - Site 4 (B4): Set up on a small sand hill among indigenous Murray Pines, in Victoria.
- Within the current Study Area:
 - Site 5 (B5): Set up among mixed Black box and River Red-gum in the northern part of the Victorian section.
 - Site 6 (B8): Set up among River Red-gum forest in the NSW section.
 - Site 7 (B7): Set up on the banks of the Murray River among large and tall River Red-gum trees, on the NSW side.
 - Site 8 (B6): Set up among River Red-gum forest in another section of the NSW part of the Study Area.

3.1.6.2.3.4 Second Bat Survey

Following the results of the initial bat survey, it was decided a second bat survey would be undertaken to provide further information of the abundance of particular species. During the second bat survey; the same eight sites were used to record bats as were used in the first survey (described above). Recording during the second survey was carried out between 24th February and 4th March, 2012 for the first four sites, and between 5th and 14th March, 2012 for the second four sites. Unlike the first survey, the Anabat recorders were left for ten nights in the field at each of the recording sites.

This extended survey period was recommended by Dr. Greg Richards (Greg Richards and Associates Pty Ltd, Canberra) as to provide additional information on the presence and abundance of threatened bat species.

3.1.6.2.4 *Growling Grass Frog targeted survey*

A brief call playback survey for Growling Grass Frog was undertaken in the current Study Area early January 2009, at a billabong in River Red-gum woodland in the NSW portion of the Study Area.

A follow up, more detailed, Growling Grass Frog (GGF) survey was carried out in October 2012, in accordance with the Federal guidelines (DEWHA 2010), which are also consistent with DELWP and OEH guidelines.

The survey was undertaken on two consecutive nights: 17th and 18th October 2012. Prior to commencing surveying, wetlands with potential to support GGF were examined to identify suitable survey locations. Two sites were selected in the NSW portion of the Study Area (i.e. current Study Area, see Figures 1, 2 and 4), as the only potential habitat in the Victorian portion was dry, and therefore not suitable for GGF detection. The sites were selected based on their likelihood for supporting GGF.

The surveys were conducted at night during warm weather conditions where temperatures were not lower than 14°C with moderate to no wind. Under these conditions, frogs are more likely to be calling and active, making detection easier. For each survey, weather conditions were recorded throughout the survey, including ambient temperature, wind strength and cloud cover / presence absence of precipitation.

Two survey methods were employed: call playback and active searches.

On first arrival at a site, 15 minutes was spent listening for frog calls and all frog species heard calling were noted. After the first five minutes, the call of the Growling Grass Frog was played through a megaphone in an effort to elicit the response of this species.

Following the 15 minute frog call playback and listening time, each site was systematically searched for frogs with a spotlight for 30 minutes. This involved visual inspection of the water body, call recognition and limited active searching (including turning surface debris). All frog species seen or heard during the search time were recorded.

In addition to Federal guidelines, the OEH guidelines require Growling Grass Frog tadpole surveying be carried out in conjunction with call playback and visual searches.

Tadpole surveying was carried out in suitable aquatic habitat in accordance with OEH's survey and assessment guidelines for threatened amphibians (DECC 2009). The specific method applied was dip-netting adjacent to the vegetated margins of suitable wetlands at various depths

in the water column. Dip-netting was carried out both night and day on two consecutive days; the 17th and 18th October 2012.

3.1.6.3 Arboreal cage trapping for Squirrel Glider

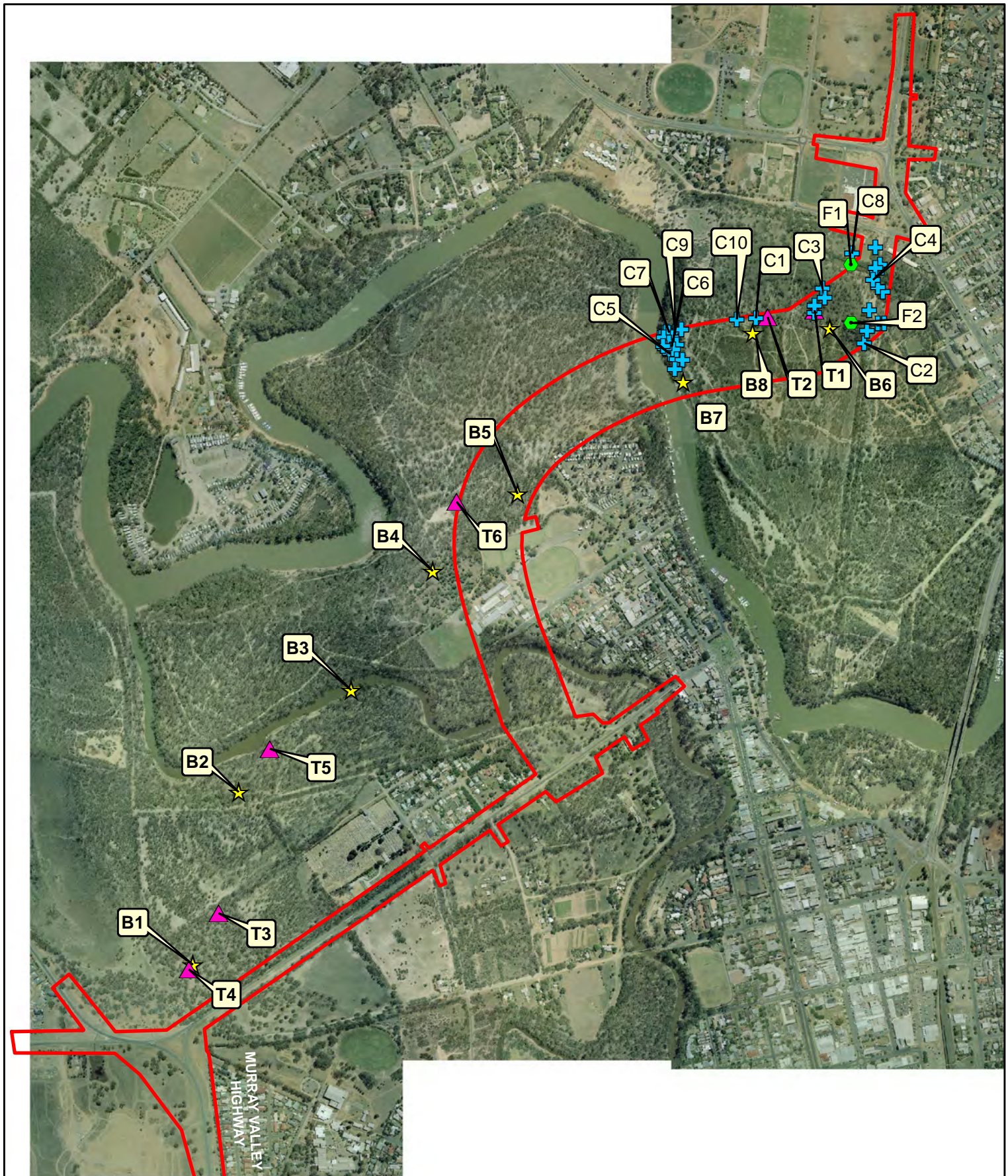
Arboreal cage trapping for Squirrel Glider was recommended by Envirokey (2012) as a more suitable method of trapping the species than the large 'Elliot' traps and hair tube traps previously employed (see above). OEH guidelines for survey effort using cage traps requires a minimum of 24 trap-nights over three to four consecutive nights per 50 hectares of suitable habitat (DEC 2004).

Arboreal cage trapping was conducted on four consecutive nights between the 15th and 18th October 2012, using ten standard cage traps in the NSW section of the Study Area (i.e. in the current Study Area, see C1- C10 in Figure 4: Targeted Fauna Survey Locations). This equated to a survey effort of 40 trap-nights. Each cage trap was affixed to a suitable Squirrel Glider habitat tree at a height of between two to three metres from the ground, with the trap entrances easily accessible from either the tree trunk or a branch.

The suitability of trees chosen for the traps was based on the following criteria:

- Preference for trees with suitable hollows and evidence of sap feeding sites; and
- Preference for habitat supporting Acacia species in the understorey.

Additional trapping surveys for Squirrel Gliders were undertaken by the Australian Research Centre for Urban Ecology (ARCUE) between the 16th and 27th of March 2015 using wire cage traps (Wiretainers, 20 cm x 20 cm x 50 cm) set on the trunks of trees at approximately 3–5 m above the ground. Fifteen sites spread across the NSW and Victorian sides of the Murray River were selected for Squirrel Glider surveys. Nine sites were located within and immediately adjacent to the Preferred Alignment with the remaining six sites distributed more broadly along the Murray River, but within 5 km of the Preferred Alignment. This additional survey involved 1,068 trap nights (van der Ree et al. 2015).



Legend

- Study area
- ★ Anabat locations (Bat Survey Sites)
- ▲ Mammal trapping locations (Hair Tubes)
- + Mammal trapping locations (Aerial Cage Traps)
- ◆ Growling Grass Frog Survey Sites



Figure 4: Targeted fauna survey locations

Project: Murray River Crossing Echuca

Client: VicRoads

Project No.: 8194

Date: 16/09/2014

Created By: J. Sullivan / M. Ghasemi



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3.2 Study Area characteristics

3.2.1 Site description

3.2.1.1 Study Area

The Study Area encompasses the Mid-West 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 2). 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, the former Echuca 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 Rivers. 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 the former Echuca 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 Victorian section of the Study Area falls within the North Central Catchment Management Authority region and occurs across the boundary of the Victorian Riverina and Murray Fans bioregions. Based on interpretation of DELWP's online biodiversity mapping, the Campaspe River has been used as the boundary between the two bioregions, with the Victorian Riverina occurring to the south and the Murray Fans occurring to the north of the Campaspe River.

The New South Wales section of the Study Area falls within the Murray CMA and the Murray Fans CMA sub-region in the Riverina bioregion. The NSW section of the Study Area occurs across two Mitchell Landscapes; the Murray Scalded Plains and the Murray Channels and Floodplains. The Local Government Area in the NSW section of the Study Area is the Murray Shire Council.

3.2.1.2 Wildlife Habitat Connectivity

Terrestrial wildlife habitat in the Study Area has been reduced to a series of woodland remnants associated with the Murray and Campaspe Rivers. For less mobile species, the current state of the riparian corridor is effectively fragmented, with either cleared land or waterways representing barriers to movement.

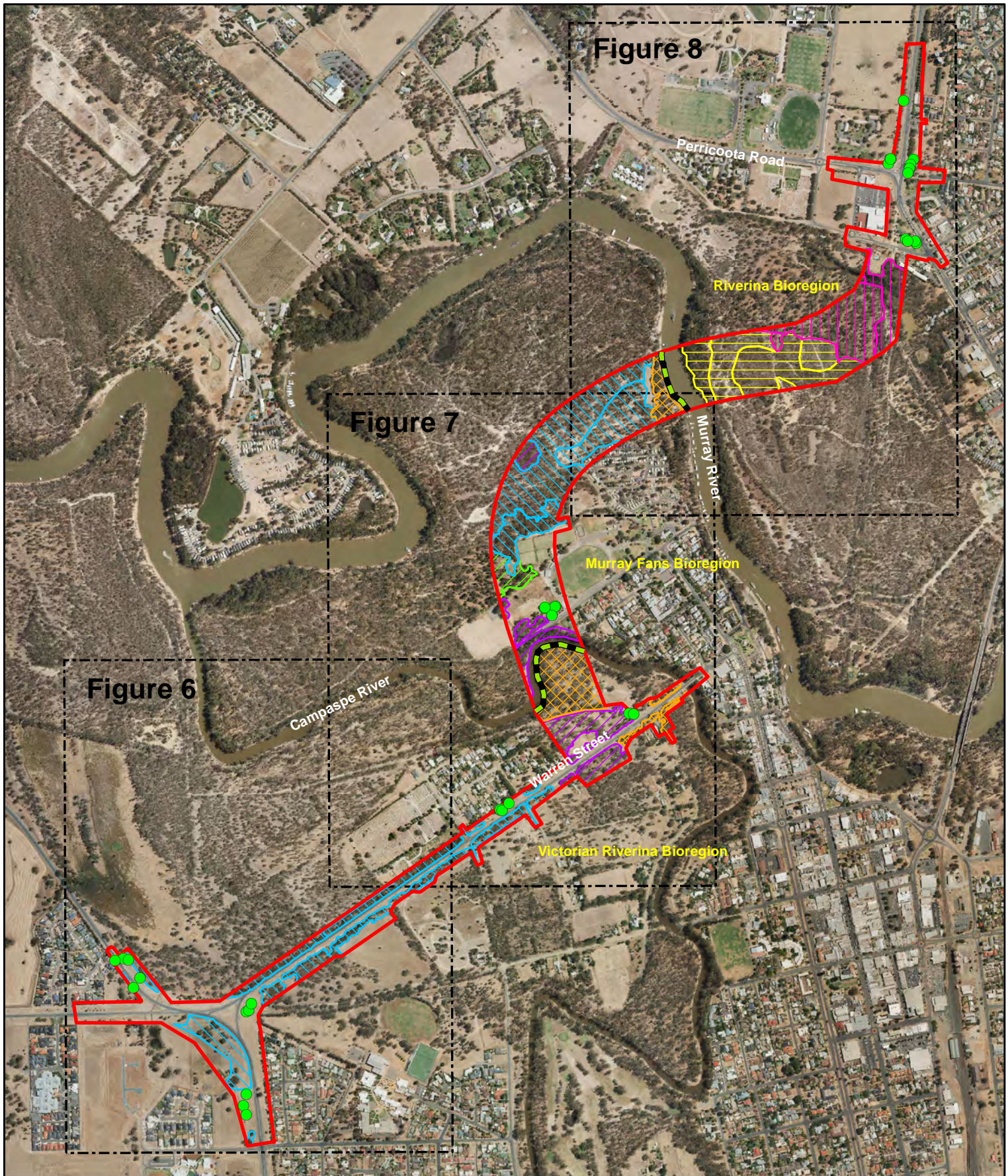
Notwithstanding its effectively fragmented condition, the Murray River vegetation corridor remains an important linking habitat between Barmah National Park and the Gunbower State Forest – Perricoota State Forest block, as well as with other significant habitat areas further afield.

3.3 Vegetation assessment

3.3.1 Native Vegetation

Native vegetation within the Study Area has been determined based on the relevant state level definitions for Victoria and New South Wales. The results of the native vegetation assessment have been provided separately for Victoria and New South Wales in the sub-sections below. For the purpose of this assessment, a unique Vegetation Site identification number has been given to each patch of vegetation across the entire Study Area.





The native vegetation recorded within the Study Area is presented in Figure 5 and in more detail in Figures 6 to 8. This vegetation is a sub-set of a more extensive area of floodplain vegetation on the Murray and Campaspe River floodplains between the existing Murray River crossing in the east and the northern end of Whaparilla Drive to the west.





Legend




Native Vegetation

Victoria

-  Grassy Riverine Forest (EVC 106)
-  Riverine Chenopod Woodland (EVC 103)
-  Riverine Grassy Woodland (EVC 295)
-  Semi-arid Woodland (EVC 97)

New South Wales

-  River Red Gum - herbaceous tall open forest
-  River Red Gum - Black Box woodland

-  Study Area
-  Bioregion Boundaries
-  Scattered trees

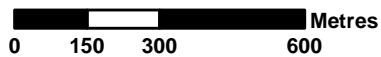


Figure 5: Study area and native vegetation - Overview

Project: Murray River Crossing Echuca

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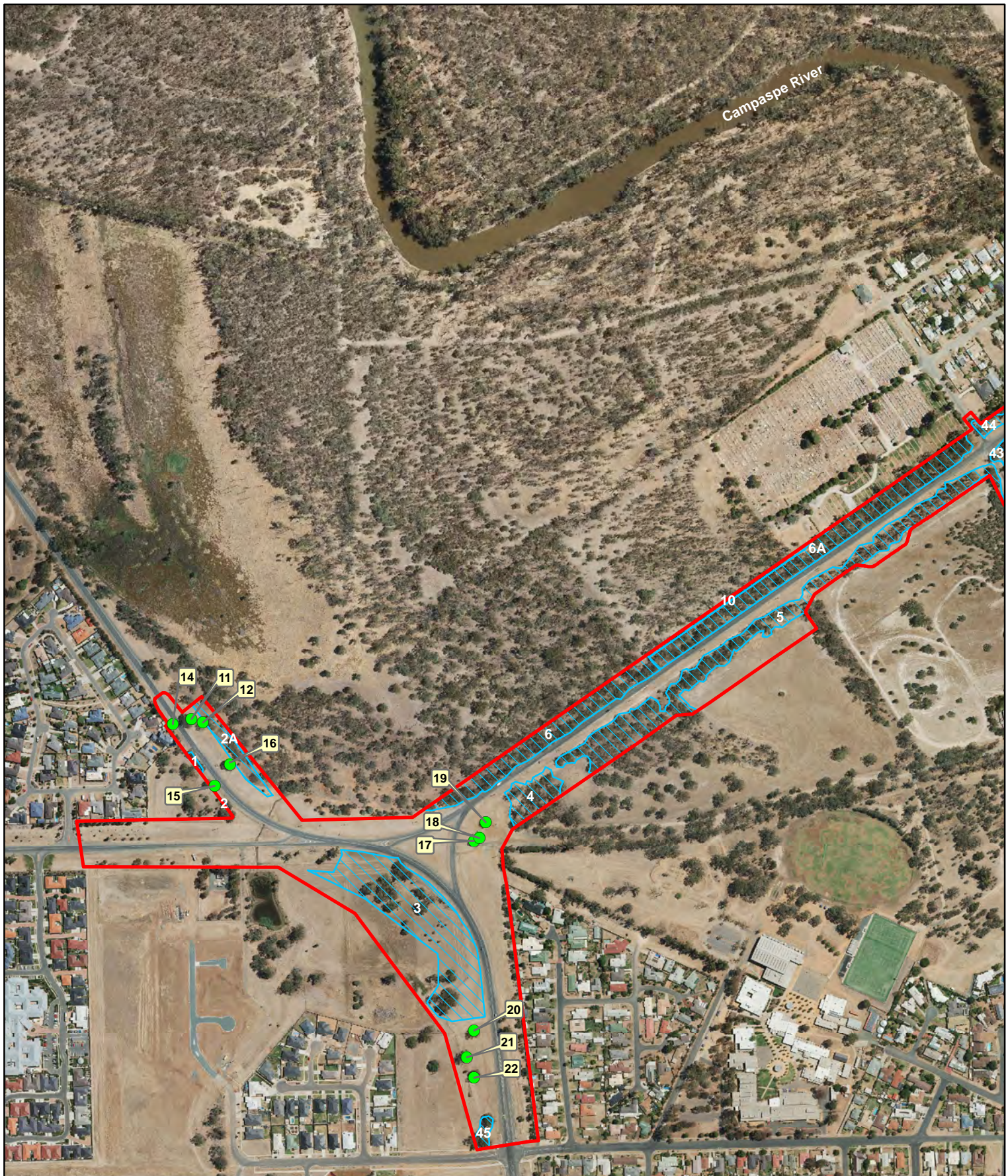
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Created By: J. Sullivan / M. Ghasemi

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Legend


Native Vegetation

Victoria

-  Grassy Riverine Forest (EVC 106)
-  Riverine Chenopod Woodland (EVC 103)
-  Riverine Grassy Woodland (EVC 295)
-  Semi-arid Woodland (EVC 97)

New South Wales

-  River Red Gum - herbaceous tall open forest
-  River Red Gum - Black Box woodland

 Study Area

 Scattered trees

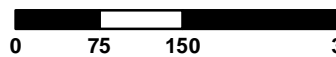
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Figure 6: Study area and native vegetation - Detailed

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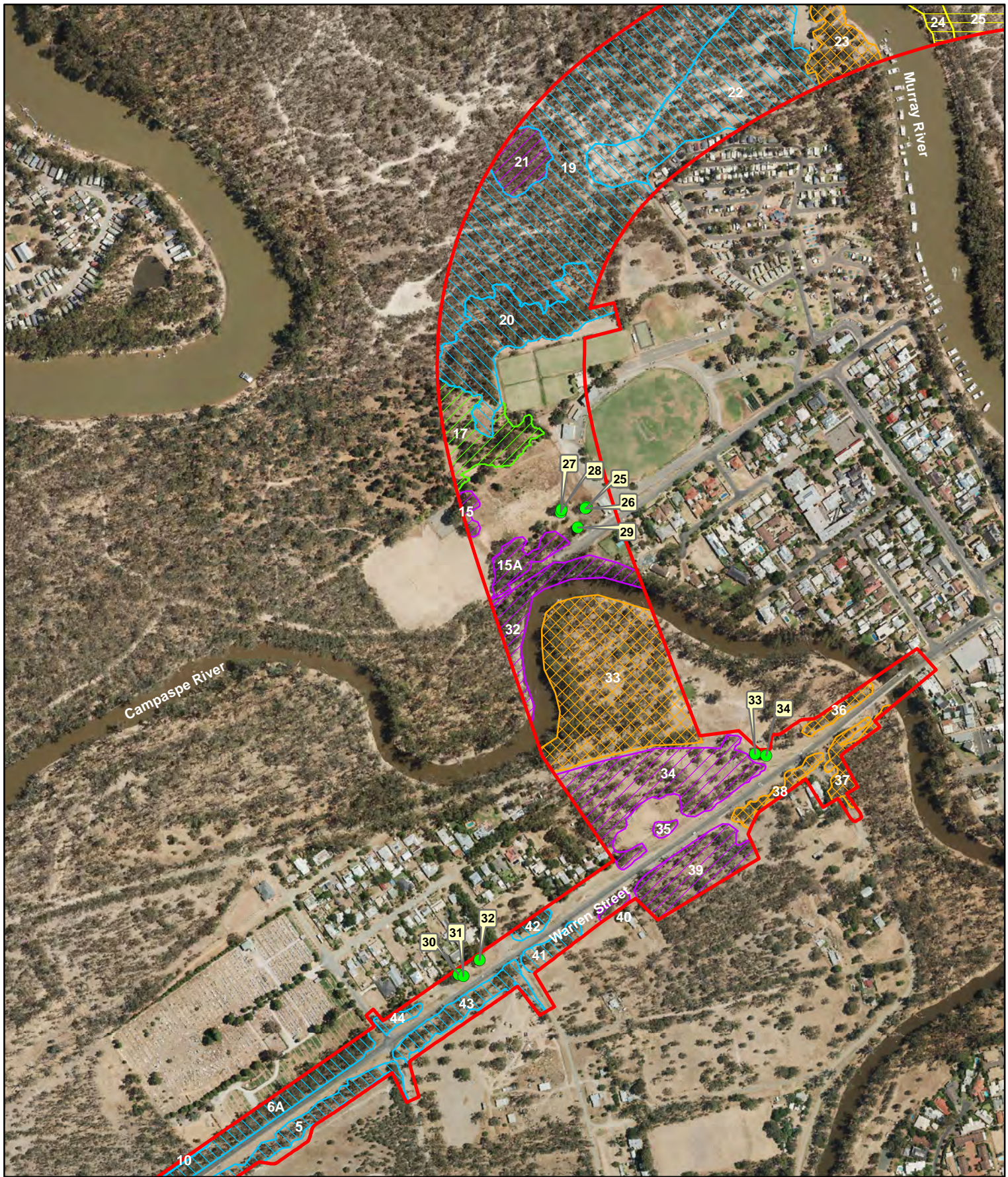
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N











Legend

Native Vegetation

Victoria

-  Grassy Riverine Forest (EVC 106)
-  Riverine Chenopod Woodland (EVC 103)
-  Riverine Grassy Woodland (EVC 295)
-  Semi-arid Woodland (EVC 97)

New South Wales

-  River Red Gum - herbaceous tall open forest
-  River Red Gum - Black Box woodland

 Study Area

 Scattered trees

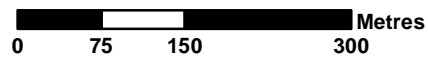
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Figure 7: Study area and native vegetation - Detailed

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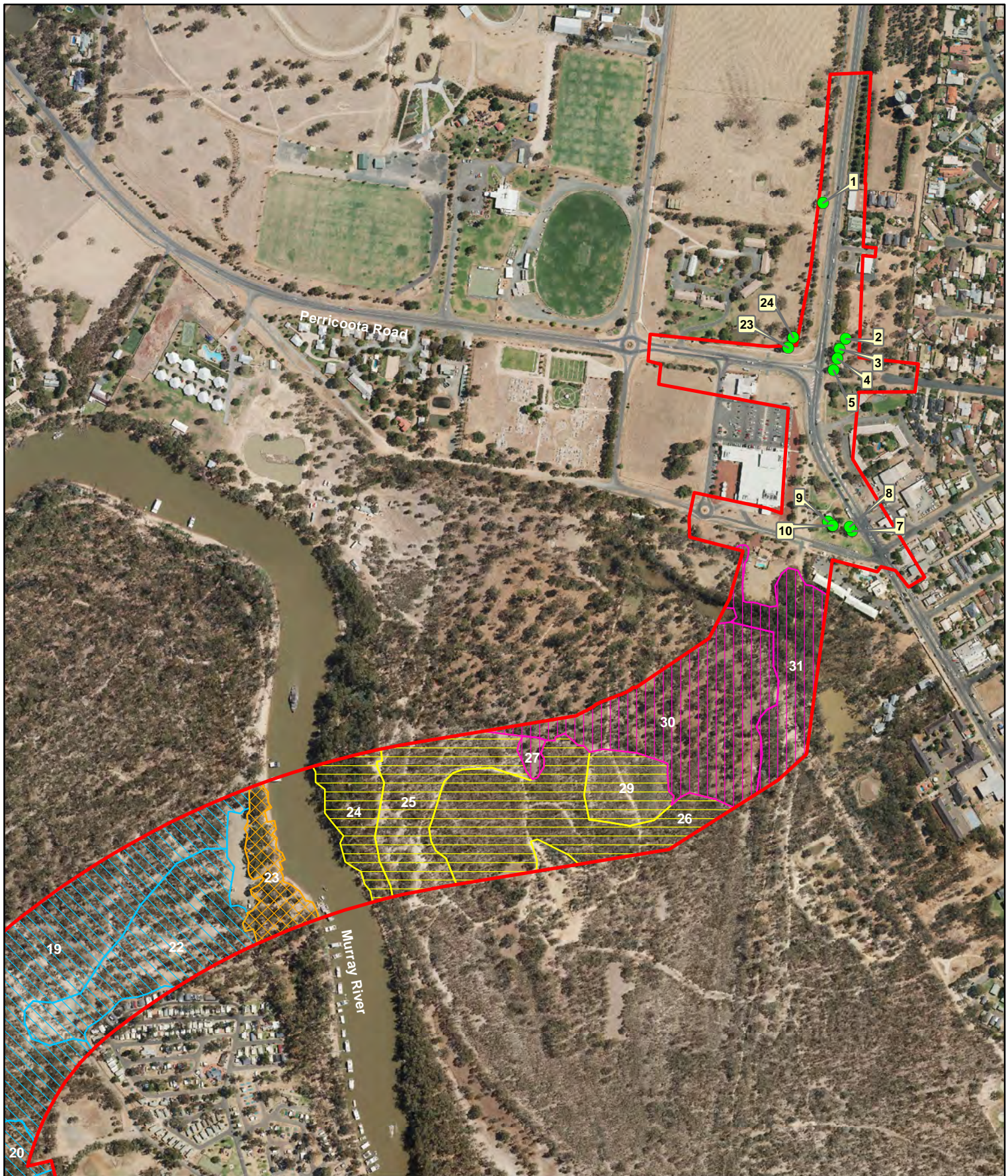
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Legend

Native Vegetation


Victoria

-  Grassy Riverine Forest (EVC 106)
-  Riverine Chenopod Woodland (EVC 103)
-  Riverine Grassy Woodland (EVC 295)
-  Semi-arid Woodland (EVC 97)

New South Wales

-  River Red Gum - herbaceous tall open forest
-  River Red Gum - Black Box woodland

 Study Area

 Scattered trees

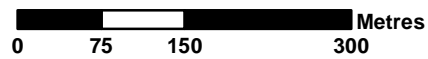


Figure 8: Study area and native vegetation - Detailed

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Client: VicRoads

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3.3.1.1 Native Vegetation in Victoria

3.3.1.1.1 Remnant Patches

Pre-European EVC mapping in Victoria (DSE 2011b) indicates that the Study Area and surrounds would have supported various Ecological Vegetation Classes (EVCs) prior to European settlement based on modelling of factors including rainfall, aspect, soils and remaining vegetation.

Evidence on site, including floristic composition and soil characteristics, suggested that the following EVCs were present within the Study Area:

- Semi-arid Woodland (EVC 97);
- Riverine Chenopod Woodland (EVC 103);
- Grassy Riverine Forest (EVC 106); and
- Riverine Grassy Woodland (EVC 295).

Details of the above recorded EVCs are provided below.

Semi-arid Woodland (EVC 97) has a vulnerable conservation status in the Murray Fans bioregion. The benchmark for this EVC describes it as “Non-eucalypt woodland or open forest to 12 m tall, of low rainfall areas. [It] occurs in a range of somewhat elevated positions not subject to flooding or inundation. The surface soils are typically light textured loamy sands or sandy loams” (Appendix 5). This EVC was distinguished in the Study Area by the presence of Murray Pines as the dominant canopy species.

Note: It was determined, after much consideration, that EVC 97 was present in the Study Area based on the evidence available at the time of the assessment. It may well be that EVC 264 Sand Ridge Woodland – described as “Open pine-box woodland to 15 m tall with a small or medium shrub layer of variable density and including a range of annual herbs, grasses and geophytes, in the dense ground layer. Occupies distinctive sandy rises (or sand mounts) adjacent to major rivers and wetlands. Very sandy, deep, free draining, moderately fertile soil, developed on sand blown up by wind action from a prior stream bed” is present on the sand hill. However, given the similar conservation status for each EVC type the EVC has no bearing on the implications for the project.

Riverine Chenopod Woodland (EVC 103) has a vulnerable conservation status in the Victorian Riverina 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. [It is] 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 (Appendix 5). This EVC was distinguished in the Study Area by the presence of Black Box as the dominant canopy species.

Grassy Riverine Forest (EVC 106) has a depleted conservation status in both the Victorian Riverina and Murray Fans bioregions. The benchmark for this EVC describes it as "Occur[ing] on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. [It is] River Red Gum forest to 25 m tall with a ground layer dominated by graminoids. Occasional tall shrubs [are] present" (Appendix 5). This EVC was distinguished in the Study Area by the presence of tall dense River Red-gum as the dominant canopy species.

Riverine Grassy Woodland (EVC 295) has a vulnerable conservation status in both the Victorian Riverina and Murray Fans bioregions. The benchmark for this EVC describes it as "Occur[ing] on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. [It is] River Red Gum woodland to 20 m tall with a ground layer dominated by graminoids and sometimes shrubby or with chenopod shrubs" (Appendix 5). This EVC was distinguished in the Study Area by the presence of sparse River Red-gum as the dominant canopy species.

Thirty-one (31) remnant patches (referred to herein as Habitat Zones 1 - 6, 10, 15, 17, 19 - 23, 32 - 45 and HZ 2A, 6A and 15A) comprising the abovementioned EVCs were identified in Victoria (Table 1). Refer to Figures 6 to 8 for Habitat Zone locations.

The habitat hectare assessment results for these habitat zones are provided in Table 2. More detailed habitat scoring results are presented in Appendix 3.

Table 1: Description of Habitat Zones in Victoria

Habitat Zone	EVC	Bioregional Conservation Status	Description
1, 2, 2A	103	Endangered	Small patch of Black Box woodland that generally lacks the canopy layer. Understorey consists mostly of immature Black Box as well as a light cover of native wallaby grass and few indigenous herbs.
3	103	Endangered	Roadside remnant of Black Box dominated woodland. Understorey consists of native shrubs and grasses. High cover of introduced grasses.
4	103	Endangered	Roadside remnant of Black Box dominated woodland. Understorey consists of native shrubs including Pale fruit Ballart and grasses. Consists of moderate cover of introduced grasses and Fog Fruit (creeping weed).
5	103	Endangered	Roadside remnant of Black Box dominated woodland. Understorey consists of native shrubs including Pale fruit Ballart and grasses. Consists of moderate cover of introduced grasses and Fog Fruit (creeping weed).
6, 19	103	Endangered	Large patch of high quality Black Box dominated woodland with high proportion of Large Old Trees (LOT's) present. Sparse yet diverse understorey of indigenous herbs, shrubs and grasses. High leaf litter and low weed cover. River Red-gums becoming co-dominant west of HZ 21.

Habitat Zone	EVC	Bioregional Conservation Status	Description
6A	103	Endangered	Roadside patch of Woodland consisting of a mixed canopy of Black Box and River Red-gum. Native shrub layer consisting of Pale-fruit Ballart and chenopods. High weed cover, mainly Perennial Veldt-grass.
10	103	Endangered	Contiguous woodland patch consisting mostly of immature Black Box. Low canopy cover. Sparse understorey of indigenous herbs, shrubs and grasses. Very high leaf litter and low weed cover.
15	295	Vulnerable	Small patch in the north west corner of the former Echuca College grounds consisting of few River Red-gum trees and three Murray Pines. Understorey disturbed and consists predominantly of introduced species.
15A	295	Vulnerable	Small remnant patch with contiguous River Red-gum canopy in front of former Echuca College grounds.
17	97	Vulnerable	Outlying occurrence of Semi-arid woodland distinguished by the occurrence of Murray Pines (<i>Callitris gracilis</i>) as the dominant canopy species. Patch occurs on the Sandhill area northwest of the former Echuca College. Understorey sparse yet diverse cover of indigenous shrubs and herbs. Weed cover very high consisting predominantly of Bridal Creeper, forming a mat over the ground layer.
20	103	Endangered	Patch of Black Box dominated woodland consisting of a sparse yet diverse cover of indigenous shrubs and herbs. Weed cover very high consisting predominantly of Bridal Creeper, Panic Veldt-grass and Annual Veldt-grass.

Habitat Zone	EVC	Bioregional Conservation Status	Description
21	295	Vulnerable	Patch of recruiting River Red-gum woodland, distinguished by the dense occurrence of immature River Red-gums and few Large Old Trees. Sparse understorey consisting of indigenous sedges and a very low weed cover.
22	103	Endangered	Large patch of Black Box dominated woodland with high proportion of Large Old Trees (LOT's) present. Patch occurs in a disturbed area supporting a matrix of dirt tracks which provide vehicular access to the boat ramp on the Murray River to the north. Sparse yet diverse understorey of indigenous herbs, shrubs and grasses, including the presence of Blue-burr Daisy (rare). High leaf litter and high weed cover.
23	106	Depleted	Linear patch of River Red-gum dominated Forest consisting of several Large Old Trees. Understorey heavily disturbed as occurs in an area of recreation adjacent to the Murray River, therefore predominately consisting of introduced grasses.
32	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.

Habitat Zone	EVC	Bioregional Conservation Status	Description
33	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).
34	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).
35, 39, 40,	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).
36, 37, 38	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).

Habitat Zone	EVC	Bioregional Conservation Status	Description
41, 42, 43, 44, 45	103	Endangered	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.

Table 2: Summary of habitat hectare assessment results for native vegetation in Victoria

Habitat Zone	EVC	Area (ha)	Habitat Score (out of 100)	Habitat Hectare (Hha)
1	103	0.019	33	0.006
2	103	0.003	33	0.001
2A	103	0.272	47	0.128
3	103	1.884	47	0.885
4	103	0.095	45	0.043
5	103	0.952	57	0.543
6	103	0.886	71	0.629
6A	103	1.262	51	0.644
10	103	0.109	50	0.055
15	295	0.106	34	0.036
15A	295	0.379	38	0.144
17	97	0.950	60	0.570
19	103	7.360	67	4.931
20	103	1.884	56	1.055
21	295	0.524	66	0.346
22	103	3.153	49	1.545
23	106	0.999	37	0.370
32	295	0.840	40	0.336
33	106	3.637	36	1.309
34	295	2.086	36	0.751
35*	295	0.054	60	0.032
36	106	0.186	27	0.050
37	106	0.289	30	0.087
38	106	0.224	42	0.094
39	295	1.030	34	0.350
40	295	0.071	25	0.018
41	103	0.201	30	0.060
42*	103	0.115	60	0.070
43	103	0.556	22	0.122

44*	103	0.103	60	0.062
45	103	0.076	29	0.022
Totals		30.305		15.294

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West Option would indeed have an impact on them. As such, these zones have been assigned a default condition score of 0.60.

3.3.1.1.2 Scattered trees

Scattered trees recorded at the intersection of the Murray Valley Highway and Warren Street in Victoria would have once comprised the canopy component of Riverine Chenopod Woodland (EVC 103). A total of 21 scattered trees occurred in the Victorian side of the Construction Area.

All scattered trees recorded within the Construction Area (including within New South Wales) are detailed in Appendix 4 of this report and locations can be viewed in Figures 6 to 8.

A large proportion of scattered trees were hollow-bearing.

3.3.2 Native Vegetation in New South Wales

3.3.2.1 Remnant Patches

Current native vegetation mapping, as indicated in Keith (2006), suggested the following vegetation formations may occur within the Study Area:

- Grassy Woodlands;
- Semi-arid Woodlands; and
- Forested Wetlands.

Information provided from the BioMetric database of vegetation types in the Murray CMA, combined with evidence on site, including floristic composition and soil characteristics, suggested that all native vegetation in the New South Wales section of the Study Area was of the Forested Wetlands formation, and furthermore classified as Inland Riverine Forest. Two different vegetation types were recorded within the Inland Riverine Forest class:

- River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone (45% cleared in Murray CMA); and
- River Red Gum - herbaceous tall open forest of the Riverina and Murray Darling Depression Bioregions (10% cleared in the Murray CMA)

Seven patches (referred to herein as Habitat Zones 24 to 31) comprising the abovementioned vegetation types were identified in the New South

Wales section of the Study Area. Habitat Zones 24 to 31 are described and areas presented below in Table 3. A total of 14.47 hectares of native vegetation was recorded in New South Wales. Locations of Habitat Zones in NSW are shown 5 and in more detail in Figure 6 to Figure 8.

Table 3: Description of Habitat Zones in New South Wales

Habitat Zone	Vegetation Type	% cleared in Murray CMA	Area (ha)	Description
24	River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone	45%	1.16	River Red-gum dominated patch of woodland abutting the Murray River, with some Black Box in the canopy. Indigenous shrubs including Pale-fruit Ballart, Silver Wattle and Tangled Lignum present. Ground layer supports a high cover of introduced grasses, namely Annual Veldt-grass. Banks of the Murray River highly impacted by erosion.
25	River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone	45%	2.21	Sparse River Red-gum dominated patch of woodland with some Black Box present. Canopy sparse with moderate cover of eucalypt re-growth. Under-storey disturbed to form series of tracks. Ground layer very sparse, mostly bare ground.

Habitat Zone	Vegetation Type	% cleared in Murray CMA	Area (ha)	Description
26	River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone	45%	3.77	River Red-gum dominated patch of woodland with some Black Box present. Canopy mostly absent, rather patch distinguished by high cover of re-growth of various age cohorts. Indigenous shrubs including Pale-fruit Ballart and Silver Wattle present. Ground layer very sparse, supporting mostly leaf litter and bare ground.
27	River Red Gum - herbaceous tall open forest of the Riverina and Murray Darling Depression Bioregions	10%	0.16	River Red-gum dominated shallow forested wetland. Old growth River Red-gums scattered throughout. Predominately indigenous understorey dominated by Common Spike-sedge with scattered rushes.
29	River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone	45%	1.02	Patch of River Red-gum woodland consisting entirely of young dense re-growth. Canopy absent due to previous disturbance. Ground layer very sparse, supporting mostly leaf litter and bare ground.

Habitat Zone	Vegetation Type	% cleared in Murray CMA	Area (ha)	Description
30	River Red Gum - herbaceous tall open forest of the Riverina and Murray Darling Depression Bioregions	10%	4.21	River Red-gum dominated shallow forested wetland. Old growth River Red-gums scattered throughout. Indigenous under-storey dominated by Common Spike-sedge and rushes, with various indigenous wetland species present including Nardoo, Water Ribbons, Water Milfoil and <i>Amphibromus sp.</i> . Low weed cover and moderate eucalypt recruitment.
31	River Red Gum - herbaceous tall open forest of the Riverina and Murray Darling Depression Bioregions	10%	1.94	Disturbed River Red-gum dominated woodland occurring adjacent to existing billabong. Vegetation occurs either side of an existing bush track and has therefore been susceptible to weed invasion by species such as Desert Ash and Patterson's Curse. Billabong full of sitting water at time of survey.
Total area (ha)			14.47	

*Note that Habitat Zone 28 has been removed based on the current assessment

All remnant patches of native vegetation in the NSW section of the Study Area occur within the Murray Channels and Floodplains Mitchell Landscape, which is 56% cleared.

3.3.2.2 Scattered Trees

Scattered trees recorded around the intersection of the Cobb Highway and Perricoota Road in New South Wales would have once comprised the canopy component of 'River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone'. Eleven scattered trees occurring outside areas mapped as patches of native vegetation were recorded in the New South Wales side of the Study Area. All scattered trees recorded within the Study Area are detailed in Appendix 4 of this report and locations are shown in Figure 5 to Figure 8.

Scattered Trees in the NSW Section of the Study Area occur across two Mitchell Landscapes; the Murray Channels and Floodplains (56% cleared) and the Murray Scalded Plains (92% cleared).

3.4 Flora Assessment

During the field assessment 115 plant species were recorded in the study area. Of these, 68 (60%) were indigenous and 47 (40%) were introduced or non-indigenous native in origin. All flora species recorded during the current field assessment are listed in Appendix 1.

