ecology & heritage partners

FINAL REPORT:

Western Highway Project – Section 3: Ararat to Stawell, Victoria

Biodiversity and Habitat Impact Assessment Report – Flora, Fauna and Ecological Communities

PREPARED FOR:

VicRoads
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Ecology and Heritage Partners Pty Ltd

HEAD OFFICE: 420 Victoria Street, Brunswick VIC 3056 MELBOURNE: PO Box 298, Brunswick VIC 3056 GEELONG: PO Box 8048, Newtown VIC 3220

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Report author(s)	Clio Gates Foale, Senior Zoologist Robyn Giles, Consultant Botanist Damien McMaster, Aquatic Ecologist
Report reviewer	Aaron Organ, Senior Ecologist / Director
Other EHP Staff	Jo Day, Amanda Smith, Stuart Cooney, Cristina Del Borrello, Andrea Canzano, Kim Downs
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GLOSSARY OF TERMS

AVW	Atlas of Victorian Wildlife
CALP	Catchment and Land Protection
CVU	Central Victorian Uplands
DSE	Department of Sustainability and Environment
DTV	Degraded Treeless Vegetation
DBH	Diameter at Breast Height
EPBC	Environment Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
FFG	Flora and Fauna Guarantee
FIS	Flora Information System
GEWVVP	Grassy Eucalypt Woodland of the Victorian Volcanic Plain
LOT	Large Old Tree
NES	National Environmental Significance
PMST	Protected Matters Search Tool
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
VBA	Victorian Biodiversity Atlas
VLOT	Very Large Old Tree
VVP	Victorian Volcanic Plain

EXECUTIVE SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was engaged by VicRoads to undertake a flora, fauna and Net Gain assessment of multiple alignment options for Section 3 of the proposed Western Highway Project between Ararat and Stawell, Victoria. The assessment was required, as part of the Environment Effects Statement (EES), to identify any species or vegetation communities of conservation significance, to record any potential areas of indigenous vegetation that may have Net Gain implications within the study area, and to provide advice in relation to potential impacts and mitigation measures associated with the Western Highway Project.

Scoping Requirements

The Draft EES Evaluation Objective relevant to the flora and fauna assessment outlined in the Scoping Requirements is as follows:

- To avoid or minimise effects on flora and fauna species and ecological communities listed under the *Flora and Fauna Guarantee Act 1975* or the *Environment Protection and Biodiversity Conservation Act 1999* and to comply with requirements under Victoria's Native Vegetation Management: A Framework for Action.

The current assessment was required to identify any flora or fauna species or vegetation communities of national or State significance, to record any potential areas of indigenous vegetation that may have Net Gain implications within the study area, and to provide advice in relation to potential impacts and mitigation measures associated with the Western Highway Project.

Methods

Flora, fauna and Net Gain assessment

Biological databases maintained by the Department of Sustainability and Environment were reviewed, including the Atlas of Victorian Wildlife and the Flora Information System. The presence of Ecological Vegetation Classes within the study area were reviewed using Department of Sustainability and Environment's Biodiversity Interactive Maps, while information referring to matters (such as listed taxa and ecological communities, Ramsar wetlands, etc) protected under the Commonweatlh's *Environment Protection and Biodiversity Conservation Act 1999* were also obtained from the Department of the Sustainability, Environment, Water, Population and Communities Protected Matters Search Tool.

A field assessment was undertaken from 15 to 18 June 2010 and 28 to 30 June 2010 with the aim of documenting fauna and flora species, remnant native vegetation patches, and significant communities in the study area.

A preliminary Net Gain assessment was undertaken in accordance with the Department of Sustainability and Environment's habitat hectare methodology. The study area was assessed on foot, with all vascular plants recorded and the overall vegetation condition noted.

Targeted flora assessment

Targeted flora surveys for the nationally significant Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens* (Critically Endangered), Trailing Hop–bush *Dodonea procumbens* (Vulnerable), Tawny Spider Orchid *Caladenia fulva* (Endangered), Pomonal Leek-orchid *Prasophyllum subbisectum* (Endangered), Button Wrinklewort *Rutidosis leptorhynchoides* (Endangered) and Large–headed Fireweed *Senecio macrocarpus* (vulnerable), and State significant Emerald-lip Greenhood *Pterostylis smaragdyna* (vulnerable), Fringed Sun-orchid *Thelymitra luteocilium* (rare), Crimson Sun-orchid *Thelymitra X macmillanii* (vulnerable), Rising Star Guinea-flower *Hibbertia humifusa* subsp. *humifusa* (rare), Pale-flower Crane's-bill *Geranium* sp. 3 (rare), Fitzgerald's Leek-orchid *Prasophyllum* sp. aff. *fitzgeraldii* A (endangered), Woodland Leek-orchid *Prasophyllum* sp. aff. *validum* A (poorly known), Half-bearded Spear-grass *Austrostipa hemipogon* (rare) were conducted within the study area on 2 and 3 September 2010, 18 and 19 October 2010, and 19 and 21 January 2011.

Targeted fauna assessment

A series of targeted surveys were undertaken within, and in the immediate surrounds of, the study area from September 2010 to April 2011. Twenty-one significant species were targeted: two invertebrates (Golden Sun Moth and Yellow Ochre Butterfly); four mammals (Southern Brown Bandicoot, Brush-tailed Phascogale, Squirrel Glider, Fat-tailed Dunnart); eleven birds (Elegant Parrot, Brown Treecreeper, Grey-crowned Babbler, Chestnut-rumped Heathwren, Speckled Warbler, Painted Honeyeater, Hooded Robin, Diamond Firetail, Black-chinned Honeyeater, Barking Owl, Powerful Owl); one amphibian (Brown Toadlet), and; two reptiles (Striped Legless Lizard and Lace Goanna).

Targeted aquatic fauna assessment

Aquatic fauna surveys, water quality and habitat assessments were undertaken from Ararat to Stawell at all significant waterbodies intersecting the proposed alignments in June 2010, September 2010, June 2011 and January 2012. A general aquatic assessment (including the assessment of farm dams) was conducted between 15 and 17 June 2010 to determine the habitat quality and biodiversity values within the study area. Targeted aquatic fauna surveys, water quality and instream habitat assessments were undertaken in September 2010 and between 16 and 22 June 2011 (across all suitable creeks and drainage lines). Macroinvertebrate surveys, water quality and riparian vegetation assessments were undertaken between 19 and 20 January 2012.

Results

A total of 201 plant taxa (139 indigenous, 62 exotic) were recorded within the study area. One nationally significant flora species (Trailing Hop-bush - Vulnerable), two State significant flora species (Emerald-lip Greenhood - vulnerable and Rising Star Guinea-flower - rare) and numerous species of regional significance were identified. A summary of Ecological Vegetation Classes and significant flora recorded within the study area is presented in Tables 1a and 1b.

A total of 71 fauna (terrestrial and aquatic) species were recorded within the study area. One nationally significant fauna species (Golden Sun Moth), four State significant fauna species (Brush-tailed Phascogale, Brown Toadlet, Brown Treecreeper and Barking Owl), three regionally significant species (Bearded Dragon, Black-chinned Honeyeater and Fat-tailed Dunnart) and one significant community (Victorian Temperate Woodland Bird Community) were identified. A summary of significant fauna recorded within the study area is presented in Table 1c.

Legislative and Policy Implications

Environment Protection and Biodiversity Conservation Act 1999

One flora species, Trailing Hop-bush, and one fauna species, Golden Sun Moth, listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* were recorded within the final alignment. Based on the EPBC Act Significant Impact Guidelines (DEWHA 1999, 2009), the Project would have a significant impact both of these species.

An *Environment Protection and Biodiversity Conservation Act 1999* referral has been submitted for the proposed Project. VicRoads were advised by the Department of the Sustainability, Environment, Water Population and Communities on 17 December 2010 that the proposed project is a controlled action requiring assessment and approval in accordance with the *Environment Protection and Biodiversity Conservation Act 1999*.

Flora and Fauna Guarantee Act 1988

One flora species, four fauna species and one community listed under the *Flora and Fauna Guarantee Act* were recorded during the current assessment. No legal implications relating directly to *Flora and Fauna Guarantee Act* listed fauna species exist, however the Department of Sustainability and Environment and local authorities may impose conditions relating to these species under other approvals (e.g. *Planning and Environment Act 1987*). A *Flora and Fauna Guarantee Act* permit to remove or disturb native vegetation on public land would be required for the Western Highway Project: Ararat to Stawell.

Planning and Environment Act 1987

A Planning Permit or Planning Scheme Amendment is required to remove/disturb native vegetation from land within the study area. In this instance, the Department of Sustainability and Environment is a mandatory referral authority.

Wildlife Act 1975

Persons undertaking any inspection, removal or relocation of fauna species located in vegetation to be impacted upon as part of the project must be authorised and hold a current permit under the *Wildlife Act 1975*.

Catchment and Land Protection Act 1994

VicRoads is responsible for controlling any infestation of noxious or environmental weeds that may become established as a result of works associated with the Project. As such, weeds should be appropriately controlled to minimise their spread.

Net Gain Assessment

Net Gain offset requirements for losses of native vegetation and scattered trees for the proposed alignment are provided in Table 1a below. A total of 116.62 hectares (64.54 habitat hectares) of Very High conservation significance vegetation, and 16.52 hectares (5.19 habitat hectares) of High conservation significance vegetation is proposed for removal.

It is important to note that some of the Very High conservation significance vegetation comes from EVCs that have been elevated to a higher conservation significance based on providing "Best or Remaining 50% of habitat for threatened flora or fauna species" (see Section 7.3). If the Best or Remaining 50% assessment is excluded, the total amount of Very High conservation significance vegetation decreases to 55.53 hectares (28.81 habitat hectares), while the total amount of High conservation significance vegetation increases to 57.72 hectares (30.30 habitat hectares).

Impacts and Mitigation Measures

One of the main impacts of the Project to ecological values would arise from the removal of Very High and High conservation significance vegetation. The residual consequence (see Risk Assessment) of this impact has been classified as Moderate, with between 0.1 and 1% of the EVCs within the bioregion proposed for removal. The proposed removal of this vegetation would have implications for the significant flora and fauna populations that have been recorded within, and adjacent to the study area.

With the avoidance and minimisation measures applied at the design phase of the Western Highway Project, and the implementation of mitigation measures outlined in Section 9, the residual consequence for the majority of impacts has been classified as either Insignificant or Minor. The exceptions to this are impacts to Golden Sun Moth and scattered trees, both of which are classified as Moderate.

The Options Assessment for the Project has sought to minimise impacts to significant flora, fauna and ecological communities via a process of elimination, progressively excluding potential alignment options that support areas of high ecological value.

The final alignment has been progressively refined, to minimise impacts to vegetation, with particular consideration for vegetation of High and Very High conservation significance, as well as flora and fauna species listed under the EPBC Act and FFG Act.

The mitigation measures outlined in Section 9 seek to minimise these impacts, providing a framework for managing environmental effects and hazards in order to achieve an acceptable environmental outcome. VicRoads' standard environmental protection measures, and some additional Project specific controls identified in Section 9, have been incorporated into the Environmental Management Framework for the Project. VicRoads would require the construction contractor to incorporate all of these measures into the Construction Environmental Management Plan.

Table 1a. Summary of vegetation losses and Net Gain targets within the proposed alignment.

Bioregion	Target EVC	Conservation significance	Vegetation			Large Old Trees		
			Total Losses (ha)	Total Losses (HabHa)	Net Gain Target (HabHa)	Total Losses	Total to be Protected	Total to be Recruited
CVU	CGW	V. High	4.36	1.74	3.48	35	280	1400
	GW	V. High	0.19	0.09	0.18	2	16	80
	HW	V. High	47.5	30.29	60.58	257	2056	10280
		High	0.4	0.2	0.3	0	0	0
		Medium	0.02	0.01	0.01	0	0	0
	PGW	V. High	16.29	7.26	14.52	116	928	4640
		High	6.34	1.9	2.85	32	128	640
VVP	CGW	V. High	9.04	4.03	8.06	66	528	2640
	GDF	V. High	1.47	0.78	1.56	12	96	480
		High	1.07	0.5	0.75	9	36	180
		Medium	0.47	0.16	0.16	4	8	40
	GW	V. High	37.64	20.29	40.58	302	2416	12080
		High	0.44	0.11	0.17	4	16	80
	PGW	V. High	0.13	0.06	0.12	2	16	80
		High	8.27	2.48	3.72	41	164	820
Total			**133.63**	**69.9**	**137.04**	**882**	**6688**	**33440**

Notes: GDF = Grassy Dry Forest, PGW = Plains Grassy Woodland, CGW = Creekline Grassy Woodland, GW = Grassy Woodland, HW = Heathy Woodland, Gold = Goldfields, CVU = Central Victorian Uplands, Wimm = Wimmera, Dep = Depleted, Vul = Vulnerable, En = Endangered, N/A= Not Applicable. Large Old Tree losses are based on estimates of trees present within each patch, further assessment is required to determine the number of Large Old Trees within all patches within the study area.

Table 1b. Summary of scattered tree losses and Net Gain targets within the proposed alignment.

Bioregion	Conservation significance	Size	No. trees to be removed	Protect and Recruit				Recruit only	
				Multiplier	Offset total	Multiplier	Offset total	Offset requirement per tree	Total plants required for offset
CVU	High	VLOT	1	4	4	20	20	200	4000
	High	LOT	8	2	16	10	80	100	8000
	High	MOT	5	1	5	5	25	50	1250
	Low	VLOT	4	4	16	20	80	50	4000
	Low	LOT	7	2	14	10	70	50	3500
	Low	MOT	6	1	6	5	30	50	1500
	Low	ST#	13	NA	0	NA	0	NA	0
	DD	UN^	12	2	24	10	120	18	2160
Gold	High	LOT	2	2	4	10	20	100	2000
	High	MOT	1	1	1	5	5	50	250
	Medium	VLOT	5	4	20	20	100	100	10000
	Medium	LOT	5	2	10	10	50	50	2500
	Medium	MOT	2	1	2	5	10	50	500
	Low	ST#	4	NA	0	NA	0	NA	0
	DD	UN^	4	2	8	10	40	18	720
	Total				**130**		**650**		**40380**

Notes: = Goldfields, CVU = Central Victorian Uplands, N/A= Not Applicable, VLOT = Very Large Old Tree, LOT = Large Old Tree, MOT = Medium Old Tree, ST = Small Tree, UN = Unknown (within Due diligence area).

Table 1c. Summary of flora and fauna listed under the EPBC Act, FFG Act and DSE Advisory List that are present within the proposed alignment.

EPBC Act		FFG Act			DSE Advisory List	
Flora	Fauna	Flora	Fauna	Communities	Flora	Fauna
Trailing Hop-bush (x21)	Golden Sun Moth (24.74 ha confirmed habitat; 99.94 ha potential habitat)	Trailing Hop-bush (x21)	Golden Sun Moth Brush-tailed Phascogale* Barking Owl* Brown Toadlet^	VTWBC*	Rising-star Guinea-flower (x11) Emerald-lip Greenhood (x203) Rosemary Grevillea (x37)	Golden Sun Moth Brush-tailed Phascogale* Barking Owl* Brown Toadlet^

Notes: Individual numbers for certain threatened fauna species not provided as assessment is based on habitat loss rather than species present. VTWBC = Victorian Temperate Woodland Bird Community.

* Species habitat recorded throughout the study area. Species likely to make use of GDF, PGW, CGW, GW and HW (see Table 1a).

^ Species is widespread throughout the study area in many of the drainage lines, seeps, road ditches and culverts located within or adjacent to woodland vegetation.

1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by VicRoads to undertake a flora, fauna and Net Gain assessment of multiple alignment options for the proposed duplication of the Western Highway between Ararat and Stawell, Victoria (Figures 1 and 2). The assessment was required to identify any species or vegetation communities of conservation significance, to record any potential areas of indigenous vegetation that may have Net Gain implications within the study area, and to provide advice in relation to potential impacts and mitigation measures associated with the proposed duplication of the Western Highway.

Numerous alignment options were assessed. The options assessment process culminated in the selection of the proposed alignment (final alignment) which is assessed in this report.

1.2 Western Highway Project

The Western Highway (A8) is being progressively upgraded as a four-lane divided highway for approximately 110 kilometres (km) between Ballarat and Stawell, and this is referred to as the Western Highway Project. As the principal road link between Melbourne and Adelaide, the Western Highway serves interstate trade between Victoria and South Australia and is the key corridor through Victoria's west, supporting farming, grain production, tourism and a range of manufacturing and service activities. Currently, more than 5500 vehicles travel on the highway west of Ballarat each day, including 1500 trucks.

The Western Highway Project (the Project) consists of three stages:

- Section 1: Ballarat to Beaufort;
- Section 2: Beaufort to Ararat; and,
- Section 3: Ararat to Stawell.

The EES for Section 3 will assess the proposed alignment of the Western Highway between Ararat and Stawell to a freeway standard complying with the road category 1 of VicRoads Access Management Policy (AMP1), except for an 800 m section from Pollard Lane to the Majors Road which would be constructed to AMP3 (highway) standard.

To date $505 million has been committed for the Western Highway Project by the Victorian Government and the Australian Government as part of the Nation Building Program.

1.2.1 Project Proponent

The proponent for the Project is the Roads Corporation trading as VicRoads. The Roads Corporation is a Victorian statutory authority for arterial roads (including highways), established under the *Transport Act 1983*. It is one of several State government agencies that assist the Government to achieve its integrated transport policy objectives. VicRoads also administers a number of other Acts and Regulations including the *Road Management Act 2004* and the *Road Safety Act 1986*. VicRoads Chief Executive is accountable to the Minister for Roads, reporting through the Secretary of the Department of Transport.

1.2.2 Project Objectives

The objectives of the Project specified by VicRoads are to:

- Provide safer conditions for all road users by:
    - Reducing the incidence of head-on and run-off-road crashes;
    - Improving safety at intersections; and,
    - Improving safety of access to adjoining properties.
- Improve efficiency of freight by designing for High Productivity Freight Vehicles.
- Provide adequate and improved rest areas.
- Locate alignment to allow for possible future bypasses of Beaufort and Ararat.

1.2.3 Project Area

The project area was defined for the purposes of characterising the existing conditions for the Project, and to consider alignment alternatives. The project area encompasses a corridor extending up to 1500 metres (m) either side (east and west) of the edge of the road reserve, except around Great Western where the project area extends up to 1800 m (encompassing the extent of new alignment possibilities).

1.3 EES Scoping Requirements

1.3.1 Draft EES Evaluation Objectives

For the flora and fauna aspects of the Western Highway Project, the relevant draft evaluation objectives outlined in the EES Scoping Requirements are:

- To avoid or minimise effects on flora and fauna species and ecological communities listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as well as to comply

with requirements under *Victoria's Native Vegetation Management - A Framework for Action* (2002) (The Framework).

1.3.2 EES Scope of Works

The EES should provide an assessment of any potential direct and indirect effects of the proposed works and relevant alternatives on terrestrial and aquatic biodiversity, habitats and other conservation values. The EES Scoping Requirements specify that the EES must cover the following scope of work in relation to biodiversity and habitat:

- *"Characterise the native vegetation and terrestrial and aquatic habitat located in the project area. Such characterisation should include the existence or potential existence of any species or ecological communities listed under the FFG Act or EPBC Act and any declared weeds or pathogens. The characterisation should be informed by relevant databases, literature and appropriate seasonal and targeted surveys;*

- *Provide evidence to demonstrate that adequate information (e.g., desktop database searches, targeted surveys and/or modelling) has been compiled on the potential and actual presence of threatened species and ecological communities, having regard to the likelihood and consequence of impact. In the absence of positive identification, a precautionary approach should be taken for the potential existence of listed species and ecological communities listed under the EPBC Act;*

- *Identify and assess potential effects of the proposed project and relevant alternatives on existing native vegetation, habitat (quality and continuity), listed flora and fauna species and ecological communities. Potential effects to be assessed should include barriers to the movement of wildlife, fragmentation of habitat and vehicle road kills. This assessment should address the relevant Potentially Threatening Processes listed under the FFG Act;*

- *Assess any effect of the project on other conservation values, including areas of scientific or other special conservation significance;*

- *Identify and assess potential direct and indirect effects on aquatic habitat values, including on significant aquatic species, that may result from the project and, in particular any proposed waterway crossings;*

- *Identify potential effects of the project on the dispersion and distribution of weeds and pathogens;*

- *Specify any measures to avoid, minimise and mitigate biodiversity impacts, especially on threatened or other listed species;*

- *Outline any obligations arising from Victoria's Biodiversity Strategy and Victoria's Native Vegetation Management - A Framework for Action. In particular, the EES*

should address how vegetation removal has been avoided and minimised by the proposed works;

- *Outline an offset strategy for unavoidable clearing of native vegetation in the context of both Victoria's Native Vegetation Management - A Framework for Action and Draft Policy Statement 4.1: Use of environmental offsets under the EPBC Act. This offset strategy should describe proposed arrangements for ongoing management of offsets, as well as details on the security of tenure and ownership of offsets;*

- *Identify methods of vegetation rehabilitation for both areas disturbed for construction purposes only and of any sections of existing road to be made redundant;*

- *Describe the proposed approach and measures for long-term management of retained native vegetation and habitat areas within and adjacent to the road reservation along the duplication highway; and*

- *Describe at a level of detail proportionate to the significance of potentially affected assets, the likely residual effects of the project on biodiversity and habitat values.*

The EES should also include a separate summary assessment addressing effects on, and avoidance, mitigation and management measures for, matters of national environmental significance. This summary must include, but not be limited to, information on the following species and ecological communities listed as threatened under the EPBC Act:

- *Golden Sun Moth (Synemon plana), Southern Brown Bandicoot (Isoodon obesulus subsp. obesulus) and Striped Legless Lizard (Delma impar);*

- *Australian Grayling (Prototroctes maraena), Murray Cod (Maccullochella peelii subsp. peeli) and Eastern Dwarf Galaxias (Galaxiella pusilla).*

- *Button Wrinklewort (Rutidosis leptorhynchoides), Spiny Rice Flower (Pimelea spinescens subsp. spinescens), Large-fruit Fireweed (Senecio macrocarpus), Tawny Spider Orchid (Caladenia fulva), Pomonal Leek-orchid (Prasophyllum subbisectum) and Trailing Hop-bush (Dodonea procumbens)."*

1.4 Study Area

The study area consists primarily of road reserve and private properties on either side of the Western Highway, between Ararat and Stawell. It is situated approximately 220 km west of Melbourne, Victoria and according to the DSE Biodiversity Interactive Map (DSE 2010a), is partly located within the Central Victorian Uplands (CVU) and partly located within Goldfields and Wimmera bioregions.