3.4.1 Threatened flora species

Database searches from the Flora Information System (FIS) of Victoria (Viridans Biological Databases 2011a), the Wildlife Atlas of New South Wales (OEH 2011) and the EPBC Act Protected Matters Search Tool (DSEWPC 2011) indicate that within the search region there are records of, or there occurs potential suitable habitat for, 38 rare or threatened flora species. Of these, nine species were listed under the federal EPBC Act, seven on the New South Wales *Threatened Species Conservation Act 1995* (TSC Act), 13 on the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and 35 on the Victorian DELWP's Advisory List for Rare and Threatened Flora (DEPI 2014a). These species are listed in Appendix 1.

Two listed rare or threatened flora species were recorded in the Study Area during the current investigation;

- Blue Burr-daisy; and
- Pale Flax-Lily.

The status of these species and their occurrence in the Study Area is discussed below. These two species are likely to be impacted by the project.

Weeping Myall was initially thought to occur within the Study Area. However, these records were later found to be Willow Wattle (*Acacia salicina*).

3.4.1.1 Blue Burr-daisy (*Calotis cuneifolia*)


Blue Burr-daisy is listed as rare in Victoria on the DELWP Advisory list. This species was recorded in one area in Black Box Woodland in Victoria (within HZ 19) and is shown in Figure 9.

3.4.1.2 Pale Flax-Lily (*Dianella sp. aff. longifolia (Riverina)*)


Pale Flax-lily is listed as vulnerable in Victoria on the DELWP Advisory list. This species is not well described in Victoria, though is restricted to the Riverina area and is deemed to have affinities with *Dianella longifolia*. This species was recorded throughout the Victorian section of the Study Area as sparsely scattered individuals in several locations and therefore is not shown in Figure 9.



Legend

 Study area

Threatened Flora

 Blue Burr-daisy (DELWP Advisory List)

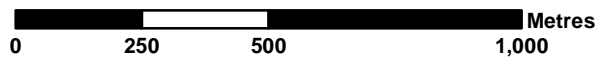






Figure 9: Threatened Flora Species recorded		
Project: Murray River Crossing Echuca		
Client: VicRoads		
Project No.: 8194	Date: 18/02/2015	Created By: K. Al-Dabbagh / M. Ghasemi
 Brett Lane & Associates Pty. Ltd. <i>Ecological Research & Management</i>		
<ul style="list-style-type: none">  Experience  Knowledge  Solutions 	Suite 5, 61 - 63 Camberwell Road Hawthorn East, VIC 3123 PO Box 337, Camberwell, VIC 3124, Australia	Ph (03) 9815 2111 / Fax (03) 9815 2688 enquiries@ecologicalresearch.com.au www.ecologicalresearch.com.au



The likelihood of occurrence in the Study Area of threatened species listed under the EPBC Act, TSC Act and/or FFG Act is addressed in Table 4. Suitable habitat is considered to exist for seven species of threatened flora within areas of high quality Black Box dominated woodland in Victoria and Forested Wetland in New South Wales based on this assessment:

- Chariot Wheels (EPBC Act, FFG Act and TSC Act);
- Hairy Tails (FFG Act);
- River Swamp Wallaby-grass (EPBC Act and TSC Act); and
- Silky Swainson-pea (FFG Act and TSC Act);
- Slender Darling-pea (EPBC Act, FFG Act and TSC Act);
- Small Scurf-pea (FFG Act and TSC Act);
- Western Water Starwort (EPBC Act, FFG Act and TSC Act).

3.4.1.3 Threatened Flora targeted survey

Targeted flora surveying was undertaken in areas of suitable habitat in the current Study Area in January 2009 and in the Mid-West 2 alignment corridor in November 2011. The timing of these surveys captured the peak flowering times for all of the above listed species, except Silky Swainson-pea. However, both of the detailed flora surveys (October 2008 and September 2011) were carried out during the regular flowering period of Silky Swainson-pea (August to October), which was considered sufficient survey effort for detecting the species. None of the above listed threatened flora species were recorded during these surveys and therefore are now considered unlikely to occur. The results of the targeted flora survey are reflected in Table 4.

3.5 Listed threatened ecological communities

3.5.1 Victorian portion of the Study Area

Available information on the characteristics and geographic range of threatened communities listed under the FFG Act was reviewed and the native vegetation that was assessed in the Study Area was compared with these. In particular, communities that include either native pine or River Red Gum were reviewed. Based on this, it was concluded that no listed threatened ecological communities were recorded in the Victorian portion of the Study Area.

3.5.2 NSW portion of the Study Area

One listed threatened ecological community was recorded in the NSW section of the Study Area, namely, the *Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment* (commonly known as the Murray River EEC), listed as endangered by the NSW Department of Primary Industries (DPI 2007). This EEC is made up

of an assemblage of native fauna and is dealt with in the aquatic ecological assessment for the Project (GHD 2015).

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

Common Name	Scientific Name	Conservation Status			Habitat	Flowering period	Likelihood of occurrence in Study Area
		EPBC	FFG	TSC			
Chariot Wheels	<i>Maireana cheelii</i>	V	L	V	Usually found on heavier, grey clay soils with Bladder Saltbush (DEC 2005).	October (end of flowering, start of fruiting)	Not recorded during either of the two targeted surveys. Only the November 2011 survey was conducted during the flowering/fruiting period, which was limited to the Mid-West 2 alignment corridor. Considering the species was not detected in that survey (in higher quality vegetation) it is considered – unlikely to occur.
Buloke	<i>Allocasuarina luehmannii</i>		L		Woodlands on non-calcareous soils. This tree species commonly grows with Grey Box (Entwistle 1996a).	N/A	No suitable habitat and no Buloke recorded in Study Area – does not occur.
Hairy Tails	<i>Ptilotus erubescens</i>		L		Fertile soils with grassland and woodland communities in northern and western Victoria (Walsh 1996).	November to February	Suitable habitat originally considered in Black Box Woodland in Victoria. Not recorded during either targeted survey, both of which were carried out during in known flowering period – unlikely to occur.
Ridged Spider-orchid (Greencomb Spider-orchid)	<i>Caladenia tensa</i>	E			Eucalyptus and Callitris woodland in well drained sandy loams. Grows among shrubs (Jones 2006).	N/A	Area of sandy soil within the Study Area is limited to 'the Sandhill' behind the former Echuca Secondary College in Victoria. While this area supports a Callitris dominated canopy, the under-storey is highly disturbed and covered by a thick layer of bridal creeper throughout. No suitable habitat – Unlikely to occur.
Red Swainson-pea	<i>Swainsona plagiotropis</i>	V	L	V	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).	N/A	No grassland habitat recorded within the Study Area – unlikely to occur.
Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	V	L		Rare and restricted to northern and north western Victoria where it has been recorded growing in temporary waterholes, lagoons, farm dams, and rock holes and on clay pans (Jeanes 1996a).	N/A	Endemic to Victoria. Ground layer of River Red-gum dominated woodland on the Victorian side of the Study Area is highly degraded and disturbed. No suitable habitat in Victoria. Does not occur in NSW – Unlikely to occur.
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	V		V	Confined to permanent swamps principally along the Murray River between Wodonga and Echuca, uncommon to rare in the south (Walsh 1994).	November to March (Species only emerges when inundated)	Suitable habitat in Forested Wetland habitat in New South Wales. Not recorded during either targeted survey, which were both conducted during flowering period, and most of the suitable habitat was inundated during the November 2011 survey – unlikely to occur.

Common Name	Scientific Name	Conservation Status			Habitat	Flowering period	Likelihood of occurrence in Study Area
		EPBC	FFG	TSC			
Silky Swainson-pea	<i>Swainsona sericea</i>		L	V	Rare in Victoria, of disjunct occurrence in north of state where usually found in grassland and grassy woodland (Jeanes, 1996b).	August to October	Some suitable habitat in Black Box Woodland in Victoria. Both targeted surveys were carried out outside of flowering period. However, as this species was not recorded during both detailed flora surveys (October 2008 and September 2011) undertaken during the known peak flowering time for the species, it is considered – unlikely to occur.
Slender Darling-pea	<i>Swainsona murrayana</i>	V	L	V	In black box and grassland on level plains, floodplains and depressions (DEC 2005). Seasonally inundated flats and around lakes (Jeanes, 1996b).	September to December	Suitable habitat in Black Box Woodland in Victoria and Forested Wetland habitat in New South Wales. Not recorded during either of the two targeted surveys. Only the November 2011 survey was conducted during the flowering/fruitletting period, which was limited to the Mid-West 2 alignment corridor. Considering the species was not detected in that survey (in higher quality vegetation) it is considered – unlikely to occur.
Small Scurf-pea	<i>Cullen parvum</i>		L	E	Seasonally wet areas with heavy soils in Grasslands and Grassy (River Red-gum) Woodlands (Jeanes, 1996b).	October to January	Suitable habitat in Black Box Woodland in Victoria and Forested Wetland habitat in New South Wales. Not recorded during either targeted survey, which were both conducted during flowering period – unlikely to occur.
Spiny Rice-flower	<i>Pimelea spinescens subsp. spinescens</i>	C	L		Grasslands or open shrublands on basalt derived soils (Entwistle 1996b).	N/A	No suitable grassland habitat recorded within Study Area – unlikely to occur.
Turnip Copperburr	<i>Sclerolaena napiformis</i>	E	L	E	Grasslands on clay-loam soils (DEC 2005).	N/A	No suitable grassland habitat recorded within Study Area – unlikely to occur.
Weeping Myall	<i>Acacia pendula</i>		L		Rare in Victoria with isolated occurrences near Waracknabeal and Echuca. Mainly on floodplains in fertile alluvial clay and red earth soils (Entwistle <i>et.al</i> 1996).	N/A	Suitable habitat in the Study Area. Potential to occur due to original mis-identification.
Western Water-starwort	<i>Callitriche cyclocarpa</i>	V	L	V	NSW and Victoria in thick patches in floodwaters (DEC 2005). Mostly aquatic, in damp, swampy places (Jeanes, 1999).	September to December	Suitable habitat in Forested Wetland habitat in New South Wales. Not recorded during either of the two targeted surveys. Only the November 2011 survey was conducted during the flowering/fruitletting period, which was limited to the Mid-West 2 alignment corridor. Considering the species was not detected in that survey (in higher quality vegetation) it is considered – unlikely to occur.

Common Name	Scientific Name	Conservation Status			Habitat	Flowering period	Likelihood of occurrence in Study Area
		EPBC	FFG	TSC			
Yarran Wattle	<i>Acacia omalophylla</i>		L		Widespread in New South Wales but just crossing the Murray River into Victoria where present as mainly remnant populations in paddocks and roadsides (Entwistle, <i>et. al</i> 1996).	N/A	Not recorded during initial detailed assessment – unlikely to occur.
Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>		L		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).	N/A	No suitable habitat recorded – unlikely to occur.

C = Critically Endangered; **E** = Endangered; **V** = Vulnerable; **L** = Listed as threatened under FFG Act

3.6 Fauna assessment

3.6.1 Habitat assessment

Much of the Study Area supports native vegetation, including large contiguous areas of Black Box and River Red-gum dominated woodland. All such forested and woodland areas were considered **high** quality habitat for fauna. Wetland habitat recorded in the Study Area was considered as **moderate** quality for fauna.

River Red-gum Forests: Consisted of several age cohorts of River Red-gum's with the oldest occurring adjacent to the Murray River.

In the NSW section of the Study Area, the River Red-gum Forests consist of distinct patches of regrowth within this area, likely due to previous disturbance events. A large area of forested wetland occurs within the north eastern section of the corridor. This area supports a sparse canopy of large River Red-gums with an indigenous understorey component dominated by wetland species including Common Spike-sedge, Poong'ort and various rushes, grasses and herbs.

In the Victorian section of the Study Area, the areas either side of the Campaspe River and the shores of the Murray River were dominated by River Red-gum. These areas, while supporting several large trees and a contiguous canopy, had a highly disturbed ground layer, distinguished by a dense cover of introduced grasses such as Great Brome. Indigenous plants including Pale-fruit Ballart, Tangled Lignum and various other herbs and shrubs occurred in these areas at low cover.

Black Box Woodlands: The Black Box Woodlands in the Victorian part of the Study Area consists of numerous large old trees. These areas of Black Box dominated woodland exist north of Warren Street and to the north and south of the Sandhill, between the Murray River and the Murray Pine dominated woodland. The Warren Street area supports some of the highest quality habitat in the Victorian section of the corridor, supporting a sparse, but mostly native understorey. The NSW section of the Study Area supports scattered Black Box trees.

Mixed Murray Pine–River Red-gum woodland: In the Victorian part of the Study Area an area of woodland dominated by the Murray Pine occurs to the west of the existing Tennis Courts. This area of vegetation occurs on a raised area of sandy soil and while supporting an indigenous canopy of Murray Pines, is distinguished by the dense carpet of Bridal Creeper, a highly invasive weed species that has taken over the ground layer.

Wetlands: Aquatic habitat in the Study Area consists of the Campaspe River in Victoria and Murray River and billabongs on the New South Wales section of the Study Area. There is little bank side aquatic vegetation along either of the rivers within the Study Area, although sedges and Common Reed were present on small sections of the Murray River. The rivers provide continuity in habitat, and are therefore high value habitat corridors, mostly for fish and other aquatic fauna. Common species of frogs may also utilise the rivers for movement, in particular during the non-breeding season.

Several billabongs were located within the River Red-gum woodland in the New South Wales part of the Study Area and in similar habitat along the Campaspe River in the Victorian section of the Study Area.

Some of these have a moderate cover of fringing vegetation, which is likely to provide cover and breeding habitat for a number of common native frog species. The water quality was found to be poor and carp were present in at least one of the billabongs. The habitat quality of the billabongs for fauna is considered as moderate.

In addition, a dam is located at the edge of the investigation corridor south near the Warren Street - Murray Valley Highway junction. At the time of the survey, the wetland was well vegetated and was found to provide habitat for five species of local frogs and several aquatic birds.

Disturbed roadside vegetation: This habitat 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. It was determined to be of low quality as fauna habitat.

3.6.2 Fauna species

The review of existing information and current field survey indicated that 210 fauna species may occur within the Study Area (Both of the Victorian and NSW sections), including 161 bird (eight introduced), 23 mammal (four introduced), 10 reptile and six frog species (Appendix 2).

During the field assessment 139 fauna species were recorded. This included 105 bird (seven introduced), 22 mammal (four introduced), four reptile and six frog (Appendix 2).

The Study Area was found to be rich in fauna as it consisted of high quality forest and woodlands, and moderate quality wetlands. These habitats attracted a large and diverse fauna. Fauna species, particularly birds, were not usually restricted to certain habitats; they were almost

equally distributed among the various habitat types, with the exception of the waterbirds, which were generally confined to the river banks and other wetlands. Records for fauna, as stated above, originated from existing databases and those recorded during the field inspection days. The distribution of records is summarised in Table 5 below.

Table 5: Fauna species in the Study Area from existing databases and observations in the field

Fauna	Number of species from source				Total species
	AVW	BA	ANSWW	Recorded	
Birds	137	141	66	105	161
Mammals	20	–	15	22	23
Reptiles	6	–	3	4	9
Frogs	4	–	1	6	6

Sources: AVW, Atlas of Victorian Birds; BA, New Atlas of Australian Birds; ANSWW, Atlas of NSW Wildlife; Recorded during field inspection days.

3.6.2.1 Listed threatened fauna species

The review of existing information and current field survey indicate that within the search region 54 listed terrestrial fauna species (41 bird, eight mammal, three reptile, one frog and one invertebrate) listed on the EPBC Act, FFG Act and/or the DELWP advisory list (DEPI 2013) may occur within the Victorian section of the Study Area.

Similarly, threatened species listed on the TSC Act and FM Act including those listed on the EPBC Act, that are considered likely to occur in the NSW section of the Study Area included 36 terrestrial species (26 birds, seven mammals, one reptile, one frog and one invertebrate).

Their likelihood of occurrence within the Study Area is assessed and presented in Table 6. Species that are likely to occur are highlighted. Table 6 indicates all threatened species and also species listed as migratory species under the EPBC Act.

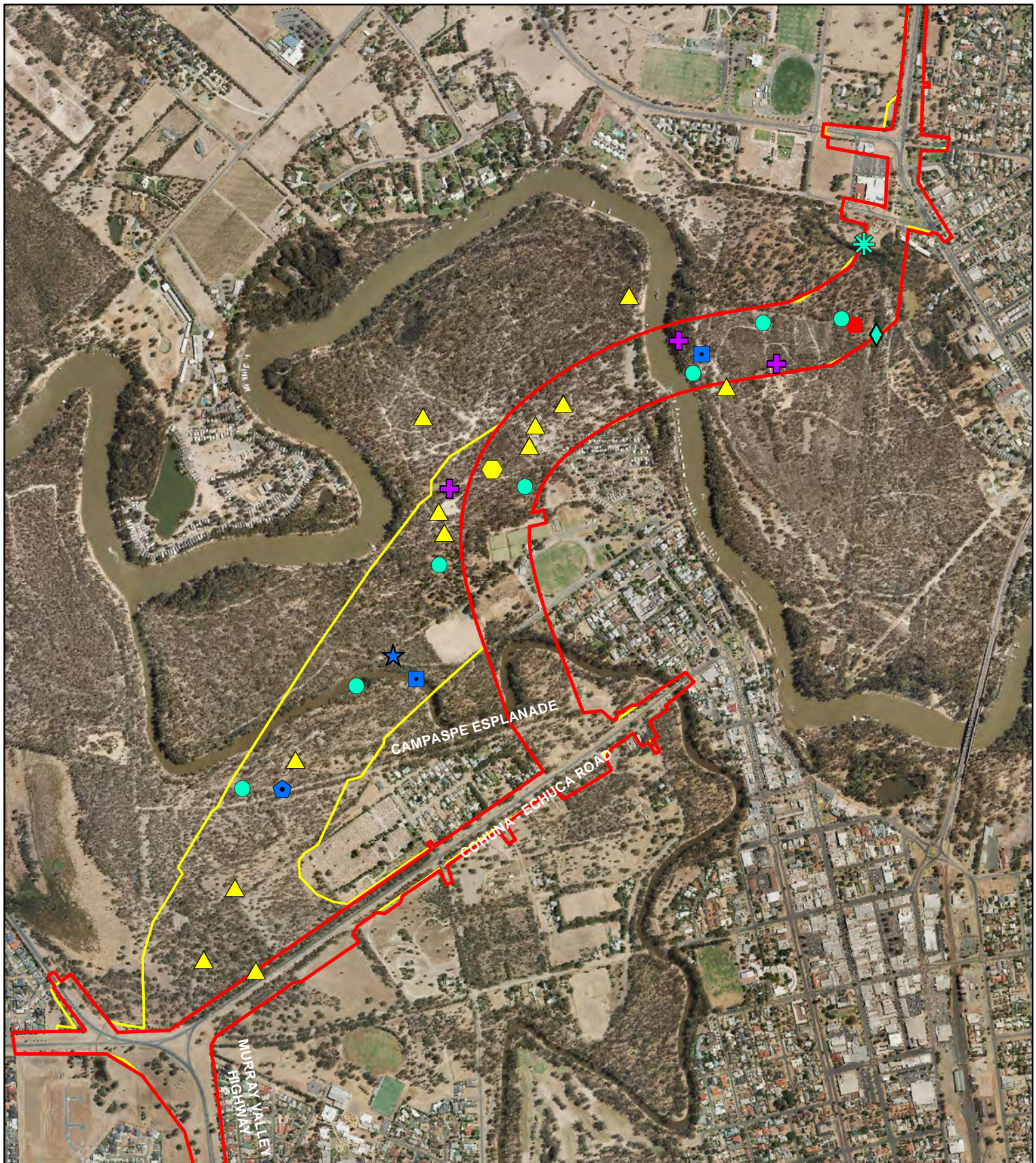
Of the listed fauna species predicted to occur in the Study Area (Victoria and NSW), 10 threatened fauna species were recorded. These include:

- Brown Treecreeper;
- Masked Owl;
- Azure Kingfisher;
- Brown Quail;
- Varied Sittella;

- Nankeen Night Heron;
- Black-chinned Honeyeater;
- Rainbow Bee-eater;
- Yellow-bellied Sheathtail Bat; and
- Squirrel Glider.

The location of threatened fauna species recorded during the investigation is presented in Figure 10. Threatened fauna species recorded in and adjacent to the Study Area are discussed in the following sections.

Based on the likelihood of occurrence assessment for threatened fauna, suitable habitat was deemed to occur in the Study Area for 25 listed fauna species, including the 10 listed species recorded. These 25 species, including those recorded in the Study Area are shaded in grey in Table 6 and are discussed in more detail below. Species considered unlikely to occur based on lack of suitable habitat or lack of recent and regular records from the search region are not highlighted and are not discussed further (with the exception of the South-eastern Long-eared Bat and Growling Grass Frog).



Legend

- Study area
- Additional investigation area
- FFG, DELWP, TSC Listed**
- ◆ Masked Owl
- ✱ Squirrel Glider
- Yellow-bellied Sheat-tail Bat
- EPBC Listed**
- + Rainbow Bee-eater
- TSC Listed**
- Varied Sittella

- DELWP, TSC Listed**
- ⬡ Black-chinned Honeyeater
- ▲ Brown Treecreeper
- DELWP Listed**
- ★ Azure Kingfisher
- ⬢ Brown Quail
- Nankeen Night Heron

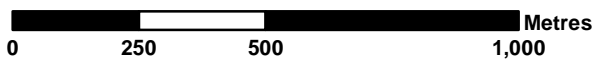


Figure 10: Threatened Fauna Species recorded		
Project: Murray River Crossing Echuca		
Client: VicRoads		
Project No.: 8194	Date: 12/06/2015	Created By: K. Al-Dabbagh / M. Ghasemi
Brett Lane & Associates Pty. Ltd. Ecological Research & Management		
<ul style="list-style-type: none"> ● Experience ● Knowledge ● Solutions 	Suite 5, 61 - 63 Camberwell Road Hawthorn East, VIC 3123 PO Box 337, Camberwell, VIC 3124, Australia	Ph (03) 9815 2111 / Fax (03) 9815 2688 enquiries@ecologicalresearch.com.au www.ecologicalresearch.com.au



Table 6: Listed fauna identified as occurring or potentially occurring in the Study Area

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
Birds										
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	L	EN	VU	Usually inhabits permanent freshwater wetlands with tall dense vegetation, particularly those dominated by sedges, rush, reeds or cutting grass (Marchant and Higgins 1990).	2	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Australian Painted Snipe	<i>Rostratula australis</i>	VU, M (CAMBA)	L	CE	EN	Shallow freshwater or brackish swamps, usually inland and often ephemeral, with emergent vegetation such as River Red Gum and Lignum and muddy margins. Uncommon summer visitors to Victoria (Marchant and Higgins 1993; Garnett and Crowley 2000).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Azure Kingfisher	<i>Alcedo azurea</i>			NT		Mostly well vegetated freshwater wetland margins or along tidal rivers and creeks, especially with still or slowly flowing waters (Higgins 1999).	6	3	0	One bird observed on the Murray River. Recorded in the Study Area
Barking Owl	<i>Ninox connivens connivens</i>		L	EN	VU	Eucalyptus dominated forests and woodlands, commonly near water-bodies, such as streams and rivers, and requires hollow trees for nesting and trees with dense foliage for roosting. Prefers edge habitats to the interior of forests, with riparian vegetation through farmland supporting the species most regularly. It prefers sites with higher proportion of large trees greater than 60 centimeters in diameter at breast height and containing hollows (Higgins and Davies 1996; Taylor <i>et al.</i> 2002).	0	0	1	Suitable habitat present and targeted survey was undertaken. The Barking Owl was not recorded during targeted survey, therefore unlikely to occur
Black Falcon	<i>Falco subniger</i>			VU	VU	Inhabits woodlands, open country and terrestrial wetlands in arid and semi-arid zones. Mainly occurs over open plains and undulating land with large tracts of low vegetation. More commonly found in north western Victoria and only occasionally found in southern Victoria. A highly mobile species, moving in response to food availability and seasonal	2	1	0	No suitable habitat and lack of recent and regular records, unlikely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						conditions (Marchant and Higgins 1993).				
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>			NT	VU	Open box-ironbark forests and woodlands. Usually found in Red or Mugga Ironbarks, Grey Box, Yellow Gum and Yellow Box. Especially mature tall trees along gullies, low-lying flats and lower slopes. Characteristic box-ironbark species, widespread but moderately common. The species is gregarious, usually seen in groups of 3–10 birds (Higgins <i>et al.</i> 2001; Tzaros 2005).	0	0	1	Few birds observed within the Black Box woodland. Recorded in the Study Area
Blue-billed Duck	<i>Oxyura australis</i>		L	EN	VU	Terrestrial freshwater and brackish wetlands, preferring deep permanent, well vegetated water bodies. Secretive birds, usually feeding in open water or beside tall dense vegetation (Marchant and Higgins 1990).	5	2	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Brolga	<i>Grus rubicunda</i>		L	VU	VU	Wetlands that include permanent open water and deep freshwater marsh (Marchant and Higgins 1993).	1	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Brown Quail	<i>Coturnix ypsilophora australis</i>			NT		Prefers tall ground vegetation, such as grass, ferns and shrubs over damp or swampy ground. Also occurs in grasslands, cereal crops, stubble, leafy crops, heath, bracken and stands of vegetation fringing freshwater wetlands. In Victoria it is widespread and could be locally common in suitable habitats (Marchant and Higgins 1993).	0	2	0	Two pairs were observed in Black Box forest in Victorian section. Recorded in the Study Area
Brown Treecreeper	<i>Climacteris picumnus victoriae</i>			NT	VU	Woodlands dominated by eucalyptus, especially Stringybarks or other rough-barked eucalypts usually with open grassy understorey, some dead trees and fallen timber (Higgins <i>et al.</i> 2001).	30	17	6	A thriving population occurred on both sides of Murray River. Recorded at the Study Area
Bush Stone-curlew	<i>Burhinus grallarius</i>		L	EN	EN	Plains and riverine grassy woodlands, box-ironbark forests often with dead leaves and fallen dead timber. The species is mainly found in north and west Victoria. This species has declined since European settlement, especially in the south of the state (Marchant and Higgins 1993; Robinson and	10	5	1	Suitable habitat present and targeted survey was undertaken. The Bush Stone-curlew was not recorded during targeted survey, therefore is considered unlikely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						Johnson 1997; Olsen et al. 2005).				
Cattle Egret	<i>Ardea ibis</i>	M (JAMBA, CAMBA)				Terrestrial freshwater wetlands and pasture, in association with cattle (Marchant and Higgins 1990).	0	1	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Diamond Dove	<i>Geopelia cuneata</i>		L	NT		Mostly arid and semi-arid grassland savannah, often of spinifex and in low open woodlands with grassy understorey; also often in open riparian woodlands (Higgins and Davies 1996).	1	1	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Diamond Firetail	<i>Stagonopleura guttata</i>		L	VU	VU	Commonly found in open forests and woodlands often with sparse grassy understorey also occur along watercourses and in farmland areas. Widespread but scattered. Populations have declined in Victoria since the 1950's (Higgins et al. 2006).	1	1	1	Suitable habitat present, likely to occur
Eastern Great Egret	<i>Ardea modesta</i>	M (JAMBA, CAMBA)	L	VU		Variety of wetlands including estuaries and intertidal mudflats; various permanent and ephemeral freshwater, brackish and saline wetlands; shallows of deep permanent lakes (Marchant and Higgins 1990).	13	8	0	Suitable habitat present in wetland habitats along the Murray River and billabongs, likely to occur
Fork-tailed Swift	<i>Apus pacificus</i>	M (JAMBA, CAMBA, ROKAMBA)				Aerial, over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999).	0	0	0	May occasionally fly over the study area, potential to occur
Grey Goshawk	<i>Accipiter novaehollandiae novaehollandiae</i>		L	VU		Inhabit rainforests, open forests, swamp forests, woodlands and plantations. Most abundant where forest or woodland provide cover for hunting from perches, some movement to open farmland and urban areas outside breeding season. In Victoria most common in Otway ranges (Marchant and Higgins 1993).	1	1	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Grey-crowned Babbler	<i>Pomatostomus temporalis temporalis</i>		L	EN	VU	Inhabits dry woodlands and forests with a shrub layer and a groundcover of leaf litter and fallen timber. In Victoria it is found in woodlands and forests with box-ironbark eucalypt associations and	1	0	4	Suitable habitat present and local residents have reported sightings. Likely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						River Red Gums, including narrow remnants along roadsides and streams. Formerly widespread over much of Victoria, but populations has declined and range has contracted markedly, mostly from the south and west since the 1970's (Higgins and Peter 2002; Tzaros 2005).				
Gull-billed Tern	<i>Gelochelidon nilotica</i>		L	EN		Shallow freshwater and saline wetlands, intertidal mudflats, also in sheltered inshore marine waters where they roost on sandbars and beaches. In Victoria mainly on inland lakes of Western district and Murray Valley and also occur at Corner Inlet (Higgins and Davies 1996).	1	1	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Hardhead	<i>Aythya australis</i>			VU		Inhabits large, deep waters where vegetation is abundant, particularly deep swamps and lakes, pools and creeks. It also occurs on freshwater meadows, seasonal swamps with abundant aquatic flora, reed swamps, wooded lakes and swamps, rice fields, and sewage ponds (Marchant and Higgins 1990).	10	5	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Hooded Robin	<i>Melanodryas cucullata cucullata</i>		L	NT	VU	Mostly in lightly timbered woodlands dominated by acacias or eucalypts, often with pockets of saplings or taller shrubs, an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter with scattered fallen timber. This species typically occurs north of the great divide in shrubland or woodland dominated by acacias (Higgins and Peter 2002; Tzaros 2005).	1	0	1	Suitable habitat present, likely to occur
Intermediate Egret	<i>Ardea intermedia</i>		L	CE		Mainly in inland freshwater wetlands, occasionally visit coastal wetlands and forages amongst aquatic vegetation in shallow water and requires trees for roosting and nesting. Often occurs in wetlands that contain vegetation, including <i>Typha</i> . They are generally scarce in Victoria only few breeding records from Gunbower Island and Murray River,	5	5	0	Suitable habitat present in wetland habitats along the Murray River and billabongs, likely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						few pairs nested near Barmah during deep spring floods (Marchant and Higgins 1990).				
Latham's Snipe	<i>Gallinago hardwickii</i>	M (JAMBA, CAMBA, ROKAMBA, Bonn Convention (A2H))		NT		Occurs in wide variety of permanent and ephemeral wetlands; it prefers open freshwater wetlands with dense cover nearby, such as the edges of rivers and creeks, bogs, swamps, waterholes (Naarding 1983; Higgins and Davies 1996).	1	0	0	Suitable habitat present in wetlands, however due to lack of records it is considered unlikely to occur
Malleefowl	<i>Leipoa ocellata</i>	M, VU	L	EN		Mainly in semi-arid zones in heath and mallee-heath, rarely arid zones. Associated with mallee, particularly floristically rich tall dense mallee of higher rainfall areas (Marchant and Higgins 1993).	0	0	0	No suitable habitat, unlikely to occur
Masked Owl	<i>Tyto novaehollandiae</i> race <i>novaehollandiae</i>		L	EN	VU	Mostly occurs in open woodlands and forests that provide dense and tall tree cover, and adjoining open habitats such as cleared farmlands (Higgins 1999).	0	0	0	Suitable habitat at the Study Area and was recorded on the NSW section. Recorded in the Study Area
Musk Duck	<i>Biziura lobata</i>			VU		This species inhabits terrestrial wetlands, estuarine habitats and sheltered inland waters. Almost entirely aquatic, preferring deep water of large swamps, lakes and estuaries, where conditions are stable and aquatic flora abundant (Marchant and Higgins 1990).	8	7	0	No suitable habitat, unlikely to occur
Nankeen Night Heron	<i>Nycticorax caledonicus hillii</i>			NT		Inhabits littoral and estuarine habitats and terrestrial wetlands. Mainly nocturnal foraging over soft or firm substrates in still or slow-moving shallow water, on exposed shores, banks and flats of wetlands, or swampy vegetation. Often occurs where sheltered by tall emergent or ground vegetation and near trees used for roosting (Marchant and Higgins 1990).	4	1	0	Suitable habitat present along the rivers and at wetlands in the Study Area. Recorded in the Study Area
Plains Wanderer	<i>Pedionomus torquatus</i>	VU	L	CE		This species inhabits native grasslands with sparse cover, preferring grasslands that include Wallaby Grass and <i>Stipa</i> species. In Victoria no recent records in south east, sporadic reports from Keilor-	0	0	0	No suitable habitat, unlikely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						Werribee Plains. Widespread in small areas in the mallee, most common in northern Victoria between Bendigo and Swan Hill (Marchant and Higgins 1993).				
Rainbow Bee-eater	<i>Merops ornatus</i>	M (JAMBA)				Usually in open or lightly timbered areas, often near water. Occur in partly cleared land such as farmland and in sand-dunes, both coastal and inland (Higgins 1999).	18	14	1	Birds observed flying over the Study Area in woodland habitats, Recorded in the Study Area
Regent Honeyeater	<i>Anthochaera phrygia</i>	EN, M (JAMBA)	L	CE	VU	Mainly occurs in dry sclerophyll forests and box-ironbark woodlands with copious flowering eucalypts and/or mistletoes, usually near rivers and creeks on inland slopes of the Great Dividing Range. It can also occur in small remnant patches or isolated clumps of mature flowering trees in farmland, coastal or urban areas. Occur in northern and central Victorian box-ironbark forests. It is now considered extinct in western Victoria (Higgins <i>et al.</i> 2001).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Royal Spoonbill	<i>Platalea regia</i>				VU	This species occurs in terrestrial wetlands, sheltered marine habitats and wet grasslands. Foraging limited to shallow waters, often among aquatic or emergent vegetation or submerged logs that shelter prey and favour coastal habitats (Marchant and Higgins 1990).	4	3	0	Suitable habitat present in wetland habitats along the Murray River and billabongs, likely to occur
Rufous Fantail	<i>Rhipidura rufifrons</i>	M (Bonn Convention (A2H))				Primarily found in dense, moist habitats. Less often present in dry sclerophyll forests and woodlands (Higgins <i>et al.</i> 2006).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	M (Bonn Convention (A2H))				Tall forests and woodlands in wetter habitats but not in rainforest (Higgins <i>et al.</i> 2006).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Speckled Warbler	<i>Chthonicola sagittata</i>		L	VU	VU	Inhabits dry eucalypt forests and woodlands, especially those with box-ironbark eucalypt associations. It is also found in River Red Gum woodlands. The species is uncommon, populations have declined since the 1980s (Higgins and Peter	0	0	1	Suitable habitat present, likely to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						2002; Tzaros 2005).				
Superb Parrot	<i>Polytelis swainsonii</i>	VU	L	EN	VU	It occurs in riparian River Red Gum forests and adjacent areas of box eucalypt vegetation from the Murrumbidgee and Murray Rivers northwards to the Namoi Valley (Higgins 1999).	0	0	2	Suitable habitat present, but lack of recent and regular records, potential to occur
Swift Parrot	<i>Lathamus discolor</i>	EN	L	EN	VU	This species prefers a narrow range of eucalypts in Victoria, including White Box, Red Ironbark and Yellow Gum as well as River Red Gum when this species supports abundant 'lerp'. It breeds in Tasmania and migrates to the mainland of Australia for the autumn, winter and early spring months (Higgins 1999; Kennedy and Tzaros 2005).	0	0	1	Suitable foraging habitat present when River Red-gum is flowering, but lack of recent and regular records, potential to occur
Turquoise Parrot	<i>Neophema pulchella</i>		L	NT	VU	Occur in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low understorey of shrubs. It usually occurs in native grassy forests and woodlands composed of mixed assemblages of native pine and variety of eucalypts. It can also occur in savannah woodlands and riparian woodlands. In Victoria is has been recorded in East Gippsland, the north and north east districts (Higgins 1999).	3	3	0	Suitable habitat present, likely to occur
Varied Sittella	<i>Daphoenositta chrysoptera</i>				VU	Inhabits eucalypt open woodlands and forests (Higgins and Peter 2002)	0	4	0	Birds observed in the woodland habitat. Recorded in the Study Area
Whiskered Tern	<i>Chlidonias hybridus javanicus</i>			NT		Inhabit shallow terrestrial freshwater wetlands, either permanent or ephemeral, including lakes, swamps, river pools, reservoirs and sewage farms. In Victoria few records in Gippsland and north east, but widespread elsewhere in west of state (Higgins and Davies 1996).	3	2	0	No suitable habitat and lack of recent and regular records, unlikely to occur
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	M (CAMBA)	L	VU		Occurs in maritime habitats, terrestrial large wetlands and coastal lands of tropical and temperate Australia and offshore islands. Its range extends far inland only over large rivers and wetlands (Marchant	1	1	0	Suitable habitat present along Murray River, may occasionally fly over, but lack of recent and regular records, potential to occur

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
						and Higgins 1993).				
White-throated Needletail	<i>Hirundapus caudacutus</i>	M (JAMBA, CAMBA, ROKAMBA)				Aerial, over all habitats, but probably more over wooded areas, including open forest and rainforest. Often over heathland and less often above treeless areas such as grassland and swamps or farmland (Higgins 1999).	1	1	0	May fly over the study area during summer months, potential to occur
Mammals										
Brush-tailed Phascogale	<i>Phascogale tapoatafa tapoatafa</i>		L	VU	VU	Dry forest and woodland in association with box, ironbark and Stringybark eucalypts (Menkhorst 1995).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Brush-tailed Rock Wallaby	<i>Petrogale penicillata</i>	VU	L	CE		Rock faces with large tumbled boulders, ledges and caves (Menkhorst 1995).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
South-eastern Long-eared Bat (south-eastern form)	<i>Nyctophilus corbeni</i>	VU	L	VU	VU	Occurs in a range of inland woodland and shrubland communities including box, ironbark and cypress pine woodlands (Menkhorst 1995, DSEWPC 2013).	0	0	1	Habitat initially deemed suitable. Targeted surveying undertaken. Initial analysis of recorded calls indicated species was present. Peer Review (Gration 2015) found species was not recorded and habitat is not suitable (Appendix 11). Species unlikely to occur.
Koala	<i>Phascolarctos cinereus</i>	VU in NSW only			VU	Inhabits sclerophyll forests and woodlands on both sides of the GDR. Arboreal, agile climbers and mostly solitary (Menkhorst 1995).	0	0	1	Suitable habitat present, but lack of recent and regular records, potential to occur
Large-footed Myotis	<i>Myotis macropus</i>			EN	VU	They inhabit vegetated areas in association with streams and permanent waterways (Churchill 2008).	0	0	0	Suitable habitat present although species was not recorded during bat surveys. Unlikely to occur
Spot-tailed Quoll	<i>Dasyurus maculatus maculatus</i>	EN	L	EN	VU	Rainforest, wet and dry forest, coastal heath and scrub and River Red-gum woodlands along inland rivers (Menkhorst 1995).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Squirrel Glider	<i>Petaurus norfolcensis</i>		L	EN	VU	Dry forest and woodland and nearby riverine corridors (Menkhorst 1995).	25	28	1	Suitable habitat present. Recorded in the Study Area

Common Name	Scientific Name	Conservation Status				Habitat	Number of records from VBA (2014)	Number of Records from the AVW (2011)	Number of Records from NSW databases (2014)	Likelihood of Occurrence
		EPBC	FFG	DEPI	TSC					
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>		L		VU	Wide range of habitats, from wet and dry sclerophyll forests to open woodlands, acacia shrubland and mallee. Migratory species found only between January and April (Churchill 2008).	0	0	1	Suitable habitat present. Recorded in the Study Area
Reptiles										
Bandy Bandy	<i>Vermicella annulata</i>		L	NT		Wide range of habitats including wet coastal forest, savannah woodland, mallee, mulga and other <i>acacia</i> scrub to spinifex-covered desert sandhills (Cogger 2000).		2	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Murray River Tortoise	<i>Emydura macquarii</i>			DD		Rivers, creeks and lagoons associated with the Murray/Darling drainage system (Wilson and Swan 2003).	2	2	0	Suitable habitat along the Murray River and wetland habitats, likely to occur
Striped Legless Lizard	<i>Delma impar</i>	VU	L	EN	VU	Tussock grasslands on the volcanic plains often associated with scattered rocks and cracked soils (Cogger 2000).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur
Frogs										
Growling Grass Frog	<i>Litoria raniformis</i>	VU	L	EN	EN	Permanent, still or slow flowing water with fringing and emergent vegetation in streams, swamps, lagoons and artificial wetlands such as farm dams and abandoned quarries (Clemann and Gillespie 2004).	0	0	0	Suitable habitat in wetlands in the NSW section of the Study Area however was not recorded during targeted survey, unlikely to occur
Insects										
Golden Sun Moth	<i>Synemon plana</i>	CE	L	CE		Areas that are, or have been native grasslands or grassy woodlands. It is known to inhabit degraded grasslands with introduced grasses being dominant, with a preference for the native wallaby grass being present (DEWHA 2009).	0	0	0	No suitable habitat and lack of recent and regular records, unlikely to occur

DEPI – Status from DELWP Advisory List; **EPBC** – Status under EPBC Act; **FFG** – Status under FFG Act; **TSC** – Status from Threatened Species Conservation Act (NSW); **AVW** – Atlas of Victorian Wildlife; **NSW databases** – Atlas of NSW wildlife; **CE** – Critic ally endangered; **EN** – Endangered; **VU**– Vulnerable; **NT** – Lower risk near threatened; **DD** = data deficient; **L** – Listed on FFG Act; **FM** – Status under Fisheries Management Act; **M** = Listed migratory species; **(JAMBA)** = Japan-Australia Migratory Bird Agreement; **(CAMBA)** = China-Australia Migratory Bird Agreement; **(ROKAMBA)** = Republic of Korea-Australia Migratory Bird Agreement; **(Bonn Convention (A2H))** = listed under Section of Bonn Convention.