The CVU bioregion extends from Stawell in the west to Bright in the east and from Glenrowan in the north-east to Meredith in the south. The Goldfields bioregion is located north of the CVU extending from Stawell in the west to the Goulburn River in the east and from Ararat and Daylesford in the south to the base of the Riverina area in the north. The Wimmera bioregion is located north- west of Stawell, extending west to the South Australian border and east to the Avoca River. The northern section of the study area is located within the Northern Grampians Shire and the southern section within the City of Ararat. The majority of the study area is located within the Wimmera Catchment Management Authority with a small section near Ararat located within the Glenelg–Hopkins Catchment Management Authority area.

The study area is characterised by native and exotic grassland vegetation, with scattered areas of remnant indigenous vegetation consisting of forest, grassland and wetland communities. The existing highway dissects Concongella Creek north of Ararat and Cobey's Creek and Donald Creek north of Great Western.

It should be noted that the study area referred to as the 'Assessment Area' in this report refers to the area within the supplied indicative shortlisted road alignments plus a buffer of 60 m either side of the outer edge of the ROW corridor. The 'final alignment option' forms a refined alignment footprint within the overall Assessment Area.

2 METHODS

2.1 Nomenclature

Common and scientific names of vascular plants follow the Flora Information System (FIS 2009) and the Census of Vascular Plants of Victoria (Walsh and Stajsic 2007). Vegetation community names follow the Department of Sustainability and Environment (DSE) EVC benchmarks (DSE 2010b).

Terrestrial and aquatic vertebrate fauna (mammals, birds, reptiles, amphibians and fish) follow the Atlas of Victorian Wildlife (AVW 2009) of DSE.

2.2 Desktop Assessment

Information from the VBA, FIS and AVW was reviewed to obtain a list of species previously recorded within a 10 km radius of the study area. EVC Benchmarks for the study area was also reviewed, together with other relevant literature. Aerial photography of the proposed alignments was provided by the client. The presence of EVCs and BioSites within the study area was reviewed using DSE's Biodiversity Interactive Maps (DSE 2010a).

Relevant reports, including the Desktop Flora and Fauna Assessment, of the Western Highway, Burrumbeet to Stawell (Ecology Partners Pty Ltd 2008) were reviewed.

Information referring to matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (listed taxa and ecological communities, Ramsar wetlands) was also obtained from the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) Protected Matters Search Tool (SEWPaC 2010).

2.3 Preliminary Flora and Fauna Assessment

2.3.1 Flora Assessment

A flora assessment was undertaken from 15 to 18 and 28 to 30 June 2010 which documented the flora species and vegetation types within the study area. The entire study area was visually assessed, with all vascular plants recorded and the overall condition of vegetation noted. A list of observed flora species was compiled (Appendix 2.1). Based on the flora assessment, a Net Gain assessment was also undertaken.

EVCs were determined by reference to DSE pre-1750 and extant EVC mapping and their published descriptions (DSE 2010b). The significance assessment criteria of taxa and vegetation communities are presented in Appendix 1.

2.3.2 Fauna Assessment

A habitat assessment and fauna survey was undertaken between 15 and 17 June 2010, to obtain information on terrestrial fauna values within the study area. Survey conditions were generally cool and overcast with a moderate breeze.

Binoculars were used to scan the area for birds, and observers also listened for calls and searched for other signs such as nests, feathers, remains of dead animals, droppings and footprints. Habitat features, including ground cover composition and structure, and the presence of hollows and fallen ground debris was noted. The presence of tree hollows, burrows, rocky areas, or any other features likely to be important for fauna habitat were also noted.

An inventory of all fauna species recorded during the survey, and a description of habitats and their overall quality, was documented.

2.3.3 Due Diligence Assessment

A due diligence assessment was undertaken on several broad areas adjacent to the original alignment options to identify EVC's, scattered trees, general habitat condition and determine presence of and/or potential habitat for significant flora and fauna species. All areas were visually assessed, documenting flora and fauna species, vegetation types and overall condition of vegetation within the additional areas.

EVCs were determined by reference to DSE pre-1750 and extant EVC mapping and their published descriptions (DSE 2010b). A detailed Net Gain assessment was not undertaken in areas subject to Due Diligence assessment. Such areas were assigned an average habitat score based on other patches of the same EVC within the study area.

This level of assessment is sufficient to identify key opportunities and constraints associated with the highway construction, as well as to inform decisions relating to alignment options with least ecological impact. However, the supplied vegetation losses were indicative and a formal Net Gain assessment has been undertaken on the final preferred alignment to determine actual vegetation losses and offset requirements.

2.4 Preliminary Net Gain Assessment

Net Gain is the overall outcome where native vegetation and habitat gains are greater than the losses and where losses are avoided, where possible. A preliminary Net Gain assessment was undertaken concurrently with the flora assessment. The vegetation within the study area was assessed according to the habitat hectare methodology with areas of differing quality and/or EVC type scored against the DSE's Benchmarks (DSE 2004).

2.4.1 Habitat Hectares

The *Native Vegetation Management: A Framework for Action* (2002) (herein referred to as The Framework) uses the habitat hectare measurement to assist with quantifying Net Gain outcomes for native vegetation. Methodology on habitat scoring and habitat hectares is described in the Vegetation Quality Assessment Manual (DSE 2004, 2010a). The habitat hectare is a unit of measurement, which combines both quality (relative to a published Benchmark) and quantity (EVC type) for a habitat zone.

Under the DSE guidelines, three categories of vegetation have been defined (DSE 2007a). The three categories are 'remnant patches', 'scattered trees' and 'degraded treeless vegetation'. Habitat hectare assessments were only undertaken in areas of vegetation considered to be remnant patches or scattered trees.

- A remnant patch is defined as:
    - An area of vegetation, with or without trees, where less than 75% of the total understorey plant cover is weeds or non-native plants (i.e. at least 25% understorey cover is indigenous); or,
    - A group (i.e. three or more) of trees where the tree canopy cover is at least 20%.
- Scattered Trees are defined as canopy trees within an area where at least 75% of the total understorey plant cover are non-native and the overall canopy cover for a group (i.e. three or more) of trees is less than 20%.
- 'Degraded Treeless Vegetation' (DTV) generally occurs in previously disturbed areas that contain greater than 25% cover of native understorey species, though native species are few and typically opportunistic colonisers that do not represent the pre-1750 flora cohort.
- All other vegetation that does not meet the thresholds for a remnant patch, scattered trees or DTV is considered Predominantly Introduced Vegetation (PIV).

Where losses are permitted, the definition of conservation significance and offset objectives are guided by the Framework and the Glenelg Hopkins Native Vegetation Plan 2003 (GHCMA 2006), based on the location of the study area.

For remnant patches containing trees, the habitat score is calculated using the following ten components: large trees, tree canopy cover, understorey, weediness, recruitment, organic litter, logs, patch size, neighbourhood context and distance to core area. In treeless environments such as grasslands, the large trees, tree canopy cover and log components are not applicable and the habitat score is standardised to obtain a comparable score. Each component is listed on the Vegetation Quality Field Assessment Sheet (DSE 2004). An assessor then scores the site according to the conditions and landscape context.

2.4.2 Best or Remaining 50% of Habitat for Threatened Species

The best or remaining 50% for rare and threatened flora and fauna is used to inform the overall conservation significance of native vegetation and habitat found within the study area, as compared to habitat present within the Bioregion. In order to determine the best or remaining 50% of habitat for rare and threatened flora and fauna, species that are considered likely to be present within each EVC were assessed according to the steps outlined in Table 2 in the *Native Vegetation Guide for Assessment of Referred Planning Permit Applications* (DSE 2007a).

Threatened flora species considered likely to be present (i.e. species given a likelihood rating of at least 2 in Appendix 2.2) within each EVC, was based on previous records, habitat type present and the requirements of each flora species.

Threatened fauna species considered likely to use the study area for foraging and/or breeding due to the high quality of habitat (i.e. species given likelihood rating of at least 2 in Appendix 3.1 and are listed as endangered, vulnerable or rare) was based on previous records, habitat type present and the requirements of each fauna species.

If significant flora and fauna species were not considered to be a 'resident' or to 'make significant use of the study area' no further consideration was given to these species in regards to determining best or remaining 50% habitat (Table 2, DSE 2007a). The habitat assessment is in accordance with the *Native Vegetation Guide for assessment of referred planning permit applications* (DSE 2007), summarised below (Table 2).

Table 2. Habitat Assessment for threatened species

Step	Description	Outcome
A	Is the species, or has the species been recorded as resident on site> OR if the species is not 'resident' has it been recorded regularly (e.g. annually) on-site?	Yes – go to B No – go to D
B	Is it possible to discriminate between the importance of different populations of the species? For example, can numbers be reasonably estimated and is there available knowledge on what are typical population sizes?	Yes – go to C No – go to E
C	Does the site contain a population that is above average size or importance for the bioregion?	Yes – Best 50% of habitat No – remaining 50% of habitat
D	Does the habitat on site clearly meet one or more of the habitat requirements of the species? Is it reasonable to expect that the species is present or would make significant use of the site in the medium term (i.e. within the next 10 years)?	Yes to both – go to F No to either – no further consideration required for that species
E	Has some form of habitat modelling been undertaken for the species in the bioregion?	Yes – use this information to determine Best 50% of habitat or Remaining 50% of habitat No – go to F
F	Does the site represent above-average condition and landscape context for the relevant EVC or habitat type in the bioregion?	Yes – best 50% of habitat No – Remaining 50% of habitat

2.4.3 Tree Assessment

The Framework recognises that old trees are important environmental assets, and these can be found in remnant patches or as scattered trees. Trees are assessed according to specific tree DBH benchmarks for large old trees in 'habitat zones' and scattered trees, which are determined based on the corresponding EVC (Table 3; Appendix 1). The Framework includes minimum protection/replacement ratios for trees that are to be removed as part of permitted clearing, based on Diameters at Breast Height (DBH). Ratios apply to large old trees in 'habitat zones' and to scattered old trees where the indigenous understorey cover is less than 25% of the total understorey cover (Table 1). Small scattered trees (i.e. not old trees) are also considered to be environmental assets, and any permitted clearance would require offset ratios.

The removal of scattered trees that are reproductively mature, but that are smaller in diameter than medium old trees for that EVC, would also require replacement ratios. Regardless of the Conservation Status of the EVC to which these trees belong, they are considered to have a Conservation Significance of "Low", unless the tree species itself has the status of a threatened species (GHCMA 2006).

Given the dense nature of the vegetation within much of the study area, a sample from each EVC present, within each site, was assessed for large old trees and used to extrapolate approximate large old trees numbers for the remainder of the area. Further assessment of large old trees within remnant patches would be required to provide a more accurate estimate of the net gain requirement once a preferred alignment is chosen. Any permitted clearance requires offset ratios to be determined in accordance with the Framework and the Glenelg Hopkins Native Vegetation Plan (GHCMA 2006).

Table 3. Benchmark tree measurements for EVCs within the study area.

Bioregion	Ecological Vegetation Class (number)	Canopy cover	Very Large Old Tree (cm)	Large Old Tree DBH (cm)	Medium Old Tree DBH (cm)	Large Old Tree density hectare
Goldfields	Grassy Dry Forest (EVC 22)	30%	90	60	45	20/ha
Goldfields	Plains Grassy Woodland (EVC 55)	15%	105	70	52.5	15/ha
Goldfields/ Central Victorian Uplands	Grassy Woodland (EVC 175_61)	15%	105	70	52.5	15/ha
Goldfields/ Central Victorian Uplands	Creekline Grassy Woodland (EVC 68)	15%	120	80	60	15/ha
Central Victorian Uplands	Plains Grassy Woodland (EVC 55)	15%	120	80	60	15/ha
Central Victorian Uplands	Heathy Woodland (EVC 48)	15%	90	60	45	15/ha

Notes: DBH = Diameter at Breast Height

2.4.3.1 Trees within Habitat Zones

In relation to habitat zones that contain large old trees, the Framework states:

> *For each large old tree removed as part of permitted clearing a certain number of other large old trees have to be protected and a certain number recruited* (NRE 2002).

2.4.3.2 Scattered Trees

In relation to scattered old trees in parcels of land the Framework states:

> *'For each medium or large old tree removed as part of permitted clearing an appropriate number of new trees must be recruited. The number of new trees that must be recruited will be specified in regional Native Vegetation Plans and may be graded according to conservation significance. However where it better suits their circumstances, landholders may use the 'protect other trees and ensure supplementary recruitment' approach to meet this criteria (NRE 2002)'.*

The Framework and the Regional Native Vegetation Plans (GHCMA 2006) contain offset ratios for losses of scattered trees, which are:

- protect and recruit options for Very Large, Large and Medium Old Trees,

or,

- recruit only options for Very Large, Large, Medium Old Trees and other/small scattered trees.

It should be noted that DSE's preference in the first instance is to apply the 'protect and recruit option' for the potential removal of scattered indigenous trees.

2.5 Targeted Surveys

2.5.1 Targeted Flora

Targeted flora surveys for the nationally significant Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens* (Critically Endangered), Trailing Hop–bush *Dodonea procumbens* (Vulnerable), Tawny Spider Orchid *Caladenia fulva* (Endangered), Pomonal Leek-orchid *Prasophyllum subbisectum* (Endangered), Button Wrinklewort *Rutidosis leptorhynchoides* (Endangered) and Large–headed Fireweed *Senecio macrocarpus* (vulnerable), and State significant Emerald-lip Greenhood *Pterostylis smaragdyna* (vulnerable), Fringed Sun-orchid *Thelymitra luteocilium* (rare), Crimson Sun-orchid *Thelymitra X macmillanii* (vulnerable), Rising Star Guinea-flower *Hibbertia humifusa* subsp. *humifusa* (rare), Pale-flower Crane's-bill *Geranium* sp. 3 (rare), Fitzgerald's Leek-orchid *Prasophyllum* sp. aff. *fitzgeraldii* A (endangered), Woodland Leek-orchid *Prasophyllum* sp. aff. *validum* A (poorly known), Half-

bearded Spear-grass *Austrostipa hemipogon* (rare) were conducted within the study area on 2 and 3 September 2010, 18 and 19 October 2010, and 19 and 21 January 2011.

Targeted surveys focused on likely habitat within Heathy Woodland and Grassy Woodland remnants identified during the preliminary flora and fauna assessment. Patches of Heathy Woodland (HZ2, HZ5) and Grassy Woodland (HZ1) were systematically traversed in search of all identified threatened species (Figure 3).

2.5.2 Targeted Fauna (Terrestrial)

2.5.2.1 Striped Legless Lizard and Fat-tailed Dunnart

A rectangular grid of roof tiles, 5 x 10 tiles (25 m x 50 m), was established at three sites (Figure 3) on 2 September 2010 in areas identified during the preceding assessment as suitable Striped Legless Lizard and Fat-tailed Dunnart habitat. This method is an approved and widely used technique for surveying for Striped Legless Lizard and Fat-tailed Dunnart in grassland habitats. The grid of roof tiles acts as artificial refuge under which small ground-dwelling fauna seek shelter during cooler times of the day and cooler months of the year.

The tile grids were checked by qualified personnel on 25 November, 14 and 21 December 2010 and 5 January 2011 between 7.00am and 11.00am. A final tile check was carried out on 5 April 2011 when the tiles were being collected.

2.5.2.2 Golden Sun Moth and Yellow Ochre Butterfly

Targeted Golden Sun Moth and Yellow Ochre Butterfly surveys were undertaken on four occasions between 13 December 2010 and 20 January 2011. A total of 26 sites were surveyed within the study area and immediate surrounds. Sites surveyed included all remnant patches of Plains Grassland, multiple areas of Modified Treeless Vegetation (MTV) that supported >25% cover of wallaby-grasses (*Rytidosperma* sp.) and open grassland/woodland areas supporting *Lomandra* sp. Site locations are displayed in Figure 3.

Qualified personnel walked in transects through each site in search of flying males and cryptic females. Surveys were undertaken between the hours of 10.00am and 3.55pm, during suitable climatic conditions (i.e. a warm to hot day with temperatures greater than 20°C; clear or mostly cloudless sky; still to moderate wind conditions). Specific details of dates, weather conditions and reference sites are included in Appendix 3.4.

Golden Sun Moth habitat within the study area was mapped as either 'confirmed' or 'potential' habitat:

- 'Confirmed' habitat was calculated based on the following: where a Golden Sun Moth record fell inside a native vegetation patch, the entire patch was considered to be 'confirmed' habitat. Where a Golden Sun Moth record fell outside areas considered to be a native vegetation patch, a 100 m buffer was established around each record, with

areas inside the buffer considered 'confirmed' habitat. Where the buffer intersected vegetation mapped as a patch, that patch was also mapped as 'confirmed'.

- 'Potential' habitat was calculated based on all areas that provided suitable habitat for Golden Sun Moth, regardless of whether the species was recorded in those locations during targeted surveys.

2.5.2.3 Significant Woodland-dependent Birds and Lace Goanna

Targeted surveys were undertaken for significant woodland-dependent bird species (Elegant Parrot, Brown Treecreeper, Grey-crowned Babbler, Chestnut-rumped Heathwren, Speckled Warbler, Painted Honeyeater, Hooded Robin, Diamond Firetail, Black-chinned Honeyeater) and Lace Goanna in areas identified during the preceding assessment as supporting suitable habitat (principally woodlands and other areas supporting a high density of hollow-bearing trees). These areas were systematically traversed by two qualified zoologists in spring and summer (25 November 2010, 21 December 2010) as well as, in autumn (6 and 7 April 2011, 18 and 19 April 2011).

Throughout the duration of the project, suitable habitat for significant woodland-dependent birds and Lace Goanna was scanned while undertaking other surveys (e.g. whilst checking tiles, undertaking the aquatic surveys etc.) and any incidental observations were recorded.

2.5.2.4 Brown Toadlet

Targeted surveys for Brown Toadlet were carried out at 26 locations throughout the study area. Areas previously identified as optimal habitat for the species (i.e. ephemeral drainage lines and seeps within or abutting woodland vegetation) were prioritised, however areas of sub-optimal habitat (i.e. roadside ditches, culverts and other low lying areas) were also surveyed at regular intervals (spatially).

Nocturnal surveys were undertaken by two qualified zoologists on 6 and 19 April 2011 in early Autumn when the species is known to be active. Zoologists employed call-playback to initiate males calling and listened for call responses to locate the species. At the first site the species was detected, zoologists located several individuals to confirm identification visually.

Throughout the duration of the project, suitable habitat for Brown Toadlet was scanned while undertaking other surveys (e.g. whilst checking tiles, collecting hair tubes and infrared cameras) and any incidental observations were recorded.

2.5.2.5 Powerful Owl and Barking Owl

Nocturnal surveys for Powerful Owl and Barking Owl were undertaken at seven sites throughout the study area. Survey effort was focussed on areas that supported a high density of hollow-bearing trees and incorporated habitat along all of the alignment options. Each site was at least 1.5 km apart and was visited three times (15 February 2011, 2 March 2011, 19 April 2011) thereby adhering to the DSE guidelines of survey methodology for Barking Owl.

Two qualified zoologists used call play-back recordings of the targeted species to elicit a response from any individuals in the local area. The call recording of each species was played for a period of 5 minutes, followed by 5 minutes of silence, to listen for any response calls. This was repeated three times and then followed with active spot-lighting of the area in search of roosting birds or birds that had flown in to the area in response to the call play-back.

Throughout the duration of the project, suitable habitat for Powerful Owl and Barking Owl was also scanned for scats and pellets while undertaking other surveys (e.g. whilst checking tiles, collecting hair tubes and infrared cameras, undertaking woodland bird surveys) and any incidental observations were recorded. Furthermore, when undertaking other nocturnal surveys (e.g. Brown Toadlet), zoologists were actively listening for any owl calls.

2.5.2.6 Ground-dwelling and Arboreal Mammals

Targeted surveys for significant ground-dwelling and arboreal mammals (Southern Brown Bandicoot, Brush-tailed Phascogale and Squirrel Glider) were undertaken in areas identified during the preceding assessment as supporting suitable habitat (i.e. patches and corridors of remnant forest and woodland with a high density of hollow-bearing trees and high connectivity) (Figure 3).

Two rounds of surveys were undertaken to accommodate the target species' active season: 1) in Spring and early Summer (25 November to 21 December 2010) for Southern Brown Bandicoot and Brush-tailed Phascogale and; 2) in Autumn (6 April to 19 April 2011) for Squirrel Glider and Brush-tailed Phascogale (again).

Infra-red Cameras

For each survey, an infra-red camera was strategically placed at 10 sites throughout the study area. Cameras were mounted in trees focussed on a hair tube baited with a mixture of peanut butter, treacle and oats. For the first round of surveys, targeting Southern Brown Bandicoot and Brush-tailed Phascogale, the cameras were directed on a hair tube on the ground and truffle butter was added to the bait mixture. For the second round of surveys, targeting Squirrel Glider and Brush-tailed Phascogale (again), the cameras were directed on a hair tube in an adjacent tree (on trunks and branches). The cameras were deployed for a minimum of two weeks each time.

Hair Tubes

For each survey, 60 hair tubes were distributed throughout the study area (at 11 sites in the first round and 10 sites in the second round). Hair tubes were baited with peanut butter, treacle and oats (truffle butter was added to the bait mixture for the Southern Brown Bandicoot surveys). For the first round of surveys, targeting the Southern Brown Bandicoot and Brush-tailed Phascogale, a line of hair tubes, approximately 25 m apart, were positioned on the ground in suitable micro-habitats. For the second round of surveys, targeting Squirrel Glider and Brush-tailed Phascogale, the line of hair tubes was positioned in trees, on trunks and

along branches. Double sided tape was placed at the entrances of each tube, to collect hair samples of any mammals that venture inside. Hair samples were then sent to Barbara Triggs (Dead Finish®) to be analysed and identified. The hair tubes were deployed for a minimum of two weeks each time.

2.5.3 Targeted Fauna (Aquatic)

2.5.3.1 Timing and location of aquatic surveys

Aquatic fauna surveys, water quality and habitat assessments were undertaken from Ararat to Stawell at all significant waterbodies intersecting the proposed alignments in June 2010, September 2010, June 2011 and January 2012. A general aquatic assessment (including the assessment of farm dams) was conducted between 15 and 17 June 2010 to determine the habitat quality and biodiversity values within the study area. Targeted aquatic fauna surveys, water quality and instream habitat assessments were undertaken in September 2010 and between 16 and 22 June 2011 (across all suitable creeks and drainage lines). Macroinvertebrate surveys, water quality and riparian vegetation assessments were undertaken between 19 and 20 January 2012.

Where possible, all sites (Figure 3) were located within the alignment options however, if suitable habitat was identified nearby up or down stream, sites were established to account for the high degree of connectivity within creeks and drainage lines. The number and location of sites surveyed as well as, the methodology used to survey, was limited by the availability of water at the time of assessment.

2.5.3.2 Riparian Vegetation Assessments

Riparian vegetation assessments were conducted following the rapid appraisal of riparian condition (RARC) (Jansen *et al.* 2006). A 500 m reach was used to determine the riparian condition of each waterway. Where a waterway continued for an extended period along the alignment (i.e. Concongella Creek) several assessments were made. Briefly, the RARC assesses ecological condition of riparian habitats using indicators that reflect functional aspects of the riparian zone. This assessment index is made up of five sub-indices, each with a number of indicators:

1. Habitat continuity and extent (HABITAT)
2. Vegetation cover and structural complexity (COVER)
3. Dominance of natives versus exotics (NATIVES)
4. Standing dead trees, hollows, fallen logs and leaf litter (DEBRIS)
5. Indicative features (FEATURES).

2.5.3.3 Instream Habitat Assessments

Several site-specific habitat variables were assessed to quantify the current habitat quality within each of the waterbodies, including:

- Presence of riparian and instream aquatic flora species;
- Habitat availability and condition [wetted widths, depths, large woody debris (i.e. wood and logs >10cm in diameter) (LWD) and coarse particulate organic matter (CPOM)];
- Instream vegetation diversity, structure, composition and percentage of cover;
- Substrate type and bank stability; and,
- Presence of pollutants, in stream barriers, level of weed invasion and other threatening processes.

2.5.3.4 Water Quality

In-situ water quality data was collected using a calibrated Horiba™ multiprobe for the following parameters; dissolved oxygen, pH, electrical conductivity, temperature and turbidity. Turbidity was recorded using an A Hach - Portable Turbidimeter (Model 2100P).

All sites sampled from Ararat to Stawell fall within the Murray and Western Plains segment of the State Environment Protection Policy (SEPP) Waters of Victoria (WoV) (Schedule F8 Western Port) (EPA 2003). Given most creeks and drainage lines from Ararat to Stawell are intermittent (i.e. cease to flow over the summer months), water quality generally deteriorates as surface water contracts into pools over the summer months. This is a natural occurrence and water quality results should be interpreted accordingly. The combination of winter (when the creeks are flowing) and summer (when the creeks have contracted to isolated pools) water quality data capture the seasonal variability of these intermittent streams.

2.5.3.5 Macroinvertebrate Surveys

Aquatic macroinvertebrates were sampled using standard RBA methods (EPA Victoria, 2003). Edge and riffle habitats were sampled with a sweep and kick net (250 lm mesh) over a 10 m stream stretch. A riffle sample was not taken if either a riffle was absent, <10 m of habitat could be sampled or if the riffle was too shallow for effective sampling. A site was recorded as dry if pools were absent or had less than 10 m of available pool habitat to sample. Macroinvertebrates were live-picked from the sample for 30–60 min, with the aim being to collect all families in the sample and pick a total of approximately 200 individuals. Specimens were preserved in 70%EtOH, and later identified in the laboratory using published and in-house taxonomic keys and guides. Specimens were identified to family level with the following exceptions: Acarina and Oligochaeta were identified to the order level only, and Chironomidae were identified to subfamily (EPA Victoria, 2003).

Four biological indices were used to assess aquatic condition and to compare with SEPP (WoV) biological objectives for the Murray and Western Plains (EPA 2003);

1. Number of families (a measure of diversity)
2. Number of EPT taxa (i.e. those taxa belonging to the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies) families)
3. SIGNAL score
4. Number of key families (a measure of community composition).

2.5.3.6 Aquatic Fauna Surveys

Aquatic fauna surveys were undertaken by a qualified aquatic ecologist and a zoologist in all suitable creeks, drainage lines and water bodies intersecting the alignment options (as well as suitable sites up and down stream) identified as providing potential habitat for Dwarf Galaxias, Golden Perch and River Blackfish. Aquatic fauna surveys included the use of collapsible bait traps, fyke nets, dip netting and electrofishing. Survey effort varied depending on the size and habitat availability at each site, but a site generally had ten bait traps and one fyke net set overnight. Dip netting or electrofishing was also conducted within suitable waterbodies. The collection methodology adhered to Ecology and Heritage Partners' Department of Primary Industries (DPI) fish research permit (DPI Permit No.: RP958) and the backpack electrofishing methodology was conducted adhered to the Electrofishing Code of Practice (SCFFA 1997). All traps set were collected and processed the following morning.

Bait trapping

Ten bait traps with glow sticks were set on dusk, left overnight and retrieved the following morning. Traps were set within microhabitats present at each site including within fringing, emergent, floating vegetation; under overhanging banks; amongst snags and; in open pools.

Fyke netting

One fyke net (either a double or single fyke) was set on dusk, left overnight and retrieved the following morning. Sites where fyke nets could be set were limited by the amount of water available. Nets were aligned to guide fish into the net during their movements up and down stream.

Electrofishing

Electrofishing was conducted by a qualified aquatic ecologist using a LR-24 Smith-Root backpack electrofisher and dip net within two farm dams. All stunned fish and crustaceans were caught, identified and placed in a recovery bucket and released within five minutes of recovery. No other sites were electrofished due to high conductivity (greater than 1500uS/cm), excess in-stream vegetation, high turbidity or high velocity.

Dip netting

Active searching with a hand held dip net was undertaken for 5-10 minutes within appropriate sites. Areas comprising a good cover of aquatic vegetation were specifically targeted.

2.6 Assessment Qualifications and Limitations

It should be noted that at finer scales, EVC mapping becomes less accurate due to the inherently broad environmental and ecological parameters used in the mapping process and as a result of site-specific factors such as disturbance and modification. Where a vegetation type observed in the study area was not reflective of what would be expected from EVC mapping, and did not clearly fit within the EVC classification systems, it was apportioned to the 'best-fit' EVC based on its physical growing environment, structural and floristic attributes and with reference to regional EVC descriptions.

As discussed in Section 2.4.3, due to the dense and mature nature of the vegetation present throughout much of the study area, large old trees were not individually recorded and measured within vegetation deemed to constitute a patch under the Framework. Only scattered trees have been individually recorded during the current assessment. The estimated number of large old trees present within each patch has been determined by assessing a sample from each habitat zone and extrapolated for the entire patch. Individual trees within vegetation patches should be individually recorded prior to any proposed works being undertaken to determine the exact number of large old trees proposed to be lost from within the chosen alignment.

The SEPP objectives for nutrients and water quality are percentiles based on 12 data points (e.g., one year's worth of monthly sampling data) and the biological objectives are based on two seasons of sampling (e.g., spring and autumn) (EPA, 2003a; 2003b). The 12 data points allow for trends to be determined. The biological objectives are based on two sampling events in Spring and Autumn; to allow for different breeding lifecycles of macroinvertebrates, variation in seasonal flow and to encourage replication of sampling effort (EPA, 2003a; 2003b). The current macroinvertebrate survey was only completed as a snap-shot survey in Summer 2012. Therefore, comparisons to the EPA objectives can only be used as a guide for river health, not as absolute comparisons.

Some alignment sections were modified after the flora and fauna assessments had been completed. However, where these modifications occurred, a due diligence assessment had been undertaken which identified EVC's, scattered trees and determined presence of and/or potential habitat for significant flora and fauna species. This level of assessment is sufficient to identify key opportunities and constraints associated with the highway construction, as well as to inform decisions relating to alignment options with least ecological impact. However, the supplied vegetation losses are indicative and a formal Net Gain assessment should be undertaken on the final preferred alignment to determine actual vegetation losses and offset requirements.

Despite these limitations, the methodology undertaken here is considered adequate to represent the ecological values of the study area.

2.7 Impact and Risk Assessment

2.7.1 Impact Pathways and Risk Ratings

The following impact assessment methodology was used to determine the flora and fauna impact pathways and risk ratings for the Project:

1. Determine the impact pathway (how the Project impacts on a given flora and fauna value or issue).

2. Describe the consequences of the impact pathway.

3. Determine the maximum credible 'consequence level' associated with the impact. Table 4 provides guidance criteria for assigning the level of consequence. The method for defining these criteria is described in Section 2.7.2.

4. Determine the likelihood of the consequence occurring to the level assigned in step 3. Likelihood descriptors are provided in Table 5 below; and

5. Use the Consequence Level and Likelihood Level in the Risk Matrix in Table 6 to determine the risk rating.

Impact pathways for flora and fauna were divided into several categories based on matters of national and State significance and other important features present within the Project area. Impacts to flora and fauna species listed under the EPBC Act, FFG Act and DSE Advisory List were identified as separate impact pathways in the Consequence Table (Table 4). The loss of remnant vegetation was assessed based on the relative loss (as a percentage) of EVCs of High and Very High conservation significance in the region and the ability to achieve Net Gain through appropriate offsets. Impacts to fauna habitat were considered via two impact pathways focussing on the loss of scattered trees in the Project area and disturbance to wildlife corridors or habitat linkages.

2.7.2 Consequence Criteria

Consequence criteria range on a scale of magnitude from "insignificant" to "catastrophic". Magnitude was considered a function of the size of the impact, the spatial area affected and expected recovery time of the environmental system. Consequence criteria descriptions indicating a minimal size impact over a local area, and with a recovery time potential within the range of normal variability were considered to be at the insiginificant end of the scale. 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 descriptors for flora and fauna were determined based on an assessment of the area of vegetation or number of individuals to be removed as a relative percentage of the total known area or number of individuals present. For example, in the case of impacts to

EPBC Act-listed vegetation communities, if the loss was considered to be <0.1% of the total known area of the community, the consequence would be rated as 'Minor'. If the loss was considered to be >5% of the total known area of the community, the consequence would be rated as 'Catastrophic'. These comparisons require accurate data on the total area to be impacted by the Project as well as the total known populations present within the specified area (i.e. national, state or bioregion). Scattered tree consequences relate to exact numbers of individuals to be removed as part of construction, while the impact to wildlife corridors was determined based on the percentage reduction of corridor width (generally related to the width of the road reserve) and the number of intercepts with habitat linkages.

The consequence criteria were discussed and reviewed by numerous relevant agencies as part of the Technical Reference Group for the Project, including DSE, DPCD and Parks Victoria.

Table 4. Flora and Fauna Impacts Consequence Table.

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
Listed Threatened Fauna Species	Population change not detectable for any fauna species listed under the EPBC Act, FFG Act or DSE Advisory List	Removal of < 1% of the project area population for an EPBC-listed species, OR Removal of < 1% of the regional area population for an FFG or DSE 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 DSE 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 - or DSE Advisory-listed species	Removal of > 1% of the State population for an EPBC-listed species
Listed Flora Species	Population change not detectable for any flora species listed under the EPBC Act, FFG Act or DSE Advisory List	Removal of < 1% of the project area population for an EPBC-listed species, OR Removal of < 1% of the regional area population for an FFG or DSE 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 < 10% of the State population for an FFG- or DSE Advisory-listed species	Removal of > 1% of the regional population BUT < 10% of the national population for an EPBC-listed species, OR Removal of > 10% of the State population for an FFG- or DSE Advisory-listed species	Removal of > 10% of the national population for an EPBC-listed species
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). Net Gain 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). Net Gain 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). Net Gain achievable.	Loss of > 5% of anEVC of High or Very High conservation significance from the region (based on the total area of an EVC from the bioregion). Net Gain not achievable.

Aspect	Insignificant	Minor	Moderate	Major	Catastrophic
EPBC listed community - Grassy Eucalypt Woodland of the VVP, Natural Temperate Grassland of the VVP. FFG listed community - Western (Basalt) Plains Grassland community	No measurable impacts on the extent of a community listed under the EPBC Act or FFG Act	Loss of <1 ha of an EPBC Act or FFG Act-listed community.	Loss of 1-10 ha of an EPBC Act or FFG Act-listed community.	Loss of 10-50 ha of an EPBC Act or FFG Act-listed community.	Loss of > 50 ha of an EPBC Act or FFG Act-listed community.
Scattered trees / wildlife habitat	Loss of < 5 scattered trees (including MTs, LOTs and VLOTs).	Loss of 6-50 scattered trees (including MTs, LOTs and VLOTs).	Loss of 51-500 scattered trees (including MTs, LOTs and VLOTs).	Loss of 501-5000 scattered trees (including MTs, LOTs and VLOTs).	Loss of > 5000 scattered trees (including MTs, LOTs and VLOTs).
Wildlife corridor	No measurable impact on the quantity and extent of wildlife corridors. Alignment does not intercept or reduce any existing wildlife corridors or habitat linkages.	Alignment reduces the width of the wildlife corridor by up to 10%. Alignment intercepts 1 - 2 habitat linkages.	Alignment reduces the width of the wildlife corridor by 10-50%. Alignment intercepts 3 - 4 habitat linkages.	Alignment reduces the width of the wildlife corridor by 50-75%. Alignment intercepts 5 habitat linkages.	Alignment reduces the width of the wildlife corridor by greater than 75%. Alignment intercepts 6 or more habitat linkages.

Table 5. 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 not expected
Rare	The event may occur only in exceptional circumstances

Table 6. Risk 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

3 SIGNIFICANT SPECIES DESCRIPTIONS

The study area provides potential habitat for a range of significant flora and fauna species. Targeted surveys have been conducted for the species listed below.

3.1 Targeted Flora Species

The purpose of the targeted significant flora surveys was to locate and record any of the 14 species listed below that may potentially be impacted by the proposed alignment of the Western Highway between Ararat and Stawell. The targeted flora species that were the focus of this survey were chosen because they have previously been recorded either within the study area, and/or immediate surrounds (i.e. within a 10 km radius surrounding the study area) (FIS 2009) (Figure 4). A brief summary for each species is provided below.

3.1.1 Nationally Significant Species

Targeted surveys were conducted for the following nationally significant flora species:

Trailing Hop-bush ***Dodonaea procumbens***

Trailing Hop-bush *Dodonaea procumbens* is listed as Vulnerable under the EPBC Act and considered vulnerable in Victoria (DSE 2005; FIS 2009). It is typically associated with grassland and woodland habitats in south-eastern Australia, where there are approximately 5,000 plants within 55 wild populations (Carter 2010). In Victoria, FIS records show there are 52 documented records of Trailing Hop-bush in Victoria, six of which occur within 10 km of Stawell (FIS 2009). There is one record (1991) located immediately north of the study area on the Western Highway, and the most recent documented record of the species in this area prior to this study was in 1998 approximately five km west of Stawell (FIS 2009). Carter (2010) describes one population of three plants on the roadside of the Western Highway near Stawell (record dated 2004), which may correlate with the 1991 record identified on the FIS.

Button Wrinklewort ***Rutidosis leptorhynchoides***

Button Wrinklewort *Rutidosis leptorhynchoides* is listed as Endangered under the EPBC Act, is listed under the FFG Act, and is considered endangered in Victoria (DSE 2005; FIS 2009). In Victoria the species occurs in Plains Grassland and Grassy Woodland (Walsh and Entwistle 1994). There are 146 documented records of Button Wrinklewort in Victoria, one of which occurs immediately north of Stawell and there are 12 records within 10 km of Ararat (Figure 4). The most recent documented record of the species prior to this study is in 2003 (FIS 2009).

Large–fruit Fireweed ***Senecio macrocarpus***

Large-fruit Fireweed *Senecio macrocarpus* is listed as Vulnerable under the EPBC Act and endangered in Victoria (DSE 2005; FIS 2009). The species occurs predominantly within the Western Basalt Plains Grassland, together with open grassy woodland communities in Victoria (Walsh and Entwistle 1994). There are 102 documented records of Large-fruit Fireweed in Victoria, with the nearest record to the study area prior to this study (dated 1992) occurring near Armstrong (FIS 2009) (Figure 4). There are also several documented records of the species in the Deep Lead Nature Conservation Reserve near Stawell, located approximately 10 km from the study area (FIS 2009).

Spiny Rice–flower ***Pimelea spinescens subsp. spinescens***

Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens* is listed as Critically Endangered under the EPBC Act, is listed under the FFG Act, and is considered endangered in Victoria (DSE 2005; FIS 2009). Spiny Rice-flower occurs in Plains Grassland in Victoria, with most populations occurring within the EPBC Act-listed Natural Temperate Grassland of the Victorian Volcanic Plain vegetation community. There are at least 505 documented records of Spiny Rice-flower in Victoria, with the nearest and most recent record (2003) to the study area occurring south of Ararat, near Dobie (FIS 2009).

Pomonal Leek-orchid ***Prasophyllum subbisectum***

Pomonal Leek-orchid *Prasophyllum subbisectum* is listed as Endangered under the EPBC Act and is considered endangered in Victoria (DSE 2005; FIS 2009). There are 10 documented records of the Pomonal Leek-orchid in Victoria with most records occurring immediately north of Stawell in the Deep Lead Nature Conservation Reserve (most recent dated 1998). Only one additional record for the species occurs in Pomonal (dated 1932), directly west of the study area (FIS 2009).

Tawny Spider Orchid ***Caladenia fulva***

Tawny Spider Orchid *Caladenia fulva* listed as Endangered under the EPBC Act and considered endangered in Victoria (DSE 2005; FIS 2009). The Tawny Spider Orchid is associated with open ironbark forests in the Stawell area in Victoria (Walsh and Entwistle 1994). There are 27 documented records of Tawny Spider Orchid in Victoria (FIS 2009). All records for this species have been recorded around the Deep Lead Nature Conservation Reserve area north of Stawell, with the most recent record dated 1998 (FIS 2009).

3.1.2 State Significant Species

Targeted surveys were conducted for the following state significant flora species:

Emerald–lip Greenhood Pterostylis smaragdyna

Emerald–lip Greenhood *Pterostylis smaragdyna* is considered vulnerable in Victoria (DSE 2005; FIS 2009). The Emerald–lip Greenhood is associated with dry foothill forests, drier forests and woodlands in Victoria (Walsh and Entwistle 1994). There are 46 documented records of Emerald–lip Greenhood in Victoria. The nearest records are less than five kilometres north of Ararat (dated 1993) with additional records to the west of the study area in the Grampians National Park.

Rising Star Guinea-flower Hibbertia humifusa subsp. humifusa

Rising Star Guinea-flower *Hibbertia humifusa* subsp. *humifusa* is considered rare in Victoria (DSE 2005; FIS 2009). The Rising Star Guinea-flower is associated with grassy woodlands in Victoria (Walsh and Entwistle 1994). There are 63 documented records of Rising Star Guinea-flower in Victoria (FIS 2009). Two records (dated 1998 and 2000) have been recorded directly adjacent to the study area near Stawell, with several additional records documented in the Deep Lead area north of Stawell (FIS 2009) (Figure 4).

Fringed Sun-orchid Thelymitra luteocilium

Fringed Sun-orchid *Thelymitra luteocilium* is considered rare in Victoria (DSE 2005; FIS 2009). The Fringed Sun-orchid occurs in moist depressions but is very rare in Victoria (Walsh and Entwistle 1994). There are 60 documented records of the Fringed Sun-orchid in Victoria (FIS 2009). Three records (dated 1965) are located immediately north of the study area near Stawell, with most records occurring immediately north of Stawell in the Deep Lead Nature Conservation Reserve (most recent dated 1995).

Crimson Sun-orchid Thelymitra X macmillanii

Crimson Sun-orchid *Thelymitra X macmillanii* is considered vulnerable in Victoria (DSE 2005; FIS 2009). There are 54 documented records of the Crimson Sun-orchid in Victoria with several records (most recent dated 1999) occurring just north of Stawell in the Deep Lead Nature Conservation Reserve (FIS 2009). There are also four records near Ararat with the most recent dated 1939.

Pale-flower Crane's-bill Geranium sp. 3

Pale-flower Crane's-bill *Geranium* sp. 3 is considered rare in Victoria (DSE 2005; FIS 2009). The Pale-flower Crane's-bill is associated with grassy woodlands in Victoria (Walsh and Entwistle 1994). There are 52 documented records of Pale-flower Crane's-bill in Victoria. One record (dated 1998) has been recorded directly adjacent to the study area near Stawell with several additional records found west of Stawell in the Grampians National Park (FIS 2009).

Fitzgerald's Leek-orchid Prasophyllum sp. aff. fitzgeraldii A

Fitzgerald's Leek-orchid *Prasophyllum* sp. aff. *fitzgeraldii* A is considered endangered in Victoria (DSE 2005; FIS 2009). Fitzgerald's Leek-orchid occurs in fertile open woodland but is very rare in Victoria (Walsh and Entwistle 1994). There are eight documented records (most recent dated 1998) of the Fitzgerald's Leek-orchid in Victoria, with most records occurring approximately five kilometres north of Stawell in the Deep Lead Nature Conservation Reserve and further west at Halls Gap (FIS 2009).

Woodland Leek-orchid Prasophyllum sp. aff. validum A

Woodland Leek-orchid *Prasophyllum* sp. aff. *validum* A is considered poorly known in Victoria (DSE 2005; FIS 2009). Woodland Leek-orchid occurs in a variety of habitats but is very rare in Victoria (Walsh and Entwistle 1994). There are only four documented records (most recent dated 2004) of the Woodland Leek-orchid in Victoria, and these are from an area near Axedale, east of Bendigo (FIS 2009).

Half-bearded Spear-grass Austrostipa hemipogon

Half-bearded Spear-grass *Austrostipa hemipogon* is considered rare in Victoria (DSE 2005; FIS 2009). Half-bearded Spear-grass occurs in Mallee scrubs, woodlands and grassland in isolated areas of Victoria (Walsh and Entwistle 1994). There are 43 documented records of the Half-bearded Spear-grass in Victoria (FIS 2009). There has been one documented record (dated 1998) from within one kilometre of the study area near Stawell, while several additional records of the species are from sites located within five kilometres west of study area.

3.2 Targeted Fauna Species

3.2.1 Nationally Significant Species

Targeted surveys were conducted for the following nationally significant fauna species:

Southern Brown Bandicoot Isoodon obesulus obesulus

EPBC Act: Endangered; FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Near Threatened.

Southern Brown Bandicoot is a marsupial with coarse brindled dark grey to yellow-brown fur on its back, with creamy white feet and underbelly (Plate 1). Ears are short and rounded, barely extending above the head. Individuals tend to be 28-35 centimetres (cm) in length (head-body), with an 8-13 cm long tail. Females weigh 400-1000 grams, whilst males weigh 500-1500 grams (Menkhorst and Knight, 2004).