3.6.2.2 Birds

Based on the assessment in Table 6, 20 listed threatened bird species were considered likely to occur in the Study Area. The vulnerability of these species to potential impacts from the proposed development is discussed below.

3.6.2.2.1 Threatened species within the Study Area

Eight species of threatened birds were recorded during the field inspection days within the Study Area. These are shown Figure 10 and discussed below.

- **Brown Treecreeper** (DELWP - near threatened, TSC - vulnerable): This species (*Climacteris picumnus victoriae*) is listed as near threatened in Victoria on the DELWP Advisory List and vulnerable in NSW under the TSC Act. It occurs mostly in eucalypt dominated woodlands, especially with rough-barked eucalypts and often with open grassy understorey. It has been recorded in River Red-gum and Black Box woodlands and requires hollows for breeding (Higgins et al. 2001).

A large and viable population of the Brown Treecreeper was found to inhabit all sections of the Study Area particularly those areas dominated by Black Box. The species was also found to breed in suitable hollows within the Study Area. The removal of native vegetation within the Study Area is likely to have a negative impact on this species, namely through the reduction of suitable breeding habitat.

The taxonomic status of the population at Echuca was questioned by Envirokey (2012), as Echuca lies in a distributional transition zone between the threatened *Victorian* sub-species and the non-threatened *picumnus* sub-species, according to Shodde and Mason (1999). As such, in the absence of detailed taxonomic studies of the population, and under the precautionary principle, the Echuca population must be considered as the threatened *Victorian* sub-species. Further analysis could be undertaken (and consultation with the Office of Environment and Heritage (OEH)) to provide more confidence in whether the Brown Treecreeper recorded at the Study Area is the threatened sub-species.

- **Masked Owl** (FFG Act listed, DELWP - endangered, TSC - vulnerable): This species (*Tyto novaehollandiae race novaehollandiae*) is listed as threatened under the Victorian FFG Act, endangered in Victoria under the DELWP Advisory List and listed as vulnerable in NSW under the TSC Act. It mostly occurs in open woodlands and forests that provide dense and tall tree cover, and adjoining open habitats such as cleared farmlands (Higgins 1999). According to the NSW recovery plan for the Masked Owl (DEC 2006), records of the species are very scarce in the Echuca/Moama region. Similarly, there are very few records in the Victorian AVW for the region. Therefore it is likely to occur in low numbers in the region.

One individual was recorded in the NSW component of the Study Area (Figure 10),

- **Azure kingfisher** (DELWP - near threatened): This species is listed as near threatened in Victoria on the DELWP Advisory List. It is a wetland associated species, found to inhabit vegetated freshwater wetland margins or along streams and rivers (Higgins 1999). One individual was recorded on the shores of the Campaspe River (Figure 10).

This species is not likely to be directly impacted since it is restricted to the river banks and only a small section of their habitat would be altered during the development. However there is potential for indirect impacts such as sediments or spills entering the waterway making it difficult to fish and shading of the bridge.

- **Brown Quail** (DELWP - near threatened): This species is listed as near threatened in Victoria on the DELWP Advisory List. It inhabits tall ground vegetation over damp ground, usually in woodlands, grassland, heath, bracken and stands of vegetation fringing wetlands (Marchant & Higgins 1993). A pair was located in tall grass on the margin of a billabong along the Campaspe River (Figure 10).

The removal of native vegetation within the Study Area is likely to have an impact on this species, namely through the reduction of suitable habitat.

- **Varied Sittella** (TSC – vulnerable): This species is listed as vulnerable on the NSW TSC Act. This species is not listed in Victoria. It inhabits eucalypt open woodlands and forests (Higgins and Peter 2002). One individual was recorded in the NSW component of the Study Area (Figure 10).

The removal of native vegetation within the Study Area is likely to have an impact on this species, namely through the reduction of suitable habitat.

- **Nankeen Night Heron** (DELWP – near threatened): This species is listed as near threatened in Victoria on the DELWP Advisory List. This heron inhabits littoral and estuarine habitats and terrestrial wetlands. Nankeen Night Herons are mainly nocturnal species but roost in tall trees near wetlands during the day (Marchant & Higgins 1990). Several Nankeen Night Heron individuals were located during spotlighting on both the shores of the Murray and the Campaspe Rivers (Figure 10).

This species is not likely to be impacted since it is restricted to the aquatic habitats and only a small section of their habitat would be altered during the development.

- **Black-chinned Honeyeater** (DELWP – near threatened, TSC – vulnerable): This species is listed as near threatened in Victoria on the DELWP Advisory List and vulnerable in New South Wales under the TSC Act. This honeyeater inhabits open box-ironbark forests and

woodlands. Usually found in Red or Mugga Ironbarks, Grey Box, Yellow Gum and Yellow Box. Especially mature tall trees along gullies, low-lying flats and lower slopes. The species is gregarious, usually seen in groups of 3–10 birds (Higgins et al. 2001).

The removal of native vegetation within the Study Area is likely to have an impact on this species, namely through the reduction of suitable habitat.

- **Rainbow Bee-eater** (EPBC Act - migratory) is a summer visitor to the region, was recorded within the study area. The bee-eater was not recorded during the initial 2011 survey, probably as it had not yet arrived in the area, but was later recorded during the November 2011 and October 2012 surveys. It has also previously been reported on both sides of the river in the study area (BL&A 2013b). The Rainbow Bee-eater is widespread in Australia and while listed under the EPBC Act as a migratory species, it is not threatened. The removal of native vegetation within the Study Area is unlikely to have a significant impact on this species.

3.6.2.2 *Species with suitable habitat not recorded within the Study Area*

Apart from species recorded in the Study Area, 13 additional threatened bird species are considered likely to occur or have the potential to occur within the Study Area, these include:

Woodland birds: Ten species of woodland birds were considered likely to occur in the Study Area. These included three parrots and seven additional bush birds. The likelihood of the presence of these species in the Study Area is as follows:

- **Swift Parrot** (EPBC Act – endangered, FFG Act listed, DELWP – endangered, TSC – vulnerable): 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 species is considered as nomadic in Victoria and NSW, with movements being determined by flowering eucalypts (Emison et al. 1987; Higgins et al. 2001). Although the Swift Parrot may occasionally pass through the Study Area, it is highly unlikely it would occur regularly or in significant numbers. For this reason this species is unlikely to be significantly impacted by the project. There are no records of the species in AVW but one record in the ANSWW, and although the Study Area contains potential foraging habitat, the preferred food trees of the species in this region, such as Red Ironbark, Grey Box, Yellow Gum and White Box, are absent.
- **Superb Parrots** (EPBC Act – vulnerable, FFG Act listed, DELWP – endangered, TSC – vulnerable): This species occurs 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. It

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, especially as no records within the search region were found in Victoria or NSW. The centre of the Victorian population occurs in habitats further east along the Murray River, associated with the Barmah – Millewa forests. This species is unlikely to be significantly impacted by the Project.

- **Turquoise Parrot** (FFG Act listed, DELWP – near threatened, TSC – vulnerable): This species 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 three old records of this species from the AVW (1984–86) and none in the ANSWW. Although this species may occur in the Study Area as suitable habitat is present, it is unlikely to occur there regularly, as evidenced by the lack of recent atlas records, despite records being submitted regularly to most of these databases. This species is unlikely to be significantly impacted by the Project.
- **Grey-crowned Babbler** (FFG Act listed, DELWP – endangered, TSC vulnerable): 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-operative breeding species. 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. The 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).

Four records of the Grey-crowned Babbler were located within the ANSWW search region from 2004 and 2005. No records of this species exist from the Victorian section of the search region. The highest quality potential habitat is considered to occur in the Black Box woodland. Given that potential habitat exists, this species was considered to have potential to occur in woodland habitat within both sides of the Study Area. During the field survey, as was the case during the 2009 surveys (BL&A 2013b), 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 Preferred Alignment on the New South Wales side of the Murray River (BL&A 2013b). 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 occurs in the vicinity of the Preferred Alignment, although they may occur elsewhere along the Murray River nearby. This species is considered unlikely to be significantly impacted by the Project.

- Potentially suitable habitat also occurs for several other woodland species, such as the **Diamond Firetail**, **Speckled Warbler** (FFG Act listed, DELWP – vulnerable, TSC - vulnerable) and **Hooded Robin** (FFG Act listed, DELWP - near threatened, TSC - vulnerable). The AVW did not contain record of these species, but the ANSWW contains one record for each within the search region. Therefore, although these species may occasionally utilise the habitats in the Study Area, they are unlikely to occur regularly or in significant numbers. These species are unlikely to be significantly impacted by the project.

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3.6.2.2.3 *Waterbirds*

The AVW lists a number of threatened waterbird species from the search region. These species include: **Eastern Great Egret** (EPBC Act – migratory, FFG Act listed, DELWP - vulnerable) (8 records between 1984 and 2001), **Intermediate Egret** (FFG Act listed, DELWP – critically endangered)(5 records between 1994 and 2001), and **Royal Spoonbill** (DELWP – vulnerable) (3 records between 1989 and 1994), Very limited habitat for waterbirds occurs along the Rivers and the billabongs, and such habitat would be temporarily used for foraging but unlikely to support breeding. In addition, there were more records of threatened ducks and terns; none of which was considered likely to occur due to a lack of suitable habitat (see Table 6). These species are unlikely to be significantly impacted by the Project.

3.6.2.2.4 *Migratory Birds*

The EPBC Act Protected Matters Search results also identified suitable habitat in the search region for listed migratory bird species protected under the EPBC Act.

White-bellied Sea-eagle (EPBC Act – migratory, FFG Act listed, DELWP – vulnerable): The eagle may occur in 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 on regular basis. This species is unlikely to be significantly impacted by the project.

Eastern Great Egret (EPBC Act – migratory) **has** very limited suitable habitat occurs along the Rivers and the billabongs in the vicinity of the study area. While such habitat would be temporally used for foraging, it is unlikely to support breeding activities. As such, this species is unlikely to be significantly impacted by the proposal.

Fork-tailed Swift and White-throated Needletail (EPBC Act – migratory) are highly nomadic when in Australia and move in flocks ahead of weather fronts, often over heavily forested areas. These species have the potential to occur in the study area occasionally due to the presence of suitable habitat. These species are unlikely to be significantly impacted by the proposal.

3.6.2.3 Mammals

Based on the assessment in Table 6, three listed mammal species were considered likely to occur in the Study Area, including two arboreal mammals and one bat. The vulnerability of these species to potential impacts from the proposed development is discussed below.

- **Squirrel Glider** (FFG Act listed, DELWP – endangered, TSC – vulnerable): 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. The species requires hollows for building dens 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 were 28 AVW records of this species within the search region ranging from 1980 to 2000; three of these locations are close to the Study Area (within one kilometre). While not detected during either of the initial or targeted hair tube trapping surveys undertaken by BL&A in the Study Area, one Squirrel Glider was detected incidentally during spotlighting surveys in November 2012. This Squirrel Glider was recorded adjacent to arboreal cage trap no. 8 (see section 3.6.3.2). Subsequently, additional cage trapping was undertaken by ARCUE (van der Ree et al. 2015) recording seven Squirrel Gliders adjacent to the Preferred Alignment within Victoria and NSW.

Habitat connectivity for this species within the Victoria portion of the study area is currently impaired. As such, a further barrier in the form of the new road skirting the existing township is unlikely to have a significant impact, particularly if mitigation measures such as the installation of crossing zones are taken into account. Mitigation measures for this species would be developed on a project wide basis

(refer to Attachment 12). For these reasons, significant impacts on this species are not anticipated.

- **Koala** (EPBC Act – vulnerable in NSW, TSC – vulnerable): Inhabits sclerophyll forest and woodlands on both sides of the Great Divide (Menkhorst 1995). While the AVW contained no records of the species, the ANSWW contained one record from the search region. It is likely that the species may inhabit the Study Area, but such presence would be rare since habitats in the Study Area lack the preferred eucalypt food for the Koala. This species is unlikely to be significantly impacted by the project.
- **Bats: Yellow-bellied Sheathtail Bat** (TSC – vulnerable, FFG Act listed).

The Yellow-bellied Sheathtail Bat is discussed further below.

3.6.2.4 Reptiles

Based on the assessment in Table 6, The **Murray River Tortoise** (DELWP – data deficient) is the only listed reptile species considered likely to occur in the Study Area. There were three records of the turtle in the AVW search region, but none from the ANSWW. The species is likely to inhabit the shores of the Murray and Campaspe Rivers and also probably billabongs along these rivers.

3.6.2.5 Frogs

Based on the assessment in Table 6, no listed frog species was considered to potentially occur in the Study Area. Growling Grass Frog was not recorded during targeted surveying and so was considered unlikely to occur in the Study Area.

3.6.2.6 Fish

Impacts to fish species are considered in a separate report (GHD 2015).

3.6.3 Threatened fauna species targeted surveys

3.6.3.1 Results of the hair tube trapping

An extensive trapping regime was set up during November 2011 (8–22/11/2011) to investigate possible presence of the threatened Squirrel Glider within the Study Area. Hair tube traps were used and set up at six different transects (Figure 4) representing the different woodland and forest habitats within the Study Area.

The analysis of hair trapped by the hair tubes did not reveal the presence of Squirrel Glider at any section of the Study Area. However, the hair tubes recorded the presence of the Common Brushtail Possum and Sugar Glider, both common arboreal mammals, in both Victoria and NSW.

3.6.3.2 Results of the arboreal cage trapping for Squirrel Glider (NSW only)

Arboreal cage trapping was conducted by BL&A within suitable habitat in the NSW portion of the Study Area during October 2012 (16-19/10/2012) to determine the status of the threatened Squirrel Glider in NSW.

The results were negative for Squirrel Glider; the only species trapped was the Common Brushtail Possum. Detailed results are presented in Table 7 and trap locations are presented in Figure 4.

However, during incidental spotlighting during the 2012 Growling Grass Frog targeted survey, a Squirrel Glider was detected adjacent to arboreal cage trap no. C8 (see below).

Weather conditions during each trap night of the arboreal cage trapping for Squirrel Glider are summarised as follows:

- 15/10/2012 - Cool evening, gentle breeze, 90% cloud cover, moderate precipitation, 1/4 moon.
- 16/10/2012 - Cool evening, gentle breeze, clear sky, no precipitation, 1/4 moon.
- 17/10/2012 - Cool evening, no breeze, clear sky, no precipitation, 1/4 moon.
- 18/10/2012 - Cool evening, no breeze, clear sky, no precipitation, 1/4 moon.

Subsequently, additional cage trapping was undertaken by ARCUE (van der Ree et al. 2015) recording seven Squirrel Gliders adjacent to the Preferred Alignment within Victoria and NSW.

Table 7: Detailed results of the arboreal cage trapping for Squirrel Glider by BL&A

Trap no.	Trap set date	Habitat type	Trap tree details	Species trapped	Trap status
C1	15/10/2012	Floodplain woodland, shallow ephemeral inundation, dominated by sparse canopy of young and mature River Red-gum, numerous hollow-bearing trees, shrub layer largely absent, ground layer dominated by indigenous semi-aquatic grasses, sedges and herbs.	Large River Red-gum, several small hollows, sap flows evident	Nil	Closed, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C2	15/10/2012	Floodplain woodland, shallow ephemeral inundation, dominated by sparse canopy of young and mature River Red-gum, numerous hollow-bearing trees, shrub layer largely absent, ground layer dominated by indigenous semi-aquatic grasses, sedges and herbs.	Very large River Red-gum, numerous large and small hollows, sap flows evident	Nil	Open, baited
	16/10/2012			Common Brushtail Possum	N/A
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Closed, baited
C3	15/10/2012	Floodplain woodland, shallow ephemeral inundation, dominated by sparse canopy of young and mature River Red-gum, numerous hollow-bearing trees, shrub layer largely absent, ground layer dominated by indigenous semi-aquatic grasses, sedges and herbs.	Very large River Red-gum, numerous large and small hollows, sap flows evident	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Closed, baited
	18/10/2012			Nil	Open, baited
C4	15/10/2012	Floodplain woodland, shallow ephemeral inundation, dominated by sparse canopy of young and mature River Red-gum, numerous hollow-bearing trees, shrub layer largely absent, ground layer dominated by indigenous semi-aquatic grasses, sedges and herbs.	Large River Red-gum, several large and small hollows, sap flow evident	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C5	15/10/2012	Riparian woodland dominated by full canopy of mature River Red-gum, numerous hollow-bearing trees, tall shrub layer dominated by Silver Wattle, ground layer dominated by exotic grasses.	Large River Red-gum, 1 large hollow, sap flows evident	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C6	15/10/2012	Riparian woodland dominated by full canopy of mature River Red-gum, numerous hollow-bearing trees, tall shrub layer dominated by Silver Wattle, ground layer dominated by exotic grasses.	Large River Red-gum, no hollows, sap flows evident	Nil	Closed, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C7	15/10/2012	Riparian woodland dominated by full canopy of mature River Red-gum, numerous hollow-bearing trees, tall shrub layer dominated by Silver Wattle, ground layer dominated by exotic grasses.	Large River Red-gum, no hollows, sap flows evident	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C8	15/10/2012	Grassy woodland dominated by Black Box and River Red-gum regrowth with thin scattering of mature canopy trees, hollow-bearing trees largely absent, shrub layer dominated by Pale-fruit Ballart, <i>Acacia</i> species absent. Ground layer very sparse.	Medium sized River Red-gum, no hollows	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Open, baited
C9	15/10/2012	Riparian woodland dominated by full canopy of mature River Red-gum,	Large River Red-gum,	Common Brushtail Possum	N/A

Trap no.	Trap set date	Habitat type	Trap tree details	Species trapped	Trap status
	16/10/2012	numerous hollow-bearing trees, tall shrub layer dominated by Silver Wattle, ground layer dominated by exotic grasses.	several large hollows, sap flows evident	Nil	Closed, baited
	17/10/2012			Common Brushtail Possum	N/A
	18/10/2012			Nil	Closed, baited
C10	15/10/2012	Floodplain woodland, shallow ephemeral inundation, dominated by sparse canopy of young and mature River Red-gum, numerous hollow-bearing trees, shrub layer largely absent, ground layer dominated by indigenous semi-aquatic grasses, sedges and herbs.	Large River Red-gum, no hollows, sap flows evident	Nil	Open, baited
	16/10/2012			Nil	Open, baited
	17/10/2012			Nil	Open, baited
	18/10/2012			Nil	Closed, baited

The BL&A and ARCUE results indicate that a small Squirrel Glider population occurs in the area. Squirrel Glider occurs along the Murray River between the Gunbower Forest and the Keiwa River (Ahern 2003). The results of the surveys indicate that the species is likely to occur at a low density in the River Red Gum woodlands on the floodplains of the Murray and Campaspe Rivers. There are historical records in the VBA from this region.

3.6.3.3 Results of call playback and spotlighting

3.6.3.3.1 2009 surveys

A diurnal survey and evening spotlighting and call playback was undertaken in January 2009 in an attempt to locate Bush Stone-curlew 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 Preferred Alignment.

Evening spotlight and call playback surveying was carried out in January 2009 in an attempt to locate Squirrel Glider in all potential habitats along the Preferred Alignment. Although the results of this survey were negative, the species was still considered likely to occur in the Study Area.

3.6.3.3.2 2011 surveys

Detailed targeted surveys were undertaken at the Study Area during November 2011. These were designed to complement earlier surveys carried out during the initial surveys of September 2011. The methods and timing for these surveys are described above in the methods section (section 3.0.6.2).

Surveys were aimed at determining the status of the Bush Stone-Curlew and Barking Owl. Results of these surveys are summarised in Table 8 below.

Despite extensive survey effort, neither of the above two threatened fauna species were detected although suitable habitat is present. Due to this it has been concluded that the Bush Stone-curlew and Barking Owl are not permanent residents in the Study Area.

3.6.3.3.3 2012 survey

Incidental arboreal spotlight surveying was carried out on the evenings of October 17th and 18th 2012 in the NSW portion of the Study Area, concurrently with the Growling Grass Frog survey (see below).

On the 17th October 2012 an unidentified glider (*Petaurus* spp.) was observed in a tree adjacent cage trap no. F8 (Figure 10). Numerous photographs were taken of the specimen to aid in identification. Expert advice on the identification of the glider was provided by Rodney Van der ree, based on the photographs. His conclusion was the specimen was 'almost certainly a Squirrel Glider' (pers. Com. Rodney Van der Ree). Based on this observation, the Squirrel Glider was considered resident (at least) in the NSW portion of the Study Area. Subsequent surveys by ARCUE (van der Ree et al 2015) have shown they are present on both sides of the Murray River (see Section 3.6.3.2 above)

On the 18th October 2012, a Masked Owl was identified near cage trap no. F2 (Figure 10) in the NSW portion of the study area (See above for details).

Table 8: Summary of results from the targeted fauna surveys undertaken during November 2011. Survey targeted the Barking Owl, Bush Stone–Curlew and Squirrel Glider.

Site	Date	Weather conditions	Habitat type	Findings	
				Threatened spp	Other species
Site No. 1 (F1)– southern part of Study Area; Victorian section	8 / 11 / 2011	Clear night, Calm, warm	Black Box Woodland	No threatened spp detected	6 Common Ringtail Possum 6 Common Brushtail Possum
Site No. 2 (F2)– central part of Study Area; Victorian section	8 / 11 / 2011	Clear night, Calm, warm	River red-gum forest close to large billabong	No threatened spp detected	4 Common Ringtail Possum 6 Common Brushtail Possum 2 Nankeen Night Heron 1 Southern Boobook 1 Tawny Frogmouth Many Barking Marsh Frog Few Peron’s Tree Frog Few Plain Froglet

Site	Date	Weather conditions	Habitat type	Findings	
				Threatened spp	Other species
Site No. 3 (F3) – northern part of Study Area; NSW section	15/ 11 / 2011	Clear night, Calm, warm	River Red-gum Forest – close to Murray river	No threatened spp detected	2 Common Ringtail Possum 3 Common Brushtail Possum 1 Black Rat 1 Southern Boobook Many Barking Marsh Frog
Site No. 4 (F4) – northern part of Study Area; NSW section	15/ 11 / 2011	Clear night, Calm, warm	River Red-gum Forest – away from Murray river	No threatened spp detected	1 Common Brushtail Possum 1 Black Rat
Site No. 5 (F5) – northern part of Study Area; Victorian section	16 / 11 / 2011	Clear night, Calm, warm	River Red-gum – Black Box mixed Forest	No threatened spp detected	12 Common Ringtail Possum 11 Common Brushtail Possum 2 Black Rat 1 Tawny Frogmouth 1 Red Fox

Spp = species.

3.6.3.3.4 *Results of the Growling Grass Frog survey*

Call playback for the Growling Grass Frog was undertaken in January 2009 at a billabong in River Red-gum woodland on the Moama side of the Study Area. The results of that survey were negative.

During the October 2012 survey, suitable habitat for the Growling Grass Frog was identified in the NSW portion of the Study Area, but not in the Victorian. Two survey sites were selected, and are described as follows:

3.6.3.3.4.1 Site 1: Deep semi-artificial billabong aquatic habitat

This water body was presumably one of a chain of a shallow billabongs, situated some 600 metres north-east of the Murray River channel. However, there was ample evidence that it had been dammed and excavated, thereby increasing its size and depth.

The banks were steep and moderately vegetated with young River Red-gum and Black Box trees, planted willows and bottlebrush and Pale-fruit Ballart shrubs. The ground layer was very sparse, comprising introduced grass and forb species. Aquatic and semi-aquatic flora was sparse, comprising sedges and rushes, Slender Knot-weed, Cumbungi, Water Couch, Water Buttons, Slender Dock and Swamp Wallaby-grass.

3.6.3.3.4.2 Site 2: Flooded red gum woodland aquatic habitat

This aquatic habitat occurred on ephemeral flooded red gum woodland, some 500 metres east of the Murray River channel. It is presumed that periodic inundation would be effected by both flooding of the Murray River and heavy rainfall.

The entire water column was well vegetated with a sparse canopy of large and sapling River Red-gums, virtually no shrub stratum and a ground stratum dominated by indigenous wetland species such as Common Spike-sedge, Poong'ort and various rushes, Swamp Wallaby-grass, Austral Sweet-grass, Common Blown-grass, willow herb, Water Milfoil, Ferny Small-flower Buttercup, Common Sneezeweed and Slender Dock.

The location of the above survey sites are presented in Figure 4.

Six frog species were aurally detected during the survey, and none was detected visually (Table 9). These were all common frogs and are not threatened species. No Growling Grass Frogs were heard or observed during the current targeted survey. Weather conditions recorded during the survey are presented in Table 10.

Table 9: Frog species detected during the targeted survey

Site	Survey Date	Species						
		Eastern Banjo Frog	Barking Marsh Frog	Spotted Marsh Frog	Common Froglet	Plains Froglet	Peron’s Tree Frog	Growling Grass Frog
F1	17/10/2012	2	-	-	-	3	-	-
	18/10/2012	1	1	-	-	2	-	-
F2	17/10/2012	2	-	4	1	7	1	-
	18/10/2012	1	-	7	-	9	-	-
Totals		6	1	11	1	21	1	0

Table 10: Weather conditions during Growling Grass Frog survey

Site	Survey Date	Start Time	Temperature °C	Wind	Cloud cover	Precipitation
F1	17/10/2012	21:15	15.6	Still	Clear sky	No
	18/10/2012	21:15	16.0	Still	Clear sky	No
F2	17/10/2012	20:30	15.9	Still	Clear sky	No
	18/10/2012	20:20	17.2	Still	Clear sky	No

3.6.3.3.5 *Hollow-bearing tree survey (NSW only)*

Thirty-five (35) hollow-bearing trees were recorded in the NSW component of the Study Area, the majority of which were associated with the riparian zone of the Murray River and the gazetted road reserve (Forbes Street) in the north-east of the Study Area. The number, nature of and approximate size of the hollows is presented in Table 11, and their locations are presented in Figure 11.

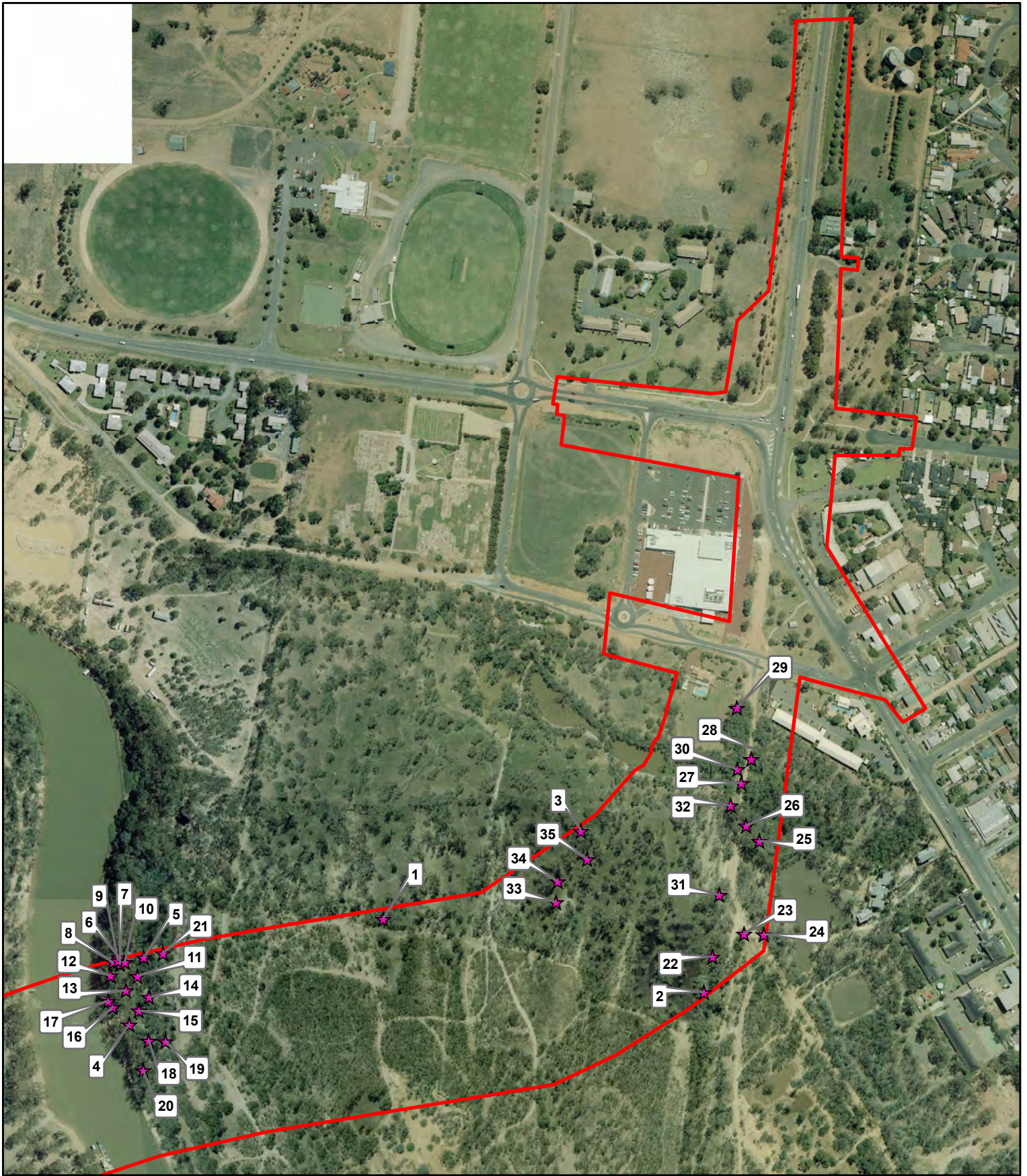
Hollow dependant threatened species include:

- Brown Treecreeper;
- Masked Owl;
- Superb Parrot;
- Turquoise Parrot;
- Squirrel Glider; and
- Yellow-bellied Sheathtail Bat.

Table 11: Hollow bearing trees in the NSW part of the Study Area

Tree no.	Tree species	Tree hollow details
1	River Red-gum	5 Potential small spouts
2	River Red-gum	4 Trunk hollows (20-50 cm diam'), 8 spouts (10-25 cm diam')
3	River Red-gum	2 Trunk hollows (20 cm diam'), one spout (15 cm diam')
4	River Red-gum	One spout (15 cm diam')
5	River Red-gum	3 Spouts (10-25 cm diam')
6	Dead stag	One trunk hollow (20 cm diam')
7	Dead stag	One trunk hollow (25 cm diam')
8	River Red-gum	Numerous potential trunk fissures
9	River Red-gum	One spout (10 cm diam')
10	River Red-gum	One potential 10 cm diam' spout
11	River Red-gum	Numerous potential spouts
12	River Red-gum	One spout (15 cm diam')
13	River Red-gum	2 Spouts (10 cm diam')
14	River Red-gum	2 Spouts (10 cm diam')
15	River Red-gum	Large trunk basal hollow
16	Dead stag	One trunk hollow (30 cm diam'), 3 spouts (15 cm diam')
17	River Red-gum	One trunk hollow (30 cm diam'), 5 spouts (10 cm diam')
18	River Red-gum	One trunk hollow (20 cm diam')
19	River Red-gum	One trunk hollow (15 cm diam')
20	River Red-gum	One trunk hollow (20 cm diam')
21	River Red-gum	One trunk fissure (10 cm diam')
22	River Red-gum	2 Potential spouts
23	River Red-gum	2 Spouts (10-15 cm diam')
24	River Red-gum	3 Potential spouts (10 cm diam')
25	Dead stag	One trunk fissure (10 cm diam')
26	River Red-gum (near dead)	One large trunk hollow (30 cm diam')
27	River Red-gum	One spout (20 cm diam')

Tree no.	Tree species	Tree hollow details
28	River Red-gum	3 Potential spouts (10 cm diam')
29	River Red-gum	2 Spouts (15 cm diam')
30	Dead stag	Potential small spouts
31	River Red-gum	2 Potential spouts (10 cm diam')
32	River Red-gum	One trunk hollow (15 cm diam'), 2 spouts (10 cm diam')
33	River Red-gum	4 Spouts (10 cm diam')
34	River Red-gum	2 Potential spouts (10 cm diam')
35	Dead stag	One trunk hollow (30 cm diam'), one spout (15 cm diam)



Legend

- Study Area
- ★ Hollow-bearing trees



Figure 11: Location of hollow-bearing trees in the NSW portion of study area

Project: Murray River Crossing Echuca		
Client: VicRoads		
Project No.: 8194	Date: 16/09/2014	Created By: B. MacDonald / M. Ghasemi
Brett Lane & Associates Pty. Ltd. Ecological Research & Management		
<ul style="list-style-type: none"> Experience Knowledge Solutions 	Suite 5, 61 – 63 Camberwell Road, Hawthorn East, VIC 3123 PO Box 337, Camberwell, VIC 3124, Australia	Ph (03) 9815 2111 / Fax (03) 9815 2685 enquiries@ecologicalresearch.com.au www.ecologicalresearch.com.au
		N

3.6.3.4 Results of the Bat Surveys

Bats were recorded across two separate survey periods, the first during November 2011 (First Bat Survey) and second during February and March 2012 (Second Bat Survey). During these surveys, bats were recorded at eight sites representing the various habitats presented in and adjacent the Study Area; five of the sites were within the Victorian part of the Study Area and three sites were in the NSW part of the Study Area. The location of the bat survey sites is presented in Figure 4. The timing and location of the survey sites are described above in the methods section (Section 3.0.6.2).

The high number of bat calls recorded during both surveys suggests the Study Area is an important area for bats in general. This is not surprising since the woodlands and forest within which recording was carried out, combined with the presence of the Murray and Campaspe Rivers and associated woodlands, provided high quality habitats both for roosting and foraging.

3.6.3.4.1 Results of the First Bat Survey

During the First Bat Survey, more than 20,000 calls were recorded by the Anabat recorders from the eight sites in and adjacent to the Study Area. Site No. 1 was excluded from the results as the recording Anabat experienced machine failure and only seven calls were recorded from the seven nights of recording.

The seven recording sites recorded a total of 20,295 bat calls, ranging from 248 calls at Site No. 8 to 5,089 calls at Site No. 2, over the seven nights of recording. The majority of sites registered over 1,500 calls over the seven nights.

No attempt was made to separate the number of calls for each species of the common bats as such a process is time and effort consuming and would add little knowledge to the abundant species. Calls of threatened species were identified and the number of calls recorded counted. Given that the number of bat calls recorded on an Anabat system is not a measure of abundance, the higher the amount of bat calls from one point may reflect a relative measure of the importance of that area to bats at any given point. For example if an Anabat system had a high number of bat calls from any given location, that area is likely to be highly utilised by bats and is therefore an important area for bats in general.

During the First Bat Survey, 11 species of bats were recorded from the eight sites. The list included nine common and secured bat species, one uncommon but widely spread species and two threatened forms.

Table 12 presents the bat species recorded in the Study Area during the first bat survey and the number of nights in which species were recorded. The table shows that common species were recorded almost at every night of recording and in all the sites of study. All species of Long-eared bats (*Nyctophilus*) have been aggregated for the purpose of this assessment.

Based on the interpretation of calls recorded during the first bat survey, it was determined that South-eastern Long-eared Bat was present. However, a subsequent peer review of these findings found that the habitat present is not suitable, the recorded calls could not be attributed to South-eastern Long-eared Bat and, as such, it was not present within the study area (Gration 2015, see Appendix 11).

Detailed results of the First Bat Survey are provided in Appendix 6.

3.6.3.4.1.1 Threatened bats

Of the 11 species of bats recorded for the Study Area during the First Bat Survey, the species listed below is known to be threatened in one or both jurisdictions:

- **Yellow-bellied Sheathtail Bat** (FFG Act listed, TSC – vulnerable).

The number of bat calls recorded for this species during the first bat survey is presented in Tables 12 and 13.

Table 12: Bat species, status and number of nights recorded during the first bat survey within and adjacent the Study Area

Common names	Scientific name	No. nights Recorded at sites								Ecological status		
		1	2	3	4	5	6	7	8	Victoria	NSW	EPBC
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		7	5	7	7	7	7	7		Common-secured	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		7	7	7	7	7	7	6		Common-secured	
Southern Freetail bat (spp. 2)	<i>Mormopterus spp. 2</i>		7	4	6	7	6	7	7		Common-secured	
Southern Freetail bat (spp. 4)	<i>Mormopterus spp. 4</i>		7	7	7	7	7	7	2		Common-secured	
Long-eared Bat	<i>Nyctophilus spp.</i>		7	7	7	7	7	7	7		Common-secured	
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>		7	4	7	7	5	7	6	Uncommon but widespread	Common-secured	
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>		7	2	7	7	1	7	3	Threatened	Vulnerable	
White-striped Freetail Bat	<i>Tadarida australis</i>		7	7	7	7	7	7	7		Common-secured	
Large Forest Bat	<i>Vespadelus</i>	1*	7	7	7	7	7	7	7		Common-	

Common names	Scientific name	No. nights Recorded at sites								Ecological status			
		1	2	3	4	5	6	7	8	Victoria	NSW	EPBC	
	<i>darlingtoni</i>											secured	
Southern Forest Bat	<i>Vespadelus regulus</i>		7	2	5	7	0	7	0			Common-secured	
Little Forest Bat	<i>Vespadelus vulturnus</i>		7	7	7	7	7	7	7			Common-secured	

* There was only one call during the seven nights of recording at Site 1; possible equipment failure.

Table 13: Threatened bat species and the number of calls recorded within and adjacent the Study Area during the first bat survey

Threatened Bat Species	Total number of calls for the seven nights of recording at each site														Overall total
	2		3		4		5		6		7		8		
Yellow-bellied Sheathtail Bat	32	3-7	7	0-4	40	4-8	13	0-4	2	0-2	32	3-8	3	0-1	129

3.6.3.4.2 Results of the Second Bat Survey

During the Second Bat Survey, three of the recording sites (sites 2, 3, and 7) failed to record due to unusual heavy rains and partial flooding in the area. The remaining five sites (Sites 1, 4, 5, 6 and 8) recorded a total of 11,276 files, ranging from 35 files at Site No. 6 to 8424 files at Site No. 4, over the ten nights of recording. The recording sites were three in Victoria (1, 4 and 5) and two in NSW (6 and 8).

No attempt was made to separate the number of calls for each species of the common bats as such a process is time and effort consuming and would add little knowledge to the abundant species. Calls of threatened species were identified and the amounts were counted. Although bat calls are not a measure of abundance, they may reflect a relative measure of the importance of bats in a given area.

During the Second Bat Survey, 11 species of bats were recorded from the five sites. The list included ten common and secured bat species, one uncommon but widely spread species and one threatened form.

Based on the interpretation of calls recorded during the second bat survey, it was determined that South-eastern Long-eared Bat was present. However, a subsequent peer review of these findings found that the habitat present is not suitable, the recorded calls could not be attributed to South-eastern Long-eared Bat and, as such, it was not present within the study area (Gration 2015).

Table 14 below presents the bat species recorded in the Study Area during the Second Bat Survey and the number of nights in which species were recorded. The table shows that common species were recorded almost at every night of recording and in all the sites of study.

The species recorded in the Second Bat Survey were the same as that of the First Bat Survey, with one additional common species, the Little Broad-nosed Bat. This species is suspected to undergo seasonal movements or change in foraging behaviour (Churchill 2008), which may explain the absence of this species in the First Bat Survey in November 2011. The Little Broad-nosed Bat was not previously recorded for Victoria (Menkhorst 1995).

Despite the reduction of recording sites in the Second Bat Survey, the findings were generally the same as the First Bat Survey with the majority of bat call files being that of the common species.

Detailed results of the Second Bat Survey are provided in Appendix 7.

3.6.3.4.2.1 Threatened bats

The one threatened bat species recorded during the first survey was again recorded during the second bat survey with little change in the number of calls recorded (Tables 14, 15 and 16).

Table 14: Bat species, status and number of nights recorded during the Second Bat Survey within and adjacent the Study Area

Common name	Scientific name	Recording sites*					Conservation status		
		1	4	5	6	8	Vic.	NSW	EPBC
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	8	10	4	1	2		Common-secured	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	4	10	10	5	4		Common-secured	
Southern Freetail bat (spp. 2)	<i>Mormopterus ridei</i>	7	10	10	1	1		Common-secured	
Southern Freetail bat (spp. 4)	<i>Mormopterus spp. 4</i>	10	10	10	3	0		Common-secured	
Long-eared Bat	<i>Nyctophilus spp.</i>	6	10	10	3	3		Common-secured	
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	6	6	10	2	1	Uncommon but widespread	Common-secured	
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>	0	4	3	0	0	Threatened	Vulnerable	
White-striped Freetail Bat	<i>Tadarida australis</i>	2	10	10	3	0		Common-secured	
Large Forest Bat	<i>Vespadelus darligtoni</i>	9	10	10	5	10		Common-secured	

Common name	Scientific name	Recording sites*					Conservation status		
		1	4	5	6	8	Vic.	NSW	EPBC
Southern Forest Bat	<i>Vespadelus rugulus</i>	3	5	5	1	5		Common-secured	
Little Forest Bat	<i>Vespadelus vulturnus</i>	8	10	10	1	9		Common-secured	
Little Broad-nosed Bat	<i>Scotorepens greyi</i>	0	10	0	0	0		Common-secured	

* Sites 2, 3 and 7 failed to record the bat calls due to Anabat failure.