The diet is omnivorous consisting largely of soil invertebrates, seeds and underground (hypogeal) fungi. In the RBGC the species' diet is dominated by green jewel beetles and

population numbers have been reported to crash when beetle numbers decline (Coates 2006). Breeding is usually seasonal, with most births occurring between July and December. Young remain in the pouch for two months, and become sexually mature at seven months, with females able to give birth to over eight young per year. The death rate of juveniles is usually high, while adults may live up to 3.5 years (Strahan 2004).

In Victoria, the species' remaining distribution is divided into five major groups, or loose sub-populations, centred around Portland-Mount Gambier, Grampians National Park, Otway Ranges, South-central (Port Phillip-Westernport-Wilson's Promontory) and East Gippsland (Coates 2006). The species is absent from Victorian Islands even though some such as French, Phillip, Snake and Sunday Islands have large areas of apparently suitable woodland habitat (Norris *et al.* 1979: In Menkhorst 1995).

Striped Legless Lizard Delma impar

EPBC Act: Vulnerable; FFG Act: Listed; National Action Plan: Vulnerable; DSE Advisory List: Endangered.

Striped Legless Lizard is a member of the family Pygopodidae, the legless or flap-footed lizards (Cogger 1996). As with other members of the legless lizard family, Striped Legless Lizards lack forelimbs and have only very reduced hind limbs. These hind limbs are apparent only as small flaps on either side of the vent. Superficially, these animals resemble snakes, but can be readily distinguished from the latter by the presence of external ear openings, a fleshy undivided tongue and a tail which is longer than the body (Cogger 1996). Striped Legless Lizards can be readily distinguished from other legless lizards by body colouration, body size and head scalation.

In Victoria, the microhabitat requirements for the species usually include cover or mat of native or introduced grasses, together with basalt rocks on the surface or embedded in the cracking clay soils (Cogger *et al.* 1993). The lizards shelter in grass tussocks, thick ground cover, soil cracks, spider burrows, under rocks and ground debris such as timber (Smith and Robertson 1999)

The species is restricted to the lowland tussock grassland habitats (Coulson 1990) in temperate south-eastern Australia where the species has a limited, patchy distribution. Since European settlement the distribution of Striped Legless Lizard is believed to have declined and is known to have disappeared from many sites. A very small percentage of the original habitat for *D. impar* now exists, and therefore this species is thought to probably occur in fairly small, isolated populations because the remaining habitat is very limited and severely fragmented (Webster *et al.* 2003).

Dwarf Galaxias ***Galaxiella pusilla***

EPBC Act: Endangered; FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Near Threatened.

Dwarf Galaxias is a very small Galaxiid, with females reaching up to 40mm and males only 35mm (DPIW 2006). It is a slightly stocky fish, with a deepened trunk at the belly and small head with a blunt snout (McDowall 1996). The fins are small and membranous (McDowall 1996) with large flanges on the caudal (tail) fin that cause it to almost reach the dorsal and anal fin (McDowall 1996; DPIW 2006). The colour of Dwarf Galaxias is generally transparent olive-amber on the dorsal surface, with three longitudinal black stripes (laterally) and a silvery, white underside. Males also have a vivid orange stripe between the middle and lower black lateral stripe; females lack this orange colouration (McDowall 1996; DPIW 2006).

Breeding occurs in spring, where pairs will spawn eggs one by one on aquatic plants (likely less than 100 eggs), each approximately 1mm in diameter. Larvae hatch in 2-3 weeks, with an estimated life expectancy of one year, only allowing for one spawning event per individual (Humphries 1986). Dwarf Galaxias lives its entire life cycle in freshwater (McDowall 1996; DPIW 2006). The species is mostly found in still (McDowall 1996) or slow-flowing waters (DPIW 2006), which are often overgrown with aquatic and/ or emergent plants. They can occur within permanent waterbodies, though are commonly located within ephemeral pools (connected to permanent waterways) and are thought to be able to aestivate when waterbodies dry up (McDowall 1996).

Dwarf Galaxias occurs in southern Victoria from Gippsland east to Mount Gambier in South Australia, also on Flinders Island and in the east of the north coast of Tasmania (Humphries 1996; McDowall 1996) and is intermittent in occurrence, though often locally abundant (DPIW 2006).

Golden Sun Moth ***Synemon plana***

EPBC Act: Critically Endangered; FFG Act: Listed; National Action Plan: not applicable; DSE Advisory List: Critically Endangered.

The Golden Sun Moth is a medium-sized, day-flying moth. The wingspan of females and males is about 3.1 cm and 3.4 cm respectively. The smaller wingspan of the female is unique within the *Synemon* genus (Edwards 1991). The upper-side of the forewing is dark grey with patterns of paler grey scales on female moths, and the hindwing is golden yellow with black spots along the edges of the wings. The underside of both wings is white with small black spots along the edge of the wings. In the male, the upper-side of the forewing is dark brown with patterns of pale grey scales and the hindwing is bronze/brown with dark brown patches. The underside of both wings is pale grey with dark brown spots. Both males and females have clubbed antennae. The female has a long extensible ovipositor, which is an elongated organ extending from the posterior abdomen, used to lay eggs.

Adult moths survive between one and four days after pupal emergence and are unable to feed because they lack functional mouthparts (Clarke & O'Dwyer 2000; O'Dwyer & Attiwill 1999). Males spend their adult life patrolling approximately 1 m above the grass in search of females for breeding. Females have reduced hind wings and are reluctant to fly and will only do so when disturbed (Edwards 1991).

The Golden Sun Moth typically occurs in native grassland, grassy woodland, dominated by greater than 40% cover of wallaby-grass *Rytidosperma* spp. (DSE 2004), but is also known to inhabit areas dominated by Kangaroo Grass (Endersby and Koehler 2006) and introduced species such as Chilean Needle-grass (Araon Organ pers. obs. – Ecology and Heritage Partners Pty Ltd).

Prior to European settlement, the Golden Sun Moth was widespread and relatively continuous throughout its range, inhabiting grassy open woodlands and grassland (Dear 1996; DSE 2004). Habitat loss, disturbance and fragmentation due to preferential agricultural expansion and urbanization of open woodland and grasslands, means that many populations are now small, isolated and fragmented. As a result, it is difficult for this relatively immobile species to recolonise areas in the event of local extinctions (females are almost entirely immobile while males are usually found less than 100 m from suitable habitat). Furthermore, the the small size typical of remaining habitat patches and the lack of genetic exchange between them, may result in an inability to maintain genetically viable populations and increase the risk of local extinctions.

Golden Sun Moths are known to exist in less than a dozen sites in each of New South Wales and the Australian Capital Territory and, until the last two–three years, only six active sites in Victoria. However, recent targeted surveys around Melbourne have detected the species from at least 60 additional sites (Biosis Research Pty Ltd 2008; Gilmore *et al.* 2008; Ecology Partners Pty Ltd in prep.).

3.2.2 State Significant Species

Targeted surveys were conducted for the following State significant fauna species:

- Brush-tailed Phascogale *Phascogale tapoatafa* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Vulnerable)
- Squirrel Glider *Petaurus norfolcensis* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Endangered)
- Elegant Parrot *Neophema elegans* (FFG Act: not listed; National Action Plan: Not applicable; DSE Advisory List: Vulnerable)
- Powerful Owl *Ninox strenua* (FFG Act: Listed; National Action Plan: Not applicable Threatened; DSE Advisory List: Vulnerable)
- Barking Owl *Ninox connivens* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Endangered)

- Brown Treecreeper *Climacteris picumnus* (FFG Act: Not listed; National Action Plan: Near Threatened; DSE Advisory List: Near Threatened)
- Grey-crowned Babbler *Pomatostomus temporalis temporalis* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Endangered)
- Chestnut-rumped Heathwren *Hylacola pyrrhopygia* (FFG Act: Listed; National Action Plan: Not applicable; DSE Advisory List: Vulnerable)
- Speckled Warbler *Chthonicola sagittata* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Vulnerable)
- Painted Honeyeater *Grantiella picta* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Vulnerable)
- Hooded Robin *Melanodryas cucullata* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Near Threatened)
- Diamond Firetail *Stagonopleura guttata* (FFG Act: Listed; National Action Plan: Near Threatened; DSE Advisory List: Vulnerable)
- Lace Goanna *Varanus varius* (FFG Act: Not listed; National Action Plan: Not applicable; DSE Advisory List: Vulnerable)
- Brown Toadlet *Pseudophryne bibroni* (FFG Act: Listed; National Action Plan: Data Deficient; DSE Advisory List: Endangered)
- Golden Perch *Macquaria ambigua* (FFG Act: Not listed; National Action Plan: Not applicable; DSE Advisory List: Vulnerable)
- Yellow Ochre Butterfly *Trapezites lutea lutea* (FFG Act: Listed; National Action Plan: Near Threatened: Not applicable; DSE Advisory List: Endangered)

Descriptions for these species are provided in Appendix 3.6.

4 FLORA AND FAUNA WITHIN THE ASSESSMENT AREA

The 'Assessment Area' is defined as the broader area that was assessed for ecological values. Based on this assessment, along with other assessment criteria, several potential alignment options were identified. Flora, fauna and ecological communities identified within the Assessment Area are presented below (Section 4).

The following stages of the EES process led to the selection of the final alignment options. Flora, fauna and ecological communities recorded specifically within the final alignment options are presented in Section 5.

4.1 Flora Assessment

A total of 201 plant taxa (139 indigenous, 62 exotic) were recorded within the study area during the assessment (Appendix 2.1). Planted trees and shrubs were not recorded unless they were seen to be naturally spreading on site.

Several significant flora species and communities were recorded during the preliminary assessment and targeted flora surveys. National and State significant flora species recorded in the local area (within 10 km of the study area) (Figure 4), and their likelihood of occurrence are provided in Appendix 2.2.

Additional flora species have been recorded from within the local area, and as potentially occurring, or their habitats as potentially occurring, within a 10 km radius of the study area (FIS 2007; SEWPaC Protected Matters Search Tool).

4.1.1 Ecological Vegetation Classes (EVC)

Modelled pre-1750 (pre-European settlement) vegetation cover by DSE indicates the section of study area between Ararat and Great Western once supported Grassy Woodland (EVC 175), Heathy Dry Forest (EVC 20), Heathy Woodland (EVC 48), Alluvial Terraces Herb-rich Woodland (EVC 67) and Creekline Grassy Woodland (EVC 68) within the Goldfields bioregion. The area from Great Western to Stawell consisted predominantly of Plains Grassy Woodland (EVC 55) and Heathy Woodland (EVC 48), as well as Creekline Grassy Woodland (EVC 68) and Riparian Scrub (EVC 191) within the CVU and the Wimmera bioregion. Based upon the current assessment, it is considered that the vegetation within the study area is largely consistent with the modelled mapping with predominantly Grassy Woodland between Ararat and Great Western and large areas of Plains Grassy Woodland and Heathy Woodland between Great Western and Stawell.

4.1.2 Vegetation Condition

The southern half of the study area, located within the Goldfields bioregion, is dominated by Grassy Woodland in moderate to good condition (Figure 3). The tree canopy consists predominantly of Yellow Gum *Eucalyptus leucoxylon*, Bundy *E. goniocalyx* and Yellow Box *E. melliodora* with Narrow-leaf Peppermint *E. radiata*, River Red-gum *E. camaldulensis* and

Red Stringybark *E. macrorhyncha* also present. The shrub layer consists of Drooping Sheoak *Allocasuarina* verticillata, Golden Wattle *Acacia pycnantha*, Hedge Wattle *A. paradoxa,* Daphne Heath *Brachyloma daphnoides*, with the understorey dominated by native grass and herb species, including Supple Spear-grass *Austrostipa mollis,* Common Wheat-grass *Elymus scaber* var. *scaber*, Silvertop Wallaby-grass *Joycea pallida*, Black-anther Flax-lily *Dianella admixta,* Common Everlasting *Chrysocephalum apiculatum* s.l., Wattle Mat-Rush *Lomandra filiformis* and Magenta Storks-bill *Pelargonium rodneyanum*.

Remnants of Plains Grassy Woodland are in poor to moderate condition and are dominated by River Red-gum with Yellow Box and Yellow Gum also persisting (Figure 3). The understorey consists predominantly of Hedge Wattle, Lightwood *Acacia implexa* and Silver Wattle *A. dealbata* with a sparse native ground cover including Kangaroo Grass *Themeda triandra* and Common Wallaby-grass *Rytidosperma caespitosa*. Remnants of Creekline Grassy Woodland were also in poor to moderate condition with an intact tree canopy dominated by River Red-gum and a largely introduced understorey including Spiny Rush *Juncus acutus* and Water Couch *Paspalum distichum*. A small area of Grassy Dry Forest in moderate condition within the southern end of the alignment consists of a range of Eucalypt canopy species and diverse shrub and ground layer.

Additional weed species, including Toowoomba Canary-grass *Phalaris aquatica*, Large Quaking-grass *Briza maxima*, Cocksfoot *Dactylis glomerata* and Soursob *Oxalis pes-caprae* were also commonly found throughout many of the remnant patches (see Appendix 2.1 for comprehensive weed list and classification).

The northern half of the study area, located within the CVU and Wimmera bioregions, is dominated by Plains Grassy Woodland and Heathy Woodland in moderate to good condition (Figure 3). The Plains Grassy Woodland is consistent with patches in the southern half of the study area. Remnants of Heathy Woodland consist of a tree canopy including Red Box *E. polyanthemos*, Red Stringybark, Yellow Box and Bundy. The shrub layer is dominated by a diverse range of small to medium shrubs including Flame Heath *Astroloma conostephioides*, Cranberry Heath *A. humifusum*, Honey-pots *Acrotriche serrulata*, Erect Guinea-flower *Hibbertia riparia*, Daphne Heath, Gold-dust Wattle *Acacia acinacea* and Hedge Wattle. The ground-layer is sparse native species commonly present including Black-anther Flax-lily, Kangaroo Grass, Supple Spear-grass and Wattle Matt-rush as well as introduced species such as Cocksfoot, Large Quaking-grass and Soursob. Remnants of Creekline Grassy Woodland were also in poor to moderate condition with an intact tree canopy dominated by River Red-gum and a largely introduced understorey.

Within many of the paddock areas there are large patches of native grass persisting amongst pasture species including spear grasses, wallaby grasses and Common Wheat-grass. These areas of indigenous grasses within the paddocks are heavily grazed and have historically been used for grazing, cropping and other agricultural activities. Based on this, it is likely that DSE would consider these areas to be Degraded Treeless Vegetation.

4.1.3 Due Diligence Assessment

Several areas adjacent to the study area (Figure 3) were broadly assessed to provide advice on any opportunities or constraints that may arise, however detailed Habitat Hectare Assessments were not undertaken. In addition, several potential road alignments were realigned subsequent to the original detailed field assessments and have been included as part of the due diligence assessment. Native vegetation patches that fall within these areas were assigned a median score and are indicated with an asterisk in Appendix 2.3.

Flora

The study area contains many vegetation types ranging from highly modified areas dominated by exotic vegetation (i.e. open pasture) in poor condition to areas comprising relatively intact grassland, woodland and forest in very good condition.

The majority of the due diligence area consists of open pasture that has been cleared from previous activities (i.e. agriculture) and most was currently being used for grazing or cropping. However, many of these areas contain scattered indigenous trees, typically River Red Gums, persisting in paddocks. Scattered trees within the due diligence area were not individually recorded during the assessment and are not highlighted on the mapping provided. Based on observations in the field, most open paddocks contain remnant scattered trees and these are all clearly visible in aerial photography included in Figure 3.

Road reserves and other reserve areas were generally dominated by native vegetation in moderate to good condition. These areas and any other patches of remnant vegetation were recorded during the current assessment and are clearly mapped in Figure 3a-3r and the relevant EVC is also provided.

4.1.4 Significant Flora Species and Communities

One nationally significant species (Trailing Hop-bush - Vulnerable) and three State significant flora species (Emerald-lip Greehood - vulnerable, Rising-Star Guinea-flower – rare and Rosemary Grevillea – rare) were recorded during the assessment. National and State significant flora species recorded in the local area (within 10 km of the study area) (Figure 4), and their likelihood of occurrence are provided in Appendix 2.2.

4.1.4.1 National

Eleven nationally significant flora species, including Button Wrinklewort *Rutidosis leptorhynchoides*, Large-fruit Fireweed *Senecio macrocarpus* and Pomonal Leek-orchid *Prasophyllum subbisectum*, have previously been documented within the local area (10 km radius of the study area) (FIS 2007). An additional two nationally significant species not previously documented within the local area but with habitat for these species being identified as potentially occurring within a 10 km radius of the study area (EPBC Act Protected Matters Search Tool, SEWPaC 2010) (Appendix 2.2). Eleven of these thirteen nationally significant flora species are also listed as threatened under the FFG Act.

Trailing Hop-bush

Approximately 67 Trailing Hop-bush plants were recorded within the Assessment Area during the targeted surveys (Figure 3). All plants were recorded in habitat zones HW5 (57 plants), HW3 (6 plants) and PGW3 (4 plants) within the road reserve south of London Rd on the west and east side of the Western Highway.

Additional Nationally-significant Species

Despite the presence of suitable habitat and nearby documented records (Figure 4), no Button Wrinklewort, Large-fruit Fireweed, Spiny Rice-flower, Pomonal Leek-orchid or Tawny Spider Orchid specimens were located during the targeted survey. It is considered unlikely that these are present within the proposed alignment footprint.

4.1.4.2 State

The FIS contains 44 additional records of State significant species, which have previously been recorded within a 10 km radius of the local area (Appendix 2.2). Ten State significant flora species are also listed as threatened under the FFG Act.

Emerald-lip Greenhood

Approximately 250 Emerald-lip Greenhoods were recorded within the Assessment Area during the targeted surveys (Figure 3). Plants were located in habitat zones HW5, HW9, GW1 and GW2 within the road reserve of the Western Highway.

Heathy Woodland: Populations of the Emerald-lip Greenhood present within Heathy Woodland are present in the far north of the study area within the road reserve, on the west side of the Western Highway between London Road and Hurst Road. In addition, specimens were also recorded within the road reserve on the east and west side of the Western Highway south of Hurst Road.

Grassy Woodland: Populations of Emerald-lip Greenhood present within Grassy Woodland were detected within the road reserve and adjacent bushland in the far south of the study area. Plants were located on the east side of the Western Highway south of McKays Circuit, on the eastern side of the Western Highway north and south of The Majors Road, and on the western side of the Western Highway north of Main Divide Road.

Rising Star Guinea-flower

Forty Rising Star Guinea-flower plants were recorded within or immediately adjacent to the Assessment Area during the targeted surveys (Figure 3). Plants were located in habitat zones HW5 and HW9, with additional plants located in GW2.

One population of 10 Rising Star Guinea-flower plants was recorded in the far north of the study area within the road reserve on the east side of the Western Highway south of London Road. One additional plant was found within bushland on the western side of the Western Highway, west of Harvey Lane and the railway overpass.

Additional State-significant Species

One State significant flora species (Rosemary Grevillea), listed as rare in Victoria (DSE 2005), was recorded within the Assessment Area. Approximately 37 records of this species were identified within HW5, HW9, GW2 and GDF4.

Despite the presence of suitable habitat and nearby documented records (Figure 4) (FIS 2009), no Fringed Sun-orchid, Crimson Sun-orchid, Pale-flower Crane's-bill, Fitzgerald's Leek-orchid, Woodland Leek-orchid or Half-bearded Spear-grass specimens were located during the targeted survey. It is considered unlikely that these are present within the proposed alignment footprint.

4.1.4.3 Regional and Local

A total of 66 regionally significant flora species (45 from the Central Victorian Uplands, 39 from the Goldfields and 56 from the Wimmera bioregion) were recorded within the study area during the present assessment (Appendix 2.1).

All other indigenous species are considered to be of local significance due to the depletion of native vegetation in the local area.

4.1.4.4 Significant Communities

No national or State significant vegetation communities were recorded during the current assessment. Three nationally significant communities have been identified as potentially occurring within a 10 km radius of the study area (EPBC Act Protected Matters Search Tool, SEWPaC 2010). These include the Grassy Eucalypt Woodland of the Victorian Volcanic Plain, Natural Temperate Grassland of the Victorian Volcanic Plain and the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-Eastern Australia. As the study area does not cross in to the Victorian Volcanic Plain bioregion, it was considered unlikely that any significant communities from that bioregion would be present within any of the proposed alignments. In regards to the Grey Box Woodland, several individual Grey Box trees were recorded during the current assessment; however, there were no areas of vegetation present within the study area that met the condition thresholds for the nationally significant community.

The Grassy Woodland EVC is listed as vulnerable in the Goldfields and Endangered in the Central Victorian Uplands and Wimmera bioregions. Creekline Grassy Woodland and Plains Grassy Woodland EVC are listed as endangered within the Central Victorian Uplands, Goldfields and Wimmera bioregions. Heathy Woodland and Grassy Dry Forest are listed as depleted within the Central Victorian Uplands, Goldfields and Wimmera bioregions.

4.2 Fauna Assessment

A total of 76 fauna (terrestrial and aquatic) species were recorded within the study area during the present survey. These comprised four mammals (three native, one introduced), 64 birds (62 native, two introduced), two native frogs, five fish (two native, three introduced) and one freshwater crayfish species (Appendix 3.1). Domesticated pets or livestock were not recorded as part of the study.

Significant terrestrial fauna species derived from respective Commonwealth and State databases as occurring, or having the potential to occur within the study areas are provided in Appendix 3.2. Several additional (both terrestrial and aquatic) fauna have been identified as potentially occurring, or their habitats as potentially occurring within the study area (EPBC Act Protected Matters Search Tool) (Appendix 3.2).

4.2.1 Fauna Habitat

Five major habitat types occur in the study areas, with each realignment option supporting several habitat types. These include: woodlands, farm dams and drainage lines, native grasslands, scattered trees, and exotic pasture. The condition of the overall habitat within the study area for fauna ranges from low to high. A high number of native and introduced species are likely to use these habitats, particularly within riparian and woodland habitats.

Woodland (corresponding EVC's: Grassy Dry Forest, Grassy Woodland, Heathy Woodland, Plains Grassy Woodland)

Description: Areas of remnant woodland occur throughout the study area both as roadside vegetation and remnant patches. This habitat type is intersected by all alignment options and is of moderate to high habitat value for fauna. Remnant woodlands provide important habitat for a diversity of fauna, particularly in the local area with woodland extensively cleared for agricultural purposes.

This habitat varied according to its EVC, but generally comprised a tree canopy of Yellow Box, Red Stringybark, River Red Gum, Yellow Gum, Bundy, Grey Box, Red Box and Messmate. This habitat type is typically characterised by a relatively open canopy up to 10–20 m high, with a variable midstorey and ground layer component.

In woodland areas that have been disturbed, the understorey is modified and lacks important habitat features (e.g. dense vegetation, ground debris) required by many fauna. The understorey within the majority of these areas is in moderate to good condition, dominated by native herb and grass species and possesses a number of important habitat attributes (e.g. ground debris such as logs, hollow bearing trees) for a suite of terrestrial fauna. In some areas the woodland areas have modified understorey, with greater density of exotic vegetation and slightly lower habitat value for native fauna.

Terrestrial Fauna: Woodland comprising a dense understorey of herbs and grasses provides habitat for several native ground dwelling mammals potentially including the state-significant Brush-tailed Phascogale *Phascogale tapoatafa*.

This habitat type also provides a valuable resource for a range of fauna including diurnal raptors (e.g. Whistling Kite *Haliastur sphenurus* and Brown Goshawk *Accipiter fasciatus*) and nocturnal raptors (e.g. Southern Boobook *Ninox novaeseelandiae*), which would use this area periodically for foraging. Avian raptors would also utilise modified woodland remnants and scattered trees for perching, roosting and foraging activities.

Higher quality remnants supporting a complexity of habitat features provide a diversity of niches for other woodland dependent birds. For example, insectivorous species such as Brown Treecreeper *Climacteris picumnus victoriae* can forage on tree trunks and underneath bark, on leaves and flowers, and in ground debris at ground level. Eucalypts also provide an important source of food for nectar-feeding woodland birds including Black-chinned Honeyeater *Melithreptus gularis,* recorded in the current survey. Any tree hollows present provide nesting and denning sites for hollow-dependent mammals such as Common Ringtail Possum *Pseudocheirus peregrinus* and insectivorous bats.

A number of additional reptiles and amphibians are likely to use low lying areas within woodlands, supporting leaf litter and coarse woody debris as habitat for foraging and refuge.

Farm dams and drainage lines (corresponding EVC: Creekline Grassy Woodland)

Description: A number of water bodies (e.g. farm dams) and dry creeks (Concongella Creek, Cobey's Creek, Donald Creek, Robinsons Creek, Hyde Park Creek) exist within the study area, and are considered to be of high value for riparian dwelling fauna. At the time of survey, all drainage lines within the study area were dry. Drainage lines may provide habitat for common aquatic and semi-aquatic fauna when flowing. However, they were considered to be low quality habitat during the present assessment due to exotic vegetation encroachment and lack of water.

Farm dams within the study area provide habitat to wetland birds (e.g. Australian Wood Duck *Chenonetta jubata*), however, are generally frequented by cattle and as such, are of limited value to native fauna due to high level of disturbance, poor water quality and a general lack of aquatic vegetation.

Terrestrial fauna: Riparian habitats provide important foraging, refuge and dispersal habitat to a suite of native fauna species, including Southern Brown Bandicoot and a range of significant bird species. Drainage lines may also provide habitat to the State significant Brown Toadlet *Pseudophryne bibronii.* This species exhibits a preference for creekline habitats that are occasionally inundated.

Aquatic Fauna: Drainage lines within the study area were dry at the time of the assessment and had been consistently dry for over 12 months according to local landowners. Whilst these areas may provide occasional habitat for aquatic fauna when in flow, they are unlikely to support significant aquatic fauna values.

Native grassland (corresponding EVC: Plains Grassland)

Description: Much of the study area supports scattered patches of moderate quality Plains Grassland remnants. This grassland supports a number of native flora species, including Kangaroo Grass, Wallaby-grasses *Rytidosperma* spp. and Blue Devil *Eryngium ovinum.* Whilst these patches are not continuous along the various alignments, they are in areas large enough to support a suite of native fauna. For alignment options which abut or closely follow the existing highway alignment, many of these grassland remnants are connected to road reserve vegetation, which provides important corridors for dispersal for native fauna species.

Terrestrial Fauna: Native grasslands are an important habitat type for many native fauna, who use them for foraging, breeding, dispersal and refuge. Native grasslands are known to support a range of threatened species, such as the nationally significant Golden Sun Moth *Synemon plana*. It also provides habitat to ground dwelling mammals and reptiles including Eastern Grey Kangaroo *Macropus giganteus* and potentially the regionally significant Fat-tailed Dunnart *Sminthopsis crassicaudata*. Grasslands are also used by diurnal raptors including; Wedge-tailed Eagle *Aquila audax,* Nankeen Kestrel *Falco cenchroides* and Brown Falcon *Falco berigora* for foraging.

Scattered trees

Description: Scattered trees range from low habitat value for small trees, to moderate habitat value for mature specimens and large stands of trees.

Scattered trees comprise an assortment of Yellow Box, Red Stringybark, River Red Gum, Yellow Gum, Bundy and Messmate. Many of these trees are mature and reach a height of up to 15 m, often supporting hollows (Figure 3 and 7). The midstorey is largely absent with an understorey containing both native and introduced grasses.

Terrestrial fauna: Many of the scattered trees provide an important foraging resource, primarily for lorikeets, pardalotes and wattlebirds.

Species utilising these habitats during the present assessment include; Red-rumped Parrot *Psephotus haematonotus,* Flame Robin *Petroica phoenicea,* Tree Martin *Hirundo nigricans,* Brown Thornbill *Acanthiza pusilla* and White-plumed Honeyeater *Lichenostomus penicillatus.* Several hollow-dependent bird species such as parrots and lorikeets are likely to use this habitat.

Introduced pasture/grassland

Description: Introduced pasture/grassland occurs throughout the proposed alignment, where remnant native vegetation has been removed, and/or where the soil has previously been disturbed. These areas comprise almost exclusively perennial pasture grasses including Toowoomba Canary-grass *Phalaris aquatic* and Cocksfoot *Dactylis glomerata*. This habitat type is considered to be of low habitat value for fauna.

Terrestrial fauna: Few native species are known to use this habitat, principally birds adapted to modified habitats such as the Magpie-lark *Grallina cyanoleuca*, Australian Magpie *Gymnorhina tibicen*, Galah *Eolophus roseicapilla*, Red Wattlebird *Anthochaera carunculata* and Welcome Swallow *Hirundo neoxena*. Raptors (Brown Goshawk *Accipiter fasciatus* and Whistling Kite *Haliastur sphenurus*) would search for prey items over this habitat, and introduced species (Common Starling *Sturnus vulgaris*, House Sparrow *Passer domesticus* and Common Myna *Acridotheres tristis*) were also prevalent in this habitat.

Although this habitat does not provide important habitat for native fauna as such, it does provide dispersal opportunities for reptiles, frogs and potentially small mammals into higher quality habitats (i.e. remnant grassland) within the study area.

4.2.1.1 Wildlife Corridors

Wildlife corridors and 'stepping stones' of vegetation have numerous benefits to native fauna populations, particularly in modified landscapes where much of the surrounding vegetation is restricted to linear strips along roadsides or streams. They often constitute valuable habitat in their own right. Some of the key benefits of wildlife corridors associated with the maintenance of biodiversity on a local and landscape level include:

- Protection and ongoing maintenance of ecosystem functionality through the reduction of threatening processes (erosion, weed spread, hydrological alterations);
- Provision of habitat (refuge, shelter, breeding opportunities) for a range of fauna either residing within corridors, or moving through the landscape;
- Maintenance of species richness and diversity;
- Immigration of animals to supplement declining populations, thus reducing the likelihood of local extinctions;
- Availability of habitat for reintroduction following extinction events;
- Preventing demographic changes occurring in populations that may result from prolonged isolation from other populations of the same species by aiding gene flow, thus enhancement of genetic variation and prevention of inbreeding; and,
- Facilitating fauna movement through modified landscapes to more optimal habitats.

The remnant woodland vegetation along roadsides (particularly the Western Highway) and riparian zones along creeks is likely to constitute habitat for native fauna as well as act as a wildlife corridor, facilitating movement throughout the landscape.

4.2.2 Significant Fauna

4.2.2.1 Nationally Significant Species

Thirteen nationally significant fauna species listed under the EPBC Act have previously been recorded from the local area (AVW 2009) or are predicted to occur (SEWPaC 2010) (Appendix 3.2.). These species include:

- One frog: Growling Grass Frog *Litoria raniformis*;
- Four birds: Plains-wanderer *Pedionomus torquatus*, Regent Honeyeater *Anthochaera Phrygia,* Swift Parrot *Lathamus discolour* and Australian Painted Snipe *Rostratula australis*;
- Three mammals: Southern Brown Bandicoot *Isoodon obesulus obesulus*, Heath Mouse *Pseudomys shortridgei* and Spot-tailed Quoll *Dasyurus maculatus;*
- One reptile: Striped Legless Lizard *Delma impar;*
- One invertebrate: Golden Sun Moth *Synemon plana*; and,
- Three fish: Australian Grayling *Prototroctes maraena,* Murray Cod *Maccullochella peelii* subsp. *peeli* and Dwarf Galaxias.

Golden Sun Moth

A total of approximately 448 Golden Sun Moths were recorded during the targeted surveys (Figure 4; Appendix 3.4). The species was recorded at 14 of the 26 sites surveyed, most of which were concentrated in three core areas between Ararat and Great Western (Figure 4). The highest numbers of Golden Sun Moth were recorded in paddocks east of the junction of St Ethels Road and Grellet Road and in paddocks to the east and west of the junction of Old Brewery Road and the Western Highway. A large number were also recorded in paddocks between Western-Armstrong Deviation Highway and the railway while two individuals were recorded approximately 500 m west of the junction of Main Divide Road and the Western Highway.

Generally, sites where Golden Sun Moth was recorded supported the following: a high cover of wallaby-grass (≥ 40%); inter-tussock space (but bare ground not exceeding 20%); low cover of introduced grasses (≤15%) and low grazing intensity. Meanwhile, sites where Golden Sun Moth was not recorded generally supported one or more of the following: a high cover of bare ground (≥ 30%); a high cover of introduced grasses (≥ 30%) and/or; moderate to high grazing intensity.

The species has also been recorded on private property within five kilometres of the study area (pers. comm. Jenny Holmes, resident of Great Western township).

Southern Brown Bandicoot

There are 38 previous records of Southern Brown Bandicoot from the local area, the most recent in 2002 (AVW 2009). There is suitable habitat for this species in forested areas within the study area, particularly in areas of Heathy Woodland with dense ground cover south of Stawell. Southern Brown Bandicoot may also use narrow strips of vegetation, including roadside vegetation and riparian zones, for dispersal. The species was not detected during the targeted surveys undertaken within the study area, however, due to the highly cryptic nature of the species; the presence of suitable habitat; and landscape context, there is potential (albeit low likelihood) that this species is present within the Project area.

Striped Legless Lizard

Although not listed on the AVW, grassland remnants with rocky outcrops may provide habitat to Striped Legless Lizard. This species exhibits a preference for tussock grasses such as Kangaroo Grass and Spear grasses *Austrostipa* sp. *w*ith surface rock or cracking clays. There are several small areas south of Stawell that meet these criteria, however they are fairly localised and isolated (Figure 3). Despite targeted surveys undertaken in these habitats, no Striped Legless Lizards were recorded during targeted surveys. Given the lack of historical records in the local area and the limited suitable habitat for Striped Legless Lizard present, there is a low likelihood that the species is present within the Project area.

Growling Grass Frog

There are five previous records of Growling Grass Frog from the local area, the most recent in 1963 (AVW 2009). The majority of drainage lines within the study area were dry at the time of assessment, and local residents indicate they rarely flow. In addition, the majority of farm dams within the study area supported little or no vegetation. Given the lack of previous records and suitable habitat there is a low likelihood that Growling Grass Frog is present within the study area.

However, given the transient nature of this species, it would be prudent to apply the precautionary principle when undertaking work around certain waterways. Salvage and translocation measures should be implemented at Robinsons Creek and Donald Creek (Figure 3G) where construction works are likely to impact areas within 20 m of either waterway.

Plains Wanderer

There are two previous records of Plains Wanderer from the local area (one of which is within 500 m of the study area), the most recent in 1975 (AVW 2009). Although some paddocks and cropped areas within the study area may superficially provide habitat for Plains Wanderer, the species' distribution is largely confined to north-central Victoria and adjacent areas of New South Wales. As such the species is unlikely to be present within the study area.

Regent Honeyeater and Swift Parrot

Woodland remnants within the study area also provide foraging, shelter and dispersal habitat for Regent Honeyeater and Swift Parrot. Although these species are found predominantly in Box-Ironbark forests, they may, on occasion, feed on flowering Yellow Gums and Grey Box within the study area. However the study area is unlikely to provide permanent or limiting habitat for these species.

Australian Grayling, Murray Cod and Dwarf Galaxias

There are no previous records of Australian Grayling, Murray Cod or Dwarf Galaxias from the local area and targeted aquatic surveys did not detect the species within the study area. As such, these species are unlikely to be present within the study area.

4.2.2.2 State Significant Species

Twenty-six state significant fauna species have previously been documented from within 10 km of the study area, including the following:

- One diurnal raptor: White-bellied Sea Eagle *Haliaeetus leucogaster*;
- Two nocturnal raptors: Powerful Owl *Ninox strenua* and Barking Owl *Ninox connivens;*
- Eight wetland dependent birds: Eastern Great Egret *Ardea modesta,* Brolga *Grus rubicunda,* Royal Spoonbill *Platalea regia,* Australasian Shoveler *Anas rhynchotis*, Hardhead *Aythya australis*, Freckled Duck *Stictonetta naevosa*, Blue-billed Duck *Oxyura australis*, Musk Duck *Biziura lobata*;
- Nine woodland dependant bird: Brown Treecreeper *Climacteris picumnus victoriae,* Bush Stone-curlew *Burhinus grallarius*, Elegant Parrot *Neophema elegans,* Hooded Robin *Melanodryas cucullata,* Grey-crowned Babbler *Pomatostomus temporalis,* Chestnut-rumped Heathwren *Calamanthus pyrrhopygius,* Speckled Warbler *Pyrrholaemus sagittatus,* Painted Honeyeater *Grantiella picta* and Diamond Firetail *Stagonopleura guttata;*
- Two mammals: Brush-tailed Phascogale and Squirrel Glider *Petaurus norfolcensis;*
- One reptile: Lace Goanna *Varanus varius;*
- One fish species: Golden Perch *Macquaria ambigua;*
- One frog species: Brown Toadlet *Pseudophryne bibronii;* and,
- One invertebrate: Yellow Sedge Skipper *Hesperilla flavescens flavescens.*

Brown Toadlet

Over 60 records (visual and aural) of Brown Toadlet were collected within the study area throughout the duration of the project. Individuals were detected during the targeted nocturnal surveys and incidentally whilst undertaking other surveys (e.g. whilst checking tiles for Striped Legless Lizard at Donald Creek). Records of Brown Toadlet collected during the targeted surveys and incidentally are presented in Figure 3, however this species is widespread throughout the study area in many of the drainage lines, seeps, road ditches and culverts located within or adjacent to woodland vegetation.

Brush-tailed Phascogale and Squirrel Glider

One Brush-tailed Phascogale was recorded on an infra-red camera in grassy dry forest on the edge of the Ararat Regional Park abutting the Western Hwy roadside vegetation, between McLoughlin Rd and Main Divide Rd (Figure 3). The individual was recorded investigating the baited hair-tube that was set at ground level during the first round of targeted surveys (25 November to 21 December 2010). While not recorded at any other locations within the study area during the targeted surveys, there is sufficient habitat and connectivity within the study area to suggest that the species may be present elsewhere.

Golden Perch

The Golden Perch has been previously recorded within 10 km of the study area. In years of good rainfall tributaries of major waterbodies such as the Wimmera River in the Murray Darling Basin can potentially have Golden Perch utilising these waterbodies for resources. However, Golden Perch was not recorded within the study area during targeted surveys and is considered unlikely to occur within the study area.

Powerful Owl and Barking Owl

Barking Owl was detected on one occasion during the targeted surveys. On the evening of 2 March 2011 an individual responded vocally to the pre-recorded Barking Owl call that was played on the corner of Churchill Crossing Road and the Western Hwy. Powerful Owl was not detected during the targeted surveys, however both species are considered to have a moderate likelihood of occurrence within the study area.

Woodland-dependent Birds and Lace Goanna

Brown Treecreeper was observed regularly (spatially and temporally) throughout the study area. The species was recorded during the targeted woodland-dependent bird surveys as well as during other surveys undertaken throughout the duration of the project. Some of these records are presented in Figure 3, however the presence of this species is widespread throughout the study area in most riparian habitats that support hollow-bearing River Red Gums and Yellow Box.

Several other woodland-dependent birds are also likely to use the study area, including Hooded Robin, Grey-crowned Babbler, Chestnut-rumped Heathwren, Speckled Warbler, Painted Honeyeater and Diamond Firetail. Lace Goanna may also be found in these areas and Elegant Parrot may forage within the study area on occasion. With the exception of Brown Treecreeper, none of these species were recorded during targeted surveys and are considered to have a low likelihood of occurrence within the study area.

Yellow Ochre Butterfly

One additional State-significant species, Yellow Ochre Butterfly *Trapezites luteus luteus*, has been recorded in the local area (pers. comm. Jenny Holmes, resident of Great Western township). This species inhabits eucalypt woodland, cypress-pine woodland and grasslands, preferring open grassy areas supporting its larval food plant, *Lomandra filiformis* (Braby 2005). This species was not recorded during targeted surveys in potential habitat and is considered to have a low likelihood of occurrence within the study area.

Other Species

There is no suitable wetland habitat within the study area for any wetland-dependent bird species, although Brolga may forage in ploughed fields within the study area on occasion.

The likely use of the study area by these species is provided in Appendix 3.2. There is no suitable habitat within the study area for any other species of State significance.

4.2.2.3 Regional and Locally Significant Species

Nine regionally significant fauna have previously been documented from within 10 km of the study area on the AVW, and the likely use of the study area by these species is provided in Appendix 3.2. These species include:

- Two mammals: Fat-tailed Dunnart *Sminthopsis crassicaudata* and Eastern Pygmy-possum *Cercartetus nanus;*
- One diurnal raptor: Spotted Harrier *Circus assimilis*;
- Two wetland dependent birds: Pied Cormorant *Phalacrocorax varius* and Whiskered Tern *Chlidonias hybridus*;
- One grassland-dependent bird: Brown Quail *Coturnix ypsilophora;*
- Two woodland-dependent birds: Black-eared Cuckoo *Chrysococcyx osculans* and Black-chinned Honeyeater *Melithreptus gularis;*and,
- One reptile: Woodland Blind Snake *Ramphotyphlops proximus* and Bearded Dragon *Pogona barbata.*

Bearded Dragon

Bearded Dragon *Pogona barbata* has been recorded on seven occasions in the local area, the most recent record in 2001. The species may utilise woodland areas throughout the study area. One deceased Bearded Dragon was recorded in roadside vegetation at the intersection between London Rd and Western Hwy, Stawell during targeted fauna surveys.

Black-chinned Honeyeater

Black-chinned Honeyeater was recorded during both the preliminary and targeted assessments foraging in eucalypts on the boundary of private property abutting the railway between St Georges Rd and Churchill Crossing Road (Figure 3). The species is likely to use woodland areas throughout the study area.

Fat-tailed Dunnart

Eleven Fat-tailed Dunnarts were recorded during the targeted surveys. Ten individuals and numerous nests were recorded from a tile grid located on the rocky rise just south-west of the intersection of Churchill Crossing Road and the Western Hwy (Figure 3e). One individual was recorded from Tile Grid 2 located just south-east of the same intersection. No Fat-tailed Dunnarts were recorded from the Tile Grid 3 located along Donald Creek, south of the railway line and east of Churchill Crossing Rd.

Little Button-quail

Not previously recorded in the local area, one female Little Button-quail *Turnix velox* (DSE Advisory List: Near Threatened) was recorded on Military Bypass Road whilst undertaking Brown Toadlet surveys (Figure 3).

Other Species

Although remnant woodland within the study area superficially provides habitat to Woodland Blind Snake and Eastern Pygmy-possum, there is lack of recent records from the local area. As such, there is a low likelihood that these species are present within the study area.

Spotted Harrier may forage or fly over the study area on occasion, however the area is unlikely to provide important or limiting habitat for the species.

Platypus has been recorded on one occasion (2007) in a waterway west of Ararat. Drainage lines within the study area were dry at the time of the assessment and had been consistently dry for over 12 months, according to local landowners. Whilst these areas may provide occasional habitat for Platypus when in flow, they are unlikely to support permanent habitat for the species.

All other native fauna (primarily birds) are of local significance, as they are not listed as rare or threatened on a national, State or regional level.

4.2.2.4 Significant Communities

One FFG Act-listed fauna community, the Victorian Temperate Woodland Bird Community, is likely to be present within the alignment options. Habitat for the community is widespread throughout the study area in most riparian habitats that support hollow-bearing River Red Gums or Yellow Box.

The study area supports suitable habitat and assemblage of birds that defines this community. This community is listed as threatened on Schedule 2 of FFG Act. The Victorian Temperate Woodland Bird Community is defined as "a group of bird species characteristic and commonly found within box-ironbark, yellow box, cypress pine and other woodlands" (FFG Nomination 512). This assemblage or 'community' of birds is dependent on the characteristics of these temperate woodlands for their survival. The geographic area that contains this bird assemblage is broadly defined as the country that lies in the south east along the slopes and plains of the Great Dividing Range (FFG Nomination 512).

4.2.3 Aquatic Assessment

4.2.3.1 Riparian Vegetation Assessments

Riparian vegetation condition ranged from poor to very poor across each of the waterways (Table 7). This is typical of lowland agricultural areas throughout Victoria, where in many cases cropping or sheep and cattle grazing occur right up the stream banks. Pleasant Creek, Donald Creek, Cobeys Creek and Concongella Creek (Sites 1-3) were in very poor riparian condition, with little habitat continuity and extent and low levels of native vegetation cover. The other section of Concongella Creek (Sites 4-6) was in poor riparian condition. This particular section of Concongella Creek had a good longitudinal riparian extent and a moderate level of native vegetation cover.