Table 15: Threatened bat species and the number of calls recorded within and adjacent the Study Area during the Second Bat Survey

Threatened bat species	Number of calls and range recorded at recording sites										Total	Av. call/night*
	1		4		5		6		8			
Yellow-bellied Sheathtail Bat	0	0	13	0-6	4	0- 2	0	0	0	0	17	1.7

* Over 10 nights; call analysis undertaken by Greg Richards

Table 16: Comparison of threatened bat species number of calls recorded between First Bat Survey and Second Bat Survey

Site	Yellow-bellied Sheathtail Bat			
	First survey		Second survey	
	No. of calls	Av./night*	No. of calls	Av./night**
B1	***	-	0	0
B2	32	4.6	***	-
B3	7	1.0	***	-
B4	40	5.7	13	1.3
B5	13	1.9	4	0.4
B6	2	0.3	0	0
B7	32	4.6	***	-
B8	3	0.4	0	0
Totals	129	18.4	17	1.7

* First survey, n = 7 nights, ** Second survey, n = 10 nights; *** -failure of recording at the site.

Note: Call analysis undertaken by Greg Richards and peer reviewed by Rob Gration (Gration 2015) — see Appendix 11.

3.6.4 Threatened bats recorded within and adjacent to the Study Area

This section discusses the habitats, results of surveying and potential impacts for the one threatened bat species recorded within and adjacent to the Study Area during both bat surveys — Yellow-bellied Sheathtail Bat.

Based on the analysis of calls recorded during the bat surveys, it was initially determined that the EPBC Act-listed South-eastern Long-eared Bat was also present within the study area. However, a subsequent peer review of these findings found that the habitat present was not suitable and that the recorded calls could not be attributed to South-eastern Long-eared Bat — as such, this species was not likely to occur within the study area (Gration 2015).

3.6.4.1 *Yellow-bellied Sheathtail Bat*

The Yellow-bellied Sheathtail Bat (YBS Bat) is listed as threatened under the Victorian FFG Act and as vulnerable in NSW (TSC Act). The species is not listed on DELWPs advisory list of threatened vertebrates (DSE 2007).

3.6.4.1.1 *First YBS Bat Survey results*

During the First YBS Bat Survey, the Yellow-bellied Sheathtail Bat was recorded on 129 occasions from the seven recording sites over the seven nights of the First YBS Bat Survey. The number of calls varied between the sites (Table 13). Between two to 40 calls were recorded over seven nights. The total calls of this bat constitute only 0.63% of the total calls of bats recorded, indicating low activity compared to the other common bats found in the Study Area.

3.6.4.1.2 *Second YBS Bat Survey results*

During the Second YBS Bat Survey, the Yellow-bellied Sheathtail Bat was recorded on 17 occasions from the five recording sites over the ten nights of the Second YBS Bat Survey. Calls were recorded from sites 4 and 5 and were recorded on seven nights out of the 20 nights of recording.

The numbers of calls recorded indicate low activity of this species at this time of year (February to March 2012) compared to the number of calls recorded during the First Bat Survey undertaken in November 2011 (See Table 15). This is likely to be due to the seasonal movements of the species, which is known to be a rare visitor in the southern part of its range during summer and autumn (Churchill 2008).

3.6.4.1.3 *Conclusion*

The review of existing information and results of the surveys suggest that while the Yellow-bellied Sheathtail Bat may infrequently occur in the region, it is unlikely to be a permanent resident there, considering the dispersive characteristics of the species. It is also unlikely that the species breeds in the region either, as very few captured specimens in southern Australia have been in breeding condition.

4. EES Scoping Requirements

4.1 EES Evaluation Objectives

For the biodiversity aspects of the Echuca-Moama Bridge Project, the relevant draft evaluation objective as outlined in the EES Scoping Requirements is:

To avoid or minimise adverse effects on native vegetation and listed flora and fauna species and ecological communities, and address opportunities for offsetting potential losses consistent with relevant policy.

4.2 EES Scoping Requirements

The EES Scoping requirements specific to the scope of this biodiversity assessment — as determined by the initial biodiversity assessment — are as follows:

4.2.1 Key Issues

- Loss of, or degradation to, native vegetation and associated significant habitat for listed flora species such as Blue Burr-daisy and Pale Flax-Lily.
- Loss of, or degradation to, habitat for listed species of fauna, in particular the South Eastern Long-eared Bat (South-eastern Long-eared Bat), Masked Owl, Squirrel Glider and Yellow-bellied Sheath-tail Bat.
- Degradation to local and downstream aquatic habitat from increase in sedimentation.

4.2.2 Priorities for characterising the existing environment

- Characterise the distribution and quality of biodiversity values that could be affected by the project, including native vegetation, terrestrial and aquatic habitat and patterns of wildlife movement.
- Identify the existence or likely existence of any listed species or communities and any declared weeds or pathogens.
- Identify any potentially threatening processes that could result from the project under the FFG Act.
- This characterisation is to be informed by relevant databases, literature and appropriate targeted and/or seasonal surveys and modelling where appropriate. In the absence of positive identification of the presence of listed species and communities, but where suitable habitat is identified, a precautionary approach to the further investigation and assessment of its occurrence should be applied.

4.2.3 Design and mitigation measures

- Identify and describe the potential and proposed design and mitigation measures, which could avoid or minimise significant effects on native vegetation, and/or any listed flora, fauna and ecological communities and potentially threatening processes.

4.2.4 Assessment of likely effects

- Identify and assess likely direct and indirect effects on native vegetation, ecological communities and the habitat of any listed species of flora and fauna along the alignments.

4.2.5 Approach to manage performance

- Identify proposed measures to further mitigate and manage residual effects of the project, including addressing the offset requirements of Victoria's native vegetation permitted clearing regulations and relevant provisions of planning schemes.
- Identify in the EES any further methods proposed to manage risks of effects on other biodiversity values and native vegetation, including as part of the Environmental Management Framework (EMF) and resulting residual effects.

5. Legislation, Policies and Guidelines

As part of this Biodiversity and Habitat Impact Assessment for the Project, it has been necessary to review and consider any relevant legislation, policies or guidelines that apply.

5.1 Commonwealth

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects a number of threatened or migratory species and ecological communities that are considered to be matters of national environmental significance. Any significant impact on such matters requires the approval of the Australian Minister for the Environment.

Based on the analysis of calls recorded during the bat surveys, it was initially determined by Greg Richards that South-eastern Long-eared Bat was present. However, a subsequent peer review of these findings found that the habitat present was not suitable and that the recorded calls could not be attributed to South-eastern Long-eared Bat and, as such, it was not likely to occur within the study area (Gration 2015).

Based on the initial findings, a Referral under the *Environment Protection and Biodiversity Conservation Act 1999* was undertaken in respect of potential impacts upon this bat. Given the information provided, the Project was determined by the Commonwealth Department of Environment to be a 'controlled action' that would require assessment by Preliminary Documentation.

Preliminary Documentation is currently being prepared based on the current understanding that South-eastern Long-eared Bat is not likely to occur within the study area.

A Decision under this Act will be made by the Commonwealth Minister for the Environment.

5.2 State

5.2.1 Victoria

Victoria's planning schemes are constituted under the *Planning and Environment Act 1987*. This section discusses planning provisions in the local planning scheme applicable to flora and fauna.

5.2.1.1 Planning and Environment Act 1987

The Planning and Environment Act 1987 (P&E Act) establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interests of all Victorians.

The Act sets out the following objectives for planning in Victoria:

- To provide for the fair, orderly, economic and sustainable use and development of land.
- To provide for the protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity.
- To secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria.
- To conserve and enhance those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value.
- To protect public utilities and other assets and enable the orderly provision and coordination of public utilities and other facilities for the benefit of the community.
- To facilitate development in accordance with the objectives set out in the points above.
- To balance the present and future interest of all Victorians.

The Act provides for a single instrument of planning control, the planning scheme, which sets out the way in which land may be used or developed. The planning scheme is a legal document, prepared and approved under the Act. Within Victoria, the Campaspe Planning Scheme is the relevant Planning Scheme.

Planning Scheme

Destruction, lopping or removal of native vegetation on land which, together with all contiguous land in-one-ownership, has an area of 0.4 hectares or more requires a planning permit under Clause 52.17 of all Victorian Planning Schemes, including the Campaspe Planning Scheme. This includes the removal of dead trees with a DBH (diameter at breast height or 1.3 metres) of 40 centimetres or more and any individual scattered native plants.

On 20th December 2013 a planning scheme amendment was gazetted to implement a number of reforms to Victoria's native vegetation permitted clearing regulations, particularly Clauses 12.01 (Biodiversity), 52.16 (Native vegetation precinct plan) and 52.17 (Native vegetation). As part of these reforms the previously incorporated document *Victoria's Native Vegetation – a Framework for Action* was replaced by a new incorporated document, *Permitted clearing of native vegetation – Biodiversity assessment guidelines* (DEPI 2013a) (Guidelines).

Before issuing a planning permit, Responsible Authorities are obligated to refer to Clause 12.01 (Biodiversity) in the Planning Scheme, specifically to Clauses 12.01-1 Protection of biodiversity and Clause 12.01-2 Native vegetation management. This refers in turn to the following online tool and an incorporated document in all planning schemes:

- The Native Vegetation Information Management (NVIM) system (DELWP 2014a); and
- *Permitted clearing of native vegetation – Biodiversity assessment guidelines* (DEPI 2013a) (the 'Guidelines').

These are discussed below.

5.2.1.1.1 *Native Vegetation Information Management system*

The online Native Vegetation Information Management system (NVIM) is an interactive mapping tool, which provides some of the information required to accompany a permit to remove native vegetation. It does not replace the application process.

The information provided by NVIM can include the following (described in more detail below):

- The location risk of the native vegetation;
- The condition of the native vegetation – used for the low-risk assessment pathway only;
- The strategic biodiversity score of the native vegetation proposed to be removed; and
- The native vegetation offset requirement – used for the low risk assessment pathway only.

5.2.1.1.2 *Biodiversity assessment guidelines*

5.2.1.1.2.1 Guidelines objective

As set out in the incorporated document *Permitted clearing of native vegetation – Biodiversity Assessment Guidelines* ('the Guidelines'), the objective for permitted clearing of native vegetation in Victoria is 'No net loss in the contribution made by native vegetation to Victoria's biodiversity'. The key strategies for ensuring this outcome when considering an application to remove native vegetation are:

- Avoiding the removal of native vegetation that makes a significant contribution to Victoria's biodiversity;
- Minimising impacts on Victoria's biodiversity from the removal of native vegetation; and
- Where native vegetation is permitted to be removed, ensuring it is offset in a manner that makes an equivalent contribution to Victoria's biodiversity made by the native vegetation to be removed.

Note: if native vegetation does not meet the definition of either a remnant patch or scattered trees, the Guidelines are not required to be applied.

5.2.1.1.2.2 Risk-based assessment pathways

The first step in determining the type of assessment required for any site in Victoria is to determine the risk to biodiversity associated with the proposed native vegetation removal and therefore the risk-based assessment pathway for

the proposed native vegetation removal. There are three risk-based pathways for assessing an application to remove native vegetation, below.

- Low risk
- Moderate risk
- High risk

This risk-based assessment pathway is determined by two factors, outlined below.

Extent risk – the area in hectares proposed to be removed *or* the number of scattered trees. *Note:* extent risk also includes any native vegetation clearing for which permission has been granted in the last five years.

Location risk – the likelihood that removing native vegetation in a location will have an impact on the persistence of a rare or threatened species classified into three categories: Location A, Location B and Location C.

The risk-based pathway for assessing an application to remove native vegetation is determined by the following matrices for remnant patches and scattered trees:

Extent (remnant patches)	Location A	Location B	Location C
< 0.5 hectares	Low	Low	High
≥ 0.5 hectares and < 1 hectare	Low	Moderate	High
≥ 1 hectare	Moderate	High	High
Extent (scattered trees)	Location A	Location B	Location C
< 15 scattered trees	Low	Moderate	High
≥ 15 scattered trees	Moderate	High	High

Notes: All native vegetation within any subdivision plot of less than 0.4 hectares is deemed to be lost; For applications with combined removal of both remnant patch and scattered trees, the extent of the scattered trees is converted to an area by assigning a standard area of 0.071 hectares per tree – the total extent is then used to determine the risk-based pathway.

The presence of any Location B or Location C risk categories within an area of proposed native vegetation removal means this whole area of removal is considered to belong to that category for the purpose of determining the risk-based assessment pathway.

5.2.1.1.2.3 Strategic biodiversity score

The strategic biodiversity score generated by NVIM acts as a measure of the site's importance for Victoria's biodiversity relative to other locations across the landscape. It is calculated based on a weighted average of scores across an area of native vegetation proposed for removal on a site.

5.2.1.1.2.4 Habitat importance

Habitat importance mapping produced by DELWP is based on one or a combination of habitat importance models, habitat distribution models or site record data. It identifies the following:

- Habitat importance for dispersed species – based on habitat distribution models and assigned a habitat importance score ranging from 0 to 1; and
- Highly localised habitats – considered to be equally important for a particular species and assigned a habitat importance score of 1.

Habitat importance mapping is used to determine the type of offset required under the moderate and high risk assessment pathways.

5.2.1.1.2.5 Biodiversity equivalence

Biodiversity equivalence scores are used to quantify losses in the contribution to Victoria's biodiversity from removing native vegetation and gains in this contribution from a native vegetation offset. There are two types of biodiversity equivalence scores depending on whether or not the site makes a contribution to the habitat of a Victorian rare or threatened species.

- A general biodiversity equivalence score is a measure of the contribution native vegetation on a site makes to Victoria's biodiversity overall and applies when no habitat importance scores are applicable according to the equation:

$$\text{General biodiversity equivalence score} = \text{habitat hectares} \times \text{strategic biodiversity score}$$

- A specific biodiversity equivalence score is a measure of the contribution that native vegetation on a site makes to the habitat of a particular rare or threatened species – calculated for each such species for which the site provides important habitat (using habitat importance scores provided by DELWP) according to the equation:

$$\text{Specific biodiversity equivalence score} = \text{habitat hectares} \times \text{habitat importance score}$$

5.2.1.1.2.6 Offset requirements

A native vegetation offset is required for the approved removal of native vegetation. Offsets conform to one of two types and each type incorporates a risk factor to address the risk of offset failing:

- A general offset applies if the removal of native vegetation impacts Victoria's overall biodiversity and has an offset risk factor of 1.5 applied according to the equation:

$$\text{General risk-adjusted offset requirement} = \frac{\text{general biodiversity equivalence score (clearing site)}}{1.5}$$

- A specific offset applies if the native vegetation makes a significant impact to habitat for a rare or threatened species determined by a specific-general offset test. It applies to each species impacted and has an offset risk factor of 2 applied according to the equation:

$$\text{Specific risk-adjusted offset requirement} = \text{specific biodiversity equivalence score (clearing site)} \times 2$$

Note: if native vegetation does not meet the definition of either a remnant patch or scattered trees an offset is not required.

5.2.1.1.2.7 DELWP referral criteria

Clause 66.02 of the planning scheme determines the role of DELWP in the assessment of native vegetation removal permit applications. If an application is referred, DELWP may make certain recommendations to the responsible authority in relation to the permit application. An application to remove native vegetation must be referred to DELWP in the following circumstances:

- Applications where the native vegetation to be removed is 0.5 hectares or more (this does not apply to removal of scattered trees only);
- All applications in the high risk-based pathway;
- Applications where a property vegetation plan applies to the site; and
- Applications on Crown land which is occupied or managed by the responsible authority.

5.2.1.1.2.8 Summary of the assessment process

The assessment process, decision guidelines and offset requirements for approved native vegetation removal are outlined in Table 17.

Table 17: Summary of the assessment process and offset requirements

Risk-based pathway	Assessment quantum inputs	Decision guidelines	Offset requirements
Low	Habitat hectares* (NVIM) Strategic biodiversity score (NVIM) General biodiversity equivalence score	An application for removal cannot be refused on biodiversity grounds (unless it is not in accordance with any property vegetation plan that applies to the site). <i>Note: this guideline also applies to native vegetation that does not meet the definition of either a remnant patch or scattered trees.</i>	General offset applies: General offset = general biodiversity equivalence score (clearing site) x 1.5 Offset must be located in the same CMA [^] or Local Government Area as the removal Offset must have a strategic biodiversity score at least 80% of the native vegetation removed Offset must be secured before the removal of native vegetation
Moderate	Habitat hectares* (site assessment) Strategic biodiversity score (NVIM) Habitat importance scores for each Victorian rare and threatened species Specific biodiversity equivalence score for each rare and threatened species	The responsible authority will consider: The strategic biodiversity score and habitat importance score of the native vegetation proposed to be removed Any property vegetation plan that applies to the site Whether reasonable steps have been taken to ensure that impacts of the proposed removal of native vegetation on biodiversity have been minimised with regard to the contribution to biodiversity made by the native vegetation to be removed and the native vegetation to be retained Whether an offset has been identified that meets the requirements The need to remove native vegetation to create defensible space to reduce the risk of bushfire	If the specific biodiversity equivalence scores for any rare and threatened species fails the specific-general offset test, then a general offset applies (as above) Otherwise, a specific offset applies for <u>each</u> rare and threatened species: Specific offset = specific biodiversity equivalence score (clearing site) x 2 Offset must be located in the same species habitat anywhere in Victoria as determined by DELWP habitat importance mapping
High	OR General biodiversity equivalence score if no habitat importance scores apply	In addition to the considerations for the moderate pathway (above) the responsible authority will determine whether the native vegetation to be removed makes a significant contribution to Victoria’s biodiversity. This includes considering: Impacts on important habitat for rare or threatened species, particularly highly localised habitat Proportional impacts on remaining habitat for rare or threatened species If the removal of the native vegetation will contribute to a cumulative impact that is a significant threat to the persistence of a rare or threatened species The availability of, and potential for, gain from offsets	When a specific offset is required for multiple species, the offset site must satisfy the specific offset requirements for all of these species or multiple offset sites may be used Offset must be secured before the removal of native vegetation

* Habitat hectares = condition score (out of 1) x extent (hectares); ^ Catchment Management Authority

Note: All applications must provide information about the vegetation to be removed such as location and address of the property, description of the vegetation, maps and recent dated photographs.

5.2.1.2 Flora and Fauna Guarantee Act 1988

The Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) lists threatened and protected species and ecological communities (DEPI 2014a). Any removal from public land of threatened flora species or communities, or protected flora, listed under the FFG Act requires a Protected Flora Licence or Permit under the FFG Act, obtained from DELWP.

As the project will be undertaken mostly on public land, a permit will be required to remove wattles and daisy species. An estimate (as accurate as possible) of the number of protected flora species to be removed is needed for any permit application. As wattles and daisies regenerate quickly and construction is some time away, it is recommended that an inventory of the affected plants be prepared closer to construction.

5.2.1.3 Wildlife Act 1975

The project may lead to impacts on hollow-dwelling fauna that may need to be salvaged and translocated at the beginning of construction for animal welfare reasons. This activity will require a 'Management Authority' under the Wildlife Act.

5.2.1.4 Catchment and Land Protection Act 1994

The Victorian *Catchment and Land Protection Act 1994* (CALP Act) applies to all landowners in the state. It promotes the sustainable management of catchments and water supplies, and protection of land against erosion. Of particular relevance to this project is a requirement for a permit for works in waterways (on the Victorian riverbank) for bridge construction activities and a need to ensure works don't lead to the spread of regionally significant weeds.

5.2.1.5 DELWP Advisory Threatened Species Lists

In addition to planning policies and legislation, DELWP issue advisory lists of threatened flora and fauna from time to time reflecting changes in knowledge and the status of species across the state (DEPI 2013b, 2014b). These lists have no statutory status but are referred to regularly as a source of information on species of concern. The status of threatened species on these lists has been considered in this report and possible and known impacts on them from the proposed project have been assessed.

5.2.2 New South Wales

5.2.2.1 Planning Controls

5.2.2.1.1 State Environmental Planning Policy (Infrastructure) 2007

The New South Wales State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the Project is for the construction of new road infrastructure and is to be carried out by the Roads and Maritime Services (RMS) Transport Department, it is assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EPA Act) and development consent from council is not required (see below).

5.2.2.1.2 State Environmental Planning Policy No. 44 (SEPP 44) (Koala Habitat)

State Environmental Planning Policy No. 44 (SEPP 44) requires Councils to take into consideration impacts on the Koala before taking a decision about a proposed project. Specifically, it "aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline".

Murray Shire is listed in Schedule 1 of this SEPP as a shire to which the policy applies.

The policy identifies Koala habitat as either:

- **Core Koala habitat** is an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population; or
- **Potential Koala habitats** are areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component."

SEPP 44 would apply to the development proposal should either of the above Koala habitat types be identified in the Study Area.

5.2.2.1.3 Other State Environmental Planning Policy

The proposed development may also have implications under the following policies and guidelines:

- National Parks and Wildlife Act 1974;
- State Environmental Planning Policy No. 14 - Coastal Wetlands; or
- State Environmental Planning Policy No. 26 - Littoral Rainforests.

5.2.2.2 Native Vegetation Act 2003

Development consent is not required under the New South Wales *Native Vegetation Act 2003* for the Project as it will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

Impacts on aquatic flora and fauna are documented in a separate report (GHD 2015).

5.2.2.3 Environmental Planning and Assessment Act 1979

New South Wales' planning policies are constituted under the state *Environmental Planning and Assessment Act 1979* (EPA Act).

In NSW, the Project will be assessed under Part 5 of the *EPA Act*.

5.2.2.3.1 Threatened Species

The 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.

Threatened Species are considered under Criteria A, D and F of the Seven Part Test. The Seven Part Test was undertaken for a threatened species whenever the presence of a threatened species listed on the TSC Act in an affected area was confirmed or likely. The results are provided in BL&A Report 8194 (15.1) (BL&A 2014).

5.2.2.3.2 Endangered Populations

Endangered populations are considered under Criteria B and D of the Seven Part Test.

5.2.2.3.3 Endangered and Critically Endangered Communities

Endangered and critically endangered communities are considered under Criteria C and D of the Seven Part Test.

5.2.2.3.4 Critical Habitat

Critical Habitat is considered under Criterion E of the Seven Part Test.

5.2.2.3.5 Threatening Processes

Threatening processes are considered under Criterion G of the Seven Part Test.

5.2.2.4 Noxious Weeds Act 1993

Under the *Noxious Weeds Act 1993* (NW Act), all listed noxious weeds in the relevant council area must be controlled to the level stated on the NSW DPI Noxious Weeds database. The NW Act would apply to the development proposal should any matters listed under that Act be identified in the Study Area.

5.3 Local

5.3.1 Victoria

5.3.1.1 Planning overlays

The Study Area is subject to several overlays in the Campaspe Planning Scheme, one of which, the Heritage Overlay and the nominated heritage place (HO79) under the Heritage Overlay is relevant to this assessment. The purpose and implications of this overlay are discussed in this section.

Note: HO 79 (Murray Pines) is not currently within the Project footprint. However, Council does have an amendment currently on exhibition that seeks to extend the Overlay into the Project footprint.

5.3.1.1.1 Heritage Overlay (HO79)

The purpose of the Heritage Overlay is to conserve and enhance heritage places of natural or cultural significance. Heritage Overlay 79 (HO79) aims specifically for the conservation and enhancement of the Stand of Murray Pine, north-west of Echuca Tennis Club.

A permit is generally required under the Heritage Overlay to carry out works and/or remove trees in respect of land affected by the Heritage Overlay. A Planning Scheme Amendment is proposed to exempt the Project from the requirement to obtain such a permit. This report provides the required information to inform any required permit application for the removal of vegetation under HO79.

5.3.1.1.2 Environmental significance Overlay (ESO1)

ESO1 specifically relates to the Murray River Corridor and affects most of the study area. The environmental objectives for this area are:

- To promote consistent planning and management along the Murray River corridor.

- To protect the environs of the Murray River recognising its importance for nature conservation, flooding, economic development, recreation and tourism.
- To protect and enhance the biodiversity, ecological, and cultural values of waterways.
- To prevent development of land adjoining the river from degrading water quality.
- To prevent the loss of riparian flora and fauna, biodiversity, habitat and wetland environments.
- To protect the values and role of the Murray River reserves and other public land as floodplains and as buffer areas for nutrients and other pollutants.
- To restrict inappropriate development on land adjoining and near the Murray River.
- To assess the use or development of land adjoining the Murray River corridor according to the capacity of the proposal to protect the environmental and landscape qualities of the river environs in accordance with sustainable development principles.
- To specifically address land degradation processes including erosion, native vegetation decline, pollution of ground or surface water, groundwater accession, salinisation and soil acidity, and adverse effects on the quality of land and water habitats.
- To ensure that buildings are sited a sufficient distance from the Murray River, waterways and drainage lines so as to:
 - Maintain and improve water quality;
 - Minimise risk and the redistributive effect on floodwater associated with the erection of buildings on the floodplain;
 - Protect the scenic landscape of the riverine corridor;
 - Improve bank stability; and
 - Protect biodiversity and conserve wildlife habitat.

A permit is generally required under this overlay to remove, destroy or lop any vegetation, including dead vegetation. A Planning Scheme Amendment is proposed to exempt the Project from the requirement to obtain such a permit. This report provides the required information to inform any required permit application for the removal of vegetation under this overlay.

5.3.2 New South Wales

Whether or not the proposed development is subject to local legislation is assessed as part of the New South Wales Review of Environmental Factors.

6. Biodiversity and Habitat Impact Assessment

The detailed Biodiversity and Habitat Impact Assessment documented in this report addresses the potential biodiversity and habitat impacts of the construction and operation of the Project.

The impacts of the Project, together with proposed mitigation measures, are considered in detail through the environmental risk assessment process. The details of the risk assessment process undertaken for the Project are outlined in the EES.

The environmental risk register is provided in this report (Section 7) and the identified impacts of the proposed option are considered in detail in the following sections.

6.1 Benefits and Opportunities

No benefits to biodiversity and habitat have been identified for the Project.

6.2 Impacts

6.2.1 Impacts on native vegetation

The Project (ultimate alignment) would result in the removal of native vegetation and fauna habitat in both Victoria and New South Wales. Native vegetation in the form of Remnant Patches and Scattered Trees is proposed to be removed. Some hollow bearing trees within these two vegetation types are proposed for removal.

The area of remnant native vegetation that would be removed by the Project totals 18.735 hectares. Of this vegetation, 13.655 hectares occur within Victoria while 5.080 hectares occur within New South Wales (Table 18). A total of 14 scattered trees (outside of patches) would also be impacted by the Project — seven in Victoria and seven in NSW (see Appendix 4).

The risk-based assessment pathway that applies to this project for the Victorian native vegetation assessment is **Moderate** based on the Biodiversity Impacts and Offset Requirements report provided by DELWP (Appendix 8).

The extent of impacts on native vegetation in both Victoria and New South Wales are shown in Figure 12. See Figures 6 to 8 for more detailed mapping, showing habitat zones affected.

Direct impacts on native vegetation will be confined to the areas of removal documented in this report (see Figure 12) through the adoption of construction environmental management measures that include but are not limited to the following:

- Pre-construction temporary fencing of remained areas of native vegetation;
- Identification and designation in construction plans of equipment laydown areas, access tracks and other areas needed for construction, to be located away from areas of remnant native vegetation.,

Mitigation measures are considered in more detail in Sections 7.4 and 8

Site condition (habitat hectare) scores for the remnant patch native vegetation to be impacted within Victoria are provided in Appendix 3.

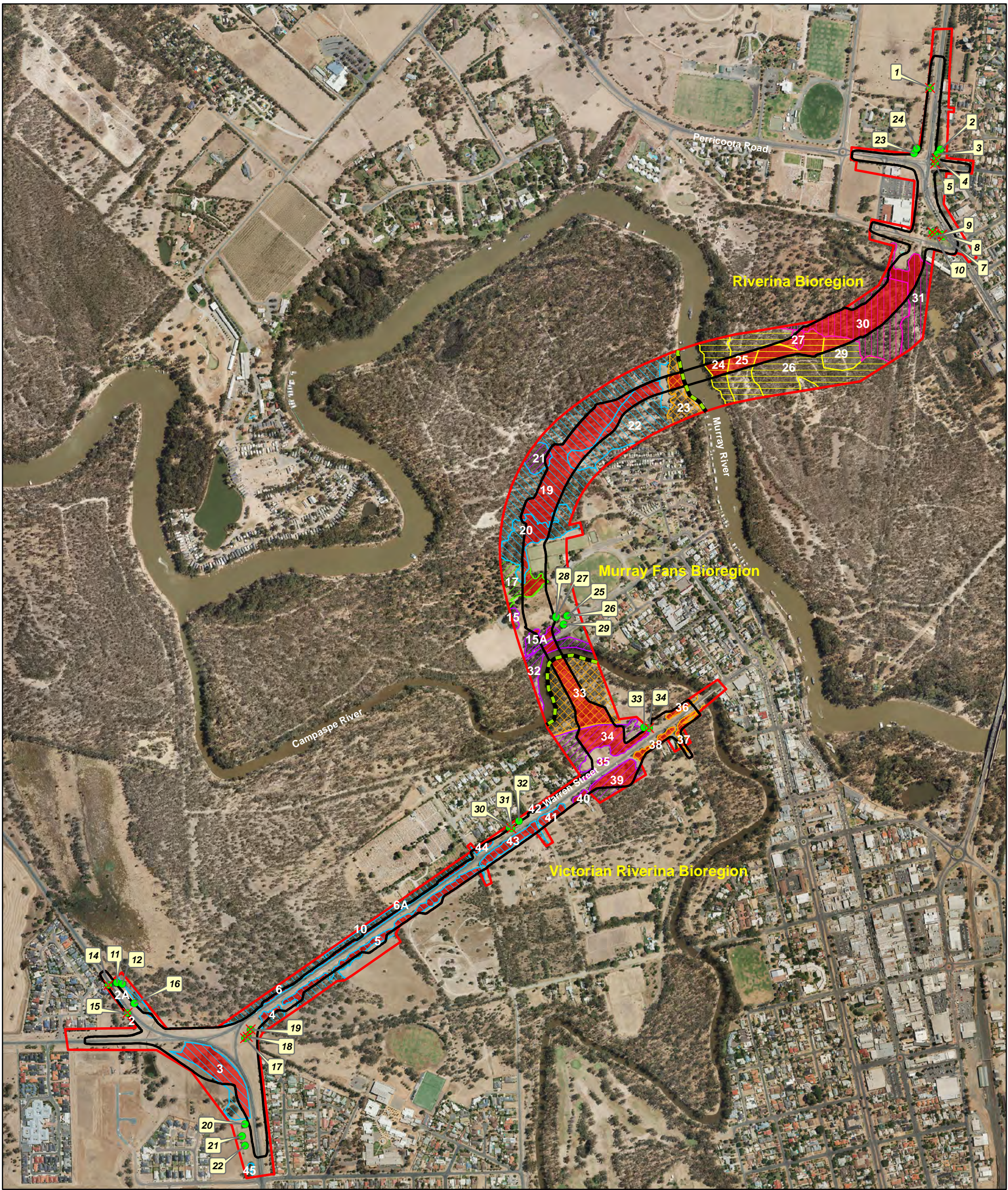
Table 18: Proposed native vegetation losses

Habitat Zone	Ecological Vegetation Class	Condition score out of 100 (Vic. Only)	Area of native vegetation removal (ha)
Victorian Portion			
1	Riverine Chenopod Woodland (EVC 103)	33	0.011
2A	Riverine Chenopod Woodland (EVC 103)	47	0.016
3	Riverine Chenopod Woodland (EVC 103)	47	1.511
4	Riverine Chenopod Woodland (EVC 103)	45	0.126
5	Riverine Chenopod Woodland (EVC 103)	57	1.166
6	Riverine Chenopod Woodland (EVC 103)	71	0.174
6A	Riverine Chenopod Woodland (EVC 103)	51	0.367
15A	Riverine Grassy Woodland (EVC 295)	38	0.129
17	Semi-arid Woodland (EVC 97)	60	0.349
19	Riverine Chenopod Woodland (EVC 103)	67	3.084
20	Riverine Chenopod Woodland (EVC 103)	56	0.631
21	Riverine Grassy Woodland (EVC 295)	66	0.057
22	Riverine Chenopod Woodland (EVC 103)	49	0.972
23	Grassy Riverine Forest (EVC 106)	37	0.194
32	Riverine Grassy Woodland (EVC 295)	40	0.111

Habitat Zone	Ecological Vegetation Class	Condition score out of 100 (Vic. Only)	Area of native vegetation removal (ha)
33	Grassy Riverine Forest (EVC 106)	36	1.294
34	Riverine Grassy Woodland (EVC 295)	36	1.174
35	Riverine Grassy Woodland (EVC 295)	30*	0.054
36	Grassy Riverine Forest (EVC 106)	27	0.142
37	Grassy Riverine Forest (EVC 106)	30	0.206
38	Grassy Riverine Forest (EVC 106)	42	0.238
39	Riverine Grassy Woodland (EVC 295)	34	0.693
40	Riverine Grassy Woodland (EVC 295)	25	0.071
41	Riverine Chenopod Woodland (EVC 103)	30	0.237
42	Riverine Chenopod Woodland (EVC 103)	30*	0.053
43	Riverine Chenopod Woodland (EVC 103)	22	0.518
44	Riverine Chenopod Woodland (EVC 103)	30*	0.080
Sub-total^			13.655
New South Wales Portion			
24	River Red Gum - Black Box woodland		0.271
25	River Red Gum - Black Box woodland		0.490
26	River Red Gum - Black Box woodland		0.917

Habitat Zone	Ecological Vegetation Class	Condition score out of 100 (Vic. Only)	Area of native vegetation removal (ha)
27	River Red Gum - herbaceous tall open forest		0.133
29	River Red Gum - Black Box woodland		0.270
30	River Red Gum - herbaceous tall open forest		2.434
31	River Red Gum - herbaceous tall open forest		0.565
Sub-total			5.080
Grand Total[^]			18.735

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West Option would indeed have an impact on them. As such, these zones have been assigned an arbitrary condition score of 0.30, as this reflects the condition scores of similar adjacent habitat zones, in favour of the DELWP prescribed default score of 0.60, as this was deemed unrealistic. ^ = Totals are based upon total's calculated by DELWP which may have rounding inaccuracies.



Legend

- Study Area
- Alignment option/Construction Area
- Bioregion Boundaries
- Native Vegetation to be removed
- Scattered trees
- × Trees to be removed
- 16 Scattered tree numbers
- 45 Habitat zones

Native Vegetation

Victoria

- Grassy Riverine Forest (EVC 106)
- Riverine Chenopod Woodland (EVC 103)
- Riverine Grassy Woodland (EVC 295)
- Semi-arid Woodland (EVC 97)

New South Wales

- River Red Gum - herbaceous tall open forest
- River Red Gum - Black Box woodland



Figure 12: Native vegetation to be removed

Project: Murray River Crossing Echuca

Client: VicRoads

Project No.: 8194	Date: 13/03/2015	Created By: M. Ghasemi / A. Brennan
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6.2.2 Impacts on significant flora

Two flora species listed as rare or threatened in Victoria have been recorded within the Victorian portion of the Study Area: Pale Flax-lily and Blue Burr-daisy. Two Blue Burr-daisy plants (rare) and an unknown number of Pale Flax-lily plants (threatened) are proposed to be removed from The Project footprint.

6.2.3 Impacts on endangered ecological communities

The Project would not impact upon any threatened ecological communities listed on the *Environment Protect and Biodiversity Conservation Act 1999* or the *Flora and Fauna Guarantee Act 1988* as none have been identified within the Study Area for the Project.

6.2.4 Impacts on fauna

Potential impacts on fauna can be minimised by ensuring mitigation measures are undertaken (Sections 7.4 and 8). These mitigation measures are described in more detail and are taken into account in the risk assessment in Section 7. Potential impacts that need to be considered are explored further below, addressing direct and indirect impacts separately.

6.2.4.1 Direct impacts

The direct impacts of the Project relate to the associated earthworks and construction and potential impacts of accidental fire. The fauna habitat being removed in the Study Area is predominantly treed habitat. The project will result in the removal of 18.738 hectares of wooded habitat, as quantified in section 6.2.1. This has consequences for a number of habitat components upon which significant fauna may depend, such as breeding sites, and foraging habitat (see Table 19).

An important habitat feature for fauna is hollow bearing trees. Such trees provide breeding sites for a range of bird species and day-time dens for tree-dwelling mammal species. Information collected on trees within the Study Area was in line with the requirements of each state. As such, hollow tree mapping was undertaken in NSW whereas in Victoria, all Large Old Trees (LOTs) within patches of native vegetation were mapped. Although specific hollow tree mapping was not undertaken in the Victorian section of the Study Area, many of the mapped LOTs were considered likely to bear hollows. Of the very many LOT's recorded in the Victorian section of the Study Area, 221 are proposed for removal. In the NSW section of the project, a total of 9 of the 35 hollow trees recorded will be removed (see Table 11; Figure 11; and Table 28). While the project will remove 230 of hollow bearing trees, two thirds of the hollow bearing trees

recorded within the Study Area will remain. Furthermore, numerous hollow bearing trees occur within contiguous habitat outside and adjacent to the Study Area.

No direct impacts are considered to occur to aquatic habitats in the Campaspe River or Murray River as no permanent bridge infrastructure will occur within the waterways themselves, therefore there will be no alterations to natural river flows.

6.2.4.2 Indirect impacts

Indirect impacts on fauna from the Project include:

- habitat fragmentation leading to disruptions to the movements of local fauna populations;
- Disturbance to fauna from traffic movements on the road; and
- Sedimentation and erosion, particularly during construction, increasing turbidity in nearby waterways;
- Increased rate of water runoff from the road leading to local erosion of habitats and increased sedimentation of nearby water bodies;
- Shading of water and vegetation by the bridge, altering microclimate and habitat suitability and in the longer term potentially affecting plant growth leading to changes in habitat structure; and
- Weed and pathogen outbreaks in the construction zone and adjacent habitats.

Most indirect impacts are considered to be confined to an area within and immediately adjacent to the road footprint, which represents a comparatively small proportion of the available similar habitat for native fauna on the floodplains of the Echuca and Campaspe floodplains in and near Echuca. Significant consequences of more than a local scale for fauna populations are therefore not anticipated. Some of these effects can be mitigated through the adoption of best practice environmental management measures, discussed later in Sections 7.4 and 8.

The floodplain of the Murray and Campaspe Rivers near Echuca supports extensive areas of River Red Gum grassy woodland. Past removal of vegetation for agricultural and urban development has fragmented treed habitat along the rivers into patches separated by the rivers themselves or by the occasional road crossing. The advent of the proposed road will not contribute significantly at a regional scale to fragmentation as habitat is already fragmented by these historical changes. The Project will lead to fragmentation at a local scale but many of the remaining fauna species in

this habitat are likely already to have adapted to a degree of habitat fragmentation due to past changes.

Disturbance to fauna from traffic movements, noise and vibration is not anticipated to be significant. The raised nature of much of the road will most likely minimise disturbance to fauna to some extent. The volume and speed of the traffic using the new road is unlikely to lead to a significant increase in mortality as fauna within the study area will already be accustomed to traffic, noise and vibration on other nearby roads.

Sedimentation and erosion, particularly during construction, are unlikely to be significant impacts given the now standard control requirements that will be implemented.

Any increased rate of water runoff from the road leading to local erosion of habitats, increased sedimentation and the spilling of oil based pollutants or building materials into water bodies will be mitigated through the use of permanent sedimentation basins and other temporary controls.

Shading of water and vegetation by the bridge, altering habitat suitability and leading to changes in habitat structure can be managed by the recommended mitigation measures — implement an Environmental Management Plan, update or develop a management plan for Victoria Park and engage experienced vegetation management contractors (as set out in Tables 24 and Table 25).

Risks from weed and pathogen outbreaks in the construction zone and adjacent habitats are expected to be minimised by implementation of hygiene measures. Experienced vegetation management contractors will be engaged to control any weed outbreaks.

Road lighting can attract fauna and so increase the risk of collisions with vehicles. The level of lighting proposed for the Project is unlikely to significantly increase impacts on any fauna species within the study area given that such fauna will already be accustomed to light from other roads within the vicinity.

Sections 7.4 and 8 present the mitigation measures that will aid in minimising any potential impacts.

6.2.4.3 Impacts on significant fauna species

Table 19 summarises the potential impacts on significant fauna species recorded or potentially occurring in and near the study area. These are discussed further below for key significant species that were recorded in the or near the Study area.

Table 19: Potential impacts on threatened fauna species likely to occur in the Study Area (see Table 6)

Species	Ecological status				Breeding habitat loss	Foraging habitat loss	Increased road mortality	Sedimentation and erosion	Shading
	EPBC	VIC FFG	VIC DELWP	NSW TSC					
Birds									
Azure Kingfisher			NT			X	X	X	
Black-chinned Honeyeater			NT	VU	X	X	X		
Brown Quail			NT		X	X	X		
Brown Treecreeper			NT	VU	X	X	X		
Diamond Firetail		L	VU	VU	X	X	X		
Eastern Great Egret	M (JAMBA, CAMBA)	L	VU			X	X	X	
Grey-crowned Babbler		L	EN	VU	X	X	X		
Hooded Robin		L	VU	VU	X	X	X		
Intermediate Egret		L	EN			X	X	X	
Masked Owl		L	EN	VU	X	X	X		
Nankeen Night Heron			NT		X	X	X	X	
Rainbow Bee-eater	M (JAMBA)					X	X		
Royal Spoonbill			VU			X	X	X	
Specked Warbler		L	VU	VU	X	X	X		
Superb Parrot	VU	L	EN	VU	X	X	X		
Swift Parrot	EN	L	EN	EN		X	X		
Turquoise Parrot		L	NT	VU		X	X		
Varied Sittella				VU	X	X	X		
White-bellied Sea-Eagle	M (CAMBA)	L	VU					X	X

Species	Ecological status				Breeding habitat loss	Foraging habitat loss	Increased road mortality	Sedimentation and erosion	Shading
	EPBC	VIC FFG	VIC DELWP	NSW TSC					
Fork-tailed Swift	M (JAMBA, CAMBA, ROKAMBA)					X			
White-throated Needletail	M (JAMBA, CAMBA, ROKAMBA)					X			
Mammals									
Koala	VU (in NSW only)			VU	X	X	X		
Squirrel Glider		L	EN	VU	X	X	X		
Yellow-bellied Sheath-tail Bat		L	DD	VU		X	X		
Reptiles									
Murray River Tortoise			VU		X	X	X	X	X

Key species for which detailed impact assessment was required under the EES Scoping Requirements included:

- South-eastern Long-eared Bat;
- Yellow-bellied Sheath-tail Bat;
- Squirrel Glider; and
- Masked Owl.

Impacts on these species are considered under separate headings below.

6.2.4.4 Potential impacts on the South-eastern Long-eared bat

Very little is known about the ecology of the South-eastern Long-eared bat (Schulz & Lumsden 2012). The only previous record of South-eastern Long-eared Bat in the search region (Table 6) indicates that the Study Area appears to be at or close to the edge of the range for this widespread species.

A peer review of the bat surveys found that the habitat within the study area was not suitable for this species and that calls recorded during the two surveys could not be attributed to this species (Gration 2015). As such, the peer review found that South-eastern Long-eared bat was not likely to occur within the study area. The expert that initially assessed the recorded bat calls — Greg Richards — has acknowledged he accepts the findings of the peer review given that the review was provided access to information that he was denied (Greg Richards, pers. Comm, May 2015).

Given that this species is unlikely to be present within the study area, it is highly unlikely that the Project will result in a significant impact to South-eastern Long-eared Bat.

6.2.4.5 Potential impacts on the Yellow-bellied Sheath-tail Bat

The Yellow-bellied Sheath-tail Bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range, it is a rare visitor in summer and autumn. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn. The review of existing information and results of the bat surveys suggest that while the Yellow-bellied Sheath-tail Bat may infrequently occur in the region, it is unlikely to be a permanent resident there, considering the dispersive characteristics of the species. It is also unlikely that the species breeds in the region, as very few captured specimens in southern Australia have been in breeding condition.

Therefore, impacts on Yellow-bellied Sheath-tail Bat as a result of the proposal would likely be negligible.

6.2.4.6 Potential impacts on the Squirrel Glider

The nocturnal Squirrel Glider occurs in woodlands, including narrow, linear remnants that support a combination of older trees with sufficient den hollows to support family parties

during the day and a winter source of carbohydrate in the form of either winter-flowering eucalypts and/or wattles with good sap-flow. Suitable habitat in the area occurs mostly along the river bank where there are hollow trees and a sub canopy of wattles. The eucalypt species that dominate the area (River Red Gum and Black Box) don't flower reliably in winter and therefore only the wattles provide a reliable winter carbohydrate source on which the species depends.

The Project will remove over 200 hollow bearing trees from the study area potentially impacting on breeding habitat. However, a much large number of hollow bearing trees will still remain in the area, so hollow availability for the glider is unlikely to be affected significantly and hollow bearing tree loss will be confined to a comparatively small proportion of the treed habitat on the Murray and Campaspe River floodplains.

Wattles will only be removed where the bridge crosses the river and lengthy river bank populations of wattles will remain in the area. The Project therefore is unlikely to result in a significant reduction in the availability of a winter carbohydrate source for the glider and the species is most likely to persist in the area after The Project is completed.

Habitat connectivity for this species within the Victoria portion of the study area is currently impaired — the township, existing roads and even the rivers act as barriers to connectivity. As such, a further barrier in the form of the new road skirting the existing township is unlikely to have a significant impact, particularly if mitigation measures are taken into account. This risk is to be mitigated via the installation of crossing zones for the Squirrel Glider. A preliminary crossing strategy has been developed in consultation with Roads and Maritime Services New South Wales (refer to Attachment 12). The location of crossing zones in Victoria would be determined in accordance with the project wide strategy, improving connectivity across the Murray River and Squirrel Glider habitat. Such crossing zones will need to consider the height of the bridge and adjaced trees.

For these reasons, significant impacts on this species are not anticipated.

6.2.4.7 Potential Impacts on the Masked Owl

The Masked Owl was recorded in the NSW portion of the Study Area in an area that will be directly affected by The Project. There are few records of this species in the Echuca – Moama region and the current record is considered of interest. It was either a non-resident dispersing bird (termed a 'floater') or was a member of a resident pair. The lack of nearby records suggested it was more likely the former but a resident pair could not be ruled out.

Masked Owl pairs occupy a home range of between 400 and 1,100 hectares (DEC 2006). The area of treed habitat being removed, at approximately 18 hectares, represents a very small proportion of a likely home range for this species. The record comes from an already highly developed landscape, with the towns of Echuca and Moama adjacent to

treed habitats. The species has been recorded in forest habitats within urban areas (DEC 2006) indicating a degree of adaptability to human settlement, including roads and vehicles. This owl requires large hollows for breeding purposes.

The Project will potentially remove breeding and foraging habitat. Given the limited development footprint of The Project compared with the usual home range size of the Masked Owl and the likelihood that the individual or individuals living in the treed habitats in the Study Area are already adapted to a developed landscape, the probability that The Project will lead to a decline in the species in the area is considered very low.

6.2.5 Potential cumulative impacts

6.2.5.1 Connectivity

The predominant habitat areas within the region surrounding the Study Area include:

- Barmah National Park;
- Gunbower State Forest – Perricoota State Forest block; and
- Murray River vegetation corridor (including Victoria Park Reserve, Banyule Park State Forest and Moama State Forest).

Land surrounding these core areas has been heavily and extensively impacted upon by a long history of agricultural and urban development. Consequently, it has been reduced in this region to series of remnants separated either by cleared land or by the Murray River (and its tributaries). For many species, the river does not represent a significant barrier to movement. For less mobile species the current state of the riparian corridor is effectively fragmented, with either cleared land or the river itself representing a barrier to movement. Notwithstanding its effectively fragmented condition, the Murray River vegetation corridor remains an important linking habitat between Barmah National Park and the Gunbower State Forest – Perricoota State Forest block, as well as with other significant habitat areas further afield.

The existing Echuca township, approximately five kilometres north to south and 4.5 kilometres east to west, comprises a fairly dense mix of residential areas and business precincts. It is gridded with local and through roads and scattered recreation reserves occur within it. Most of the town lies between the Campaspe and Murray Rivers and the Deakin Main Drain. Just over the border to the north, in New South Wales, occurs Moama, which is similar to Echuca in its geography and land use. Habitats in the two townships are generally of low biodiversity value.

Echuca and Moama limit the extent of the Murray River vegetation corridor, placing pressure on biodiversity, which still depend upon the corridor for gene flow. The Study Area is situated in a section of the corridor, which is already very narrow compared to other sections between the aforementioned core areas. While the Project will reduce the

extent of vegetation in this section of vegetation corridor further it is unlikely to reduce gene flow along the corridor below current levels.

6.2.5.2 Extent

Victoria Park Reserve, Banyule Park State Forest and Moama State Forest together form a relatively wide block of habitat along the Murray River vegetation corridor. However, each of these sites is separated by the rivers and cleared/developed land in between. The existing Echuca-Moama townships and surrounding agricultural activities place significant pressures on these divided fragments of habitat. Such pressures include:

- Threat of local extinctions arising from the inability of let mobile species to recolonise isolated patches of habitat; and
- Edge effects due to reduced extent of contiguous habitat and a high perimeter-area ratio.

The Project proposes to reduce further the area of habitat within the Victoria Park Reserve and Moama State Forest, potentially exacerbating these pressures.

The Preferred Alignment would result in the removal of a total of 18.738 hectares of native vegetation (comprising 13.655 hectares in Victoria and 5.080 hectares in NSW) and a total of 14 scattered trees (comprising 7 scattered trees in Victoria and 7 scattered trees in NSW).

This is from an area of over 400 hectares of native vegetation on the floodplains of the Campaspe and Murray Rivers around Echuca and Moama (between the current Echuca Bridge and the northern end of Wharparilla Drive). The removal represents approximately five percent of the vegetation within this area.

7. Risk Assessment

7.1 Methodology

The risk assessment for the Project included identification and management of Project risks and Environmental risks. Project risks were identified by VicRoads before an environmental risk assessment was undertaken with key specialists. A summary of the Project risks are outlined in Section 4 of the EES.

The environmental risk assessment developed for the EES included the development of impact pathways and mitigation measures that could reduce the impact of the Preferred Alignment.

A quantitative risk assessment was undertaken with key specialists. VicRoads and key members of the Project Team developed a risk register based upon a detailed understanding of the Project and the Preferred Alignment. The risk register was sent to key specialists for review and consideration prior to attendance at a workshop to:

- Review the consequence criteria developed;
- Review the risks identified;
- Identify any additional risks that need to be addressed; and
- Develop detailed mitigation measures.

7.2 Risk Significance

The significance of risks was identified, having regard to the Consequence Criteria and Likelihood Guide.

Consequence criteria were developed by VicRoads and reviewed by project specialists to define a scale of magnitude from “insignificant” to “catastrophic” risks. The scale of magnitude was based on the spatial area affected and expected recovery time of the value impacted. Accordingly, insignificant consequences were generally situated within a localised area with a recovery time potential within the range of normal variability. Conversely, catastrophic consequence criteria describe scenarios involving a very high magnitude event, affecting a State-wide area, or requiring over a decade to reach functional recovery.

The Consequence criteria for the biodiversity and habitat impacts and risks associated with the Project are outlined in Table 20.

Table 20: Consequence Criteria

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Listed Threatened Fauna species	No change detected for any fauna species listed under the EPBC Act, FFG Act or DELWP Advisory List	Removal of < 1% of the Project Area population for an EPBC Act listed species OR Removal of <1% of the regional area population for an FFG or DELWP advisory listed species	Removal of >1% of the Project Area population but <1% of the regional area population for an EPBC listed species, OR Removal of >1% of the regional population but <2% of the State population for an FFG or DELWP Advisory listed species.	Removal of >1% of the regional population but <1% of the State population for an EPBC listed species, OR, Removal of >2% of the State population for an FFG Act or DELWP Advisory listed species	Removal of >1% of the State Population for an EPBC listed species.
Listed Threatened Flora species	No change detected for any flora species listed under the EPBC Act, FFG Act or DELWP Advisory List	Removal of < 1% of the Project Area population for an EPBC Act listed species OR Removal of <1% of the regional area population for an FFG Act or DELWP advisory listed species	Removal of >1% of the Project Area population but <1% of the regional area population for an EPBC Act listed species, OR Removal of >1% of the regional population but <2% of the Stat population for an FFG Act or DELWP Advisory listed species.	Removal of >1% of the regional population but <1% of the State population for an EPBC Act listed species, or Removal of >2% of the State population for an FFG Act or DELWP Advisory listed species	Removal of >1% of the State Population for an EPBC Act listed species.
Scattered Trees	Removal of <5 scattered trees	Removal of 6-50 scattered trees	Removal of 51-300 scattered trees	Removal of 301-500 scattered trees	Removal of >500 scattered trees (including MTs, LOTs and VLOTs)
Ecological Vegetation Classes	No measurable impacts on the extent of an EVC	Loss of < 0.1% of an EVC of High or Very High conservation significance from the region (based on the total area of an EVC from the bioregion). 'No Net Loss' achievable	Loss of 0.1 - 1% of an EVC of High or Very High conservation significance from the Region (based on the total area of an EVC from the bioregion). 'No Net Loss' achievable	Loss of >1% but <5% of an EVC of High or Very High conservation significance from the region (based on the total area of an EVC from the bioregion). 'No Net Loss' achievable.	Loss of >5% of an EVC of High or Very High conservation significance from the region (based on the total area of an EVC from the bioregion). 'No net loss' not achievable.
EPBC Act , FFG Act & TSC Act Listed Communities	No measureable impact on the extent of a community listed under the EPBC Act, TSC Act or FFG Act	Loss of <1ha of an EPBC Act, TSC Act or FFG Act listed community	Loss of 1 -10 ha of an EPBC Act, TSC Act or FFG Act listed community	Loss of 10-50 ha of an EPBC Act, TSC Act or FFG Act listed community	Loss of >50ha of an EPBC Act, TSC Act or FFG Act listed community

The significance of the risks was determined having regard to the Likelihood Guide (Table 21) and the Consequence Level as outlined in Table 22.

Table 21: Likelihood Guide

Descriptor	Explanation
Almost Certain	The event is expected to occur in most circumstances
Likely	The event will probably occur in most circumstances
Possible	The event could occur
Unlikely	The event could occur but is not expected
Rare	The event may occur only in exceptional circumstances

Table 22: Risk Significance Matrix

Likelihood	Consequence Level				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Negligible	Low	Medium	High	High
Unlikely	Negligible	Low	Medium	Medium	High
Rare	Negligible	Negligible	Low	Medium	Medium

7.3 Risk Workshop

The Environmental Risk Assessment Workshop was held on 18 September 2014 to consider the risks and mitigation measures that would apply to the preferred alignment (Mid-West Alignment). The risk workshop was attended by the flora and fauna, cultural heritage, hydrology, noise, aquatic, traffic and geology specialists. The workshop also included representatives of VicRoads and the NSW Department of Roads and Maritime Services.

The risk workshop developed a risk register, which is presented in Table 23.

Table 23: Risk Register

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF1	Construction encounters confirmed habitat for EPBC Act Listed species (Rainbow Bee-eater)	Removal of fauna habitat		<p>Selected alignment avoids fauna habitat where possible. The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Insignificant	Almost Certain	Low	Refine the alignment through detailed design and/or construction planning to minimise the removal of known fauna habitat	Insignificant	Almost Certain	Low
FF2	Construction encounters confirmed habitat for EPBC Act listed species (Rainbow Bee-eater)	Possible injury or death to listed fauna species during construction		<p>Selected alignment avoids fauna habitat where possible. The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Minor	Unlikely	Low		Minor	Unlikely	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF3	Construction encounters confirmed habitat for FFG Act listed species (Masked Owl, Squirrel Glider and Yellow-bellied Sheath-tailed Bat) or impact outside of nominated construction footprint	Removal of fauna habitat		<p>Selected alignment avoids fauna habitat where possible. The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site. The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions. The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction. All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Minor	Almost Certain	Medium	Refine the alignment through detailed design and/or construction planning to minimise impacts	Minor	Almost Certain	Medium
FF4	Construction encounters confirmed habitat for FFG Act listed species (Masked Owl, Squirrel Glider and Yellow-bellied Sheath-tailed Bat) or impact outside of nominated construction footprint	Possible injury or death to listed fauna species during construction		<p>Selected alignment avoids fauna habitat where possible. The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site. The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions. The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction. All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Moderate	Possible	Medium	Include a requirement in the EMP to undertake salvage and translocation of tree-dwelling fauna species	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF5	Construction encounters Scattered LoTs	Removal of scattered trees along the alignment		<p>The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Moderate	Almost Certain	High	Refine the alignment through detailed design and/or construction planning to minimise impacts	Minor	Almost Certain	Medium

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF6	Construction encountered habitat for TSC Act listed species (Bitter Quandong, Chariot Wheels, Claypan Daisy, Narrow Doodenia, Red Swainson-pea, River Swamp Wallaby Grass, Round-leafed Wilsnia, Silky Swainson-pea, Slender Darling-pea, Small Scurf-pea, Spear grass, Turnip Copperburr, Wester Water-starwort, Windged Pettercress, Yellow Gum)	Removal of flora habitat during construction	Aquatic Hydrology	<p>The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Moderate	Possible	Medium	Refine the alignment through detailed design and/or construction planning to minimise impacts	Minor	Unlikely	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF7	Construction encounters habitat for DELWP Advisory listed flora and fauna species	Removal of flora and fauna habitat		<p>The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Minor	Likely	Medium	Refine the alignment through detailed design and/or construction planning to minimise impacts. Include a requirement in the EMP to undertake salvage and translocation of Dianella and other similar flora species.	Insignificant	Likely	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF8	Construction results in weeds and / or pathogens being spread	Invasion of native vegetation and/or fauna habitat and increased spread of weeds		The contractor shall be responsible for preparing an EMP. The contractor shall prevent the spread of declared weeds, pests and diseases within the site and offsite through the implementation of controls that include: i) treatment of declared weeds prior to the commencement of any ground disturbing activities and in response to their identification through monitoring on the site; ii) the management of weed and soil pathogen potential within imported materials; iii) provisions for cleaning plant and equipment; iv) the location of cleaning areas; and v) the use of a vehicle and machinery hygiene log book. These measures will be included in the EMP.	Minor	Possible	Low		Minor	Possible	Low
FF9	Loss of habitat due to machinery sparking fire during construction	Impact to native vegetation within a wider area and possible loss of habitat		The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site. The EMP shall include the process and responsibilities for operational control, comprising procedures to manage all identified impacts and environmental protection requirements, including the requirements where relevant in Section 177B-H, and any specific environmental requirements in Section 100.	Minor	Possible	Low	Construction not to occur on total fire ban days and diesel vehicles to be used, Keep vehicles to well designed haul roads and limit vehicle speeds.	Minor	Rare	Negligible

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF10	Light, noise, vibration disturbance to native fauna during construction and operation	Potential for stress on native fauna	Noise	<p>The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>All work under the contract shall comply with the following requirements:</p> <ul style="list-style-type: none"> i) hours of work shall be between 7am and 6pm weekdays and Saturday; ii) construction vehicles and equipment shall have appropriate measures fitted and be effectively maintained to minimise engine noise; iii) noisy equipment shall be enclosed where possible; iv) establishment of temporary noise attenuation barriers where possible; v) scheduling noisy work practices to minimise the likelihood of community annoyance; and vi) use of smart movement alarms for vehicles particularly when working in proximity to noise sensitive receptors or where working outside normal hours. <p>Minimal lighting adequate for public safety to be installed and used in operation of the road</p>	Minor	Possible	Low	<p>Include a requirement in the EMP to undertake salvage and translocation of tree-dwelling fauna species. Erect signage to alert drivers of risks of traffic to wildlife and fencing, where appropriate, to exclude animals.</p>	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF11	Construction removes remnant native vegetation and habitat	Fragmentation of habitat either side of the Project alignment effectively reducing area of connected habitat resulting in reduction in resilience of retained vegetation/habitat/populations to ongoing impacts due to reduction in area/size		The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site. The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions. The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction. All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.	Moderate	Almost Certain	High	Prepare a management plan, or update any existing management plan, for the Victoria Park Reserve in partnership/consultation with Campaspe Shire Council (being the relevant land manager). Establish an appropriate number of Squirrel Glider crossing zones. Revegetate construction footprint where possible post-construction.	Minor	Almost Certain	Medium
FF12	Shading	Loss/adverse change of flora and vegetation due to a lack of sufficient sunlight (particularly adjacent to and south of the bridge).		The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.	Insignificant	likely	Low	Prepare a management plan, or update any existing management plan, for the Victoria Park Reserve in partnership/consultation with Campaspe Shire Council (being the relevant land manager).	Insignificant	Possible	Negligible
FF13	Operational collision with wildlife, particularly at dawn, dusk and night	Possible injury or death to listed fauna species		The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.	Minor	Likely	Medium	Erect signage to alert drivers of risks of traffic to wildlife and fencing, where appropriate, to exclude animals.	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Planned Controls to Manage Risk (as per Section 177 and Project Description)	Initial Risk			Additional Controls Recommended to Reduce Risk	Residual Risk		
					Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
FF14	Construction encounters habitat for DELWP Advisory listed flora and fauna species	Possible injury or death to listed fauna species during construction		<p>The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.</p> <p>The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.</p> <p>The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.</p> <p>All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.</p>	Moderate	Possible	Medium	Include a requirement in the EMP to undertake salvage and translocation of tree-dwelling fauna species	Minor	Possible	Low

7.4 Mitigation Measures

In order to mitigate the risks for the Project, standard VicRoads and RMS environmental protection measures and some additional project specific have been identified for incorporation into the Environmental Management Framework (EMF). VicRoads, as the responsible proponent for the construction of the Project, would require the construction contractor to incorporate all of these measures from the Environmental Management Framework into the Construction Environmental Management Plan (CEMP).

Table 24 below summarises the various ways the Project is likely to adversely impact upon biodiversity within the Victorian portion of the alignment. It also indicates the likely effectiveness of implemented, proposed and/or recommended management measures (listed in Table 25) at mitigating impacts.

There are several additional Project specific controls that have been recommended to avoid, mitigate and manage potential biodiversity and habitat effects, reducing residual risks/impacts to an acceptable level. These are shown in Table 25.

All implemented, proposed and recommended controls to manage environmental risks and the responsibility for implementing them are outlined in Table 25.

Note: VicRoads Standard Management controls are referenced in Table 25.

Table 24: Summary and analysis of identified risks to biodiversity and habitat

Project phase	Aspect of project	Unmitigated Impacts						Management measures^
		Cause	Risk #	Risk description	Direct/ Indirect	Longevity	Affected significant biodiversity values	
Construction	Earthworks and construction	Land clearing	FF1, FF2, FF3, FF5, FF6, FF7 &	Loss of native vegetation, scattered LOTs and fauna habitat (e.g. hollow-bearing trees)	Direct	Permanent	Native vegetation, ecological communities and listed rare and threatened flora and fauna.	1, 2, 3, 4, 5, 6, 7
			FF2, FF3, FF4 & FF7	Possible injury or death to listed fauna species	Direct	Temporary	Listed rare and threatened fauna.	1, 2, 3, 4, 5, 6, 7
			FF11	Fragmentation of habitat either side of the Project alignment	Indirect	Permanent	Listed rare and threatened flora and fauna and native vegetation	11
			FF8	Weed invasion as a result of removing native vegetation which competes for resources	Indirect	Long-term	Native vegetation and listed rare and threatened flora and fauna	8
		Creation of road	FF11	Loss of wildlife habitat connectivity	Indirect	Permanent	Squirrel Glider	11, 15
		Accidental fire (e.g. from machinery sparks)	FF9	Impact to native vegetation within a wider area; possible loss of habitat; possible injury or death to listed fauna species	Direct	Temporary	Native vegetation; listed rare and threatened fauna	2, 12, 13
		Spillage of construction materials into the rivers	AQ11	Disruption to and/or smothering of aquatic habitat and/or habitat continuity causing impacts on fish health, movement and migration.	Indirect	Temporary	Listed ecological community	2, 9, 16, 18, 19, 20

Project phase	Aspect of project	Unmitigated Impacts						Management measures^	
		Cause	Risk #	Risk description	Direct/ Indirect	Longevity	Affected significant biodiversity values		
		Light, noise and vibration pollution	FF10	Disturbance to native fauna	Direct	Temporary	Listed rare and threatened fauna	14	
		Adverse impacts on downstream aquatic habitat / water quality	AQ11	Degraded river health and reduced aquatic habitat	Indirect	Temporary	Listed ecological community	2, 3, 4, 22, 23, 25	
	Machinery, vehicle & personnel traffic		Traffic results in weeds and / or pathogens being spread	FF8	Invasion of native vegetation and/or fauna habitat and increased spread of weeds	Direct	Long-term	Native vegetation and listed rare and threatened flora and fauna	8, 26
	Construction activity		Shading	FF12	Loss/adverse change of flora and vegetation from beneath and adjacent to bridge (particularly to the south) due to a lack of sufficient sunlight.	Indirect	Long-term	Native vegetation and listed rare and threatened flora	11, 26
Operation	Traffic	Collision with wildlife, particularly at dawn, dusk and night	FF13	Possible injury or death to listed fauna species	Direct	Long-term	Native vegetation, ecological communities and listed rare and threatened flora and fauna	24	
		Oil-based pollutant input from roads into rivers and soils	AQ11	Possible injury or death to listed fauna species	Indirect	Long-term	Native vegetation, ecological communities and listed rare and threatened flora and fauna	25	
		Noise from passing traffic, particularly at night	FF10	Displacement of noise-sensitive fauna	Indirect	Long-term	Listed rare and threatened fauna	14, 24	
	Road lighting and traffic		Light, noise, vibration pollution	FF10	Disturbance to native fauna	Permanent	Permanent	Terrestrial fauna	10, 14, 24

Project phase	Aspect of project	Unmitigated Impacts						Management measures^
		Cause	Risk #	Risk description	Direct/ Indirect	Longevity	Affected significant biodiversity values	
	Presence of bridge	Exposure of soils beneath bridge, where vegetation is unlikely to grow	FF12	Sedimentation of adjacent waterways from erosion or washing away (during floods) of exposed soils	Indirect	Permanent	Listed ecological community	11, 26

Table 25: Environmental management measures

Mitigation Measure #	Description	Responsibility	Implemented/Standard / Additional and
1	Selected alignment that minimises the amount of native vegetation and habitat removed.	VicRoads	I
2	The contractor shall be responsible for preparing an EMP, ensure that all personnel are informed of the environmental issues and specific risks and mitigation measures prior to undertaking any works on-site.	Contractor	S - 177.A3
3	The contractor shall be responsible for obtaining all necessary permits and approvals from relevant authorities, other than those already obtained by VicRoads and RMS and implementing the relevant conditions.	Contractor	S - 177.A5
4	The Contractor shall engage a suitably experienced and skilled environmental management professional to prepare the Environmental Management Plan and manage and monitor all environmental issues and environmental treatments implemented during construction.	Contractor	S - 177. A6
5	All works shall avoid, minimise and offset (where appropriate) the removal of native vegetation during construction; avoid injury to fauna or damage to protected vegetation or habitat; and management of any significant flora and fauna sites, species or habitat not previously identified.	Contractor	S - 177.A4, 177.I1
6	Minimise impacts where LoTs are known to occur through detailed design or construction planning.	VicRoads/ Contractor	S - 177.I1
7	Prepare and implement EMP inclusive of salvage and translocation of tree dwelling fauna species, Dianella and similar flora species and management measures	Contractor	A - 177.A3
8	The contractor shall prevent the spread of declared weeds, pests and diseases within the site and offsite through the implementation of controls that include: i) treatment of declared weeds prior to the commencement of any ground disturbing activities and in response to their identification through monitoring on the site; ii) the management of weed and soil pathogen potential within imported materials; iii) provisions for cleaning plant and equipment; iv) the location of cleaning areas; and v) the use of a chemical and machinery hygiene log book. These measures will be included in the CEMP.	Contractor	S- - 177.I2
9	Catch traps will be used during bridge construction to eliminate the spillage of any construction materials into the rivers.	Contractor	S - 177.D1
10	Extra lighting will be minimal and will not occur through bushland areas.	Contractor	S
11	Engage a suitably qualified and skilled ecologist to prepare a management plan, or update any existing management plan, for the Victoria Park Reserve, ensuring that any predicted future threats arising from edge effects, reduced area, etc. are managed. The plan should be prepared in consultation with Campaspe Shire Council (being the relevant managing authority).	Contractor	A - 177.A3
12	The EMP shall include the process and responsibilities for operational control, comprising procedures to manage all identified impacts and environmental protection requirements, including the requirements where relevant in Section 177B-H, and any specific environmental requirements in Section 100.	Contractor	S - 177.A3
13	Construction not to occur on total fire ban days and/or only diesel vehicles to be used. Fire fighting equipment should be carried on plant eg. fire extinguishers, fire fighting backpacks.	Contractor	S
14	All work under the contract shall comply with the following requirements:	Contractor	S- 177.H1

Mitigation Measure #	Description	Responsibility	Implemented/Standard / Additional and
	i) hours of work shall be between 7am and 6pm weekdays and Saturday; ii) construction vehicles and equipment shall have appropriate measures fitted and be effectively maintained to minimise engine noise; iii) noisy equipment shall be enclosed where possible; iv) establishment of temporary noise attenuation barriers where possible; v) scheduling noisy work practices to minimise the likelihood of community annoyance; and vi) use of smart movement alarms for vehicles particularly when working in proximity to noise sensitive receptors or where working outside normal hours		
15	In order to minimise Squirrel Glider road mortality and facilitate ease of movement across the Preferred Alignment, it is recommended that an appropriate number of crossing zones be established. Crossings should be approximately one hundred metres long and be designed in consultation with Rodney Van der ree, Centre for Urban Ecology and Campaspe Shire Council (the relevant managing authority). A preliminary crossing strategy has been developed in consultation with Roads and Maritime Services New South Wales (refer to Attachment 12). The location of crossing zones in Victoria should be determined in accordance with the project wide strategy. The following features should be incorporated into any crossings: <ul style="list-style-type: none"> ▪ Suitable Squirrel Glider vegetation to be retained as close to the road as practical; ▪ Artificial land/launch poles to be strategically placed to facilitate glider road crossing; and/or ▪ Aerial rope bridges to be constructed over the road to facilitate glider road crossing. 	VicRoads/ Contractor	A – 177.A3
16	Provision of sedimentation basins in Project design.	Contractor	I- 177.D1
17	Prompt temporary and/or permanent progressive revegetation of the site as work proceeds.	Contractor	S- 177.D1
18	Prompt covering of exposed surfaces (including batters & stockpiles) that would otherwise remain bare for >28 days.	Contractor	S- 177.D1
19	Installation, stabilisation and maintenance of catch and diversion drains that segregate water runoff from catchments outside of the construction site from water exposed to the construction site.	Contractor	S- 177.B1
20	Bridge design does not include piles within the river channel.	VicRoads	I
21	Structures to be built outside of the permanent waterway and water flow maintained.	VicRoads/ Contractor	S- 177.B1
22	Schedule construction during times of low flow periods, where possible: EMP needs to take this program into account.	Contractor	S- 177.A3
23	Water quality and rainfall shall be monitored during all stages of construction to ensure water quality in the receiving waterways does not vary between the upstream and downstream limits of the work site during the construction period and is as agreed between the Contractor, the Superintendent and the EPA.	VicRoads	S- 177.B1
24	Erect signage to alert drivers of risks of traffic to wildlife and fencing, where appropriate, to exclude animals. Minimal lighting adequate for public safety to be installed and used in operation of road.	VicRoads	A
25	If feasible, design bridge with guttering that diverts all oil-based run-offs (including during high-rainfall events and accidental spills) away from environmentally sensitive areas and preferably trapped within spill basins that can be efficiently cleaned out periodically by road maintenance contractors.	VicRoads	I- 177.D1
26	Engage a suitably qualified and skilled Bushland Contractor to control any weed outbreaks for three years, following the completion of construction	VicRoads	S- 177.I2

8. Opportunities for further mitigation of impacts

Opportunities for further mitigation of impacts to biodiversity have been identified for the Project. It should be noted that mitigation measures outlined in this report are pertinent to Victoria. Refer to BL&A Report 8194 (15.1) (BL&A 2014) for mitigation measures that have been developed under New South Wales policies for the New South Wales sections of the alignment.

Recommended mitigation measures, which should be included in a construction environmental management plan for the Project, are provided below. These represent specific biodiversity impact mitigation measures that require detailed explanation and description. This level of detail was not possible in the preceding section, which involves tabulated mitigation measures. Furthermore, the EES Scoping Requirements require that additional, specific impact mitigation measures be explicitly presented.

8.1 Pre-construction

Avoid the removal of large hollow-bearing trees where possible. Hollow trees such as large old River Red-gums support roosting habitat for the Squirrel Glider recorded in the Study Area.

In accordance with the Victorian *Catchment and Land Protection Act 1994*, the noxious weed species listed below, which were recorded in the Study Area, must be controlled using precision methods (e.g. spot spraying by hand) that avoid off-target impacts. This method of control should be *implemented throughout the Project* for the species listed below.

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

All environmental controls should be checked for compliance on a regular basis, following the completion of the Construction Environmental Management Plan for the Project.

The Project should be designed in a way that does not alter the hydrology of the Campaspe or Murray Rivers. It is understood that no direct impacts are considered likely on the Campaspe River or Murray River. Piers will be constructed as the main supports for the bridges at either side of the river and no permanent bridge infrastructure will occur within the rivers

themselves. Erosion controls must be adopted for these areas during construction to ensure that there is no change in water quality and flow.

Implement salvage and translocation of *Dianella* and similar flora species.

8.2 Construction phase

The following additional recommendations should be considered during the construction phase of the Project.

- Environmentally sensitive areas to be retained should be identified at two metres from their edge and appropriately signed. All machinery and earthworks are to be excluded from these areas.
- Any tree pruning should be undertaken by an experienced arborist to prevent disease or unnecessary damage to trees or disturbance to understorey vegetation during tree trimming.
- Any stockpiling must occur outside retained native vegetation and away from any drainage lines.
- All machinery should enter and exit works sites along defined routes that do not impact on native vegetation or cause soil disturbance and weed spread.
- All machinery brought on site should be weed and pathogen free. This is important for environmental and agricultural protection. Weeds and/or pathogens can be easily transported by machinery.
- Chytrid Fungus is a frog disease that can be easily transported by machinery and personnel. To ensure that this disease is not spread, all machinery and personnel working involved in the construction of the project should be weed and pathogen free prior to entering the site. Wash down methods including disinfecting of footwear and machinery tyres is recommended when working in or adjacent to areas of native vegetation or wetlands
- All machinery wash down, lay down and personnel rest areas should be defined (fenced) and located in disturbed areas well away from wetlands and waterway banks.
- Best practice erosion control should be established where an erosion hazard is identified.

8.3 Post-construction phase:

These additional recommendations should be considered during the post-construction phase of the Project.

- Weed control should be carried out along disturbed areas after construction to control any weed outbreaks in adjacent areas of native vegetation.
- Any areas of temporary disturbance along the Campaspe and Murray Rivers should be revegetated with appropriate indigenous plants of local genetic provenance following construction. This measure is aimed at minimising any potential long-term adverse impacts that the proposed development may have on the health and functionality of these watercourses.
- The use of local indigenous plant species, (from seed and plant species sourced within a given radius of 50 kilometres of the Project Area), should be considered in the landscaping of any development on the site. Locally indigenous species generally have low water-use requirements, high survival rates and provide habitat to local fauna species.

9. Consistency of project against relevant legislation, policy and guidelines

9.1 Commonwealth Impacts and Regulatory Implications

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) 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 lasting up to six to nine months.

A Referral has been submitted and the decision made that The Project is a 'Controlled Action'. Assessment is being made by Preliminary Documentation, which is currently being prepared for submission.

9.1.1 Threatened ecological communities

No EPBC Act listed ecological communities were recorded and none is considered likely to occur.

9.1.2 Threatened flora species

No EPBC Act listed flora species were recorded during the current investigation and none is considered likely to occur.

9.1.3 Threatened fauna species

Of the EPBC Act listed fauna species predicted to occur in the study area, only one species was recorded. This was:

- Rainbow Bee-eater (migratory).

Based on the likelihood of occurrence assessment for EPBC Act listed fauna species, suitable habitat was deemed to occur in the study area for eight species, including the one recorded (Table 6). These eight species are discussed in more detail below. Species considered unlikely to occur based on lack of suitable habitat or lack of recent and regular records from the search region are not highlighted and not discussed further (with the exception of South-eastern Long-eared Bat and Growling Grass Frog).

The **Swift** and **Superb Parrots** were species considered to have the potential to occur within the study area whilst moving between core

habitat areas. However, such occurrence would only be for short periods and no impacts are expected on their populations from changes to habitats in the Study Area arising from the proposed crossing (see Section 3.6.2.2.2).

Very limited suitable **Eastern Great Egret** habitat occurs along the Rivers and the billabongs in the vicinity of the study area. While such habitat would be temporarily used for foraging, it is unlikely to support breeding activities.

Koala has not been detected in or adjacent the study area during any of the extensive flora and fauna field investigations for this project since 2008. This indicates that there is no evidence of either a current or historical population of the Koala in the vicinity of the study area. It is therefore unlikely that a viable population of the species exists in the study area and locality, however, it has the potential to occur.

The EPBC Act threatened **South-eastern Long-eared Bat** was initially suspected to occur within the Study Area based on an analysis of recorded bat calls by Greg Richards. However, a subsequent peer review of these findings found that the habitat within the study area was not suitable and that the recorded calls could not be attributed to South-eastern Long-eared Bat — as such, this species was unlikely to be present within the study area (Gration 2015).

The bat is largely restricted in its distribution to the Murray–Darling Basin (Churchill 2008). The review of existing information revealed that one record existed in the search region for South-eastern Long-eared Bat. This was in the Atlas of NSW Wildlife database. Considering that this species was only formally described in 2009 and that distinguishing it from the closely related Gould’s Long-eared Bat (*Nyctophilus gouldi*) and Lesser Long-eared Bat (*Nyctophilus geoffroyi*) generally requires capture, historical records are likely to be misrepresentative. It is asserted in the Draft South-eastern Long-eared Bat Recovery Plan (Schulz & Lumsden 2012) that South-eastern Long-eared Bat is considered to be potentially absent from the River Red-gum forests along the Murray River (in which part of the Study Area is situated), however there is much about the species that remains unknown.

Given the initial finding that this species was indeed present, The Project was assessed against the Commonwealth significant impact criteria (Department of the Environment 2013). It was concluded that the Project ‘may, is likely to or will result in a significant impact on South-eastern Long-eared Bat’, primarily because it was initially thought that the population in the Study Area met the criteria of an important population

due to it being near the edge of the species known range; and the reduction in area of occupancy of an important population of a vulnerable species represents a significant impact according to the Commonwealth significant impact criteria. Based on this, The Project was referred under the Act and made a Controlled Action by the Australian Minister for the Environment.

No EPBC Act listed reptile species were considered to potentially occur in the study area due to a lack of suitable habitat.

One EPBC Act listed frog species — **Growling Grass Frog** — was initially considered to potentially occur in the study area. However, with a lack of historic records in the search region (i.e. 10 kilometre radius of the study area) and targeted surveying failing to record the species, it was considered that Growling Grass Frog is unlikely to occur in the study area.

9.1.4 Migratory bird species

Twelve EPBC Act listed migratory bird species were predicted to occur within or near the Study Area. Species likely to occur as outlined in Table 6 are discussed below. Those not likely to occur in the Study Area are not discussed further.

Among the EPBC Act listed migratory species, the **Rainbow Bee-eater** was recorded within the Study Area throughout the survey period. This species is a common, widespread species in inland Australia, including along the Murray River valley, and the potential removal of a small proportion of its habitat, is not considered to be a significant impact.

Another migratory species likely to pass through the Study Area is the **White-bellied Sea-eagle**. This species might occasionally travel inland over large wetlands and rivers. There are no known breeding sites within the Study Area or nearby. As its presence in the Study Area would be temporary and occasional, no impacts are expected on its population.

Fork-tailed Swift and **White-throated Needletail (migratory)** are highly nomadic when in Australia and move in flocks ahead of weather fronts, often over heavily forested areas. These species have the potential to occur in the study area occasionally as suitable habitat is present.

9.1.5 Key Threatening Processes under the EPBC Act

The following Key Threatening Processes are considered relevant for the Project:

- Infection of amphibians with Chytrid fungus resulting in chytridiomycosis;

- Land clearance;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.

Mitigation measures as outlined in Table 24 identify specific actions required to manage these key threatening processes.

9.1.6 Implications

Under the EPBC Act a Referral to the Commonwealth Government was made for the Project in respect to South-eastern Long-eared Bat given the initial interpretation of the bat survey results finding that the species was present and that the Project may, was likely to or would result in a significant impact on this species according to DotE (2013). The Project was determined by the Commonwealth Minister for the Environment to be a Controlled Action that would require assessment by Preliminary Documentation.

Preliminary Documentation is currently being prepared based on the understanding that South-eastern Long-eared Bat is not likely to occur within the study area and The Project will not significantly impact it.

9.2 Victorian Impacts and Regulatory Implications

9.2.1 Planning and Environment Act 1987

9.2.1.1 Local Provisions

9.2.1.1.1 Overlays

A permit is generally required to carry out works and/or remove trees within the portion of the Study Area that is subject to the Heritage Overlay and Schedule 79 to the overlay.

A permit is also generally required to remove, destroy or lop any native vegetation, including dead vegetation within the portion of the Study Area that is subject to the Environmental Significance Overlay and Schedule 1 to the overlay.

Approvals are proposed to be obtained via a Planning Scheme Amendment process through the inclusion of an incorporated document to exempt the Project from permit requirements.

9.2.1.1.2 State provisions

A planning permit under Clause 52.17 of the Campaspe Planning Scheme would usually be required for the removal of native vegetation. Such approval is proposed to be obtained via a planning scheme amendment process through the inclusion of an incorporated document.

The current proposal would trigger a referral to DELWP as it meets the criteria specified in Section 5.2.1.

9.2.1.1.2.1 Risk based pathway

9.2.1.1.2.1.1 Extent Risk

Development within the Construction Area will result in the removal of a total extent of **14.147 hectares** (6.798 habitat hectares) of native vegetation as determined by DELWP and shown in Figure 12. The total extent of native vegetation removed comprises **13.655 hectares of Remnant Patch** native vegetation (within Victoria) along with a standard area of **0.071 hectares for each of seven Scattered Trees**.

It is understood that no native vegetation has been approved for removal for the Project or associated works within the last five years.

9.2.1.1.2.1.2 Location Risk

The area of proposed native vegetation removal contained mapped areas of the following *location risk* categories:

- Location Risk A

9.2.1.1.2.1.3 Risk based pathway

Based on the criteria outlined in Section 5.2.1, the proposal will be assessed under the **moderate** risk assessment pathway (see Appendix 8).

9.2.1.1.2.2 Strategic biodiversity score

The strategic biodiversity score of each area of native vegetation loss has been provided by DELWP Transitional Support (See Appendix 8).