Table 7. Riparian vegetation condition results for the Western Highway Project, Ararat to Stawell

Concongella Creek (Site 1, 2 & 3)	Riparian Condition	Very
Sub-index		Poor
Habitat (max 11)	2.5 + 0 + 2 =	4.5
Cover (max 12)	2 + 1.5 + 2 + 3 =	8.5
Natives (max 9)	1.5 + 0 + 0.5 =	2
Debris (max 10)	2 + 2 + 0 + 1 + 0.75 =	5.75
Features (max 8)	0.25 + 0 + 1 + 0 =	1.25
Total (max 50)		22

Donald Creek (Site 11)	Riparian Condition	Very
Sub-index		Poor
Habitat (max 11)	1.5 + 0 + 0.75 =	2.25
Cover (max 12)	1.5 + 0.25 + 2 + 2 =	5.75
Natives (max 9)	1.5 + 0.25 + 0.75 =	2.5
Debris (max 10)	2 + 2 + 0.5 + 0.75 + 1 =	6.25
Features (max 8)	0.5 + 0.25 + 0.5 + 0 =	1.25
Total (max 50)		18

Concongella Creek (Site 4, 5 & 6)	Riparian Condition	Poor
Sub-index		
Habitat (max 11)	3 + 1 + 1 =	5
Cover (max 12)	2 + 1.5 + 3 + 2.75 =	9.25
Natives (max 9)	2 + 1.5 + 1.25 =	4.75
Debris (max 10)	1.25 + 1.25 + 0.25 + 0.75 + 1 =	4.5
Features (max 8)	0.75 + 0.75 + 0.25 + 0 =	1.75
Total (max 50)		25.25

Pleasant Creek (Site 12)	Riparian Condition	Very
Sub-index		Poor
Habitat (max 11)	1 + 0 + 0.5 =	1.5
Cover (max 12)	1.25 + 0.5 + 2 + 2.25 =	6
Natives (max 9)	1.25 + 0.5 + 0.75 =	2.5
Debris (max 10)	1.25 + 1.25 + 0.25 + 0.5 + 0.5 =	3.75
Features (max 8)	0.75 + 0.75 + 0.5 + 0 =	2
Total (max 50)		15.75

Cobeys Creek (Site 10)	Riparian Condition	Very
Sub-index		Poor
Habitat (max 11)	0.5 + 0 + 0.5 =	1
Cover (max 12)	1.5 + 0 + 2.75 + 1.75 =	6
Natives (max 9)	1.5 + 0 + 0.5 =	2
Debris (max 10)	1 + 1 + 0 + 0.75 + 0.75 =	3.5
Features (max 8)	0 + 0 + 1 + 0 =	1
Total (max 50)		13.5

4.2.3.2 Instream Habitat quality

Instream habitat conditions within Concongella Creek (Sites 1-7 and Site 9) were variable, with the eight sites ranging in condition from very poor to moderate (Appendix 4.1). All Concongella Creek sites, with the exception of site 7 (20%), had no overhanging vegetation. There were low to medium levels of Large Woody Debris (LWD) (1-10%), Coarse Particulate Organic Matter (CPOM) (5-30%) and instream macrophyte cover (2-50%). Instream macrophytes included the Water Ribbon *Triglochin sp.,* Common Rush *Juncus spp*., Tall

Spike Rush *Eleocharis sphacelata,* Common Spike Rush *Eleocharis acuta* and Cumbungi *Typha sp.*. The dominant substrate type ranged from a clay/silt at sites 1-3 to gravel/sand at sites 4-7 and Site 9.

Habitat quality within both Donald Creek (Sites 8 and 11) and Cobeys Creek (Site 10) was poor (Appendix 4.1). Overhanging vegetation (0-10%), LWD (<1-2%), CPOM (2-10%) and instream macrophyte cover (<1-5%) were all low. The Water Ribbon *Triglochin sp.* and Common Rush *Juncus sp*. were the only macrophytes observed within the two sites.

Habitat quality within Pleasant Creek (Site 10) was poor (Appendix 4.1). There was no overhanging vegetation or instream macrophyte cover. LWD (2%) and CPOM (5%) were low. Only the Common Rush *Juncus sp*. was observed on the margins of the creek.

4.2.3.3 Water Quality

Water quality results were *considered typical for these lowland creeks within the Murray and Western Plains* (Appendix 4.2). As expected, water quality was variable between winter 2011 and summer 2012, with harsher physico-chemical conditions observed during summer and particularly within isolated pools. Water temperatures across each of the sites ranged between 5.99 to 10.13 C° during winter and 13.80 to 22.69 C° during summer. Dissolved oxygen levels were variable between each waterway, ranging from 4.62 to 14.39 mg/L during winter and 4.21 to 9.14 mg/L during summer. During the winter, pH levels were generally consistent across all waterways and ranged from 6.72 to 7.68. pH levels were more variable during summer ranging from 6.33 to 7.94. Pleasant Creek (Site 10) was the only value to fall outside of the State Environment Protection Policy (SEPP) Waters of Victoria (WoV) water quality objective with a pH value of 6.33. Generally, conductivity levels were consistent between seasons, however conductivity levels were extremely variable between sites ranging from 0.078 to 15.900 (Appendix 4.2). Particular high conductivity levels were observed within Concongella Creek (Sites 1-3) and Cobeys Creek (Site 10) and were outside of the SEPP (WoV) water quality objectives (75^{th} percentile ≤1.5mS). This may be a result of the volcanic basaltic plains that occur throughout Western Victoria. Turbidity levels were variable between both seasons and sites ranging from 1.3 NTU – 143 NTU, with many levels falling outside the SEPP (WoV) water quality objectives (75^{th} percentile ≤10 NTU) (Appendix 4.2).

4.2.3.4 Macroinvertebrates

A total of 26 macroinvertebrate families were recorded across the five sites (Concongella Creek Site 3, Concongella Creek Site 6, Cobeys Creek, Donald Creek and Pleasant Creek, Appendix 4.3). All four creeks are small intermittent streams that dry frequently during the summer and autumn months. In general, the invertebrate assemblage consisted of a suite of tolerant and generalist taxa that typify degraded lowland intermittent streams. Hardy, widespread taxa dominate each of the sites including Chironomidae (non-biting midges), Coenagrionidae (damsel-fly nymphs), Corixidae (water boatmen), Culicidae (mosquito larvae), Dytiscidae (diving beetles), Hydrophilidae (scavenger beetles), Notonectidae (back swimmers), and Veliidae (small water striders). Only three Ephemerotera, Plecoptera and

Trichoptera (EPT) taxa were recorded across the five sites, including two mayflies (Baetidae, Leptophlebiidae) and one caddisfly (Leptoceridae).

The two sites on Concongella Creek contained moderate numbers of family taxa (18 and 18 respectively) and key families (15 and 15 respectively). Only two EPT taxa were recorded at Site 3 and one EPT taxa was recorded at Site 6. SIGNAL scores (4.72 and 5.67 respectively) indicate that Concongella Creek has mild to moderate levels of pollution (Appendix 4.3).

Cobeys Creek had low numbers of family taxa (14) and key families (13). Only one EPT taxa was identified, with a SIGNAL[1] score (5.29) indicating that the creek has a mild level of pollution (Appendix 4.3). Donald Creek had low numbers of family taxa (11) and key families (9). Only one EPT taxa was identified, with a SIGNAL score (5.36) indicating that the creek has a mild level of pollution (Appendix 4.3). Pleasant Creek had low numbers of family taxa (9) and key families (8). No EPT taxa were recorded, with a SIGNAL score (4.50) indicating that the creek has a moderate level of pollution (Appendix 4.3).

1 'Stream Invertebrate Grade Number – Average Level.'. SIGNAL is a simple scoring system for macroinvertebrate samples from Australian rivers, giving indication as to water quality in the river from which the sample was collected.

5 FLORA AND FAUNA WITHIN THE PROPOSED ALIGNMENT

The following section is based on information provided in Section 4 (Flora and Fauna within the Assessment Area), however relates specifically to flora and fauna recorded within the final alignment footprint.

5.1 Flora

5.1.1 Ecological Vegetation Classes

The proposed alignment intersects five EVCs with varying quality and extent including Plains Grassy Woodland, Grassy Woodland, Creekline Grassy Woodland, Grassy Dry Forest and Heathy Woodland.

The Grassy Woodland EVC is listed as Vulnerable in the Goldfields bioregion and Endangered in the Central Victorian Uplands bioregion (DSE 2010a; Figure 7). Creekline Grassy Woodland and Plains Grassy Woodland EVC are listed as Endangered, within the Central Victorian Uplands and Goldfields bioregions. Heathy Woodland and Grassy Dry Forest are listed as depleted within the Central Victorian Uplands and Goldfields bioregions.

5.1.2 Significant Flora Species and Communities

5.1.2.1 Nationally Significant Species

The proposed alignment intersects with known populations of Trailing Hop-bush (Vulnerable), located between Gilchrist Road and Hurst Road. Twenty-one plants fall within the proposed alignment footprint, of which, 10 plants fall within habitat zone HW5, 6 plants fall within HW3 and 4 plants fall within PGW3. Impacts to these individuals may be mitigated through translocation and propagation for re-introduction in to adjacent areas. A total of 46 plants have been avoided through progressive refinement of the proposed alignment.

As targeted surveys were conducted within areas of highest likelihood of occurrence within the Assessment Area, there is the potential for additional individuals of Trailing Hop-bush to occur in the proposed alignment within areas of lower quality habitat. As such, further targeted surveys are recommended within the proposed alignment footprint.

5.1.2.2 State Significant Species

The proposed alignment intersects with known populations of Rising-star Guinea-flower (rare), Emerald-lip Greenhood (vulnerable) and Rosemary Grevillea (rare). Of these species, 11, 203 and 37 plants (respectively) fall within the proposed alignment footprint.

As targeted surveys were conducted within areas of highest likelihood of occurrence within the Assessment Area, there is the potential for additional individuals of Rising Star Guinea-flower, Emerald-lip Greenhood and Rosemary Grevillea to occur in the proposed alignment

within areas of lower quality habitat. As such, targeted surveys are recommended within the proposed alignment footprint.

5.1.2.3 Flora Communities

No national or State significant flora communities were recorded within the proposed alignment.

5.2 Fauna

5.2.1 Fauna Habitat

The proposed alignment intersects a range of fauna habitats including woodlands, farm dams and drainage lines, native grasslands and scattered trees (see Section 4.2.1). A high number of native and introduced species are likely to use these habitats, particularly within riparian and woodland habitats.

5.2.1.1 Wildlife Corridors

Wildlife corridors and 'stepping stones' of vegetation are key for fauna habitat within the proposed alignment. Wildlife corridors likely to be affected by the Project include:

- Road reserves:
  - Western Highway;
  - Harvey Lane;
  - Bests Road;
  - St George Road;
  - Western-Armstrong Deviation Highway; and,
  - Ararat Railway Line.
- Riparian vegetation:
  - Concongella Creek; and,
  - Robinsons Creek.
- Woodland tracts and landscape 'stepping stones':
  - Ararat Regional Park;
  - Stawell Quarry; and,
  - Sisters Rocks and associated vegetation tracts.

5.2.2 Significant Fauna Species and Communities

5.2.2.1 Nationally Significant Species

The proposed alignment intersects habitat for Golden Sun Moth. Populations of the species were recorded scattered throughout the alignment, with a high number recorded between St Ethels Road and The Majors Road, intersecting 24.74 hectares of 'confirmed' Golden Sun Moth habitat and 99.94 hectares of 'potential' habitat (see Section 2.5.2.2 for definition of confirmed and potential habitat).

5.2.2.2 State Significant Species

The proposed alignment intersects habitat for the following species:

- Barking Owl: this species was detected on the corner of Churchill Crossing Road and the Western Highway, however is likely to utilise most habitats that support hollow-bearing trees.
- Brown Toadlet: this species is widespread throughout the study area in many of the drainage lines, seeps, road ditches and culverts located within or adjacent to woodland vegetation.
- Brown Treecreeper: this species is widespread throughout the study area in most riparian habitats that support hollow-bearing River Red Gums and Yellow Box.
- Brush-tailed Phascogale: this species was recorded in grassy dry forest on the edge of the Ararat Regional Park abutting the Western Hwy roadside vegetation, between McLoughlin Road and Main Divide Road.

5.2.2.3 Regional and Locally Significant Species

The proposed alignment intersects habitat for the following species:

- Bearded Dragon: this species was recorded in roadside vegetation at the intersection of London Road and the Western Highway.
- Black-chinned Honeyeater: this species was recorded on the boundary of private property abutting the railway between St Georges Rd and Churchill Crossing Road, however is likely to use woodland areas throughout the area.
- Fat-tailed Dunnart: this species was recorded during targeted surveys in rocky knolls near the intersection of Churchill Crossing Road and the Western Highway, on the southern side of the Western Highway. The final alignment is located in close proximity (50 m) to the rocky knoll habitat; as such this species may be impacted by the development.

5.2.2.4 Significant Communities

One FFG Act-listed fauna community, the Victorian Temperate Woodland Bird Community, is likely to be present within the proposed alignment. Habitat for the community is widespread throughout the study area in most riparian habitats that support hollow-bearing River Red Gums or Yellow Box.

5.3 BioSites

A BioSite is a physical area of land or water containing biological assets with particular attributes, such as the presence of rare or threatened flora, fauna or habitat required for their survival and/or rare or threatened vegetation communities. Knowledge of the assets and location of BioSites is held in a DSE database and map layer. There are several BioSites of regional and local significance present within and adjacent to the Project area (Figure 7). These include:

- Regional significance: 4352 and 4402;
- Local significance: 4353, 4354 and 4432; and,
- Significance yet to be determined: 3913 and 8045.

Approval from DSE is required to impact a BioSite. However there are no further legal implications for intersecting these areas. BioSites have been identified as providing ecological value within the landscape and should be retained where possible.

5.4 Ecological Significance of the Proposed Alignment

The study area supports areas of good quality remnant vegetation and is considered to be of at least State conservation significance (with some sections up to national conservation significance) due to the presence of habitat for national and State significant flora and fauna species (Appendices 2.2 and 3.2).

Reasons for Significance

The ecological significance of remnant native vegetation and faunal habitat within the proposed alignment is assigned for the following reasons:

- Presence of several flora and fauna species and ecological communities listed under the EPBC Act;
- Presence of several flora and fauna species and ecological communities listed under the FFG Act;
- Presence of the vulnerable Grassy Woodland EVC in the Goldfields bioregion;
- Presence of the endangered Grassy Woodland EVC in the CVU and Wimmera bioregion;
- Presence of the endangered Plains Grassy Woodland in the CVU, Goldfields and Wimmera bioregions; and,
- Presence of the endangered Creekline Grassy Woodland in the CVU and Goldfields bioregions.

6 ENVIRONMENTAL LEGISLATION AND POLICY

This section identifies biodiversity policy and legislation relevant to the proposed development and principally addresses:

- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth);
- *Flora and Fauna Guarantee Act 1988* (Victoria);
- *Fisheries Act 1995 (Victoria);*
- *Planning and Environment Act 1987* (Victoria);
- *Wildlife Act 1975* and Wildlife Regulations 2002 (Victoria);
- *Catchment and Land Protection* (CALP) *Act 1994* (Victoria);
- Glenelg Hopkins Native Vegetation Plan 2006; and,
- Victoria's *Native Vegetation Management Framework 2002* (Net Gain policy).

6.1 *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act* (EPBC Act) establishes a Commonwealth process for assessment of proposed actions that are likely to have a significant impact on matters of national environmental significance (MNES), or on Commonwealth land. An action (i.e. project, development, undertaking, activity, or series of activities), unless otherwise exempt, requires approval from the Commonwealth Environment Minister if it is likely to have an impact on any matters of national environmental significance. A referral under the EPBC Act is required if a proposed action is likely to have a 'significant impact' on any of the following matters of national conservation significance:

- World Heritage properties;
- National heritage places;
- Ramsar wetlands of international significance;
- Threatened species and ecological communities;
- Migratory and marine species;
- Commonwealth marine area;
- Nuclear actions (including uranium mining); and,
- The Great Barrier Reef Marine Park.

World Heritage properties and national heritage places

Based on the SEWPaC Protected Matters Search Tool, the study area is not located within or near a World Heritage or national heritage property.

Ramsar wetlands of international significance

The SEWPaC Protected Matters Search Tool (SEWPaC 2010) lists one wetland of international significance (Ramsar wetlands) as occurring within the same catchment as the study area: Lake Albacutya. However, this wetland lies over 160 km north-west of the project area and is unlikely to be impacted by the proposed development.

Listed flora and fauna species, and ecological communities

An action requires approval from the Commonwealth Environment Minister if it will, or if it is likely to, have a significant impact on an endangered or critically endangered species, or on an 'important population' or critical habitat of a listed vulnerable species.

Flora: One EPBC Act lised flora species (Trailing Hop-bush; Vulnerable) was recorded within the Assessment Area, with 21 individuals recorded within the final alignment footprint.

According to the Significant Impact Guidelines 1.1 for MNES listed under the EPBC Act (DEWHA 1999) an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species;
- reduce the area of occupancy of an important population;
- fragment an existing important population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of an important population;
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- introduce disease that may cause the species to decline; or,
- interfere substantially with the recovery of the species.

According to the National Recovery Plan for the Trailing Hop-bush (Carter 2010) there is one known population present along the Western Highway near Stawell containing three individuals. This may correlate with the population recorded within the Project alignment. Additional populations are also known nearby in the Grampians National Park (unknown size), Victoria Valley (~500 plants) and Deep Lead State Forest (unknown size). Carter (2010) describes as 'important', any population where numbers are precisely known and has recent abundance information. There are currently no 'significant impact' thresholds for Trailing

Hop-bush, therefore, based on the above criteria and the importance of this population within the landscape, the Project is considered to have a significant impact on Trailing Hop-bush.

Fauna: One EPBC Act-listed fauna species, Golden Sun Moth was recorded within the Assessment Area, with 24.74 hectares of 'confirmed' habitat and 99.94 hectares of 'potential' habitat intersected by the proposed alignment footprint. The thresholds for a 'significant impact' to Golden Sun Moth (DEWHA 2009) are as follows:

- Within a large or contiguous habitat area (>10 ha): habitat loss, degradation or fragmentation is greater than 0.5 ha;
- Within a small or fragmented habitat area (<10 ha) : any habitat loss, degradation or fragmentation; or,
- Where there is fragmentation of a population through the introduction of a barrier to dispersal.

Based on the above thresholds the Project would have a significant impact on Golden Sun Moth.

Communities: There is no remnant vegetation within the study area corresponding to any nationally significant ecological community.

Listed migratory and marine species

Migratory species may occupy habitats within the study area on occasions (e.g. Swift Parrot). However, it is considered that the study area would only provide transitory habitat for these species in circumstances where large woodland remnants are flowering, thus providing a temporary food source for the species. As such, there is a low likelihood for such species to occur within the study area and it does not act as a limiting resource.

Commonwealth marine area and nuclear actions

The study area is not within a marine area, nor is the proposed future use of the study area related to nuclear actions.

Implications for the proposed development

Based on the EPBC Act Significant Impact Guidelines (DEWHA 1999; 2009) and National Recovery Plan for the Trailing Hop-bush *Dodonaea procumbens* (Carter 2010), the Project would have a significant impact on Golden Sun Moth and Trailing Hop-bush.

An EPBC Act referral has already been submitted for the proposed project and VicRoads was advised by SEWPaC on 17 December 2010 that the proposed project is a controlled action and an EES will be required.

6.2 *Flora and Fauna Guarantee Act 1988* (Victoria)

The primary legislation for the protection of flora and fauna in Victoria is the FFG Act. The Act builds on broader national and international policy in the conservation of biodiversity.

The broad objectives of the FFG Act are to: 1) ensure native flora and fauna survive, flourish and maintain in situ evolutionary potential, 2) manage threatening processes, 3) encourage the conserving of flora and fauna through cooperative community endeavours, and 4) establish a regulatory structure for the conservation of flora and fauna in Victoria.

The Act contains protection procedures such as the listing of threatened species and/or communities of flora and fauna, and the preparation of action statements to protect the long-term viability of these values.

Flora: One FFG Act-listed flora species (Trailing Hop-bush) was recorded within the Assessment Area, with 21 individuals recorded within the final alignment footprint.

Fauna: Four FFG Act-listed fauna species were recorded within the Assessment Area: Golden Sun Moth, Brush-tailed Phascogale, Barking Owl and Brown Toadlet. Habitat for each of these species is intersected by the final alignment footprint.

Communities: One FFG Act-listed fauna community, the Victorian Temperate Woodland Bird Community, is likely to be present in woodland areas within the final alignment footprint.

Threatening processes: A number of threatening processes listed under the FFG Act are applicable to the proposed road works (Table 8).

Table 8. Threatening processes under the *Flora and Fauna Guarantee Act 1988* applicable to the proposed construction works.

Threatening process	Development action	Avoidance and/or minimisation
The invasion of native vegetation by environmental weeds.	Increase instances of weed invasion into native vegetation remnants adjacent to the road corridor.	Control environmental and noxious weeds in native vegetation. Wash machinery prior to entering the site to remove weed seeds.
Invasion of native vegetation by Blackberry *Rubus fruticosus* L. agg.	Increased disturbance promoting growth and spread of this woody weed.	Limit disturbance in native vegetation and conduct regular weed control.
The invasion of native vegetation by environmental weeds.	Soil disturbance and subsequent weed invasion into native vegetation remnants within the study area.	Control environmental and noxious weeds in native vegetation. Wash machinery prior to entering the sites to remove weed seeds.
Loss of hollow-bearing trees from Victorian native forests.	Potential removal of large-old trees.	Identify and retain all significant habitat trees in the study area, and in areas realign the route to avoid trees.
Spread of *Pittosporum undulatum* in areas outside its natural distribution.	Increase disturbance promoting growth and spread of this woody weed.	Limit disturbance in native vegetation and conduct regular weed control.

Threatening process	Development action	Avoidance and/or minimisation
Habitat fragmentation as a threatening process for fauna in Victoria.	Loss of remnant vegetation along the proposed alignment.	Where possible, attempt to minimise the removal of native vegetation during construction, and connect existing remnants with locally indigenous vegetation.
Increase of sediment input into Victorian rivers and streams due to human activities.	Erosion of soil during construction works.	Ensure that best practice sedimentation control measures (to the satisfaction of EPA) are undertaken at all times.
Input of toxic substances into Victorian rivers and streams.	Depositing/ using toxic substances in or adjacent to the creek.	Ensure that best practice pollution control measures (to the satisfaction of EPA) are undertaken at all times.

Implications for the proposed development

One flora species, four fauna species and one community listed under the FFG Act were recorded during the current assessment.

A permit from DSE is required in order to 'take' listed flora species, species that are members of listed communities or protected flora on public land, such as road reserves, and to clear or disturb protected flora species within the study area. Protected flora species include all members of the orchid family (Orchidaceae), some *Acacia* species, all members of the Asteraceae (Daisy) family and all ferns (except Bracken Fern *Pteridium esculentum*).

An FFG Act permit to remove or disturb native vegetation and listed flora species would be required for the Western Highway Project. No legal implications relating directly to FFG Act-listed fauna species recorded within the study area exist, however DSE and local authorities may impose conditions relating to these species under other approvals (e.g. *Planning and Environment Act 1987*).

6.3 *Fisheries Act 1995* (Victoria)

FFG Act-listed fish are protected under the *Fisheries Act 1995* and may not be taken without authorisation.

No FFG Act-listed fish were recorded during the targeted surveys. Limited suitable habitat for any FFG Act-listed fish species is available within the study area and it is unlikely that any of these species are present.

6.4 *Planning and Environment Act 1987* (Victoria)

All planning schemes contain native vegetation provisions at Clause 52.17. A planning permit is required under the *Planning and Environment Act 1987* to remove, destroy or lop native vegetation on a site of more than 0.4 hectares, unless:

- The application is exempt under the schedule to Clause 52.17; or,
- A Native Vegetation Precinct Plan applies.

Planning schemes may contain other provisions in relation to the removal of native vegetation.

A planning permit application must be referred to DSE if there is one or more of the following:

Scattered Trees (may include trees from patches of vegetation)

- Greater than 15 trees with a diameter less than 40 cm at 1.3 m above ground.
- Greater than five trees with a diameter more than 40 cm at 1.3 m above ground.

Areas of vegetation (may include trees)

- Greater than 0.5 hectares of vegetation in an Ecological Vegetation Class with Bioregional Conservation Status of Endangered, Vulnerable or Rare.
- Greater than one hectare of vegetation in an Ecological Vegetation Class with Bioregional Conservation Status of Depleted or Least Concern.

Other circumstances

- On Crown land managed by the responsible authority.
- Where a property vegetation plan applies to the site.

Implications for the Proposed Development

A Planning Permit from Council is required to remove/disturb native vegetation within the study area. In this instance, DSE would be the mandatory referral authority as much of the study area is within a roadside reserve. As an alternative to the need for a planning permit, vegetation removal associated with the Project could be authorised under a Planning Scheme Amendment.

6.4.1 Victoria's Native Vegetation Management: A Framework for Action (the Framework)

The Framework is implemented via the *Planning and Environment Act 1987*. Since 1989, most proposals to clear native vegetation have required a planning permit from the local Council (Responsible Authority), more recently under the native vegetation provisions of Clause 52.17 of the Victoria Planning Provisions (included in all planning schemes). In 2002, the Victorian Government released the Framework, which establishes a 'strategic direction for the protection, enhancement and revegetation of native vegetation across the State'.

Amendment (VC19) to Victoria's Planning Provisions introduced the Framework in July 2003 as an incorporated document for all Victorian Planning Schemes. Clauses 11 and 15.09 in the State Planning Policy Framework provide the framework for considering native vegetation issues in the planning system.

These clauses require planning and responsible authorities to have regard to the Framework, which establishes the strategic direction for the protection, enhancement and revegetation of native vegetation across Victoria.

The Framework states that the primary goal is to achieve 'a reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain' (NRE 2002).

Net Gain is the overall outcome where native vegetation and habitat gains are greater than the losses and where losses are avoided, where possible.

When Net Gain is considered for potential impacts on native vegetation within all planning schemes, the Framework has defined a three-step approach for applying Net Gain to protection and clearance decisions.

The three-step approach is:

1. To avoid adverse impacts, particularly through vegetation clearance.
2. If impacts cannot be avoided, to minimise impacts through appropriate consideration in planning processes and expert input to project design or management.
3. Identify appropriate offset options.

The three-step approach to Net Gain is the first consideration for all planning permit applications and planning scheme amendments relating to removal of native vegetation, with emphasis placed on the first two steps of avoidance and minimisation. Only after these two steps have been taken should offsets (actions undertaken to achieve commensurate gains) be considered (NRE 2002).

In this case, there is little chance of the proposed project avoiding all remnant native vegetation. It is understood that the requirement for this important infrastructure development needs to also consider other important factors (e.g. social, economic, road safety – see relevant specialist reports). Considering a range of options, as has been undertaken in this report, is one means of applying this process to minimise the vegetation clearance and impacts on wildlife where possible.

Implications for the proposed development

A preliminary Net Gain assessment for the proposed alignment is presented in the following section. Net Gain requirements would be revised once the alignment has been finalised and the exact losses can be determined.

6.5 *Wildlife Act 1975 and Wildlife Regulations 2002* (Victoria)

Wildlife Act 1975

The *Wildlife Act 1975* is the primary legislation in Victoria providing for protection and management of wildlife.

The Act requires people engaged in wildlife research (e.g. fauna surveys, salvage and translocation activities) to obtain a permit under the Act to ensure that these activities are undertaken in a manner consistent with the appropriate controls.

The Wildlife Act has the following objectives:

- to establish procedures for the promotion of protection and conservation of wildlife, the prevention of species extinctions, and the sustainable use and access to wildlife; and,
- to prohibit and regulate the conduct of those involved in wildlife related activities.

Wildlife Regulations 2002

Authorisation for habitat removal must be obtained either under the Wildlife Act; or through a licence granted under any other Act such as the *Planning and Environment Act 1987*.

Implications for the Proposed Development

While a permit would be required for removal of habitat within the study area during construction, this could be in the form of an approval, associated with the Planning Scheme Amendment, under the *Planning and Environment Act 1987*. Persons undertaking any inspection, removal or relocation of fauna species located in vegetation to be impacted upon as part of the project must be authorised and hold a current permit under the *Wildlife Act 1975*. A Fauna Salvage and Translocation Plan would be developed prior to commencement of works.

6.6 *Catchment and Land Protection Act 1994* (Victoria)

The *Catchment and Land Protection Act 1994* (CALP Act) contains provisions relating to catchment planning, land management, noxious weeds and pest animals.

This Act provides a legislative framework for the management of private and public land and sets out the responsibilities of land managers, stating that they must take all reasonable steps to:

- Avoid causing or contributing to land degradation which causes or may cause damage to land of another land owner;
- Protect water resources;
- Conserve soil;
- Eradicate regionally prohibited weeds;
- Prevent the growth and spread of regionally controlled weeds; and,
- Prevent the spread of, and as far as possible eradicate, established pest animals.

Essentially, the Act establishes a framework for the integrated management and protection of catchments, and provides a framework for the integrated and coordinated management, which aims to ensure that the quality of the State's land and water resources and their associated plant and animal life are maintained and enhanced.

Implications for the proposed development

The proponent is responsible for controlling any infestation of noxious or environmental weeds that may become established. As such, weeds should be appropriately controlled to minimise their spread. For example, workers and machinery involved in construction within the study area should be checked for weed material to avoid further spread of noxious weeds. Noxious weeds recorded within the study area during the current assessment are listed in Appendix 2.1.

Further to this, it is recommended that once the alignment has been finalised, a Weed Management Plan be prepared in accordance with the CALP Act, to fulfil project obligations in relation to minimising weed spread as a result of this road upgrade.

6.7 Native Vegetation Plans (Regional)

The *Wimmera Native Vegetation Plan* (WCMA 2008) and the *Glenelg Hopkins Native Vegetation Plan* (GHCMA 2006) are a guide for local government in assessing planning applications for vegetation removal and determining permit conditions (Net Gain requirements) to ensure that ecological values across the region are not compromised.

The plans provide information on biodiversity values across the region and gives guidance to local municipalities on how clearing applications should be assessed. The documents also outline actions to ensure there is more strategic and coordinated approach to address ongoing degradation in quantity and quality of native vegetation across the catchment.

Implications for the proposed development

The proposed works should address the key recommendations outlined under the *Wimmera Native Vegetation Plan* (WCMA 2008) and *Glenelg Hopkins Native Vegetation Plan* (GHCMA 2006), which include protecting and enhancing native vegetation, to promote awareness of native vegetation, to manage native vegetation sustainably and to promote land use that leads to long-term protection of native vegetation.

Key principles of the plans are to:

- Move the regional community closer towards the goal of ecologically sustainable development;
- Help protect biological diversity and maintain essential ecological processes;
- Minimise the decline in the extent and composition of native vegetation communities; and,
- Enhance the viability of existing native vegetation by regeneration and revegetation.

7 NET GAIN ASSESSMENT

7.1 Habitat Hectare Calculations

A habitat hectare assessment was conducted at sites proposed to be disturbed. Numerous habitat hectare polygons of poor to good condition vegetation were identified and classified into habitat types (Figures 3a–3z). Losses are based on the worst case scenario in terms of area of impact within the alignment and there are opportunities to reduce this impact during planning and construction.

A total of **116.62 hectares (64.54 habitat hectares)** of Very High conservation significance vegetation, and **16.52 hectares (5.19 habitat hectares)** of High conservation significance vegetation is proposed for removal. A summary of losses for the proposed alignment is provided below (Tables 12 and 13).

The final alignment north-east of Great Western runs through an existing quarry. The landowner of the quarry has approval to remove all of the vegetation present within the property that abuts Sandy Creek Road (Lot 2 on PS 202607A) (*pers. comm.* VicRoads, 09/11/2012). The landowner is also seeking approval for the removal of vegetation for the balance of the quarry land. Vegetation in these areas consists of approximately eight hectares of Very High conservation significance Heathy Woodland. As such, the quarry owner would be removing and offsetting this vegetation as part of approvals associated with the quarry, prior to construction of the proposed highway. This would reduce the overall losses associated the Project. However, the losses presented within this report are conservative and currently include this area.

7.2 Scattered Trees

A scattered tree assessment was conducted within the study area. The existing scattered trees within the proposed construction area are tabulated below (Table 12). Conservation significance for each scattered tree has been assigned based on the minimum conservation significance for the EVC present in that area (e.g. Plains Grassy Woodland and Creekline Grassy Woodland are classified as Endangered and have a minimum conservation significance of High according to the Framework). Appendix 2.4 details the Diameter at Breast Height (DBH) size and latitude / longitude coordinates of all recorded scattered tree locations.

A summary of proposed losses is provided in Tables 12, 13 and 14, and Appendix 2.5.

7.3 Assessment of Best or Remaining 50% Habitat for Rare and Threatened Species

As outlined in sub-section 2.4.2, the best or remaining 50% of rare and threatened flora and fauna is used to inform the overall conservation significance of native vegetation and habitat found within the study area, as compared to habitat present within the Bioregion. Several significant flora and fauna species have been recorded within the vicinity of the study area, and remnant patches within the study area have the possibility of containing habitat for threatened flora and fauna.

The remnant vegetation within study area provides moderate to good quality habitat for threatened flora species. Therefore, following steps within Table 9, it is considered that remnant vegetation within the study area include areas considered to be in the Best 50% habitat for Trailing Hop-bush and Emerald-lip Greenhood and Remaining 50% for Emerald-lip Greenhood, Rising Star Guinea-flower and Rosemary Grevillea. Potential habitat for five additional threatened flora species was present within several habitat zones, however, based on the survey results; it was considered that the species would not make significant use of the site.

The determination of the best or remaining habitat for threatened flora species is provided in Table 9. The remnant vegetation within study area provides moderate to high quality habitat for threatened fauna species.

Potential habitat for 14 threatened fauna species was present within several habitat zones. The determination of the best or remaining habitat for threatened fauna species is provided in Table 10.

Table 9: Habitat assessment for threatened flora within the study area

Habitat Zone	Threatened Species or Species' with the Highest Likelihood of Occurrence	Conservation status	Steps (1)	Best or Remaining 50% of Habitat for the Species?(2)	Conservation Significance	Notes
Heathy Woodland (HW 5, 9) Grassy Woodland (GW 2)	Rosemary Grevillea	r (DSE)	A yes, B no, E no, F no	Remaining 50%	Medium	Species recorded on site, below-average quality
Plains Grassy Woodland (PGW3), Heathy Woodland (HW 3, 5)	Trailing Hop-bush	v(DSE)	A yes, B no, E no, F yes	Best 50%	Very High	Species recorded on site, above-average quality

Habitat Zone	Threatened Species or Species' with the Highest Likelihood of Occurrence	Conservation status	Steps (1)	Best or Remaining 50% of Habitat for the Species?(2)	Conservation Significance	Notes
Heathy Woodland (HW5), Grassy Woodland (GW1, 2)	Emerald-lip Greenhood	r (DSE)	A yes, B no, E no, F yes	Best 50%	High	Species recorded in adjoining areas, above-average quality
Heathy Woodland (HW6)	Emerald-lip Greenhood	r (DSE)	A yes, B no, E no, F no	Remaining 50%	Medium	Species recorded in adjoining areas, below-average quality
Heathy Woodland (HW5, 9)	Rising Star Guinea-flower	r (DSE)	A yes, B no, E no, F no	Remaining 50%	Medium	Species recorded in adjoining areas, below-average quality
Grassy Woodland (GW5)	Large-fruit Fireweed	e (DSE)	A – no; D - no	No further consideration	n/a	While the sites meet some habitat requirements, based on the survey results it is considered that the species would not make significant use of the sites.
Heathy Woodland (HW1, 5)	Fringed Sun-Orchid	r (DSE)	A – no; D - no	No further consideration	n/a	
Heathy Woodland (HW1, 5)	Crimson Sun-Orchid	v (DSE)	A – no; D - no	No further consideration	n/a	
Heathy Woodland (HW1, 5)	Half-bearded Spear-grass	r (DSE)	A – no; D - no	No further consideration	n/a	
Heathy Woodland (HW1, 5)	Pale-flower Crane's-bill	r (DSE)	A – no; D - no	No further consideration	n/a	

(1) From Table 2 in the Guide for Assessment of Referred Planning Permit Applications (DSE 2007a) specify steps taken in habitat assessment to determine best 50% or remaining 50% of habitat.
(2) Specify 'best' or 'remaining'.
(3) Conservation significance of the habitat zone based on consideration of threatened species

Table 10. Habitat assessment for threatened fauna species within the study area

Remnant Patch	Threatened Species or Species' with the Highest Likelihood of Occurrence	Conservation Status (DSE Advisory List)	Steps(1)	Best or Remaining 50% of Habitat for the Species?(2)	Conservation Significance
Heathy Woodland (HW1, 2, 3, 6, 9) Plains Grassy Woodland (PGW5) Grassy Dry Forest (GDF1, 2) Grassy Woodland (GW1, 2, 3)	Barking Owl Brush-tailed Phascogale Brown Treecreeper	EN VU	A, B, E, F	Best 50%	Very High
Heathy Woodland (HW1, 2, 3, 5, 6, 8, 9) Plains Grassy Woodland (PGW5, 2) Grassy Dry Forest (GDF1, 2) Grassy Woodland (GW1, 2, 3, 5, 7) Creekline Grassy Woodland (CGW1)	Bush Stone-curlew Powerful Owl Grey-crowned Babbler Chestnut-rumped Heathwren Speckled Warbler Painted Honeyeater Diamond Firetail Squirrel Glider Lace Goanna Squirrel Glider	EN VU EN VU VU VU VU EN VU EN	A, D, F	Best 50%	Very High
Plains Grassy Woodland (PGW2, 3, 4) Grassy Dry Forest (GDF4, 5) Grassy Woodland (GW5, 6, 7) Heathy Woodland (HW3, 7, 8)	Bush Stone-curlew Barking Owl Powerful Owl Grey-crowned Babbler Chestnut-rumped Heathwren Speckled Warbler Painted Honeyeater Diamond Firetail Brush-tailed Phascogale Squirrel Glider Lace Goanna	EN EN VU EN VU VU VU VU VU EN VU	A, D, F	Remaining 50%	High
Creekline Grassy Woodland (CGW1, 2) Heathy Woodland (HW 5, 6, 9) Plains Grassy Woodland (PGW 2, 4, 5) Grassy Woodland (GW6) Grassy Dry Forest (GDF 1)	Brown Toadlet Brown Treecreeper	EN	A, B, E, F	Best 50%	Very High
Grassy Woodland (GW4, 8) Plains Grassy Woodland (PGW1) Grassy Dry Forest (GDF3) Heathy Woodland (HW4)	Bush Stone-curlew Barking Owl Powerful Owl Grey-crowned Babbler Chestnut-rumped Heathwren Speckled Warbler Painted Honeyeater Diamond Firetail Brush-tailed Phascogale Squirrel Glider Lace Goanna	EN EN VU EN VU VU VU VU VU EN VU	A, D	No further consideration	-

(1) From Table 2 in the Guide for Assessment of Referred Planning Permit Applications (DSE 2007a) specify steps taken in habitat assessment to determine best 50% or remaining 50% of habitat. (2) Specify 'best' or 'remaining'. (3) Conservation significance of the habitat zone based on consideration of threatened species.

7.4 Net Gain Implications

Net Gain is an overall outcome where native vegetation and habitat gains are greater than vegetation and habitat losses. Victoria's *Native Vegetation Management – A Framework for Action* (NRE 2002) (the Framework) has defined a three-step approach for applying Net Gain to protection and clearance decisions. Emphasis is placed on the first two steps, and only after these two steps have been taken should offsets (actions undertaken to achieve commensurate gains) be considered (NRE 2002). The three-step approach is:

1. To avoid adverse impacts, particularly through vegetation clearance.
2. If impacts cannot be avoided, to minimise impacts through appropriate consideration in planning processes and expert input to project design or management.
3. Identify appropriate offset options.

7.4.1 Avoidance (Step 1)

The Framework requires avoidance as the first step in considering the impacts of development on native vegetation. Therefore, any proposed construction within the study area needs to demonstrate how native vegetation avoidance has been achieved in the alignment selection and design process. Avoidance may generally be interpreted as avoiding adverse impacts on trees or habitat patches, particularly through vegetation clearance, with the vegetation being retained post construction (NRE 2002).

VicRoads considered a number of alternative alignment options for Section 3 of the Western Highway between Ararat and Stawell. Alignment options were considered within a project area that was 1.5km either side of the existing highway, except around Great Western where there project area extended to 1.8km to allow for a bypass of the town. A number of factors and features within the project area influenced the development of the alignment options. These included:

- the need for an appropriate connection with the existing highway;
- allowing for the future bypass of Ararat;
- ensuring design and safety standards are achieved;
- optimising use of existing infrastructure; and
- minimising ecological and social impacts.

Within the project area, the Ararat Regional Park and Sisters Rocks were considered unacceptable areas to accommodate the Project due to the presence of high quality, contiguous remnant vegetation and habitat for flora and fauna species, and were therefore excluded.

The proposed alignment follows the existing highway from Ararat to Great Western The decision to follow the existing highway considered a number of factors. In some cases, the protection of one area supporting significant ecological values required a compromise through impacting another area that also supported significant ecological values. Where possible, the effects were mitigated by the avoidance of alternative vegetation or habitat.

Section 3 was split into three zones with similar environmental, social and physical conditions to allow for evaluation of options in a localised and relevant context. One zone considered the bypass of Great Western, one zone considered areas to the west of Great Western, and a third zone considered areas to the east of Great Western.

East of Great Western

The alignment avoids impact to vegetation within Ararat Regional Park at the eastern end; however in avoiding this vegetation, the proposed alignment impacts on an area of Golden Sun Moth habitat adjacent to the road reserve. Following the existing highway avoids impacts to areas supporting Plains Grassy Woodland and Golden Sun Moth habitat adjacent to the railway, north of the settlement of Armstrong. The proposed alignment has more impact on roadside native vegetation than the alternative, which does not follow the road reserve and is located in cleared farmland. The alternative alignment, however, impacts a greater number of scattered indigenous trees (including Large and Very Large Old Trees).

Bypass of Great Western

The bypass of Great Western (proposed alignment) is located to the north-east of the town. Large areas of native vegetation are located in this area and contain mostly Heathy Woodland with smaller patches of Plains Grassy Woodland. The alternative alignment to the south-west of the town is located in cleared farmland with patches of Plains Grassy Woodland, scattered indigenous trees and Golden Sun Moth habitat. The proposed alignment impacts on native vegetation however it avoids scattered Large and Very Large Old Trees and Golden Sun Moth habitat located within the alternative alignment. The proposed alignment was selected based on a balanced consideration of environmental, social, heritage and economic impacts. Whilst this has more impact on native vegetation, the alternative alignment had greater impacts to agricultural land, land severance, scattered indigenous trees, Golden Sun Moth habitat, aboriginal cultural heritage and social values.

West of Great Western

The last length of the proposed alignment from Great Western to Stawell follows the existing highway on the western side. There is remnant native vegetation within the Western Highway road reserve, along the railway line located to the west, and a large area near London Road in the vicinity of Sisters Rocks. Pleasant Creek runs to the west of the existing highway (not crossed by the highway) which has riparian vegetation consisting of the Grassy Woodland and Creekline Grassy Woodland . The remaining area is predominantly cleared farmland with scattered indigenous trees and native vegetation in road reserves. The road reserves contain

Heathy Woodland with patches of Plains Grassy Woodland and Grassy Woodland. Adjacent to the railway is Heathy Woodland, Grassy Woodland and Golden Sun Moth habitat. At the western end of the alignment, Trailing Hop-Bush has been identified within and adjacent to the road reserve (managed by DSE). From the outset of the options assessment, the alignments between Great Western and Stawell that followed the existing highway were assumed to avoid the significant roadside vegetation near Churchill Crossing Road and in the Crown land reserve near London Road. The proposed and alternative alignments all have potential impacts to native vegetation and threatened species. The proposed alignment has higher potential impacts to Trailing Hop-bush, whereas the alternative alignments would have more impact to scattered Large and Very Large Old Trees and require a new significant crossing of Pleasant Creek.

A key driver in the selection of the proposed alignment between Great Western and Stawell was Aboriginal cultural heritage values associated with the views from Sisters Rocks (ceremonial site adjacent to London Road) to the Black Range. An alignment that followed the existing highway reduced the potential impact to Aboriginal cultural values as well as impacts to agricultural land, land severance, scattered trees, and social values. Additionally, the section of the alignment immediately north of Great Western, near Churchill Crossing Road, is proposed to be located to the west of the existing highway to address landowner concerns to the east.

During the impact assessment for the EES, refinements have been made to the alignment to reduce the impact to native vegetation and threatened species in the road reserve and north-east of Great Western. The alignment refinements are described in Table 11. The options assessment process is described in detail in Chapter 5 of the EES and the Options Assessment Report (GHD 2012) that is a Technical Appendix to the EES.

7.4.2 Minimisation (Step 2)

Minimisation may generally be interpreted as minimising impacts on scattered trees or habitat patches through appropriate consideration in planning processes and expert input to project design or management (NRE 2002). If the modification of development plans does not enable the proponent to avoid all adverse impacts to native vegetation, there are several activities that can assist to minimise impacts to native vegetation on site and in adjoining areas, thus satisfying the first two stages of avoid and minimising under the Framework (NRE 2002).

Ecology and Heritage Partners Pty Ltd have progressively provided advice relating to locations where minor alterations to the alignment would minimise impacts to vegetation, with particular consideration for vegetation of High and Very High conservation significance. Locations where these recommendations have been applied, minimising impacts to significant flora, fauna and ecological communities through progressive refinement of the proposed alignment, are shown in Table 11.