9.2.1.1.2.3 Important habitat

Development within the Construction Area would not result in the removal of important habitat for Victorian rare and threatened species as determined by DELWP Transition Support (see Appendix 8).

9.2.1.1.2.4 Losses in Biodiversity Equivalence Units (BEUs)

While the Project will be assessed under the moderate risk pathway, losses in only *general* Biodiversity Equivalence Units (BEUs) apply.

The general Biodiversity Equivalence score is calculated by multiplying the losses from remnant patches and scattered trees in *habitat hectares* by the strategic biodiversity score. As such, the Project would result in the loss of (see Appendix 8):

- 3.025 general biodiversity equivalence units (BEUs).

9.2.1.1.2.5 Offset requirements

Offsets required to compensate for the proposed removal of native vegetation from the Study Area have been determined by DELWP Transitional Support (see Appendix 8). The required offsets are: below.

- 4.537 biodiversity equivalence units

Under the Guidelines *all* offsets must be secured prior to the removal of native vegetation. Offsets should be identified through a native vegetation broker or by VicRoads itself.

General offsets must be located within the North Central Catchment Management Authority area and/or Shire of Campaspe and must have a minimum strategic biodiversity score of 0.354 (see Appendix 8). No offsets can occur within 150 metres of any dwellings and associated buildings on the subject land or adjoining properties covered by a BMO or within 50 metres of these structures on all other land occurring within Bushfire Prone Areas.

Suitable offsets to meet these requirements are available in the VicRoads offset bank (L. Coles, VicRoads, pers. comm. 17th April 2015). Other sources are also available (N. Lewis, ES Link [Offset Brokers], pers. comm. 22th April 2015).

9.2.2 Flora and Fauna Guarantee Act 1988

The Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) lists threatened flora and fauna species to provide for their protection and management.

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.

9.2.2.1 Threatened/protected flora species

No flora species listed as threatened under the FFG Act was recorded in the Victorian portion of the Study Area.

The following flora, while not listed as threatened, are listed as protected under the FFG Act and were recorded on public land within the Study Area:

- Asteraceae (Daisy Family):
 - Blue-burr Daisy;
 - Common Cudweed;

- Common Sneezeweed;
- Cotton Fireweed;
- Drooping Cassinia;
- Jersey Cudweed;
- New Holland Daisy;
- Shiny Everlasting; and
- Woodland Swamp Daisy.
- Acacia (Wattles):
 - Gold-dust Wattle; and
 - Golden Wattle.

A Protected Flora permit under the FFG Act will be required from DELWP for their removal.

9.2.2.2 *Threatened fauna species*

Apart from species discussed under the EPBC Act above, nine additional threatened fauna (seven birds, two mammals, no reptile and no frogs) were FFG Act-listed species that were assessed as likely to occur in the study area or had potential to occur in the study area.

Three of these fauna species listed under the FFG Act were recorded during the current field surveys. These were the Masked Owl, Squirrel Glider and Yellow-bellied Sheathtail Bat. The impacts and implications pertaining to these species are considered below:

- **Masked Owl:** Although the single individual Masked Owl was recorded in the NSW component of the Study Area (Figure 10), it would be considered to also occur in the Victorian component of the Study Area. The removal of native vegetation within the Study Area is likely to have a negative but not significant impact on this species, namely through the reduction of suitable habitat.

Squirrel Glider: A single individual was recorded in the NSW component of the Study Area by BL&A with subsequent surveys by ARCUE recording seven animals — three in Victoria and four in NSW. This species has the potential to be impacted by the Project in Victoria. Measures to mitigate against these potential impacts have been included in Section 11.2. Roads and Maritime Services have undertaken further investigation into the Squirrel Glider population in Echuca-Moama and determined that a Species Impact Statement is not required for the Project. The investigation assessed the local habitat conditions to inform a detailed mitigation strategy, including a crossing strategy, to provide access for the species over the proposed carriageway and Murray River at Echuca-Moama. This habitat linkage strategy, which meets the Victorian requirements, can be found at Attachment 12. Any mitigation and monitoring recommendations resulting from the study and adopted by Roads and Maritime Services would be implemented in both states.

- **Yellow-bellied Sheathtail Bat:** While this species was recorded in the Study Area, it is unlikely to be a permanent resident there, considering the

dispersive characteristics of the species. It is unlikely that the species breeds in the region either, as very few captured specimens in southern Australia have been in breeding condition. Therefore, impacts on Yellow-bellied Shearwater as a result of the proposal would likely be negligible.

Six further species are considered likely to occur within the Study Area:

- **Grey-crowned Babbler:** The Babbler inhabits dry woodlands and forests with a shrub layer and a groundcover of leaf litter and fallen timber. This babbler is likely to inhabit the woodlands and forests within the Study Area. During the 2009 site survey no evidence was found of its occurrence (BL & A 2011) and none was recorded during the current survey. Therefore the species is considered to be an occasional visitor in the Study Area. It is unlikely that the proposed development would adversely effect this species.
- **Intermediate Egret:** This species is likely to inhabit river margins and billabongs within the Study Area. However, the species is not likely to be impacted by development, as these birds could avoid disturbance by moving away from the site along the Murray River.
- Four bushbirds, namely the **Turquoise Parrot, Speckled Warbler, Hooded Robin** and **Diamond Firetail** are likely to occur in the Study Area, particularly within the Black box Woodland. Clearing of large sections of the woodland might impact on their population, but as only a few individuals are likely to use these woodlands at any one time, the impacts would be minimal.

9.2.2.3 Key Threatening Processes under the FFG Act

The following Key Threatening Processes are considered relevant for the Project as they will either occur or have the potential to occur as a result of the Project:

- Degradation of native riparian vegetation along Victorian rivers and streams.
- Habitat fragmentation as a threatening process for fauna in Victoria.
- Infection of amphibians with Chytrid Fungus, resulting in chytridiomycosis.
- Input of toxic substances into Victorian rivers and streams.
- Invasion of native vegetation by “environmental weeds”.
- Loss of coarse woody debris from Victorian native forests and woodlands.
- Loss of hollow-bearing trees from Victorian native forests.

Mitigation measures in Sections 7.4 and 8 identify specific actions required to manage these key threatening processes.

9.2.2.4 Implications

A Protected Flora permit under the FFG Act would be required from DELWP to remove the abovementioned FFG Act protected flora (refer to section

9.2.2.1) from public land and to remove habitat for the listed threatened Squirrel Glider.

9.2.3 Catchment and Land Protection Act 1994

The following Catchment and Land Protection Act 1994 (CALP Act) listed noxious weed species were recorded in the study area. All are listed as 'Regionally Controlled' weeds under the Act and as such, the proponent has a responsibility to prevent the growth and spread of these species in the study area as a consequence of The Project.

- African Box-thorn;
- Bridal Creeper
- Horehound;
- Patterson's Curse; and
- Prickly Pear.

9.2.3.1 Implications

In developing the construction and operational environmental management plans for The Project, it will be important to include specific measures to manage adaptively the possible spread of the regionally controlled weeds listed above.

9.2.4 Wildlife Act 1975

The *Wildlife Act 1975* provides for the regulation of the trapping and handling of Victorian native fauna. Management Authorities and Licenses are required for trapping, handling or humanely destroying native fauna for a range of purposes.

9.2.4.1 Implications

An important mitigation measure recommended in this report for implementation immediately before the commencement of tree removal in the development footprint is the salvage and translocation of tree-dwelling fauna species (see sections 7.4 and 8). Before this can commence, the project proponent must obtain a Management Authority from the DELWP to trap, handle and release salvaged fauna. This would need to include a clear indication of the release sites for salvaged fauna.

9.3 New South Wales Impacts & Regulatory Implications

9.3.1 Planning Controls

9.3.1.1 State Environmental Planning Policy (Infrastructure) 2007

The New South Wales State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the Project is for the construction of new road infrastructure and is to be carried out by the Roads and Maritime Services (RMS) Transport Department, it is assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EPA Act) and development consent from Murray Shire Council is not required. The implications of the EPA Act are discussed in Section 10.3.

9.3.1.2 State Environmental Planning Policy No. 44 (Koala Habitat)

State Environmental Planning Policy No. 44 requires Councils to take into consideration impacts on the Koala before taking a decision about a proposed project. Specifically, it "aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".

Murray Shire is listed in Schedule 1 of the SEPP as a shire to which the policy applies. The policy identifies Koala habitat as either:

- **"Core Koala habitat** is an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population; or
- **Potential Koala habitats** are areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component."

River Red Gum (*E. camaldulensis*) is identified in Schedule 2 of SEPP No. 44 as a Koala feed tree species. As more than 15% of the trees in the affected area belong to this species, the habitat is 'potential koala habitat'. Given this, the SEPP calls for a determination to be made on whether the habitat is core koala habitat. This is discussed below.

No Koalas have been detected in the Echuca region in any of the extensive flora and fauna field investigations for the Project since 2008. Review of the occurrence of this species in the search region (within 10 kilometres of

the proposed development site) in the Atlas of Victorian Wildlife indicates that there are no historical records of the species from the area, notwithstanding that it lies adjacent to a large population centre. The nearest records of the Koala to the Study Area are from a site approximately 10 kilometres to the west along the Murray River (one record) and the Barmah Forest, approximately 20 kilometres to the east.

This indicates that there is no evidence of either a current or historical population of the Koala in the Study Area. Therefore, the habitat is not 'core koala habitat' as defined in the SEPP and the provisions of this SEPP therefore do not apply.

9.3.1.3 Other State Environmental Planning Policy

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by *State Environmental Planning Policy No. 14 - Coastal Wetlands* or *State Environmental Planning Policy No. 26 - Littoral Rainforests*.

9.3.2 Native Vegetation Act 2003

Development consent is not required under the New South Wales *Native Vegetation Act 2003* for the Project as it will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*.

9.3.3 Fisheries Management Act 1994

The Fisheries Management Act 1994 (FM Act) lists threatened fauna and ecological communities that are threatened and provides policy and guidelines to protect threatened species habitats.

9.3.3.1 Threatened fish species

Threatened fish species listed under the FM Act are considered in a separate report (GHD 2015).

9.3.4 Environmental Planning and Assessment Act 1979

9.3.4.1 Native Vegetation

9.3.4.1.1 Native vegetation proposed for removal in New South Wales

River Red Gum - Black Box woodland of the semi-arid (warm) climatic zone is estimated to be 45% cleared in the Murray Catchment, and River Red Gum - herbaceous tall open forest of the Riverina and Murray Darling Depression Bioregions is estimated to be 10% cleared in this catchment. Both these vegetation types fall below the 70% threshold for an 'over-cleared vegetation type' based on the NSW BioMetric tool.

The area of native vegetation impacted in NSW totals 5.080 hectares (Table 26). Seven scattered trees are also required for removal in New South Wales. These are detailed in Appendix 4.

Table 26: Proposed native vegetation losses in New South Wales

Site ID	Vegetation Type	Area of native vegetation removed (ha)
24	River Red Gum - Black Box woodland	0.271
25	River Red Gum - Black Box woodland	0.49
26	River Red Gum - Black Box woodland	0.917
27	River Red Gum - herbaceous tall open forest	0.133
29	River Red Gum - Black Box woodland	0.27
30	River Red Gum - herbaceous tall open forest	2.434
31	River Red Gum - herbaceous tall open forest	0.565
Totals		5.080

Impacts to hollow-bearing trees in NSW have also been quantified and are shown in Table 28.

A biodiversity offset strategy would need to be developed in consultation with Roads and Maritime to compensate for residual impacts of the proposed action.

9.3.4.2 Threatened Species

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. The Seven Part Test does not take into account mitigation measures.

A full copy of the Seven Part Test criteria is provided in BL&A Report 8194 (15.5) (BL&A 2015). The various criteria are relevant to specific values. These are presented separately below.

Threatened Species are considered under Criteria A, D and F of the Seven Part Test. The Seven Part Test should be undertaken for a threatened species whenever the presence of a threatened species listed on the TSC Act in an affected area is confirmed or likely. The relevant criteria for the Seven Part Test are addressed in Table 27, for all TSC Act listed species recorded or deemed likely to occur in the Study Area. The following threatened species have been subjected to the relevant criteria of the Seven Part Test in this section (Table 27).

- Flora:

- Slender Darling-pea
- Small Scurf-pea
- River Swamp Wallaby-grass and
- Western Water Starwort

Fauna:

- Masked Owl
- Black-chinned Honeyeater
- Brown Treecreeper
- Diamond Firetail
- Grey-crowned Babbler
- Hooded Robin
- Speckled warbler
- Superb Parrot
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Sheath-tail Bat
- Squirrel Glider
- Koala

Table 27: Summary of responses to the criteria of the Seven Part Test for threatened species

Threatened species or communities	Significance assessment question*							Likely significant impact?
	a	b	c	d	e	f	g	
Ecological communities								

Threatened species or communities	Significance assessment question*							Likely significant impact?
	a	b	c	d	e	f	g	
Murray River EEC	X	X	Y	Y	X	Y	Y	No
Flora								
Slender Darling-pea	N	X	X	N	X	X	N	No
Small Scurf-pea	N	X	X	N	X	X	N	No
River Swamp Wallaby-grass	N	X	X	N	X	X	N	No
Western Water-starwort	N	X	X	N	X	X	N	No
Birds								
Masked Owl	N	X	X	Y	X	Y	Y	No
Brown Treecreeper	Y	X	X	Y	X	X	Y	No
Grey-crowned Babbler	N	X	X	Y	X	X	Y	No
Black-chinned Honeyeater	N	X	X	Y	X	X	Y	No
Hooded Robin	N	X	X	Y	X	X	Y	No
Diamond Firetail	N	X	X	Y	X	X	Y	No
Speckled Warbler	N	X	X	Y	X	X	Y	No
Varied Sittella	N	X	X	Y	X	X	Y	No
Swift Parrot	N	X	X	Y	X	X	Y	No
Superb Parrot	N	X	X	Y	X	X	Y	No
Turquoise parrot	N	X	X	Y	X	X	Y	No
Mammals								
Squirrel Glider	N	X	X	N	X	X	N	No
Koala	N	X	X	Y	X	N	Y	No

Threatened species or communities	Significance assessment question*							Likely significant impact?
	a	b	c	d	e	f	g	
Yellow-bellied Sheathtail Bat	N	X	X	Y	X	X	Y	No

Table notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable.

* Significance Assessment Questions as set out in the *Threatened Species Conservation Act 1995/ Environmental Planning and Assessment Act 1979*:

- 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,
- 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,
- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
 - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
 - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
- d) in relation to the habitat of a threatened species, population or ecological community:
 - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
- f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

9.3.4.3 Endangered Populations

Endangered populations are considered under Criteria B and D of the Seven Part Test. No endangered populations of flora or fauna currently listed under Schedule 1 Part 2 of the TSC Act occur in the NSW search region. Therefore, none is considered to be affected by the Project.

9.3.4.4 Endangered and Critically Endangered Communities

Endangered and critically endangered communities are considered under Criteria C and D of the Seven Part Test. Five endangered ecological communities listed under Schedule 1 Part 3 occur in the NSW search region. None of these listed communities was recorded in the New South

Wales section of the Study Area. No critically endangered ecological communities listed under Schedule 1A Part 2 of the TSC Act occur in the NSW search region or the Study Area.

9.3.4.5 Critical Habitat

Critical Habitat is considered under Criterion E of the Seven Part Test. All critical habitat listed under the TSC Act in NSW is shown on the Critical Habitat Register (OEH 2013). The habitat recorded within the Study Area does not represent any of the Critical Habitat listed in the Register. No such habitat is therefore affected by the Project.

9.3.4.6 Threatening Processes

Threatening processes are considered under Criteria G of the Seven Part Test. Key Threatening Processes as listed under Schedule 3 of the TSC Act (1995) relevant to the Project include the following:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees
- Infection of frogs by amphibian Chytrid causing the disease chytridiomycosis
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Loss of hollow-bearing Trees

The loss of hollow-bearing trees in the NSW component of the Study Area has been quantified for the project. Specific losses of these trees are presented in Table 28 below, and their locations presented in Figure 11.

As shown in Table 28, a total of nine hollow-bearing trees will be removed in NSW.

Mitigation measures in Sections 7.4 and 8 identify specific actions required to manage these above listed key threatening processes.

Table 28: Loss of hollow-bearing trees in the NSW portion of the Study Area

Tree no.	Remove/Retain
1 to 17	Retain
18	Remove
19	Remove
20	Remove
21 to 26	Retain
27	Remove

Tree no.	Remove/Retain
28	Remove
29	Remove
30	Remove
31	Retain
32	Remove
33 & 34	Retain
35	Remove
Total no. of hollow trees to be removed	9

9.3.4.7 Conclusion

Eighteen flora and fauna species listed under the NSW TSC Act and FM Act were recorded or considered likely to occur in the Study Area due to the availability of suitable habitat (Table 4, Table 6 and above in Section 4.2.3). In the addition to these threatened species one EEC was also identified as occurring within the Study Area.

The findings of the significance assessments were that there is unlikely to be any significant impact on any species. As such, Species Impact Statements are not required.

Any further mitigation and monitoring measures required in would be applied to the whole project.

9.3.5 Noxious Weeds Act 1993

Under the *Noxious Weeds Act 1993*, all listed noxious weeds in the relevant council area must be controlled to the level stated on the NSW DPI Noxious Weeds database (Appendix 9).

Paterson's Curse is the only noxious weed species recorded in the NSW section of the Study Area and must be controlled to the level specified in Appendix 9.

10. Required environmental performance monitoring

Monitoring of environmental performance that may be required to verify compliance with requirements is outlined in Table 29 below.

Table 29: Monitoring requirements

Timing	Monitoring requirements	Monitoring frequency
Pre-construction	Ensure that all required permits and licences have been obtained	NA
	Ensure an EMP has been prepared for the Project, to the satisfaction of relevant Government Authorities	NA
	Ensure that all required offsets have been secured	NA
During construction	Evaluate environmental management measures/controls against any relevant conditions in permits and licences obtained for the Project	As per EMP monitoring requirements
	Evaluate environmental management measures/controls against the Project EMP	As per EMP monitoring requirements
	Ensure that any offsets for which the proponent is responsible for managing are being implemented as per relevant offset plan	As per relevant offset plan monitoring requirements
Post construction	Evaluate environmental management measures/controls against any relevant conditions in permits and licences obtained for the Project	As required under relevant permit/licence
	Evaluate environmental management measures/controls against the Project EMP	As per EMP monitoring requirements
	Ensure that any offsets for which the proponent is responsible for managing are being implemented as per relevant offset plan	As per relevant offset plan monitoring requirements

11. Conclusion

For the biodiversity aspects of the Echuca-Moama Bridge Project, the relevant draft evaluation objective as outlined in the EES Scoping Requirements is:

To avoid or minimise adverse effects on native vegetation and listed flora and fauna species and ecological communities, and address opportunities for offsetting potential losses consistent with relevant policy.

This assessment has addressed the relevant draft evaluation objective from the EES Scoping Requirements as follows:

- Determined the extent and quality of native vegetation and associated habitat for listed flora and fauna species within the Study Area;
- Identified the alignment with the least impact on biodiversity and habitat so as to avoid and minimise adverse effects;
- Identify any potentially threatening processes that could result from the Project under the FFG Act;
- Identified and described the potential and proposed design and mitigation measures, which avoid or minimise significant effects on native vegetation, and/or any listed flora and fauna.
- Identified proposed measures to further mitigate and manage residual effects of the Project, including addressing the offset requirements of Victoria's native vegetation permitted clearing regulations and relevant provisions of planning schemes.

The key impacts of the alignment in comparison to the No Project option would involve the removal of:

- A total of 18.735 hectares of remnant native vegetation. Of this vegetation, 13.655 hectare occurs within Victoria while 5.080 hectares occur within New South Wales;
- A total of 14 scattered trees (comprising seven in Victoria and seven in NSW).
- An unknown number of Pale Flax-lily plants and two Blue Burr-daisy plants (DELWP-listed);
- A total of up to 230 hollow bearing trees (comprising up to 221 Large Old Trees that may be hollow-bearing in the Victorian section of the Study Area and nine in the NSW section);
- Treed fauna habitat supporting numerous hollow bearing trees.

It is unlikely that the Project will result in a significant impact to any species.

However, based on the initial findings that South-eastern Long-eared Bat was present and may be impacted, a Referral under the EPBC Act was lodged. The Commonwealth Minister for the Environment decided, given the information provided, that the project will be a 'controlled action' under the EPBC Act on the grounds of possible impacts on the South-

eastern Long-eared Bat. This means the action cannot be undertaken without the approval of the Minister. The EPBC Act assessment is by Preliminary Documentation. Preliminary Documentation is currently being prepared for submission. In light of the peer review (Gration 2015) this documentation will detail the reasons the project is highly unlikely to have a significant impact on this species. The Decision under this Act will be made by the Commonwealth Minister for the Environment.

Aspects of the Project that are considered likely to adversely impact upon biodiversity and habitat are listed below.

- Land clearing
- Creation of road
- Accidental fire (e.g. from machinery sparks)
- Spillage of construction materials into the rivers
- Light, noise and vibration pollution
- Structures and equipment used to construct bridges over rivers and bushland
- Adverse impacts on downstream aquatic habitat / water quality
- Traffic resulting in weeds and / or pathogens being spread
- Shading
- Collision of vehicles with wildlife, particularly at dawn, dusk and night
- Oil-based pollutant input from roads into rivers and soils
- Noise from passing traffic, particularly at night
- Light, noise, vibration pollution
- Exposure of soils beneath bridge, where vegetation is unlikely to grow

The following key impacts to biodiversity and habitat have been identified for these aspects of the Project:

- Loss of native vegetation, scattered LOTs and fauna habitat (e.g. hollow-bearing trees)
- Possible injury or death to listed fauna species
- Fragmentation of habitat either side of the Project alignment
- Reduction in resilience of retained vegetation/habitat/populations to ongoing impacts due to reduction in area/size
- Weed invasion as a result of removing native vegetation which competes for resources
- Loss of wildlife habitat connectivity
- Impact to native vegetation within a wider area;
- Loss of habitat;
- Disturbance to native fauna
- May provide a barrier or deterrent to fauna movement
- Invasion of native vegetation and/or fauna habitat and increased spread of weeds
- Loss/adverse change of flora and vegetation from beneath and adjacent to bridge (particularly to the south) due to a lack of sufficient sunlight.
- Possible injury or death to listed fauna species
- Possible injury or death to listed fauna species
- Displacement of noise-sensitive fauna

- Disturbance to native fauna
- Sedimentation of adjacent waterways from erosion or washing away (during floods) of exposed soils

These impacts can be mitigated to between negligible and medium risk levels through the implementation of the environmental management measures outlined in this report, with most impacts able to be mitigated to a low risk level.

The scale of proposed direct impacts in both Victoria and New South Wales is summarised in Table 30.

Table 30: Summary of impacts

Biodiversity/habitat values	Scale of Impacts		
	Victoria	New South Wales	Total
Native vegetation patches (ha)	13.655	5.080	18.735
Number of scattered trees	7	7	14
Number of hollow-bearing trees (max.) being potential Squirrel Glider habitat	221	9	230
Listed ecological communities (ha)	0	0*	0
Number of Pale Flax-lily plants	Unknown	Unknown	Unknown
Number of Blue Burr-daisy plants	2	-	2

* = *The Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment* (Murray River EEC) is listed under the FM Act. None of this community will be removed.

12. Assumptions and Limitations

Where feasible, all efforts are made to schedule flora and fauna field surveys in optimal weather conditions and times of year. Nevertheless, 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 initial 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 initial fauna assessment was undertaken during warm, dry and sunny weather conditions in the middle of spring (October 2008). 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.

The initial 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 this time for recreational purposes it being the peak of the holiday season. This may have impacted on the nocturnal and diurnal behaviour of both of these species.

The follow up flora surveying was carried out in early spring (September 2011), when many later spring-emergent plant species may have been absent or in the senescent stage of their life-cycle and lacking essential identification characteristics. The timing of this survey and condition of vegetation was otherwise considered suitable to ascertain the extent and quality of native vegetation. Follow up targeted flora surveys were then undertaken in late spring (November 2011) within the known flowering time for these species. The timing of the targeted flora survey was

therefore considered suitable to ascertain the presence or otherwise of the targeted flora species.

The follow up fauna assessment was undertaken during mild to warm weather conditions in September 2011. These conditions were considered suitable for detecting all groups of fauna likely to occur in the Study Area; however, many of the fauna species are highly cryptic and are difficult to detect. Follow up targeted fauna surveying was undertaken during the appropriate time of year for targeted species concerned between November 2011 and October 2012. The timing and survey effort of the targeted fauna surveys was therefore considered suitable to ascertain the presence or otherwise of the targeted fauna species.

The outer limit of works governed by the detailed design was provided from VicRoads in June 2012. On review of this data, some small areas within the alignments fell just beyond the surveyed corridor. These small areas have since been included in the current assessment based on a combination of additional survey effort in July 2012, earlier field assessments and aerial photo interpretation.

As the primary purpose of the investigation was to assess the extent and quality of native vegetation and fauna habitats in the Study Area and any potential impacts, the review of existing information, combined with the multiple field surveys undertaken at various times of the year and over considerable time was considered sufficient to complete this aspect of the assessment.

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 suitable habitat. The implications under legislation and policy are considered accordingly.

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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				Rec
				EPBC	TSC	FFG	DELWP	
*	African Box-thorn	<i>Lycium ferocissimum</i>	Solanaceae					X
*	Annual Veldt-grass	<i>Ehrharta longiflora</i>	Poaceae					X
	Ausfeld's Wattle	<i>Acacia ausfeldii</i>	Mimosaceae				v	
	Austral Trefoil	<i>Lotus australis var. australis</i>	Fabaceae				k	
	Australian Carrot	<i>Daucus glochidiatus</i>	Apiaceae					X
*	Barley	<i>Hordeum vulgare s.l.</i>	Poaceae					X
	Basalt Podolepis	<i>Podolepis sp. 1</i>	Asteraceae				e	
	Berry Saltbush	<i>Atriplex semibaccata</i>	Chenopodiaceae					X
	Black Box	<i>Eucalyptus largiflorens</i>	Myrtaceae					X
*	Black Nightshade	<i>Solanum nigrum sensu Willis (1972)</i>	Solanaceae					X
	Black-anther Flax-lily	<i>Dianella revoluta</i>	Hemerocallidaceae					X
	Blue Burr-daisy	<i>Calotis cuneifolia</i>	Asteraceae				r	X
	Bluebell	<i>Wahlenbergia spp.</i>	Campanulaceae					X
	Bluish Raspwort	<i>Haloragis glauca f. glauca</i>	Haloragaceae				k	
*	Bridal Creeper	<i>Asparagus asparagoides</i>	Asparagaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	Brown-back Wallaby-grass	<i>Rytidosperma duttonianum</i>	Poaceae					X
	Buloke	<i>Allocasuarina luehmannii</i>	Casuarinaceae			f		
	Buloke Mistletoe	<i>Amyema linophylla subsp. orientale</i>	Loranthaceae				v	
*	Cape Weed	<i>Arctotheca calendula</i>	Asteraceae					X
	Chariot Wheels	<i>Maireana cheelii</i>		V	V	f	v	
*	Clover	<i>Trifolium spp.</i>	Fabaceae					X
	Common Blown-grass	<i>Lachnagrostis filiformis s.l.</i>	Poaceae					X
	Common Cudweed	<i>Euchiton involucratus s.l.</i>	Asteraceae					X
*	Common Heron's-bill	<i>Erodium cicutarium</i>	Geraniaceae					X
	Common Nardoo	<i>Marsilea drummondii</i>	Marsileaceae					X
*	Common Peppergrass	<i>Lepidium africanum</i>	Brassicaceae					X
	Common Rice-flower	<i>Pimelea humilis</i>	Thymelaeaceae					X
	Common Sneezeweed	<i>Centipeda cunninghamii</i>	Asteraceae					X
*	Common Sow-thistle	<i>Sonchus oleraceus</i>	Asteraceae					X
	Common Spike-sedge	<i>Eleocharis acuta</i>	Cyperaceae					X
	Common Tussock-grass	<i>Poa labillardierei</i>	Poaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
*	Common Vetch	<i>Vicia sativa</i>	Fabaceae					X
	Cotton Fireweed	<i>Senecio quadridentatus</i>	Asteraceae					X
	Dark Roly-poly	<i>Sclerolaena muricata</i> var. <i>semiglabra</i>	Chenopodiaceae				k	
*	Desert Ash	<i>Fraxinus angustifolia</i> subsp. <i>angustifolia</i>	Oleaceae					X
	Dock	<i>Rumex</i> spp.	Polygonaceae					X
*	Drain Flat-sedge	<i>Cyperus eragrostis</i>	Cyperaceae					X
	Drooping Cassinia	<i>Cassinia arcuata</i>	Asteraceae					X
	Dwarf Amaranth	<i>Amaranthus macrocarpus</i> var. <i>macrocarpus</i>	Amaranthaceae				v	
	Dwarf Bitter-cress	<i>Rorippa eustylis</i>	Brassicaceae				r	
*	Fan Palm	<i>Washingtonia</i> spp.	Arecaceae					X
	Feather Spear-grass	<i>Austrostipa elegantissima</i>	Poaceae					X
	Ferny Small-flower Buttercup	<i>Ranunculus pumilio</i>	Ranunculaceae					X
*	Flatweed	<i>Hypochaeris radicata</i>	Asteraceae					X
*	Fleabane	<i>Conyza</i> spp.	Asteraceae					X
*	Fog-fruit	<i>Phyla canescens</i>	Verbenaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	Frosted Goosefoot	<i>Chenopodium desertorum subsp. virosum</i>	Chenopodiaceae				k	
	Galvanized Burr	<i>Sclerolaena birchii</i>	Chenopodiaceae				k	
	Gold-dust Wattle	<i>Acacia acinacea</i>	Mimosaceae					X
	Golden Wattle	<i>Acacia pycnantha</i>	Mimosaceae					X
*	Golden Wreath Wattle	<i>Acacia saligna</i>	Mimosaceae					X
*	Great Brome	<i>Bromus diandrus</i>	Poaceae					X
	Grey Box^	<i>Eucalyptus microcarpa</i>	Myrtaceae					X
	Grey Parrot-pea	<i>Dillwynia cinerascens</i>	Fabaceae					X
	Grey Roly-poly	<i>Sclerolaena muricata var. villosa</i>	Chenopodiaceae					X
*	Hair Grass	<i>Aira spp.</i>	Poaceae					X
	Hairy Tails	<i>Ptilotus erubescens</i>	Amaranthaceae			f		
#	Hedge Saltbush	<i>Rhagodia spinescens</i>	Chenopodiaceae					X
	Hoary Rush	<i>Juncus radula</i>	Juncaceae					X
	Hop Bush	<i>Dodonaea spp.</i>	Sapindaceae					X
*	Horehound	<i>Marrubium vulgare</i>	Lamiaceae					X
	Jersey Cudweed	<i>Pseudognaphalium luteoalbum</i>	Asteraceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	Lesser Joyweed	<i>Alternanthera denticulata s.l.</i>	Amaranthaceae					X
*	Lesser Quaking-grass	<i>Briza minor</i>	Poaceae					X
	Lightwood	<i>Acacia implexa</i>	Mimosaceae					X
	Long Eryngium	<i>Eryngium paludosum</i>	Apiaceae				v	
	Murray Pine	<i>Callitris gracilis</i>	Cupressaceae					X
	Myoporum	<i>Myoporum spp.</i>	Scrophulariaceae					X
	Native Flax	<i>Linum marginale</i>	Linaceae					X
	Native Mint	<i>Mentha spp.</i>	Lamiaceae					X
	Native Verbena	<i>Verbena officinalis var. gaudichaudii</i>	Verbenaceae				k	
	New Holland Daisy	<i>Vittadinia spp.</i>	Asteraceae					X
	Nightshade	<i>Solanum spp.</i>	Solanaceae					X
	Nitre Goosefoot	<i>Chenopodium nitrariaceum</i>	Chenopodiaceae					X
	Nodding Saltbush	<i>Einadia nutans subsp. nutans</i>	Chenopodiaceae					X
*	Oat	<i>Avena spp.</i>	Poaceae					X
*	Olive	<i>Olea europaea</i>	Oleaceae					X
*	Onion Grass	<i>Romulea rosea</i>	Iridaceae					X
	Pale Flax-lily	<i>Dianella sp. aff. longifolia</i>	Hemerocallidaceae				v	X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
		(<i>Riverina</i>)						
	Pale-fruit Ballart	<i>Exocarpos strictus</i>	Santalaceae					X
*	Patterson's Curse	<i>Echium plantagineum</i>	Boraginaceae					X
	Pepper Grass	<i>Panicum laevinode</i>	Poaceae				v	
*	Pepper Tree	<i>Schinus molle</i>	Anacardiaceae					X
*	Perrenial Veldt-grass	<i>Ehrharta calycina</i>	Poaceae					X
	Poong'ort	<i>Carex tereticaulis</i>	Cyperaceae					X
*	Prickly Lettuce	<i>Lactuca serriola</i>	Asteraceae					X
*	Prickly Pear	<i>Opuntia spp.</i>	Cactaceae					X
	Prickly Saltwort	<i>Salsola tragus subsp. tragus</i>	Chenopodiaceae					X
*	Radiata Pine	<i>Pinus radiata</i>	Pinaceae					X
	Raspwort	<i>Haloragis spp.</i>	Haloragaceae					X
*	Red Sand-spurrey	<i>Spergularia rubra s.l.</i>	Caryophyllaceae					X
	Red Swainson-pea	<i>Swainsona plagiotropis</i>	Fabaceae	V	V	f	e	
*	Ribwort	<i>Plantago lanceolata</i>	Veronicaceae					X
	Ridged Spider-orchid	<i>Caladenia tensa</i>	Orchidaceae	E			v	
	Ridged Water-milfoil	<i>Myriophyllum porcatum</i>	Haloragaceae	V		f	v	
	River Red-gum	<i>Eucalyptus camaldulensis</i>	Myrtaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Poaceae	V	V			
	Riverina Bitter-cress	<i>Cardamine moirensis</i>	Brassicaceae				r	
*	Rough Sow-thistle	<i>Sonchus asper s.l.</i>	Asteraceae					X
	Rough Spear-grass	<i>Austrostipa scabra</i>	Poaceae					X
	Ruby Saltbush	<i>Enchylaena tomentosa var. tomentosa</i>	Chenopodiaceae					X
	Rush	<i>Juncus spp.</i>	Juncaceae					X
*	Rye Grass	<i>Lolium spp.</i>	Poaceae					X
	Sand Brome	<i>Bromus arenarius</i>	Poaceae				r	
	Scaly Mantle	<i>Eriochlamys squamata</i>	Asteraceae				v	
	Shiny Everlasting	<i>Xerochrysum viscosum</i>	Asteraceae					X
	Silky Blue-grass	<i>Dichanthium sericeum subsp. sericeum</i>	Poaceae					X
	Silky Swainson-pea	<i>Swainsona sericea</i>	Fabaceae		V	f	v	
	Silver Wattle	<i>Acacia dealbata</i>	Mimosaceae					X
	Slender Darling-pea	<i>Swainsona murrayana</i>	Fabaceae	V	V	f	e	
	Slender Knotweed	<i>Persicaria decipiens</i>	Polygonaceae					X
	Small Loosestrife	<i>Lythrum hyssopifolia</i>	Lythraceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	Small Scurf-pea	<i>Cullen parvum</i>	Fabaceae		E	f	e	
	Small Vanilla-lily	<i>Arthropodium minus</i>	Anthericaceae					X
*	Small-flower Onion-grass	<i>Romulea minutiflora</i>	Iridaceae					X
	Small-leaf Bluebush	<i>Maireana microphylla</i>	Chenopodiaceae				e	
	Small-leaf Swainson-pea	<i>Swainsona microphylla</i>	Fabaceae				r	
	Smooth Minuria	<i>Minuria integerrima</i>	Asteraceae				r	
*	Soursob	<i>Oxalis pes-caprae</i>	Oxalidaceae					X
	Southern Swainson-pea	<i>Swainsona behriana</i>	Fabaceae				r	
	Spear Grass	<i>Austrostipa spp.</i>	Poaceae					X
*	Spear Thistle	<i>Cirsium vulgare</i>	Asteraceae					X
	Spider Grass	<i>Enteropogon acicularis</i>	Poaceae					X
	Spiny Rice-flower	<i>Pimelea spinescens subsp. spinescens</i>	Thymelaeaceae	C		f	e	
	Spreading Eutaxia	<i>Eutaxia microphylla var. diffusa</i>	Fabaceae					X
*	Sugar Gum	<i>Eucalyptus cladocalyx</i>	Myrtaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
	Swamp Wallaby-grass	<i>Amphibromus spp.</i>	Poaceae					X
#	Sweet Pittosporum	<i>Pittosporum undulatum</i>	Pittosporaceae					X
	Tangled Lignum	<i>Muehlenbeckia florulenta</i>	Polygonaceae					X
*	Toowoomba Canary-grass	<i>Phalaris aquatica</i>	Poaceae					X
	Tufted Burr-daisy	<i>Calotis scapigera</i>	Asteraceae					X
	Turnip Copperburr	<i>Sclerolaena napiformis</i>	Chenopodiaceae	E	E	f	e	
*	Variable Plantain	<i>Plantago varia</i>	Veronicaceae					X
*	Variegated Thistle	<i>Silybum marianum</i>	Asteraceae					X
	Wallaby Grass	<i>Rytidosperma spp.</i>	Poaceae					X
*	Water Buttons	<i>Cotula coronopifolia</i>	Asteraceae					X
	Water Milfoil	<i>Myriophyllum spp.</i>	Haloragaceae					X
	Water Ribbons	<i>Triglochin procera s.l.</i>	Juncaginaceae					X
#	Weeping Myall	<i>Acacia pendula</i>	Mimosaceae			f	e	
	Weeping Pittosporum	<i>Pittosporum angustifolium</i>	Pittosporaceae					X
	Western Water-starwort	<i>Callitriche cyclocarpa</i>	Veronicaceae	V	V	f	v	
	White Cypress Pine^	<i>Callitris columellaris</i>	Cupressaceae					X

Origin	Common Name	Scientific Name	Family Name	Conservation Status				Rec
				EPBC	TSC	FFG	DELWP	
*	White Fumitory	<i>Fumaria capreolata</i>	Fumariaceae					X
	Willow Wattle	<i>Acacia salicina</i>	Mimosaceae					X
	Windmill Grass	<i>Chloris truncata</i>	Poaceae					X
	Wingless Bluebush	<i>Maireana enchylaenoides</i>	Chenopodiaceae					X
	Wire-grass	<i>Aristida spp.</i>	Poaceae					X
	Woodland Swamp-daisy	<i>Brachyscome basaltica var. gracilis</i>	Asteraceae					X
	Yakka Grass	<i>Sporobolus caroli</i>	Poaceae				r	
	Yarran Wattle	<i>Acacia omalophylla</i>	Mimosaceae			f	e	
	Yellow Box	<i>Eucalyptus melliodora</i>	Myrtaceae					X
	Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>	Asteraceae			f	v	

* = introduced species; # = native species occurring outside of natural range; L = listed as threatened; **EPBC** = status under EPBC Act; **TSC** = status under TSC Act; **FFG** = status under FFG Act; **DELWP** = status under DELWP's Advisory List; **C** = critically endangered; **E, e** = endangered; **V, v** = vulnerable; **R, r** = rare; **k** = insufficiently known; **Rec.** = recorded, ^ = identified by John Hawker of Heritage Victoria.

Appendix 2: Vertebrate fauna species that occur or are likely to occur in the Study Area

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Birds						
Australasian Darter	<i>Anhinga novaehollandiae</i>	X	X			X
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	X	X			X
Australasian Pipit	<i>Anthus novaeseelandiae</i>	X	X			X
Australian Hobby	<i>Falco longipennis</i>	X	X			
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	X		X		X
Australian Magpie	<i>Gymnorhina tibicen</i>	X	X	X		X
Australian Pelican	<i>Pelecanus conspicillatus</i>	X	X			
Australian Raven	<i>Corvus coronoides</i>	X	X	X		X
Australian Reed-Warbler	<i>Acrocephalus australis</i>		X	X		X
Australian Shelduck	<i>Tadorna tadornoides</i>	X	X			X
Australian White Ibis	<i>Threskiornis molucca</i>	X	X	X		X
Australian Wood Duck	<i>Chenonetta jubata</i>	X	X	X		X
Azure Kingfisher	<i>Alcedo azurea</i>	X	X			X
Barking Owl	<i>Ninox connivens</i>		X			
Black Kite	<i>Milvus migrans</i>	X	X			X
Black Swan	<i>Cygnus atratus</i>	X	X	X		
Black-chinned Honeyeater	<i>Melithreptus gularis</i>		X			X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	X	X			X
Black-fronted Dotterel	<i>Euseyornis melanops</i>	X	X			
Black-shouldered Kite	<i>Elanus axillaris</i>	X	X			X
Black-tailed Native-hen	<i>Gallinula ventralis</i>	X	X			
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	X	X	X		X
Brown Falcon	<i>Falco berigora</i>	X	X			
Brown Goshawk	<i>Accipiter fasciatus</i>		X			X
Brown Quail	<i>Coturnix ypsilophora</i>	X	X	X		X
Brown Thornbill	<i>Acanthiza pusilla</i>	X	X			X
Brown Treecreeper	<i>Climacteris picumnus victoriae</i>	X	X	X		X
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	X	X			X
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	X	X			X
Bush Stone-curlew	<i>Burhinus grallarius</i>	X				
Chestnut Teal	<i>Anas castanea</i>	X	X			
Chestnut-crowned Babbler	<i>Pomatostomus ruficeps</i>		X			
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>	X				
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	X	X			
Common Blackbird	<i>Turdus merula</i>	X	X	X		X
Common Bronzewing	<i>Phaps chalcoptera</i>	X	X			X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Common Myna	<i>Acridotheres tristis</i>	X	X			X
Common Starling	<i>Sturnus vulgaris</i>	X	X	X		X
Crested Pigeon	<i>Ocyphaps lophotes</i>	X	X	X		X
Crested Shrike-tit	<i>Falcunculus frontatus</i>	X	X	X		
Crimson (Yellow) Rosella	<i>Platycercus elegans elegans</i>	X	X	X		X
Diamond Dove	<i>Geopelia cuneata</i>	X	X			
Diamond Firetail	<i>Stagonopleura guttata</i>	X	X	X		
Dollarbird	<i>Eurystomus orientalis</i>	X	X			X
Dusky Moorhen	<i>Gallinula tenebrosa</i>	X	X	X		X
Dusky Woodswallow	<i>Artamus cyanopterus</i>	X	X			X
Eastern Great Egret	<i>Ardea modesta</i>	X	X			
Eastern Rosella	<i>Platycercus eximius</i>	X	X	X		X
Eastern Yellow Robin	<i>Eopsaltria australis</i>		X			X
Eurasian Coot	<i>Fulica atra</i>	X	X	X		
European Goldfinch	<i>Carduelis carduelis</i>	X	X			
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	X	X	X		X
Flame Robin	<i>Petroica phoenicea</i>	X	X			
Galah	<i>Eolophus roseicapilla</i>	X	X	X		X
Golden Whistler	<i>Pachycephala pectoralis</i>	X	X			X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Golden-headed Cisticola	<i>Cisticola exilis</i>	X				
Great Cormorant	<i>Phalacrocorax carbo</i>	X	X			
Grey Currawong	<i>Strepera versicolor</i>		X			X
Grey Fantail	<i>Rhipidura albiscarpa</i>	X	X	X		X
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	X	X	X		X
Grey Teal	<i>Anas gracilis</i>	X		X		X
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		X	X		
Gull-billed Tern	<i>Gelochelidon nilotica</i>	X				
Hardhead	<i>Aythya australis</i>	X	X			
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	X				
Hooded Robin	<i>Melanodryas cucullata</i>			X		
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	X	X			X
House Sparrow	<i>Passer domesticus</i>	X	X			X
Intermediate Egret	<i>Ardea intermedia</i>	X	X	X		
Jacky Winter	<i>Microeca fascinans</i>	X	X	X		X
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	X	X	X		X
Letter-winged Kite	<i>Elanus scriptus</i>	X				
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	X	X			X
Little Corella	<i>Cacatua sanguinea</i>	X	X	X		X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Little Eagle	<i>Hieraaetus morphnoides</i>	X	X	X		
Little Friarbird	<i>Philemon citreogularis</i>	X	X			X
Little Grassbird	<i>Megalurus gramineus</i>	X	X	X		X
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	X	X	X		X
Little Raven	<i>Corvus mellori</i>	X	X			X
Little Wattlebird	<i>Anthochaera chrysoptera</i>	X	X			X
Long-billed Corella	<i>Cacatua tenuirostris</i>	X	X	X		X
Magpie-lark	<i>Grallina cyanoleuca</i>	X	X	X		X
Masked Lapwing	<i>Vanellus miles</i>	X	X			X
Masked Owl	<i>Tyto novaehollandiae</i> race <i>novaehollandiae</i>	X		X		X
Mistletoebird	<i>Dicaeum hirundinaceum</i>	X	X			X
Musk Duck	<i>Biziura lobata</i>	X				
Musk Lorikeet	<i>Glossopsitta concinna</i>	X	X			
Nankeen Kestrel	<i>Falco cenchroides</i>	X	X	X		X
Nankeen Night Heron	<i>Nycticorax caledonicus</i>	X	X			X
Noisy Friarbird	<i>Philemon corniculatus</i>	X	X	X		X
Noisy Miner	<i>Manorina melanocephala</i>	X	X	X		X
Pacific Barn Owl	<i>Tyto javanica</i>	X				

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Pacific Black Duck	<i>Anas superciliosa</i>	X	X	X		X
Painted Button-quail	<i>Turnix varia</i>	X	X			X
Pallid Cuckoo	<i>Cuculus pallidus</i>	X	X			
Peaceful Dove	<i>Geopelia striata</i>	X	X			X
Peregrine Falcon	<i>Falco peregrinus</i>		X			
Pied Butcherbird	<i>Cracticus nigrogularis</i>	X	X			X
Pied Cormorant	<i>Strepera graculina</i>		X			
Pied Currawong	<i>Strepera graculina</i>	X	X			
Pink Robin	<i>Petroica rodinogaster</i>					
Purple Swamphen	<i>Porphyrio porphyrio</i>	X	X			X
Rainbow Bee-eater	<i>Merops ornatus</i>	X	X			X
Red Wattlebird	<i>Anthochaera carunculata</i>	X	X	X		X
Red-browed Finch	<i>Neochmia temporalis</i>	X	X	X		X
Red-capped Robin	<i>Petroica goodenovii</i>	X	X			X
Red-rumped Parrot	<i>Psephotus haematonotus</i>	X	X	X		X
Restless Flycatcher	<i>Myiagra inquieta</i>	X	X			
Rock Dove	<i>Columba livia</i>	X	X	X		X
Rose Robin	<i>Petroica rosea</i>					X
Royal Spoonbill	<i>Platalea regia</i>	X	X			

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Rufous Fantail	<i>Rhipidura rufifrons</i>		X			X
Rufous Songlark	<i>Cincloramphus mathewsi</i>					X
Rufous Whistler	<i>Pachycephala rufiventris</i>	X	X	X		X
Sacred Kingfisher	<i>Todiramphus sanctus</i>	X	X	X		X
Scarlet Robin	<i>Petroica boodang</i>		X			
Shining Bronze-Cuckoo	<i>Chrysococcyx lucidus</i>	X	X			X
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	X	X			
Silvereye	<i>Zosterops lateralis</i>	X	X	X		X
Singing Honeyeater	<i>Lichenostomus virescens</i>		X			
Southern Boobook	<i>Ninox novaeseelandiae</i>	X	X			X
Southern Whiteface	<i>Aphelocephala leucopsis</i>		X			
Speckled Warbler	<i>Pyrrhalaemus saggitatus</i>			X		
Spotted Dove	<i>Streptopelia chinensis</i>	X	X			X
Spotted Pardalote	<i>Pardalotus punctatus</i>	X	X	X		X
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	X	X			X
Striated Pardalote	<i>Pardalotus striatus</i>	X	X	X		X
Striated Thornbill	<i>Acanthiza lineata</i>	X	X			X
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	X	X	X		X
Superb Fairy-wren	<i>Malurus cyaneus</i>	X	X	X		X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Superb Parrot	<i>Polytelis swainsonii</i>		X	X		
Tawny Frogmouth	<i>Podargus strigoides</i>	X	X			X
Tree Martin	<i>Hirundo nigricans</i>	X	X	X		X
Turquoise Parrot	<i>Neophema pulchella</i>	X				X
Varied Sittella	<i>Daphoenositta chrysoptera</i>	X	X			X
Wedge-tailed Eagle	<i>Aquila audax</i>		X	X		X
Weebill	<i>Smicrornis brevirostris</i>	X	X			X
Welcome Swallow	<i>Hirundo neoxena</i>	X	X	X		X
Western Gerygone	<i>Gerygone fusca</i>	X	X	X		X
Whiskered Tern	<i>Chlidonias hybridus</i>	X	X			
Whistling Kite	<i>Haliastur sphenurus</i>	X	X	X		X
White-backed Swallow	<i>Cheramoeca leucosterna</i>		X			
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	X				
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	X				
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	X	X	X		
White-browed Babbler	<i>Pomatostomus superciliosus</i>	X	X			
White-browed Woodswallow	<i>Artamus superciliosus</i>	X				
White-eared Honeyeater	<i>Lichenostomus leucotis</i>		X			
White-faced Heron	<i>Egretta novaehollandiae</i>	X	X	X		X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
White-necked Heron	<i>Ardea pacifica</i>	X	X			X
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	X	X	X		X
White-throated Needletail	<i>Hirundapus caudacutus</i>	X	X	X		
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	X	X	X		X
White-winged Chough	<i>Corcorax melanorhamphos</i>	X	X	X		X
White-winged Triller	<i>Lalage sueurii</i>	X	X			X
Willie Wagtail	<i>Rhipidura leucophrys</i>	X	X	X		X
Yellow Thornbill	<i>Acanthiza nana</i>	X	X			X
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	X	X			
Yellow-plumed Honeyeater	<i>Lichenostomus ornatus</i>	X	X			X
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	X	X	X		X
Zebra Finch	<i>Taeniopygia guttata</i>	X	X			
Mammals						
Black Rat	<i>Rattus rattus</i>			X		X
Black Wallaby	<i>Wallabia bicolor</i>					X
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	X		X		X
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	X		X		X
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	X		X		X
South-eastern Long-eared Bat	<i>Nyctophilus corbeni</i>			X		

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	X		X		X
European Hare	<i>Lepus europeaus</i>	X				X
European Rabbit	<i>Oryctolagus cuniculus</i>	X				X
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	X		X		X
House Mouse	<i>Mus musculus</i>	X				X
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	X				X
Large Forest Bat	<i>Vespadelus darlingtoni</i>	X		X		X
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	X		X		
Little Forest Bat	<i>Vespadelus vulturnus</i>	X		X		X
Long-eared Bat	<i>Nyctophilus spp.</i>					X
Platypus	<i>Ornithorhynchus anatinus</i>	X				
Red Fox	<i>Vulpes vulpes</i>	X		X		X
Southern Forest Bat	<i>Vespadelus regulus</i>	X		X		X
Southern Freetail Bat	<i>Mormopterus sp. 1 , 2 & 4</i>	X				X
Squirrel Glider	<i>Petaurus norfolcensis</i>	X		X		X
Sugar Glider	<i>Petaurus breviceps</i>	X		X		X
Water Rat	<i>Hydromys chrysogaster</i>	X				
White-striped Freetail-bat	<i>Tadarida australis</i>			X		X
Yellow-bellied Sheathtail Bat	<i>Saccoliamus flaviventris</i>					X

Common Name	Scientific name	AVW	BA	ANSWW	TPFSRV	Recorded
Yellow-footed Antechinus	<i>Antechinus flavipes</i>	X		X		
Reptiles						
Bandy Bandy	<i>Vermicella annulata</i>	X				
Carnaby's Skink	<i>Cryptoblepharus carnabyi</i>					X
Eastern Brown Snake	<i>Pseudonaja textilis</i>	X				X
Garden Skink	<i>Lampropholis guichenoti</i>	X				X
Marbled Gecko	<i>Christinus marmoratus</i>	X		X		
Murray River Turtle	<i>Emydura macquarii</i>	X				
Prong-snouted Blind Snake	<i>Rumphotyphlops bituberculatus</i>			X		
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>			X		
Tiger Snake	<i>Notechis scutatus</i>	X				
Tree Skink	<i>Egernia striolata</i>					X
Frogs						
Eastern Banjo Frog (Pobblebong)	<i>Lymnodynastes dumerili</i>					X
Barking Marsh Frog	<i>Lymnodynastes fletcheri</i>					X
Common Froglet	<i>Crinia signifera</i>	X				X
Peron's Tree Frog	<i>Litoria peronii</i>	X				X
Plains Froglet	<i>Crinia parinsignifera</i>	X				X
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	X		X		X

AVW: list from Atlas of Victorian Wildlife; **BA:** list from the New Atlas of Australian Birds (Birds Australia); **ANSWW:** list from the Atlas of NSW Wildlife; **TPFSRV:** Recorded on the Threatened and Protected Fish Species Records Viewer; **X:** Recorded.

Appendix 3: Detailed habitat hectare assessment results

Habitat Zone (Site ID)			1	2	2A	3	4	5	6	6A	7	8	
EVC Name (Initials)			RCW	RCW	RCW	RCW	RCW	RCW	RCW	RCW	RCW	RGW	
EVC Number			103	103	103	103	103	103	103	103	103	295	
Total area of Habitat Zone (ha)			0.021	0.016	0.275	1.884	0.333	1.675	9.647	1.356	1.231	5.292	
Site Condition	Large Old Trees	/10	0	0	0	7	9	9	9	9	7	1	
	Canopy Cover	/5	0	0	4	2	2	4	4	4	4	4	
	Lack of Weeds	/15	9	9	9	9	9	9	9	4	13	2	
	Understorey	/25	15	15	15	15	5	10	15	10	15	15	
	Recruitment	/10	0	0	0	1	3	3	10	3	6	5	
	Organic Matter	/5	3	3	3	3	3	3	3	3	3	5	
	Logs	/5	0	0	0	2	0	5	5	2	5	3	
	<i>Total site condition score</i>			27	27	31	39	31	43	55	35	53	35
	<i>Possible site condition score</i>			75	75	75	75	75	75	75	75	75	75
Landscape Context	Online DELWP Landscape Context Score (NV2005_QUAL, DSE 2008)	/25	6	6	16	8	14	14	16	16	16	16	
	Total Habitat Score	/100	33	33	47	47	45	57	71	51	69	51	
Habitat score out of 1			0.33	0.33	0.47	0.47	0.45	0.57	0.71	0.51	0.69	0.51	
Habitat Hectares in Habitat Zone#			0.007	0.005	0.129	0.885	0.150	0.955	6.849	0.692	0.849	2.699	
Area of Habitat Zone to be removed (ha)			0.011	0.000	0.016	1.511	0.126	1.166	0.174	0.367	0.000	0.000	
Habitat Hectares to be removed#			0.004	0.000	0.008	0.710	0.057	0.665	0.124	0.187	0.000	0.000	
Bioregion			Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	
EVC Conservation Status			Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	
No. Large Old Trees in Habitat Zone			0	0	0	10	4	27	187	22	5	8	

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West alignment option would indeed have an impact on them. As such, these zones have been assigned an arbitrary condition score of 0.30, as this reflects the condition scores of similar adjacent habitat zones, in favour of the DELWP prescribed default score of 0.60, as this was deemed unrealistic; # = Habitat hectares (habitat score/100 X area [ha]); ^Large and Very Large Trees.

Habitat Zone (Site ID)		9	10	11	12	13	14	15	15A	16	17
EVC Name (Initials)		RGW	RCW	RGW	RCW	GRF	RGW	RGW	RGW	RCW	SAW
EVC Number		295	103	295	103	106	295	295	295	103	97
Total area of Habitat Zone (ha)		1.442	4.196	2.085	1.236	9.311	1.832	0.163	0.379	5.388	2.784
Site Condition	Large Old Trees	/10	8	2	2	9	3	8	9	8	9
	Canopy Cover	/5	1	4	4	4	4	4	4	2	4
	Lack of Weeds	/15	2	4	9	2	0	0	2	7	0
	Understorey	/25	15	15	15	15	10	10	0	0	15
	Recruitment	/10	6	3	3	6	6	6	0	0	5
	Organic Matter	/5	5	3	5	3	5	3	3	5	3
	Logs	/5	3	3	3	3	5	5	0	0	5
	<i>Total site condition score</i>			40	34	41	42	33	36	18	22
<i>Possible site condition score</i>			75	75	75	75	75	75	75	75	75
Landscape Context	Online DELWP Landscape Context Score (NV2005_QUAL, DSE 2008)	/25	16	16	16	16	16	16	16	16	16
	Total Habitat Score	/100	56	50	57	58	49	52	34	38	55
Habitat score out of 1			0.56	0.50	0.57	0.58	0.49	0.52	0.34	0.38	0.55
Habitat Hectares in Habitat Zone#			0.808	2.098	1.188	0.717	4.562	0.953	0.055	0.144	2.963
Area of Habitat Zone to be removed (ha)			0.000	0.000	0.000	0.000	0.000	0.000	0.129	0.000	0.349
Habitat Hectares to be removed#			0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.000	0.209
Bioregion			Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Murray Fans	Murray Fans	Murray Fans	Murray Fans
EVC Conservation Status			Vulnerable	Vulnerable	Vulnerable	Vulnerable	Depleted	Vulnerable	Vulnerable	Vulnerable	Vulnerable
No. Large Old Trees^ in Habitat Zone			26	7	5	16	66	29	4	3	124

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West alignment option would indeed have an impact on them. As such, these zones have been assigned an arbitrary condition score of 0.30, as this reflects the condition scores of similar adjacent habitat zones, in favour of the DELWP prescribed default score of 0.60, as this was deemed unrealistic; # = Habitat hectares (habitat score/100 X area [ha]); ^Large and Very Large Trees.

Habitat Zone (Site ID)		18	19	20	21	22	23	32	33	34	35*	
EVC Name (Initials)		GRF	RCW	RCW	RGW	RCW	GRF	RGW	GRF	RGW	RGW	
EVC Number		106	103	103	295	103	106	295	106	295	295	
Total area of Habitat Zone (ha)		4.626	10.426	1.885	0.63	3.172	1.004	0.849	3.637	2.086	0.054	
Site Condition	Large Old Trees	/10	4	9	9	4	9	5	6	4	2	N/A
	Canopy Cover	/5	3	4	2	2	4	2	1	1	4	N/A
	Lack of Weeds	/15	0	9	0	11	2	6	4	2	6	N/A
	Understorey	/25	5	15	15	15	15	5	15	10	5	N/A
	Recruitment	/10	6	6	6	10	0	0	3	6	6	N/A
	Organic Matter	/5	5	3	3	3	3	3	3	5	3	N/A
	Logs	/5	5	5	5	5	0	0	2	0	2	N/A
	<i>Total site condition score</i>			28	51	40	50	33	21	34	28	28
<i>Possible site condition score</i>			75	75	75	75	75	75	75	75	75	75
Landscape Context	Online DELWP Landscape Context Score (NV2005_QUAL, DSE 2008)	/25	16	16	16	16	16	16	6	8	8	N/A
	Total Habitat Score	/100	44	67	56	66	49	37	40	36	36	60
Habitat score out of 1			0.44	0.67	0.56	0.66	0.49	0.37	0.40	0.36	0.36	0.60
Habitat Hectares in Habitat Zone#			2.035	6.985	1.056	0.416	1.554	0.371	0.340	1.309	0.751	0.032
Area of Habitat Zone to be removed (ha)			0.000	3.084	0.631	0.057	0.972	0.194	0.111	1.294	1.174	0.054
Habitat Hectares to be removed#			0.000	2.066	0.353	0.038	0.476	0.072	0.044	0.466	0.423	0.032
Bioregion			Murray Fans	Murray Fans	Murray Fans	Murray Fans	Murray Fans	Murray Fans	Murray Fans	Vic. Riverina	Vic. Riverina	Vic. Riverina
EVC Conservation Status			Depleted	Endangered	Endangered	Vulnerable	Endangered	Depleted	Vulnerable	Depleted	Vulnerable	Vulnerable
No. Large Old Trees^ in Habitat Zone			47	404	104	4	155	14	10	44	11	N/A

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West alignment option would indeed have an impact on them. As such, these zones have been assigned arbitrary default condition score of 0.60; # = Habitat hectares (habitat score/100 X area [ha]); ^Large and Very Large Trees.

Habitat Zone (Site ID)		36	37	38	39	40	41	42*	43	44*	45	
EVC Name (Initials)		GRF	GRF	GRF	RGW	RGW	RGW	RGW	RGW	RGW	RCW	
EVC Number		106	106	106	295	295	295	295	295	295	103	
Total area of Habitat Zone (ha)		0.303	0.405	0.286	1.03	0.087	0.221	0.115	0.605	0.113	0.076	
Site Condition	Large Old Trees	/10	0	2	2	6	4	8	N/A	2	N/A	9
	Canopy Cover	/5	3	4	4	3	1	1	N/A	1	N/A	2
	Lack of Weeds	/15	7	7	11	6	7	7	N/A	7	N/A	6
	Understorey	/25	5	5	5	5	5	5	N/A	5	N/A	5
	Recruitment	/10	0	0	10	3	0	0	N/A	0	N/A	0
	Organic Matter	/5	5	5	3	3	3	5	N/A	3	N/A	3
	Logs	/5	0	0	0	2	0	0	N/A	0	N/A	0
	<i>Total site condition score</i>			20	23	35	28	20	26	0	18	0
<i>Possible site condition score</i>			75	75	75	75	75	75	75	75	75	75
Landscape Context	Online DELWP Landscape Context Score (NV2005_QUAL, DSE 2008)	/25	7	7	7	6	5	4	N/A	4	N/A	4
	Total Habitat Score	/100	27	30	42	34	25	30	60	22	60	29
Habitat score out of 1			0.27	0.30	0.42	0.34	0.25	0.30	0.60	0.22	0.60	0.29
Habitat Hectares in Habitat Zone#			0.082	0.122	0.120	0.350	0.022	0.066	0.070	0.133	0.068	0.022
Area of Habitat Zone to be removed (ha)			0.142	0.206	0.238	0.693	0.071	0.237	0.053	0.518	0.080	0.000
Habitat Hectares to be removed#			0.038	0.062	0.100	0.236	0.018	0.071	0.032	0.114	0.048	0.000
Bioregion			Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina	Vic. Riverina
EVC Conservation Status			Depleted	Depleted	Depleted	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable
No. Large Old Trees^ in Habitat Zone			0	2	1	13	1	4	N/A	3	N/A	4

* = These habitat zones were not surveyed at the request of VicRoads, as they didn't envisage any impact on them. However, it was subsequently realised that the Mid-West alignment option would indeed have an impact on them. As such, these zones have been assigned arbitrary default condition score of 0.60; # = Habitat hectares (habitat score/100 X area [ha]); ^Large and Very Large Trees.

Appendix 4: Scattered trees in the Study Area

Tree no.	Common Name	DBH (cm)	State	Remove/Retain
1	Black Box	94	NSW	Remove
2	Black Box	117	NSW	Retain
3	Black Box	113	NSW	Retain
4	Black Box	80	NSW	Remove
5	Yellow Box	45	NSW	Remove
7	Black Box	38	NSW	Remove
8	Black Box	53	NSW	Remove
9	Black Box	118	NSW	Remove
10	River Red-gum	32	NSW	Remove
11	Black Box	151	Vic	Retain
12	Black Box	97	Vic	Retain
13	Black Box	29	Vic	Retain
14	Black Box	20	Vic	Remove
15	Black Box	52	Vic	Remove
16	Black Box	22	Vic	Retain
17	Black Box	90	Vic	Remove
18	Black Box	24	Vic	Remove
19	Black Box	133	Vic	Remove
20	Black Box	116	Vic	Retain
21	River Red Gum	75	Vic	Retain
22	Yellow Box	127	NSW	Retain
23	Black Box	77	Vic	Retain
24	Black Box	129	NSW	Retain
25	Black Box	36	Vic	Retain
26	Black Box	51	Vic	Retain
27	Black Box	116	Vic	Retain
28	Black Box	51	Vic	Retain
29^	Grey Box	80	Vic	Retain
30	River Red-gum	138	Vic	Retain
31	River Red-gum	93	Vic	Remove
32	River Red-gum	35	Vic	Retain
34	River Red-gum	138	Vic	Remove
Totals number of trees to be removed				14

Note: Trees 6 and 33 have been deleted as they fall beyond the Study Area, ^ = identified by John Hawker of Heritage Victoria.

Appendix 5: EVC Benchmarks for Victorian Native Vegetation

- Victorian Riverina:
 - Riverine Chenopod Woodland (EVC 103)
 - Grassy Riverine Forest (EVC 106)
 - Riverine Grassy Woodland (EVC 295)
- Murray Fans:
 - Semi-arid Woodland (EVC 97)
 - Riverine Chenopod Woodland (EVC 103)
 - Grassy Riverine Forest (EVC 106)
 - Riverine Grassy Woodland (EVC 295)

EVC/Bioregion Benchmark for Wetland Vegetation Assessment Victorian Riverina bioregion

EVC 103: Riverine Chenopod Woodland

Description:

Eucalypt woodland of most elevated (current) riverine terraces, intact examples with a diverse shrubby-grassy understorey which can be rich in annual species. The habitat was at least formerly prone to irregular shallow flooding, and constitutes intermittent wetland. Floodplains of north-west of the State.

Indicator species (some or all of these species should be present)

Scientific name	Common name
<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
<i>Brachyscome</i> spp.	Daisy
<i>Calocephalus sonderi</i>	Pale Beauty-heads
<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot
<i>Eremophila</i> spp.	Emu Bush
<i>Eucalyptus largiflorens</i>	Black Box
<i>Exocarpos aphyllus</i>	Leafless Ballart
<i>Goodenia</i> spp.	Goodenia
<i>Lepidium</i> spp.	Peppercress
<i>Muehlenbeckia florulenta</i>	Tangled Lignum
<i>Pittosporum angustifolium</i>	Weeping Pittosporum

Notes on indicator species

As well as indicator species, there is a general diversity of annual herbs.

Conditions when the EVC should not be assessed

None recognised other than rare instances when habitat is subject to inundation. Vegetation may be underscored during prolonged dry periods.

1. CRITICAL LIFEFORMS

Conditions when specific critical lifeform groupings should not be assessed

Vegetation may be underscored during prolonged dry periods.

General comments on assessing critical lifeform groupings

None.

Critical lifeform groupings and threshold values for determining if lifeform is substantially modified

Critical lifeform	No. spp.	% Cover	Comments
Medium shrubs	4	5	eg. Emu Bushes, Lignum, Saltbush.
Small to medium graminoids	3	5	perennial species.
Small to medium herbs	5		annual species.
Trees			substantially modified if no mature specimens evident.

EVC 103: Riverine Chenopod Woodland - Victorian Riverina bioregion

2. WEEDS

High threat weed species

Scientific name	Common name
<i>Asparagus asparagoides</i>	Bridal Creeper
<i>Asphodelus fistulosus</i>	Onion Weed
<i>Bromus rubens</i>	Red Brome
<i>Carpobrotus aequilaterus</i>	Angled Pigface
<i>Carrichtera annua</i>	Ward's Weed
<i>Gazania linearis</i>	Gazania
<i>Limonium</i> spp.	Sea Lavender
<i>Lycium ferocissimum</i>	African Box-thorn
<i>Marrubium vulgare</i>	Horehound
<i>Mesembryanthemum</i> spp.	Ice Plant
<i>Olea europaea</i>	Olive
<i>Opuntia</i> spp.	Prickly Pear
<i>Oxalis pes-caprae</i>	Soursob
<i>Sisymbrium</i> spp.	Mustard
<i>Vulpia bromoides</i>	Squirrel-tail Fescue

Conditions where weeds are considered to have a negligible impact

None recognised.

3. INDICATORS OF ALTERED PROCESSES

None recognised.

4. VEGETATION STRUCTURE AND HEALTH

Structural dominant

Black Box *Eucalyptus largiflorens*

Benchmark cover

10%

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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
<i>Eucalyptus</i> spp.	90 cm	20 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
30%	<i>Eucalyptus camaldulensis</i>	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	<i>Acacia stenophylla</i>	Eumong
LH	<i>Wahlenbergia fluminalis</i>	River Bluebell
LH	<i>Senecio quadridentatus</i>	Cotton Fireweed
MH	<i>Goodenia fascicularis</i>	Silky Goodenia
MH	<i>Eclipta platyglossa</i>	Yellow Twin-heads
MTG	<i>Setaria jubiflora</i>	Warrego Summer-grass
MNG	<i>Eleocharis acuta</i>	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	<i>Lactuca serriola</i>	Prickly Lettuce	high	low
LH	<i>Sonchus oleraceus</i>	Common Sow-thistle	high	low
LH	<i>Centaurea melitensis</i>	Malta Thistle	high	low
MH	<i>Hypochoeris glabra</i>	Smooth Cat's-ear	high	low
MH	<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover	high	low
MH	<i>Reichardia tingitana</i>	False Sow-thistle	high	low
MH	<i>Phyla canescens</i>	Fog-fruit	high	high
MTG	<i>Vulpia bromoides</i>	Squirrel-tail Fescue	high	low
MNG	<i>Bromus rubens</i>	Red Brome	high	low

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
<i>Eucalyptus</i> spp.	80 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	<i>Eucalyptus camaldulensis</i>	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	<i>Acacia dealbata</i>	Silver Wattle
MH	<i>Sida corrugata</i>	Variable Sida
MH	<i>Oxalis perennans</i>	Grassland Wood-sorrel
SH	<i>Chamaesyce drummondii</i>	Flat Spurge
SH	<i>Azolla filiculoides</i>	Pacific Azolla
LTG	<i>Austrostipa gibbosa</i>	Spurred Spear-grass
LTG	<i>Carex tereticaulis</i>	Hollow Sedge
MTG	<i>Chloris truncata</i>	Windmill Grass
MTG	<i>Themeda triandra</i>	Kangaroo Grass
MTG	<i>Aristida behriana</i>	Brush Wire-grass
MTG	<i>Elymus scaber</i> var. <i>scaber</i>	Common Wheat-grass
MNG	<i>Pseudoraphis spinescens</i>	Spiny Mud-grass
MNG	<i>Eleocharis acuta</i>	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	<i>Cirsium vulgare</i>	Spear Thistle	high	high
MTG	<i>Lolium rigidum</i>	Wimmera Rye-grass	high	low

EVC 295: Riverine Grassy Woodland - Victorian Riverina bioregion

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EVC/Bioregion Benchmark for Vegetation Quality Assessment

Murray Fans bioregion

EVC 97: Semi-arid Woodland

Description:

Non-eucalypt woodland or open forest to 12 m tall, of low rainfall areas. Occurs in a range of somewhat elevated positions not subject to flooding or inundation. The surface soils are typically light textured loamy sands or sandy loams.

Large trees:

Species	DBH(cm)	#/ha
<i>Casuarina</i> spp.	40 cm	20/ha
<i>Allocasuarina</i> spp.	40 cm	
<i>Callitris</i> spp.	40 cm	
<i>Myoporum platycarpum</i>	35 cm	

Tree Canopy Cover:

% cover	Character Species	Common Name
20%	<i>Casuarina pauper</i>	Belah
	<i>Allocasuarina luehmannii</i>	Buloke
	<i>Callitris gracilis</i> ssp. <i>murrayensis</i>	Slender Cypress-pine
	<i>Myoporum platycarpum</i>	Sugarwood

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Medium Shrub	5	15%	MS
Small Shrub	5	20%	SS
Large Herb*	2	5%	LH
Medium Herb*	7	5%	MH
Small or Prostrate Herb*	2	5%	SH
Medium to Small Tufted Graminoid	2	10%	MTG
Medium to Tiny Non-tufted Graminoid	1	1%	MNG
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	20%	S/C

* Largely seasonal life form

Total understorey projective foliage cover 75%

LF Code	Species typical of at least part of EVC range	Common Name
MS	<i>Alectryon oleifolius</i> ssp. <i>canescens</i>	Cattle Bush
MS	<i>Acacia oswaldii</i>	Umbrella Wattle
MS	<i>Hakea tephrosperma</i>	Hooked Needlewood
MS	<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	Silver Needlewood
SS	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush
SS	<i>Sclerolaena diacantha</i>	Grey Copperburr
SS	<i>Olearia pimeleoides</i>	Pimelea Daisy-bush
SS	<i>Rhagodia spinescens</i>	Hedge Saltbush
MH	<i>Einadia nutans</i> ssp. <i>nutans</i>	Nodding Saltbush
MH	<i>Vittadinia dissecta</i> s.l.	Dissected New Holland Daisy
MH	<i>Calandrinia eremaea</i>	Small Purslane
MH	<i>Crassula colorata</i>	Dense Crassula
SH	<i>Actinobole uliginosum</i>	Flannel Cudweed
MTG	<i>Austrodanthonia caespitosa</i>	Common Wallaby-grass
MTG	<i>Austrostipa</i> spp.	Spear-grass
MNG	<i>Austrostipa elegantissima</i>	Feather Spear-grass

EVC 97: Semi-arid Woodland - Murray Fans bioregion

Recruitment:

Continuous

Organic Litter:

20% cover

Logs:

20m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	<i>Brassica tournefortii</i>	Mediterranean Turnip	high	high
LH	<i>Reichardia tingitana</i>	Reichardia	high	low
MH	<i>Silene</i> spp.	Catchfly	high	high
SH	<i>Medicago minima</i>	Little Medic	high	high
MTG	<i>Schismus barbatus</i>	Arabian Grass	high	high
MTG	<i>Pentaschistis airoides</i> ssp. <i>airoides</i>	False Hair-grass	high	high
MNG	<i>Bromus rubens</i>	Red Brome	high	high
MNG	<i>Vulpia myuros</i>	Rat's-tail Fescue	high	high
MNG	<i>Critesion murinum</i> subsp. <i>glaucum</i>	Blue Barley-grass	high	high
SC	<i>Asparagus asparagoides</i>	Bridal Creeper	high	high

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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
<i>Eucalyptus largiflorens</i>	40 cm	5/ha

Tree Canopy Cover:

%cover	Character Species	Common Name
10%	<i>Eucalyptus largiflorens</i>	Black Box
	<i>Acacia stenophylla</i>	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	<i>Atriplex nummularia</i>	Old-man Saltbush
MS	<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot
MS	<i>Eremophila divaricata</i> ssp. <i>divaricata</i>	Spreading Emu-bush
SS	<i>Sclerolaena tricuspis</i>	Streaked Copperburr
SS	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush
SS	<i>Atriplex lindleyi</i>	Flat-top Saltbush
SS	<i>Rhagodia spinescens</i>	Hedge Saltbush
PS	<i>Sclerochlamys brachyptera</i>	Short-wing Saltbush
MH	<i>Einadia nutans</i> ssp. <i>nutans</i>	Nodding Saltbush
MH	<i>Calocephalus sonderi</i>	Pale Beauty-heads
MH	<i>Senecio glossanthus</i>	Slender Groundsel
MH	<i>Brachyscome lineariloba</i>	Hard-head Daisy
SH	<i>Disphyma crassifolium</i> ssp. <i>clavellatum</i>	Rounded Noon-flower
SH	<i>Maireana pentagona</i>	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	<i>Olea europaea</i> subsp. <i>europaea</i>	Olive	low	high
MS	<i>Lycium ferocissimum</i>	Boxthorn	low	high
LH	<i>Sisymbrium erysimoides</i>	Smooth Mustard	high	high
LH	<i>Critesion</i> spp.	Barley-grass	high	low
LH	<i>Gazania linearis</i>	Gazania	high	high
LH	<i>Opuntia</i> spp.	Prickly Pear	low	high
LH	<i>Sisymbrium irio</i>	London Mustard	high	high
LH	<i>Psilocaulon granulicaule</i>	Noon-flower	high	high
MH	<i>Limonium sinuatum</i>	Notch-leaf Sea-lavender	high	high
MH	<i>Limonium lobatum</i>	Winged Sea-lavender	high	high
MH	<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover	high	low
MH	<i>Mesembryanthemum nodiflora</i>	Ice-plant	high	high
MH	<i>Carrichtera annua</i>	Ward's Weed	high	high
MH	<i>Marrubium vulgare</i>	Horehound	high	high
MH	<i>Carpobrotus aequilaterus</i>	Angled Pigface	low	high
MH	<i>Silene apetala</i> var. <i>apetala</i>	Sand Catchfly	high	low
MH	<i>Medicago</i> spp.	Medic	high	low
MH	<i>Oxalis pes-caprae</i>	Soursob	high	high
MH	<i>Silene gallica</i>	French Catchfly	high	low
MH	<i>Silene nocturna</i>	Mediterranean Catchfly	high	low
SH	<i>Mesembryanthemum crystallinum</i>	Common Ice-plant	high	high
MTG	<i>Vulpia bromoides</i>	Squirrel-tail Fescue	high	high
MTG	<i>Lolium rigidum</i>	Wimmera Rye-grass	high	low
MTG	<i>Asphodelus fistulosus</i>	Onion Weed	high	high
MNG	<i>Bromus rubens</i>	Red Brome	high	high
MNG	<i>Vulpia myuros</i>	Rat's-tail Fescue	high	low
MNG	<i>Bromus</i> spp.	Brome	high	high
MNG	<i>Schismus barbatus</i>	Arabian Grass	high	low
SC	<i>Asparagus asparagoides</i>	Bridal Creeper	high	high

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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
<i>Eucalyptus</i> spp.	90 cm	20 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
30%	<i>Eucalyptus camaldulensis</i>	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	<i>Acacia stenophylla</i>	Eumong
LH	<i>Wahlenbergia fluminalis</i>	River Bluebell
LH	<i>Senecio quadridentatus</i>	Cotton Fireweed
MH	<i>Goodenia fascicularis</i>	Silky Goodenia
MH	<i>Eclipta platyglossa</i>	Yellow Twin-heads
MTG	<i>Setaria jubiflora</i>	Warrego Summer-grass
MNG	<i>Eleocharis acuta</i>	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	<i>Lactuca serriola</i>	Prickly Lettuce	high	low
LH	<i>Sonchus oleraceus</i>	Common Sow-thistle	high	low
LH	<i>Centaurea melitensis</i>	Malta Thistle	high	low
MH	<i>Hypochoeris glabra</i>	Smooth Cat's-ear	high	low
MH	<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover	high	low
MH	<i>Reichardia tingitana</i>	False Sow-thistle	high	low
MH	<i>Phyla canescens</i>	Fog-fruit	high	high
MTG	<i>Vulpia bromoides</i>	Squirrel-tail Fescue	high	low
MNG	<i>Bromus rubens</i>	Red Brome	high	low

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
<i>Eucalyptus</i> spp.	80 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
20%	<i>Eucalyptus camaldulensis</i>	River Red-gum
	<i>Eucalyptus largiflorens</i>	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	<i>Sclerolaena muricata</i> var. <i>villosa</i>	Grey Roly-poly
SS	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush
SS	<i>Maireana decalvans</i>	Black Cotton-bush
SS	<i>Chenopodium curvispicatum</i>	Cottony Saltbush
LH	<i>Wahlenbergia fuminalis</i>	River Bluebell
LH	<i>Rumex brownii</i>	Slender Dock
LH	<i>Senecio quadridentatus</i>	Cotton Fireweed
MH	<i>Einadia nutans</i> ssp. <i>nutans</i>	Nodding Saltbush
MH	<i>Atriplex semibaccata</i>	Berry Saltbush
MH	<i>Atriplex eardleyae</i>	Small Saltbush
MH	<i>Sida corrugata</i>	Variable Sida
MTG	<i>Austrodanthonia setacea</i>	Bristly Wallaby-grass
MTG	<i>Austrostipa scabra</i>	Rough Spear-grass
MTG	<i>Carex inversa</i>	Knob Sedge
MTG	<i>Juncus subsecundus</i>	Finger Rush

Recruitment:

Continuous

Organic Litter:

10 % cover

Logs:

20 m/0.1 ha.

EVC 295: Riverine Grassy Woodland – Murray Fans bioregion

Weediness:

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

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Appendix 6: Detailed Results of First Bat Survey

SITE 1	Only 1 bat call (<i>Vespadelus darlingtoni</i>) recorded; Probable equipment failure							
SITE 2	8-Nov	9-Nov	10-Nov	11-Nov	12-Nov	13-Nov	14-Nov	Total calls identified
Files generated	916	819	444	538	573	1439	355	5084
Gould's Wattled Bat	x	x	x	x	x	x	x	
Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2 30k	x	x	x	x	x	x	x	
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x	x	x	x	x	x	
Yellow-bellied Sheathtail Bat 20k	5	3	7	3	5	5	4	32
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat	x	x	x	x	x	x	x	
Little Forest Bat	x	x	x	x	x	x	x	



South-eastern Long-eared Bat	0	0	0	0	0	0	0	0
SITE 3	8-Nov	9-Nov	10-Nov	11-Nov	12-Nov	13-Nov	14-Nov	
Files generated	642	352	273	509	702	641	416	3535
Gould's Wattled Bat		x		x	x	x	x	
Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2 30k	x	x			x		x	
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x			x		x	
Yellow-bellied Sheathtail Bat 20k	3	0	4	0	0	0	0	7
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat	x		x	x				
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0

SITE 4	8-Nov	9-Nov	10-Nov	11-Nov	12-Nov	13-Nov	14-Nov	
Files generated	303	441	222	162	225	316	322	1991
Gould's Wattled Bat	x	x	x	x	x	x	x	
Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2 30k		x	x	x	x	x	x	
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x	x	x	x	x	x	
Yellow-bellied Sheathtail Bat 20k	4	7	4	6	4	7	8	40
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat		x	x		x	x	x	
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0
SITE 5	8-Nov	9-Nov	10-Nov	11-Nov	12-Nov	13-Nov	14-Nov	

Files generated	827	952	996	971	403	495	334	4978
Gould's Wattled Bat	x	x	x	x	x	x	x	
Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2 30k	x	x	x	x	x	x	x	
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x	x	x	x	x	x	
Yellow-bellied Sheathtail Bat 20k	2	0	3	0	4	2	2	13
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat	x	x	x	x	x	x	x	
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0
SITE 6	15- Nov	16- Nov	17- Nov	18- Nov	19- Nov	20- Nov	21- Nov	
Files generated	504	59	228	423	93	64	66	1437
Gould's Wattled Bat	x	x	x	x	x	x	x	



Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2 30k		x	x	x	x	x	x	
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x		x		x	x	x	
Yellow-bellied Sheathtail Bat 20k	2	0	0	0	0	0	0	2
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat								
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0
SITE 7	15- Nov	16- Nov	17- Nov	18- Nov	19- Nov	20- Nov	21- Nov	
Files generated	375	305	773	663	314	298	294	3022
Gould's Wattled Bat	x	x	x	x	x	x	x	
Chocolate Wattled Bat	x	x	x	x	x	x	x	
Southern Freetail Bat sp 2	x	x	x	x	x	x	x	

30k								
Southern Freetail Bat sp 4 28k	x	x	x	x	x	x	x	
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x	x	x	x	x	x	
Yellow-bellied Sheathtail Bat 20k	8	3	3	5	3	6	4	32
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat	x	x	x	x	x	x	x	
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	
SITE 8	15- Nov	16- Nov	17- Nov	18- Nov	19- Nov	20- Nov	21- Nov	
Files generated	63	23	28	39	23	52	20	248
Gould's Wattled Bat	x	x	x	x	x	x	x	
Chocolate Wattled Bat	x	x		x	x	x	x	
Southern Freetail Bat sp 2 30k	x	x	x	x	x	x	x	
Southern Freetail Bat sp 4	x			x				

28k								
Long-eared Bat	x	x	x	x	x	x	x	
Inland Broad-nosed Bat	x	x	x		x	x	x	
Yellow-bellied Sheathtail Bat 20k	1	0	0	1	1	0	0	3
White-striped Freetail-bat	x	x	x	x	x	x	x	
Large Forest Bat	x	x	x	x	x	x	x	
Southern Forest Bat								
Little Forest Bat	x	x	x	x	x	x	x	
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0
Total files all sites	3630	2951	2964	3305	2333	3305	180 7	20295

Appendix 7: Detailed results of the Second Bat Survey

Site 1 (files recorded = 1048)	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar
White-striped Freetail Bat	x				x					
Gould's Wattled Bat	x	x	x	x	x	x		x	x	
Chocolate Wattled Bat			x				x	x		x
Southern Freetail bat (spp. 2)	x	x		x	x		x	x	x	
Southern Freetail bat (spp. 4)	x	x	x	x	x	x	x	x	x	x
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0	0	0
Long-eared Bat	x	x			x		x	x		x
Yellow-bellied Sheathtail Bat	0	0	0	0	0	0	0	0	0	0
Inland Broad-nosed Bat		x	x	x		x	x	x		
Large Forest Bat	x	x	x	x		x	x	x	x	x
Southern Forest Bat				x	x		x			
Little Forest Bat	x	x	x	x	x		x	x	x	
Site 2 - Anabat failed (no calls recorded)										
Site 3 - Anabat failed (no calls recorded)										
Site 4 (files recorded = 8424)	24-Feb	25-Feb	26-Feb	27-Feb	28-Feb	29-Feb	1-Mar	2-Mar	3-Mar	4-Mar
White-striped Freetail Bat	x	x	x	x	x	x	x	x	x	x
Gould's Wattled Bat	x	x	x	x	x	x	x	x	x	x
Chocolate Wattled	x	x	x	x	x	x	x	x	x	x

Bat											
Southern Freetail bat (spp. 2)	x	x	x	x	x	x	x	x	x	x	x
Southern Freetail bat (spp. 4)	x	x	x	x	x	x	x	x	x	x	x
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0	0	0	0
Long-eared Bat	x	x	x	x	x	x	x	x	x	x	x
Yellow-bellied Sheathtail Bat	4	1	6	2	0	0	0	0	0	0	0
Inland Broad-nosed Bat	x	x		x		x				x	x
Little Broad-nosed Bat	x	x	x	x	x	x	x	x	x	x	x
Large Forest Bat	x	x	x	x	x	x	x	x	x	x	x
Southern Forest Bat	x	x			x		x				x
Little Forest Bat	x	x	x	x	x	x	x	x	x	x	x
Site 5 (files recorded = 1626)	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	
White-striped Freetail Bat	x	x	x	x	x	x	x	x	x	x	x
Gould's Wattled Bat			x	x	x			x			
Chocolate Wattled Bat	x	x	x	x	x	x	x	x	x	x	x
Southern Freetail bat (spp. 2)	x	x	x	x	x	x	x	x	x	x	x
Southern Freetail bat (spp. 4)	x	x	x	x	x	x	x	x	x	x	x
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0	0	0	0
Long-eared Bat	x	x	x	x	x	x	x	x	x	x	x
Yellow-bellied Sheathtail Bat	2	0	0	1	0	0	0	1	0	0	0
Inland Broad-	x	x	x	x	x	x	x	x	x	x	x

nosed Bat										
Little Broad-nosed Bat										
Large Forest Bat	x	x	x	x	x	x	x	x	x	x
Southern Forest Bat		x			x			x	x	x
Little Forest Bat	x	x	x	x	x	x	x	x	x	x
Site 6 (files recorded = 35)	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar
White-striped Freetail Bat		x	x						x	
Gould's Wattled Bat								x		
Chocolate Wattled Bat	x	x	x	x			x			
Southern Freetail bat (spp. 2)									x	
Southern Freetail bat (spp. 4)							x		x	x
South-eastern Long-eared Bat										
Long-eared Bat			x				x	x		
Yellow-bellied Sheathtail Bat										
Inland Broad-nosed Bat			x				x			
Little Broad-nosed Bat										
Large Forest Bat	x	x		x	x		x			
Southern Forest Bat								x		
Little Forest Bat										
Site 7 - Anabat failed (no calls recorded)										

Site 8 (files recorded = 107)	5-Mar	6-Mar	7-Mar	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar
White-striped Freetail Bat										
Gould's Wattled Bat	x					x				
Chocolate Wattled Bat	x	x		x		x				
Southern Freetail bat (spp. 2)									x	
Southern Freetail bat (spp. 4)										
South-eastern Long-eared Bat	0	0	0	0	0	0	0	0	0	
Long-eared Bat	x					x		x		
Yellow-bellied Sheathtail Bat	0	0	0	0	0	0	0	0	0	
Inland Broad-nosed Bat		x								
Large Forest Bat	x	x	x	x	x	x	x	x	x	x
Southern Forest Bat	x	x	x	x	x					
Little Forest Bat	x	x	x	x	x	x	x	x	x	

Appendix 8: Biodiversity assessment report (DELWP)

Biodiversity impact and offset requirements report

This report **does not represent an assessment by DELWP** of the proposed native vegetation removal. It provides additional biodiversity information to support moderate and high risk-based pathway applications for permits to remove native vegetation under clause 52.16 or 52.17 of planning schemes in Victoria.

Date of issue: 16/03/2015

Time of issue: 3:45 PM

DELWP ref: BLA_0112

Project ID	BLA_8194_Echuca_Midwest1_V3
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Summary of marked native vegetation

Risk-based pathway	Moderate
Total extent	14.147 ha
Remnant patches	13.655 ha
Scattered trees	7 trees
Location risk	A
Strategic biodiversity score of all marked native vegetation	0.442

Offset requirements if a permit is granted

If a permit is granted to remove the marked native vegetation, a requirement to obtain a native vegetation offset will be included in the permit conditions. The offset must meet the following requirements:

Offset type	General offset
General offset amount (general biodiversity equivalence units)	4.568 general units
General offset attributes	
Vicinity	North Central Catchment Management Authority (CMA) or the Local Municipal District where clearing takes place
Minimum strategic biodiversity score	0.354 ¹

See Appendices 1 and 2 for details in how offset requirements were determined.

NB: values presented in tables throughout this document may not add to totals due to rounding

¹ Minimum strategic biodiversity score is 80 per cent of the weighted average score across habitat zones where a general offset is required

Biodiversity impact and offset requirements report

Next steps

Any proposal to remove native vegetation must meet the application requirements of the moderate risk-based pathway and it will be assessed under the moderate risk-based pathway.

If you wish to remove the marked native vegetation you are required to apply for a permit from your local council. Council will then refer your application to DELWP for assessment, as required. **This report is not a referral assessment by DELWP.**

The biodiversity assessment report from NVIM and this biodiversity impact and offset report should be submitted with your application for a permit to remove native vegetation you plan to remove, lop or destroy.

The Biodiversity assessment report generated by the tool within NVIM provides the following information:

- The location of the site where native vegetation is to be removed.
- The area of the patch of native vegetation and/or the number of any scattered trees to be removed.
- Maps or plans containing information set out in the *Permitted clearing of native vegetation – Biodiversity assessment guidelines*
- The risk-based pathway of the application for a permit to remove native vegetation

This report provides the following information to meet application requirements for a permit to remove native vegetation:

- Confirmation of the risk-based pathway of the application for a permit to remove native vegetation
- The strategic biodiversity score of the native vegetation to be removed
- Information to inform the assessment of whether the proposed removal of native vegetation will have a significant impact on Victoria's biodiversity, with specific regard to the proportional impact on habitat for any rare or threatened species.
- The offset requirements should a permit be granted to remove native vegetation.

Additional application requirements must be provided with an application for a permit to remove native vegetation in the moderate or high risk-based pathways. These include:

- A habitat hectare assessment report of the native vegetation that is to be removed
- A statement outlining what steps have been taken to ensure that impacts on biodiversity from the removal of native vegetation have been minimised
- An offset strategy that details how a compliant offset will be secured to offset the biodiversity impacts of the removal of native vegetation.

Refer to the *Permitted clearing of native vegetation – Biodiversity assessment guidelines* and for a full list and details of application requirements.

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For more information contact the DELWP Customer Service Centre 136 186

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Obtaining this publication does not guarantee that an application will meet the requirements of clauses 52.16 or 52.17 of the Victoria Planning Provisions or that a permit to remove native vegetation will be granted.

Notwithstanding anything else contained in this publication, you must ensure that you comply with all relevant laws, legislation, awards or orders and that you obtain and comply with all permits, approvals and the like that affect, are applicable or are necessary to undertake any action to remove, lop or destroy or otherwise deal with any native vegetation or that apply to matters within the scope of clauses 52.16 or 52.17 of the Victoria Planning Provisions.

Biodiversity impact and offset requirements report

Appendix 1 – Biodiversity impact of removal of native vegetation

Habitat hectares

Habitat hectares are calculated for each habitat zone within your proposal using the extent and condition scores in the GIS data you provided.

Habitat zone	Site assessed condition score	Extent (ha)	Habitat hectares
1	0.330	0.011	0.004
3	0.470	1.511	0.710
4	0.450	0.126	0.057
17	0.600	0.349	0.210
21	0.660	0.057	0.038
22	0.490	0.971	0.476
23	0.370	0.194	0.072
6A	0.510	0.367	0.187
2A	0.470	0.016	0.008
15A	0.380	0.128	0.049
32	0.400	0.111	0.045
42	0.600	0.053	0.032
44	0.600	0.080	0.048
39	0.340	0.693	0.236
36	0.270	0.142	0.038
33	0.360	1.294	0.466
35	0.600	0.054	0.032
38	0.420	0.238	0.100
40	0.250	0.071	0.018
41	0.300	0.237	0.071
43	0.220	0.517	0.114
T17	0.200	0.070	0.014
T18	0.200	0.070	0.014
T19	0.200	0.070	0.014
T15	0.200	0.070	0.014
T14	0.200	0.070	0.014
T31	0.200	0.070	0.014
T34	0.200	0.070	0.014
19_1	0.670	0.008	0.005

Biodiversity impact and offset requirements report

Habitat zone	Site assessed condition score	Extent (ha)	Habitat hectares
19_2	0.670	3.076	2.061
20_1	0.560	0.005	0.003
20_2	0.560	0.626	0.350
34_1	0.360	1.126	0.405
34_2	0.360	0.047	0.017
37_1	0.300	0.150	0.045
37_2	0.300	0.056	0.017
5_1	0.570	0.913	0.520
5_2	0.570	0.252	0.144
6_1	0.710	0.174	0.123
6_2	0.710	0.001	0.001
TOTAL			6.798

Impacts on rare or threatened species habitat above specific offset threshold

The specific-general offset test was applied to your proposal. The test determines if the proposed removal of native vegetation has a proportional impact on any rare or threatened species habitats above the specific offset threshold. The threshold is set at 0.005 per cent of the total habitat for a species. When the proportional impact is above the specific offset threshold a specific offset for that species' habitat is required.

The specific-general offset test found your proposal does not have a proportional impact on any rare or threatened species' habitats above the specific offset threshold. No specific offsets are required. A general offset is required as set out below.

Clearing site biodiversity equivalence score(s)

The general biodiversity equivalence score for the habitat zone(s) is calculated by multiplying the habitat hectares by the strategic biodiversity score.

Habitat zone	Habitat hectares	Strategic biodiversity score	General biodiversity equivalence score (GBES)
1	0.004	0.686	0.003
3	0.710	0.893	0.634
4	0.057	0.671	0.038
17	0.210	0.253	0.053
21	0.038	0.257	0.010
22	0.476	0.391	0.186
23	0.072	0.160	0.011
6A	0.187	0.588	0.110
2A	0.008	0.758	0.006

Biodiversity impact and offset requirements report

Habitat zone	Habitat hectares	Strategic biodiversity score	General biodiversity equivalence score (GBES)
15A	0.049	0.243	0.012
32	0.045	0.236	0.011
42	0.032	0.237	0.008
44	0.048	0.516	0.025
39	0.236	0.271	0.064
36	0.038	0.284	0.011
33	0.466	0.330	0.154
35	0.032	0.261	0.008
38	0.100	0.312	0.031
40	0.018	0.323	0.006
41	0.071	0.254	0.018
43	0.114	0.347	0.040
T17	0.014	0.868	0.012
T18	0.014	0.884	0.012
T19	0.014	0.783	0.011
T15	0.014	0.768	0.011
T14	0.014	0.538	0.008
T31	0.014	0.473	0.007
T34	0.014	0.349	0.005
19_1	0.005	0.219	0.001
19_2	2.061	0.403	0.830
20_1	0.003	0.232	0.001
20_2	0.350	0.262	0.092
34_1	0.405	0.311	0.126
34_2	0.017	0.243	0.004
37_1	0.045	0.264	0.012
37_2	0.017	0.272	0.005
5_1	0.520	0.576	0.300
5_2	0.144	0.641	0.092
6_1	0.123	0.650	0.080
6_2	0.001	0.679	0.000

Biodiversity impact and offset requirements report

Mapped rare or threatened species' habitats on site

This table sets out the list of rare or threatened species' habitats mapped at the site beyond those species for which the impact is above the specific offset threshold. These species habitats do not require a specific offset according to the specific-general offset test.

Species number	Species common name	Species scientific name
10050	Baillon's Crake	Porzana pusilla palustris
10111	Gull-billed Tern	Gelochelidon nilotica macrotarsa
10154	Wood Sandpiper	Tringa glareola
10170	Australian Painted Snipe	Rostratula benghalensis australis
10174	Bush Stone-curlew	Burhinus grallarius
10185	Little Egret	Egretta garzetta nigripes
10186	Intermediate Egret	Ardea intermedia
10187	Eastern Great Egret	Ardea modesta
10195	Little Bittern	Ixobrychus minutus dubius
10197	Australasian Bittern	Botaurus poiciloptilus
10212	Australasian Shoveler	Anas rhynchotis
10214	Freckled Duck	Stictonetta naevosa
10215	Hardhead	Aythya australis
10216	Blue-billed Duck	Oxyura australis
10217	Musk Duck	Biziura lobata
10226	White-bellied Sea-Eagle	Haliaeetus leucogaster
10230	Square-tailed Kite	Lophoictinia isura
10238	Black Falcon	Falco subniger
10246	Barking Owl	Ninox connivens connivens
10277	Superb Parrot	Polytelis swainsonii
10443	Grey-crowned Babbler	Pomatostomus temporalis temporalis
10598	Painted Honeyeater	Grantiella picta
12177	Bearded Dragon	Pogona barbata
12283	Lace Monitor	Varanus varius
13207	Growling Grass Frog	Litoria raniformis
4774	Murray-Darling Rainbowfish	Melanotaenia fluviatilis
4871	Murray Cod	Maccullochella peelii
500217	Buloke Mistletoe	Amyema linophylla subsp. orientale
500594	Blue Burr-daisy	Calotis cuneifolia
500970	Small-flower Wallaby-grass	Rytidosperma monticola

Biodiversity impact and offset requirements report

Species number	Species common name	Species scientific name
501238	Long Eryngium	Eryngium paludosum
502240	Waterbush	Myoporum montanum
503654	Yellow-tongue Daisy	Brachyscome chrysoglossa
504944	Southern Swainson-pea	Swainsona behriana
528544	Silver Perch	Bidyanus bidyanus
528545	Freshwater Catfish	Tandanus tandanus

Biodiversity impact and offset requirements report

Appendix 2 – Offset requirements detail

If a permit is granted to remove the marked native vegetation the permit condition will include the requirement to obtain a native vegetation offset.

To calculate the required offset amount required the biodiversity equivalence scores are aggregated to the proposal level and multiplied by the relevant risk multiplier.

Offsets also have required attributes:

- General offsets must be located in the same Catchment Management Authority (CMA) boundary or Local Municipal District (local council) as the clearing and must have a minimum strategic biodiversity score of 80 per cent of the clearing.²

The offset requirements for your proposal are as follows:

Offset type	Clearing site biodiversity equivalence score	Risk multiplier	Offset requirements	
			Offset amount (biodiversity equivalence units)	Offset attributes
General	3.045 GBES	1.5	4.568 general units	Offset must be within North Central CMA or the same Municipal District as the vegetation removal Offset must have a minimum strategic biodiversity score of 0.354

² Strategic biodiversity score is a weighted average across habitat zones where a general offset is required

Biodiversity impact and offset requirements report

Appendix 3 – Images of marked native vegetation

Image 1. Native vegetation location risk map

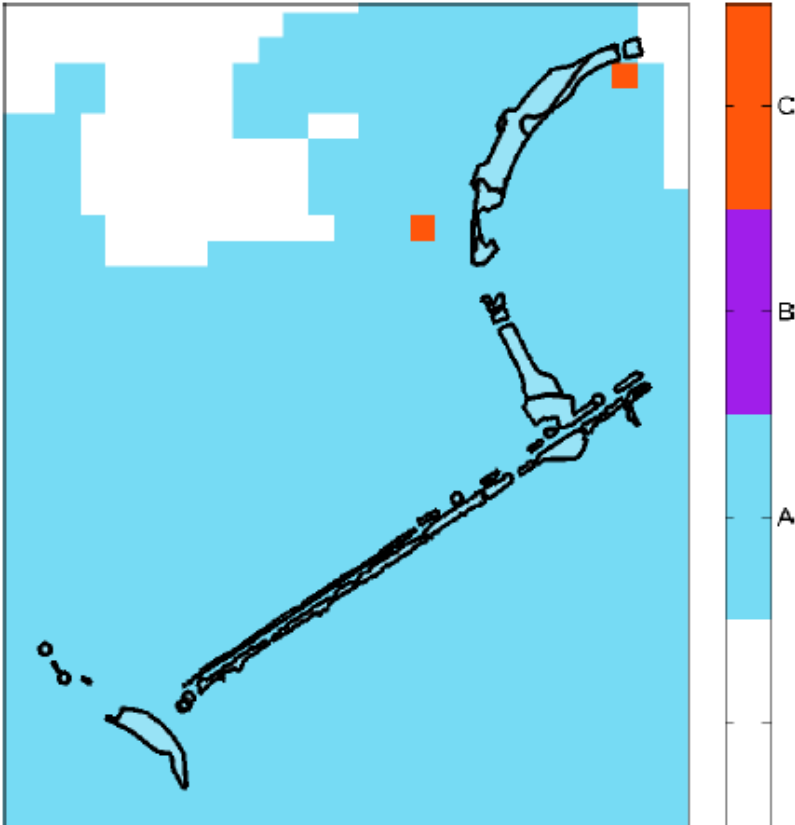
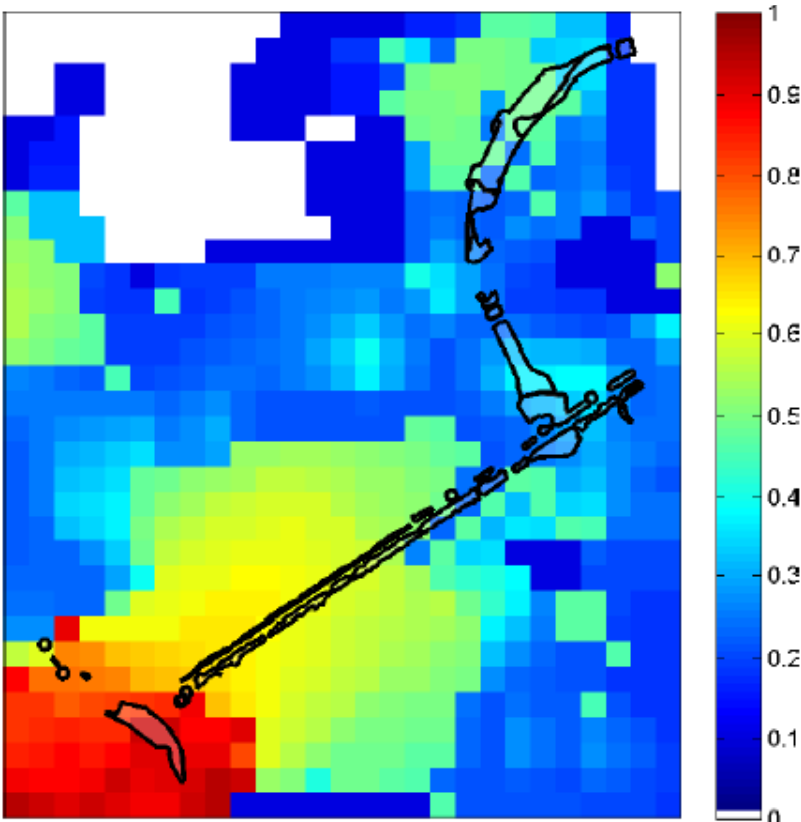


Image 2. Strategic biodiversity score map



Biodiversity impact and offset requirements report

Image 3. Aerial photograph showing marked native vegetation



Biodiversity impact and offset requirements report

Glossary

Condition score This is the site-assessed condition score for the native vegetation. Each habitat zone in the clearing proposal is assigned a condition score according to the habitat hectare assessment method. This information has been provided by or on behalf of the applicant in the GIS file.

Dispersed habitat A dispersed species habitat is a habitat for a rare or threatened species whose habitat is spread over a relatively broad geographic area greater than 2,000 hectares.

General biodiversity equivalence score The general biodiversity equivalence score quantifies the relative overall contribution that the native vegetation to be removed makes to Victoria's biodiversity. The general biodiversity equivalence score is calculated as follows:

$$\text{General biodiversity equivalence score} = \text{habitat hectares} \times \text{strategic biodiversity score}$$

General offset amount This is calculated by multiplying the general biodiversity equivalence score of the native vegetation to be removed by the risk factor for general offsets. This number is expressed in general biodiversity equivalence units and is the amount of offset that is required to be provided should the application be approved. This offset requirement will be a condition to the permit for the removal of native vegetation.

$$\text{Risk adjusted general biodiversity equivalence score} = \text{general biodiversity equivalence score clearing} \times 1.5$$

General offset attributes General offset must be located in the same Catchment Management Authority boundary or Municipal District (local council) as the clearing site. They must also have a strategic biodiversity score that is at least 80 per cent of the score of the clearing site.

Habitat hectares Habitat hectares is a site-based measure that combines extent and condition of native vegetation. The habitat hectares of native vegetation is equal to the current condition of the vegetation (condition score) multiplied by the extent of native vegetation. Habitat hectares can be calculated for a remnant patch or for scattered trees or a combination of these two vegetation types. This value is calculated for each habitat zone using the following formula:

$$\text{Habitat hectares} = \text{total extent (hectares)} \times \text{condition score}$$

Habitat importance score The habitat importance score is a measure of the importance of the habitat located on a site for a particular rare or threatened species. The habitat importance score for a species is a weighted average value calculated from the habitat importance map for that species. The habitat importance score is calculated for each habitat zone where the habitat importance map indicates that species habitat occurs.

Habitat zone Habitat zone is a discrete contiguous area of native vegetation that:

- is of a single Ecological Vegetation Class
- has the same measured condition.

Biodiversity impact and offset requirements report

Highly localised habitat	<p>A highly localised habitat is habitat for a rare or threatened species that is spread across a very restricted area (less than 2,000 hectares). This can also be applied to a similarly limited sub-habitat that is disproportionately important for a wide-ranging rare or threatened species. Highly localised habitats have the highest habitat importance score (1) for all locations where they are present.</p>
Minimum strategic biodiversity score	<p>The minimum strategic biodiversity score is an attribute for a general offset.</p> <p>The strategic biodiversity score of the offset site must be at least 80 per cent of the strategic biodiversity score of the native vegetation to be removed. This is to ensure offsets are located in areas with a strategic value that is comparable to, or better than, the native vegetation to be removed. Where a specific and general offset is required, the minimum strategic biodiversity score relates only to the habitat zones that require the general offset.</p>
Offset risk factor	<p>There is a risk that the gain from undertaking the offset will not adequately compensate for the loss from the removal of native vegetation. If this were to occur, despite obtaining an offset, the overall impact from removing native vegetation would result in a loss in the contribution that native vegetation makes to Victoria's biodiversity.</p> <p>To address the risk of offsets failing, an offset risk factor is applied to the calculated loss to biodiversity value from removing native vegetation.</p> <p style="text-align: center;"><i>Risk factor for general offsets = 1.5</i></p> <p style="text-align: center;"><i>Risk factor for specific offset = 2</i></p>
Offset type	<p>The specific-general offset test determines the offset type required.</p> <p>When the specific-general offset test determines that the native vegetation removal will have an impact on one or more rare or threatened species habitat above the set threshold of 0.005 per cent, a specific offset is required. This test is done at the permit application level.</p> <p>A general offset is required when a proposal to remove native vegetation is not deemed, by application of the specific-general offset test, to have an impact on any habitat for any rare or threatened species above the set threshold of 0.005 per cent. All habitat zones that do not require a specific offset will require a general offset.</p>
Proportional impact on species	<p>This is the outcome of the specific-general offset test. The specific-general offset test is calculated across the entire proposal for each species on the native vegetation permitted clearing species list. If the proportional impact on a species is above the set threshold of 0.005 per cent then a specific offset is required for that species.</p>
Specific offset amount	<p>The specific offset amount is calculated by multiplying the specific biodiversity equivalence score of the native vegetation to be removed by the risk factor for specific offsets. This number is expressed in specific biodiversity equivalence units and is the amount of offset that is required to be provided should the application be approved. This offset requirement will be a condition to the permit for the removal of native vegetation.</p> <p style="text-align: center;"><i>Risk adjusted specific biodiversity equivalence score</i> <i>= specific biodiversity equivalence score clearing × 2</i></p>

Biodiversity impact and offset requirements report

Specific offset attributes Specific offsets must be located in the modelled habitat for the species that has triggered the specific offset requirement.

Specific biodiversity equivalence score The specific biodiversity equivalence score quantifies the relative overall contribution that the native vegetation to be removed makes to the habitat of the relevant rare or threatened species. It is calculated for each habitat zone where one or more species habitats require a specific offset as a result of the specific-general offset test as follows:

$$\text{Specific biodiversity equivalence score} \\ = \text{habitat hectares} \times \text{habitat importance score}$$

Strategic biodiversity score This is the weighted average strategic biodiversity score of the marked native vegetation. The strategic biodiversity score has been calculated from the *Strategic biodiversity map* for each habitat zone.

The strategic biodiversity score of native vegetation is a measure of the native vegetation's importance for Victoria's biodiversity, relative to other locations across the landscape. The *Strategic biodiversity map* is a modelled layer that prioritises locations on the basis of rarity and level of depletion of the types of vegetation, species habitats, and condition and connectivity of native vegetation.

Total extent (hectares) for calculating habitat hectares This is the total area of the marked native vegetation in hectares. The total extent of native vegetation is an input to calculating the habitat hectares of a site and in calculating the general biodiversity equivalence score. Where the marked native vegetation includes scattered trees, each tree is converted to hectares using a standard area calculation of 0.071 hectares per tree. This information has been provided by or on behalf of the applicant in the GIS file.

Vicinity The vicinity is an attribute for a general offset. The offset site must be located within the same Catchment Management Authority boundary or Local Municipal District as the native vegetation to be removed.

Appendix 9: Noxious Weeds list for Murray Shire Council area

Common Name	Scientific Name	Class
African boxthorn	<i>Lycium ferocissimum</i>	4
African feathergrass	<i>Pennisetum macrourum</i>	5
African turnip weed	<i>Sisymbrium runcinatum</i>	5
African turnip weed	<i>Sisymbrium thellungii</i>	5
Alligator weed	<i>Alternanthera philoxeroides</i>	2
Anchored water hyacinth	<i>Eichhornia azurea</i>	1
Annual ragweed	<i>Ambrosia artemisiifolia</i>	5
Arrowhead	<i>Sagittaria montevidensis</i>	4
Artichoke thistle	<i>Cynara cardunculus</i>	5
Athel pine	<i>Tamarix aphylla</i>	5
Bathurst Burr and other burrs	<i>Xanthium species</i>	4
Bear-skin fescue	<i>Festuca gautieri</i>	5
Black knapweed	<i>Centaurea nigra</i>	1
Black willow	<i>Salix nigra</i>	2
Blackberry	<i>Rubus fruticosus aggregate species</i>	4
Boneseed	<i>Chrysanthemoides monilifera subspecies monilifera</i>	2
Bridal creeper	<i>Asparagus asparagoides</i>	4
Broomrapes	<i>Orobanche species</i>	1
Buffalo burr	<i>Solanum rostratum</i>	4
Burr ragweed	<i>Ambrosia confertiflora</i>	5
Cabomba	<i>Cabomba species</i>	5
Cape broom	<i>Genista monspessulana</i>	2
Cape tulip	<i>Moraea species</i>	4
Cayenne snakeweed	<i>Stachytarpheta cayennensis</i>	5
Chilean needle grass	<i>Nassella neesiana</i>	3
Chinese violet	<i>Asystasia gangetica subspecies micrantha</i>	1
Clockweed	<i>Gaura parviflora</i>	5
Columbus grass	<i>Sorghum x alnum</i>	4
Coolatai grass	<i>Hyparrhenia hirta</i>	3
Corn sowthistle	<i>Sonchus arvensis</i>	5
Creeping knapweed	<i>Rhaponticum repens</i>	4
Devil's claw (purple-flowered)	<i>Proboscidea louisianica</i>	4
Devil's claw (yellow-flowered)	<i>Ibicella lutea</i>	4
Dodder	<i>Cuscuta species</i>	5
East Indian hygrophila	<i>Hygrophila polysperma</i>	4
Espartillo	<i>Amelichloa brachychaeta, Amelichloa caudata</i>	5

Common Name	Scientific Name	Class
Eurasian water milfoil	<i>Myriophyllum spicatum</i>	1
Fine-bristled burr grass	<i>Cenchrus brownii</i>	5
Fountain grass	<i>Pennisetum setaceum</i>	5
Gallon's curse	<i>Cenchrus biflorus</i>	5
Glaucous starthistle	<i>Carthamus glaucus</i>	5
Golden dodder	<i>Cuscuta campestris</i>	4
Golden thistle	<i>Scolymus hispanicus</i>	5
Harrisia cactus	<i>Harrisia species</i>	4
Hawkweed	<i>Hieracium species</i>	1
Heteranthera	<i>Heteranthera reniformis</i>	1
Horehound	<i>Marrubium vulgare</i>	4
Horsetail	<i>Equisetum species</i>	1
Hydrocotyl	<i>Hydrocotyl ranunculoides</i>	1
Hymenachne	<i>Hymenachne amplexicaulis and hybrids</i>	1
Johnson grass	<i>Sorghum halepense</i>	4
Karoo thorn	<i>Acacia karroo</i>	1
Kochia	<i>Bassia scoparia</i>	1
Kosters curse	<i>Clidemia hirta</i>	1
Lagarosiphon	<i>Lagarosiphon major</i>	1
Lantana	<i>Lantana species</i>	4
Leafy elodea	<i>Egeria densa</i>	4
Lippia	<i>Phyla canescens</i>	4
Long-leaf willow primrose	<i>Ludwigia longifolia</i>	4
Mesquite	<i>Prosopis species</i>	2
Mexican feather grass	<i>Nassella tenuissima</i>	1
Mexican poppy	<i>Argemone mexicana</i>	5
Miconia	<i>Miconia species</i>	1
Mikania	<i>Mikania micrantha</i>	1
Mimosa	<i>Mimosa pigra</i>	1
Mossman River grass	<i>Cenchrus echinatus</i>	5
Onion weed	<i>Asphodelus fistulosus</i>	4
Parkinsonia	<i>Parkinsonia aculeata</i>	2
Parthenium weed	<i>Parthenium hysterophorus</i>	1
Paterson's curse and other echium	<i>Echium species</i>	4
Perennial ground cherry	<i>Physalis virginiana</i>	4
Pond apple	<i>Annona glabra</i>	1
Prairie ground cherry	<i>Physalis hederifolia</i>	4

Common Name	Scientific Name	Class
Prickly acacia	<i>Acacia nilotica</i>	1
Prickly pear	<i>Cylindropuntia species</i>	4
Prickly pear	<i>Opuntia species</i>	4
Red rice	<i>Oryza rufipogon</i>	5
Rhus tree	<i>Toxicodendron succedaneum</i>	4
Rubber vine	<i>Cryptostegia grandiflora</i>	1
Sagittaria	<i>Sagittaria platyphylla</i>	4
Salvinia	<i>Salvinia molesta</i>	2
Scotch Thistle and other thistles	<i>Onopordum species</i>	4
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>	1
Serrated tussock	<i>Nassella trichotoma</i>	3
Siam weed	<i>Chromolaena odorata</i>	1
Silk forage sorghum	<i>Sorghum species hybrid cultivar</i>	4
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	4
Smooth-stemmed turnip	<i>Brassica barrelieri subspecies oxyrrhina</i>	5
Soldier thistle	<i>Picnomon acarna</i>	5
Spiny burrgrass	<i>Cenchrus incertus</i>	4
Spiny burrgrass	<i>Cenchrus longispinus</i>	4
Spiny emex	<i>Emex australis</i>	4
Spotted knapweed	<i>Centaurea stoebe subspecies micranthos</i>	1
St. John's wort	<i>Hypericum perforatum</i>	3
Texas blueweed	<i>Helianthus ciliaris</i>	5
Tree-of-heaven	<i>Ailanthus altissima</i>	4
Tropical soda apple	<i>Solanum viarum</i>	2
Water caltrop	<i>Trapa species</i>	1
Water hyacinth	<i>Eichhornia crassipes</i>	2
Water lettuce	<i>Pistia stratiotes</i>	1
Water soldier	<i>Stratiotes aloides</i>	1
Willows	<i>Salix species</i>	5
Witchweed	<i>Striga species</i>	1
Yellow burrhead	<i>Limnocharis flava</i>	1
Yellow nutgrass	<i>Cyperus esculentus</i>	5

KEY TO CONTROL CLASS

Control Class	Weed type	Example control requirements
Class 1	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant.
		The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant.
		The weeds are also "notifiable" and a range of restrictions on their sale and movement exist.
Class 3	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.*
Class 4	Plants that pose a potentially serious threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction*
Class 5	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.	There are no requirements to control existing plants of Class 5 weeds.
		However, the weeds are "notifiable" and a range of restrictions on their sale and movement exists.

Appendix 10: 2014 VBA database search results

Note, results since 1970 for listed threatened species only

Common Name	Scientific name	Conservation status			Number of records	Date of last record
		EPBC	FFG	DELWP		
Flora						
Ausfeld's Wattle	<i>Acacia ausfeldii</i>			VU	1	1/04/2002
Basalt Podolepis	<i>Podolepis sp. 1</i>			EN	1	23/09/1991
Blue Burr-daisy	<i>Calotis cuneifolia</i>			R	2	26/09/2011
Bluish Raspwort	<i>Haloragis glauca f. glauca</i>			K	2	14/09/1999
Buloke	<i>Allocasuarina luehmannii</i>		L		11	7/12/1998
Dark Roly-poly	<i>Sclerolaena muricata var. semiglabra</i>			K	2	23/09/1991
Dwarf Amaranth	<i>Amaranthus macrocarpus var. macrocarpus</i>			VU	1	24/03/1971
Dwarf Bitter-cress	<i>Rorippa eustylis</i>			R	2	1/07/1986
Frosted Goosefoot	<i>Chenopodium desertorum subsp. virosum</i>			K	5	29/07/2004
Fuzzy New Holland Daisy	<i>Vittadinia cuneata var. morrisii</i>			R	1	18/10/1997
Galvanized Burr	<i>Sclerolaena birchii</i>			K	1	21/09/1994
Hairy Tails	<i>Ptilotus erubescens</i>		L		4	5/10/1999
Pepper Grass	<i>Panicum laevinode</i>			VU	1	25/01/2008
Red Swainson-pea	<i>Swainsona plagiotropis</i>	VU	L	EN	21	25/01/2008
River Red-gum	<i>Eucalyptus camaldulensis</i>				17	26/09/2011
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	VU			1	1/07/1986
Riverina Bitter-cress	<i>Cardamine moirensis</i>			R	1	9/09/1985
Silky Swainson-pea	<i>Swainsona sericea</i>		L	VU	6	25/01/2008
Slender Darling-pea	<i>Swainsona murrayana</i>	VU	L	EN	1	14/09/1999
Smooth Minuria	<i>Minuria integerrima</i>			R	1	30/09/1998

Common Name	Scientific name	Conservation status			Number of records	Date of last record
		EPBC	FFG	DELWP		
Southern Swainson-pea	<i>Swainsona behriana</i>			R	1	23/09/1991
Spiny Rice-flower	<i>Pimelea spinescens</i> subsp. <i>spinescens</i>	CE	L	EN	6	27/07/2007
Turnip Copperburr	<i>Sclerolaena napiformis</i>	EN	L	EN	10	25/01/2008
Weeping Myall	<i>Acacia pendula</i>		L	EN	4	26/09/2011
Yarran Wattle	<i>Acacia omalophylla</i>		L	EN	3	21/09/1994
Yellow-tongue Daisy	<i>Brachyscome chrysoglossa</i>		L	VU	3	14/09/1999
Birds						
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	L	EN	2	25/06/1978
Australasian Shoveler	<i>Anas rhynchotis</i>			VU	3	4/12/1999
Azure Kingfisher	<i>Alcedo azurea</i>			NT	6	8/11/2011
Black Falcon	<i>Falco subniger</i>			VU	2	9/08/1994
Blue-billed Duck	<i>Oxyura australis</i>		L	EN	5	4/12/1999
Brolga	<i>Grus rubicunda</i>		L	VU	1	31/03/1972
Brown Treecreeper (south-eastern ssp.)	<i>Climacteris picumnus victoriae</i>			NT	30	9/11/2011
Bush Stone-curlew	<i>Burhinus grallarius</i>		L	EN	10	5/06/2006
Common Sandpiper	<i>Actitis hypoleucos</i>	M (JAMBA, CAMBA, ROKAMBA, Bonn (A2H))		VU	1	18/02/1977
Diamond Dove	<i>Geopelia cuneata</i>		L	NT	1	4/08/2001
Diamond Firetail	<i>Stagonopleura guttata</i>		L	NT	3	10/12/1984
Eastern Great Egret	<i>Ardea modesta</i>	M (JAMBA, CAMBA)	L	VU	13	19/03/2001
Emu	<i>Dromaius novaehollandiae</i>			NT	1	22/05/1978
Glossy Ibis	<i>Plegadis falcinellus</i>	M (CAMBA, Bonn (A2S))		NT	1	31/03/1972
Grey Goshawk	<i>Accipiter novaehollandiae novaehollandiae</i>		L	VU	1	27/04/1999

Common Name	Scientific name	Conservation status			Number of records	Date of last record
		EPBC	FFG	DELWP		
Grey-crowned Babbler	<i>Pomatostomus temporalis temporalis</i>		L	EN	1	16/04/1978
Gull-billed Tern	<i>Gelochelidon nilotica macrotarsa</i>		L	EN	1	26/11/2006
Hardhead	<i>Aythya australis</i>			VU	10	4/12/1999
Hooded Robin	<i>Melanodryas cucullata cucullata</i>		L	NT	1	13/03/1980
Intermediate Egret	<i>Ardea intermedia</i>		L	EN	5	4/08/2001
Latham's Snipe	<i>Gallinago hardwickii</i>	M (JAMBA, CAMBA, ROKAMBA, Bonn A2H)		NT	1	31/03/1972
Musk Duck	<i>Biziura lobata</i>			VU	8	4/12/1999
Nankeen Night Heron	<i>Nycticorax caledonicus hillii</i>			NT	4	9/11/2011
Pied Cormorant	<i>Phalacrocorax varius</i>			NT	1	25/06/1978
Rainbow Bee-eater	<i>Merops ornatus</i>	M (JAMBA)			18	21/01/2001
Royal Spoonbill	<i>Platalea regia</i>			NT	4	25/08/1994
Spotted Harrier	<i>Circus assimilis</i>			NT	3	12/02/1980
Turquoise Parrot	<i>Neophema pulchella</i>		L	NT	3	13/02/1986
Whiskered Tern	<i>Chlidonias hybridus javanicus</i>			NT	3	22/09/1994
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	M (CAMBA)	L	VU	1	18/03/1999
White-throated Needletail	<i>Hirundapus caudacutus</i>	M (JAMBA, CAMBA, ROKAMBA)		VU	1	19/03/2001
Mammals						
Squirrel Glider	<i>Petaurus norfolcensis</i>		L	EN	25	22/10/1985
Reptiles						
Murray River Turtle	<i>Emydura macquarii</i>			VU	2	28/10/1982

CE = Critically Endangered; **EN** = Endangered; **VU** = Vulnerable; **R** = Rare; **L** = Listed as threatened under FFG Act; **NT** = Near threatened; **K** = Insufficiently known.

Appendix 11: Gration (2015) Peer Review of Bat Surveys

Appendix12: BL&A (2015d) Squirrel Glider Habitat Linkage Strategy