To further minimise the loss of vegetation along the preferred alignment the following should be considered:

- Appropriate consideration in planning processes and expert input into project design or management.
- Temporary fencing should be installed around remnant vegetation to minimise disturbance (i.e. designated 'no-go' areas) prior to construction.
- Tree protection measures (such as the use of temporary fencing around the perimeter of trees to protect critical root zones) should also be implemented prior to construction.

Table 11. Areas where impacts to significant flora, fauna and ecological communities were minimised

Location Description	Biodiversity and habitat value avoided	Conservation significance of vegetation	Conservation status of vegetation	Status of species
From approximately 200 m south to approximately 400 m north west of The Majors Road/ Main Divide Road (Ch. 400 – 1000)	Siting new south-bound carriageway to north of current road reserve in predominantly cleared land to reduce impacts on Grassy Dry Forest EVC in road reserve and Ararat Regional Park to south. Also, placement of median to reduce impacts on Rosemary Grevillea and Emerald-lip Greenhood (Ch. 500 – 800) and use of cleared track beside powerline for service road (Ch. 900 – 1400) to reduce impact on Grassy Woodland EVC in Ararat Regional Park.	Grassy Dry Forest ▪ Medium to Very High Grassy Woodland ▪ Very High	Grassy Dry Forest ▪ Depleted Grassy Woodland ▪ Vulnerable	Rosemary Grevillea ▪ Rare (DSE Advisory List) Emerald-lip Greenhood ▪ Rare (DSE Advisory List)
Approximately 900 m north west from Ararat Regional Park towards Petticoat Gully Road (Ch. 1400 – 2300)	Siting new north-bound carriageway in predominantly cleared land to south of current road reserve to minimise impacts on Grassy Woodland EVC and Ararat Regional Park on the north side of the current highway.	Grassy Woodland ▪ Very High	Grassy Woodland ▪ Vulnerable	-
From approximately 900 m east of Petticoat Gully Road to approximately 1,100m north west of Old Brewery Road (Ch. 2800 – 4800)	Siting a wide central median between the current highway and the new south-bound carriageway and a wide median between the current highway and proposed service road on the south side (both medians outside of construction area) to minimise impact on Grassy Woodland EVC and Creekline Grassy Woodland EVC.	Grassy Woodland ▪ Very High Creekline Grassy Woodland ▪ Very High	Grassy Woodland ▪ Vulnerable Creekline Grassy Woodland ▪ Endangered	-
Approximately 500 m south east from Eaglehawk Road (Ch. 5000 – 5500)	Siting a wide median between the existing highway and the proposed service road to the south to minimise impacts on Grassy Woodland EVC.	Grassy Woodland ▪ Very High	Grassy Woodland. ▪ Very High	-

Location Description	Biodiversity and habitat value avoided	Conservation significance of vegetation	Conservation status of vegetation	Status of species
Approximately 800 m north west from Allanvale Road (Ch. 9600 – 10400)	Siting wide medians (outside construction area) between the main carriageways and the south-bound carriageway and service road to minimise impact on Plains Grassy Woodland EVC.	Plains Grassy Woodland ▪ Very High	Plains Grassy Woodland ▪ Endangered	-
For approximately 1km between St Ethels Road and edge of Great Western township	Siting of service road to south of current road reserve to minimise clearing of Plains Grassy Woodland EVC within current road reserve.	Plains Grassy Woodland ▪ High to Very High	Plains Grassy Woodland ▪ Endangered	-
For approximately 600 m adjacent to Great Western Bushland Reserve, north-east of Great Western township (Ch. 12400 – 13000)	Siting new highway on predominantly cleared land to the west of Heathy Woodland EVC to avoid impacts on this vegetation and on Bushland Reserve.	Heathy Woodland ▪ High to Very High	Heathy Woodland ▪ Depleted	-
From approximately 400m south east to approximately 500m north west of Metcalfe Road, north of Great Western township (Ch. 13000 – 13900)	Siting new road through a disused quarry, part of a former landfill site and a currently operating quarry to minimise impacts on Heathy Woodland EVC.	Heathy Woodland ▪ High to Very High	Heathy Woodland ▪ Depleted	-
For approximately 3.7km from opposite Briggs Lane to near Harvey Lane (Ch. 16500 – 20200)	Siting new north-bound carriageway on cleared land to the south of the existing road reserve and providing a wide median outside of the construction area to minimise impacts on Plains Grassy Woodland EVC and Heathy Woodland EVC.	Plains Grassy Woodland ▪ Very High Heathy Woodland ▪ Very High	Plains Grassy Woodland ▪ Endangered Heathy Woodland ▪ Depleted	-
For approximately 1.1km from opposite Hurst Road to current intersection with London Road (Ch. 21800 – 22900)	Having a minimum width median with wire rope barriers between carriageways to minimise impacts on Heathy Woodland EVC.	Heathy Woodland ▪ Very High	Heathy Woodland ▪ Depleted	-

Location Description	Biodiversity and habitat value avoided	Conservation significance of vegetation	Conservation status of vegetation	Status of species
For approximately 1.1km north west from the current intersection with London Road (Ch. 22900 – 24000)	Siting the entire new highway and new intersection with London Road on cleared land to the north of the existing highway and utilising the existing highway as a service road in order to avoid clearing of all Emerald-lip Greenhood and Trailing Hop-bush plants in this locality and minimising clearance of Heathy Woodland EVC in this locality.	Heathy Woodland ▪ Very High	Heathy Woodland ▪ Depleted	Emerald-lip Greenhood ▪ Rare (DSE Advisory List) Trailing Hop-bush ▪ Vulnerable (EPBC Act) ▪ Listed (FFG Act) ▪ Vulnerable (DSE Advisory List)

7.4.3 Quantification of Offsets (Step 3)

Once steps 1 and 2 have been considered, then offsets or Net Gain targets can be calculated for any permitted vegetation clearance. Net Gain targets or offsets can be calculated according to Appendix 4, Table 6 within the Framework (NRE 2002).

Generally, minor lopping or pruning of foliage (not including the trunk) to the minimum required that does not affect the continued health of the tree does not attract a Net Gain requirement. Planted trees that were not funded by 'Landcare' or any other government funded authority, such as a Catchment Management Authority, or that are not part of an existing offset are also excluded from an offset requirement. Blackwoods that are classified as scattered and would not have formed part of the original canopy of the specific EVC that occurred on the site are excluded from offsets as is Cherry Ballart and isolated shrubs. Note that this does not exclude the need to avoid their removal where practical. Dead scattered trees with a diameter greater than 40 cm would be assessed as if living and would attract offsets.

Extensive areas of 'degraded treeless vegetation' (areas that have previously been cleared where indigenous species have recolonised, to be determined by DSE) have been mapped. These areas are not currently considered to be an EVC, but they do contain some floristic and habitat values, and an informal offset would be required in order to satisfy the condition under the Framework to achieve a net gain.

The Wimmera and Glenelg Hopkins Native Vegetation Plans can also contribute to Net Gain targets.

The Framework (NRE 2002) sets out responses, including like for like criteria and Net Gain ratios, to proposals to clear and offset native vegetation, based on the conservation significance of the vegetation, which is determined by the habitat score and bioregional conservation status from Appendix 3, Table 5 of the Framework (NRE 2002). The Net Gain ratios from this table have been utilised to calculate the required offsets or Net Gain targets.

To meet the objectives of the Net Gain policy, offset criteria must be met, and at least:

- 2 times the habitat hectare loss for very high conservation significance sites is required;
- 1.5 times the habitat hectare loss for high conservation significance sites is required; and,
- 1 times the habitat hectare loss for medium conservation significance sites is required.

7.5 Summary of Total Vegetation Losses and Net Gain Targets

A summary of proposed vegetation losses and Net Gain targets for the proposed alignment is provided in Table 12 and 13. Complete Net Gain tables are provided in Appendix 2.3.

It is important to note that approximately half of the Very High conservation significance vegetation comes from EVCs that have been elevated to a higher conservation significance based on providing "Best or Remaining 50% of habitat for threatened flora or fauna" (see Section 7.3). Several patches of Heathy Woodland, Plains Grassy Woodland, Grassy Dry Forest, Grassy Woodland and Creekline Grassy Woodland have been elevated to Very High conservation significance based on the presence of significant fauna species (Table 10). Principally, these species include Barking Owl, Brush-tailed Phascogale and Brown Toadlet (listed as Endangered, Vulnerable and Endangered respectively on the DSE Advisory List), which were recorded during targeted surveys and have suitable habitat throughout the final alignment. Areas of suitable habitat for these species typically comprise high quality vegetation with some connectivity to other areas of suitable habitat within the landscape. It is worth noting that, although connective woodland habitat should be retained where possible, there are numerous examples of suitable habitat for these species within the local area (e.g. Sisters Rocks, Ararat State Park, roadside reserves, riparian vegetation) with the overall potential impact to fauna species listed under the FFG Act and the DSE Advisory List defined as Minor (within the context of the broader landscape and after mitigation measures have been applied - see the Risk Assessment residual consequence, Section 8.3).

Note: If the Best or Remaining 50% assessment is excluded from the offset calculations, then the total amount of Very High conservation significance vegetation decreases from **116.62 hectares (64.54 habitat hectares)** to **55.53 hectares (28.81 habitat hectares)**, while the total amount of High conservation significance vegetation increases from 16.52 hectares (5.19 habitat hectares) to 57.72 hectares (30.30 habitat hectares).

Table 12. Summary of vegetation losses and Net Gain targets within the proposed alignment.

Bioregion	Target EVC	Conservation significance	Vegetation			Large Old Trees		
			Total Losses (ha)	Total Losses (HabHa)	Net Gain Target (HabHa)	Total Losses	Total to be Protected	Total to be Recruited
CVU	CGW	V. High	4.36	1.74	3.48	35	280	1400
	GW	V. High	0.19	0.09	0.18	2	16	80
	HW	V. High	47.5	30.29	60.58	257	2056	10280
		High	0.4	0.2	0.3	0	0	0
		Medium	0.02	0.01	0.01	0	0	0
	PGW	V. High	16.29	7.26	14.52	116	928	4640
		High	6.34	1.9	2.85	32	128	640
VVP	CGW	V. High	9.04	4.03	8.06	66	528	2640
	GDF	V. High	1.47	0.78	1.56	12	96	480
		High	1.07	0.5	0.75	9	36	180
		Medium	0.47	0.16	0.16	4	8	40
	GW	V. High	37.64	20.29	40.58	302	2416	12080
		High	0.44	0.11	0.17	4	16	80
	PGW	V. High	0.13	0.06	0.12	2	16	80
		High	8.27	2.48	3.72	41	164	820
Total			**133.63**	**69.9**	**137.04**	**882**	**6688**	**33440**

Notes: GDF = Grassy Dry Forest, PGW = Plains Grassy Woodland, CGW = Creekline Grassy Woodland, GW = Grassy Woodland, HW = Heathy Woodland, Gold = Goldfields, CVU = Central Victorian Uplands, Wimm = Wimmera, Dep = Depleted, Vul = Vulnerable, En = Endangered, N/A= Not Applicable. Large Old Tree losses are based on estimates of trees present within each patch, further assessment is required to determine the number of Large Old Trees within all patches within the study area.

Table 13. Summary of scattered tree losses and Net Gain targets within the proposed alignment.

Bioregion	Conservation significance	Size	No. trees to be removed	Protect and Recruit				Recruit only	
				Multiplier	Offset total	Multiplier	Offset total	Offset requirement per tree	Total plants required for offset
CVU	High	VLOT	1	4	4	20	20	200	4000
	High	LOT	8	2	16	10	80	100	8000
	High	MOT	5	1	5	5	25	50	1250
	Low	VLOT	4	4	16	20	80	50	4000
	Low	LOT	7	2	14	10	70	50	3500
	Low	MOT	6	1	6	5	30	50	1500
	Low	ST#	13	NA	0	NA	0	NA	0
	DD	UN^	12	2	24	10	120	18	2160
Gold	High	LOT	2	2	4	10	20	100	2000
	High	MOT	1	1	1	5	5	50	250
	Medium	VLOT	5	4	20	20	100	100	10000
	Medium	LOT	5	2	10	10	50	50	2500
	Medium	MOT	2	1	2	5	10	50	500
	Low	ST#	4	NA	0	NA	0	NA	0
	DD	UN^	4	2	8	10	40	18	720
	Total				**130**		**650**		**40380**

Notes: = Goldfields, CVU = Central Victorian Uplands, N/A= Not Applicable, VLOT = Very Large Old Tree, LOT = Large Old Tree, MOT = Medium Old Tree, ST = Small Tree, UN = Unknown (within Due diligence area).

Table 14. Summary of flora and fauna listed under the EPBC Act, FFG Act and DSE Advisory List that are present within the proposed alignment.

EPBC Act		FFG Act			DSE Advisory List	
Flora	Fauna	Flora	Fauna	Communities	Flora	Fauna
Trailing Hop-bush (x21)	Golden Sun Moth (29.92ha)	Trailing Hop-bush (x21)	Golden Sun Moth (29.92ha) Brush-tailed Phascogale* Barking Owl* Brown Toadlet^	VTWBC*	Trailing Hop-bush (x21) Rising-star Guinea-flower (x11) Emerald-lip Greenhood (x203) Rosemary Grevillea (x37)	Golden Sun Moth (29.92ha) Brush-tailed Phascogale* Barking Owl* Brown Toadlet^

Notes: Individual numbers for certain threatened fauna species not provided as assessment is based on habitat loss rather than species present. VTWBC = Victorian Temperate Woodland Bird Community.
* Species habitat recorded throughout the study area. Species likely to make use of GDF, PGW, CGW, GW and HW (see Table 1a).
^ Species is widespread throughout the study area in many of the drainage lines, seeps, road ditches and culverts located within or adjacent to woodland vegetation.

7.6 Potential Strategies to Achieve Net Gain

The offset strategy for the Western Highway Project would address offset requirements under both The Framework and the EPBC Act Environmental Offsets Policy. These requirements are discussed in further detail below.

7.6.1 Offsets under The Framework

7.6.1.1 On-site Management of Vegetation

Habitat hectare offsets may be in the form of (1) enhanced management of existing vegetation, and/or (2) revegetation (or natural recruitment). Generally, it is preferable to manage remnant vegetation as greater gains can be achieved, in both ecological and economic terms (i.e. it generally costs less and greater ecological gains can be achieved).

However, it should be noted that management requires a high level of skills, knowledge and resourcing for at least a 10 year period and the remnants are protected in perpetuity.

In order to calculate the potential gain available from managing native vegetation, estimates are made, which assist in determining the potential increase in habitat score of the vegetation being managed (i.e. the 'gain' in habitat score). For example, the cover of weeds can be reduced and the understorey diversity increased, which could both contribute to a potential increase in habitat score. Generally, an area of approximately 1 hectare of native vegetation is required to be ecologically managed to offset a loss of between 0.1 to 0.2 habitat hectares. Therefore, in order to offset a loss of 1 habitat hectare, between 5 and 10 actual hectares would require ecological management.

Management commitments/arrangements to achieve Net Gain at any offset site can be broken up into two main strategies; 1) maintenance and 2) improvement. Some of these techniques include:

Maintenance

- Retention of all remnant trees (both living or dead specimens).
- Removal of non-declared woody and herbaceous weeds.
- Foregoing allowed uses such as grazing and slashing activities.

Improvement

- Control/eradication of non-declared environmental or noxious weeds including those that are a threat to existing remnant vegetation.
- Fencing to restrict public/grazing access into areas of ecological value.
- Control of introduced animals such as foxes, rabbits and feral cats.
- Revegetation and/or supplement planting of locally indigenous tree, shrub and understorey species in appropriate areas (need to consider ecological function).

Where the management of vegetation is not practical, revegetation undertaken to a certain standard can also offset some habitat hectare losses (see below for amount). The "Revegetation Planting Standards" (DSE 2006) outline the minimum standards for revegetation to qualify as a native vegetation gain.

These standards include a requirement to plant suitable local indigenous species that are appropriate to the bioregional EVC benchmark for the site. They also require land managers to meet minimum site protection (i.e. fencing standards to exclude stock/humans), site preparation and plant stock standards, as well as agree to establish the plants according to a defined planting design and schedule; including follow up weed control (c2006). It is recommended that a variety of life forms are used (i.e. groundcovers, shrubs, trees) with consideration of site conditions and use (DSE 2006). Target tree numbers are typically between 500 and 2,500 plants per hectare depending on the EVC (DSE 2006).

For areas of very high, high and medium conservation significance, the proportion of revegetation included in the offset (in habitat hectares) is limited to 10%, 25% and 50% respectively.

7.6.1.2 Off-site Offsets

In determining the appropriate offset responses for permitted vegetation clearance, the Framework sets out several 'like for like' criteria in Table 6, Appendix 4, which must generally be considered for any offset site (NRE 2002).

In order to locate an offset site for vegetation of very high conservation significance, there is a requirement that the offset be:

- The same vegetation/habitat type;
- Similar or more effective ecological function AND land protection function as impacted by the loss; and,
- The existing vegetation proposed as an offset must be at least 90% of the quality of the area being lost.

In order to locate an offset site for vegetation of high conservation significance, there is a requirement that the offset be:

- The same vegetation/habitat type OR a Very High significance vegetation/habitat in the same bioregion;
- Similar or more effective ecological function OR land protection function as impacted by the loss.
- At least 75% of the quality of the vegetation being lost.

In order to locate an offset site for vegetation of medium conservation significance, there is a requirement that the offset be:

- Any EVC in the Bioregion OR a Very High or High significance vegetation/habitat in an adjacent bioregion.
- Similar or more effective land protection function as impacted by the loss.
- At least 50% of the quality of the vegetation being lost.

Given that the study area spans three different bioregions and includes five EVC's with varying conservation significance, considerable care should be taken to ensure that all losses are offset and that all offsets satisfy the like-for-like criteria described above. Once the road design and alignment are finalised, accurate Net Gain requirements can be determined and this would give a clearer indication of all offsets required within each bioregion.

7.6.2 Offsets under the EPBC Act

The Australian Government's EPBC Act Environmental Offsets Policy (SEWPaC 2012) outlines a framework for the use of environmental offsets under the EPBC Act including when they can be required, how they are determined and the framework under which they operate. Clear guidelines on what constitutes a suitable offset are provided and should be considered as part of any proposed offset strategy. Suitable offsets must include the following:

1. It delivers an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed development.
2. It is built around direct offsets but may include compensatory measures.
3. It is in proportion to the level of statutory protection that applies to the protected manner.
4. It is of a size and scale proportionate to the residual impacts on the protected manner.
5. It is additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs.
6. It effectiviely account for and manages the risks of the offset not succeeding.
7. It is efficient, effective, timely, transparent, scientifically robust and reasonable.
8. It has transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

Golden Sun Moth is listed as Critically Endangered under the EPBC Act. As such any habitat removed as part of the Project would need to be offset. While there are no formal offset ratios defined under the EPBC Act, based on previous decisions by SEWPaC there is likely to be an offset ratio of approximately 4:1 (i.e. 4 hectares offset for every 1 hectare removed).

Trailing Hop-bush is listed as Vulnerable under the EPBC Act, as such there are not likely to be any offsets required for impacts to this species. However individuals that are impacted would be required to be salvaged and translocated in accordance with an approved Salvage and Translocation Plan or Conservation Management Plan, with translocated individuals managed and secured in perpetuity.

7.6.3 Offset Management Strategy

VicRoads Offset Strategy is based on the Three Step Approach outlined in Victoria's Native Vegetation Management – A Framework for Action. The three steps involved are, avoid, minimise and offset (for detailed information refer to Sections 7.4 and 7.5). Only after the first two steps have been achieved can offsetting native vegetation to be removed be considered. In order to offset vegetation, VicRoads needs to outline the following:

- **Vegetation removed**: A final alignment must be selected in order to identify all vegetation proposed to be removed;
- **Offsets required**: The vegetation offsets that are required need to be calculated. A final Net Gain assessment for the proposed alignment would be undertaken when a final alignment is chosen;
- **Timing**: Project timeframes and timing for vegetation removal must be estimated. According to the Department of Transport (DoT) / DSE Memorandum of Understanding (MOU) offsets must be secured within 12 months of vegetation removal; and,
- **Offset sources**: The mechanisms followed by VicRoads for sourcing vegetation offsets are outlined below. They are listed in order of priority, but often they occur simultaneously.

Although VicRoads can enquire about the availability of offsets needed for the Project, offsets cannot be sourced until a final alignment, along with its footprint, is known. To date, the final alignment for the Western Highway Project (Section 3) is yet to be approved and as a result the exact impact to native vegetation is unknown. Estimates of impacts are based on the entire footprint of the proposed alignment (see Section 7.6.1). When the final alignment has been identified and the impacts potentially further minimised (through Steps 1 and 2 of the 3 Step Approach), VicRoads can begin to source offsets using the following mechanisms:

1. **VicRoads Net Gain Bank**: VicRoads has a Net Gain Bank (NGB) through which it purchases offset credits in advance of project requirements in order to have credits available for a quick and seamless transfer to the projects which need them. There are a range of offset credits in the NGB from a number of bioregions in which VicRoads operates. Currently available within the NGB is:
    - 1.63 Habitat hectares of Very High Conservation Significance Grassy Dry Forest from the Central Victorian Upland bioregion;

- 3.79 Habitat hectares of Very High Conservation Significance Grassy Woodland from the Goldfields bioregion;
- 1.00 Habitat hectares of Very High Conservation Significance Creekline Grassy Woodland from the Goldfields bioregion;
- 0.57 Habitat hectares of High Conservation Significance Alluvial Terrace Herb-rich Woodland from the Goldfields bioregion; and,
- Six Large Old Trees.

2. **BushBroker**: BushBroker maintains a register of landowners who are willing to sell offset credits. When the offsets required for the Project are known, a request to BushBroker is made outlining the exact amount of offsets needed. If BushBroker has these credits on their register, a transfer of those credits from the landowner to VicRoads can occur within months. Offsets secured by Bushbroker are done so via a Section 69 Agreement under the *Conservation, Forest and Lands Act 1987*. The numbers of Habitat Hectares per Bioregion and conservation significance available through Bushbroker as of May 2011 are shown below. Significant quantities of offsets are available through Bushbroker, which would be able to satisfy the offset requirements for the Project (Table 15).

Table 15. Offset quantities currently available through BushBroker.

Bioregion	Very High	High	Medium	Low
Central Victorian Uplands	37.82	6.07	6.61	1.43
Goldfields	20.57	28.14	9.72	2.42
Victorian Volcanic Plain	190.31	98.23	3.2	0.16
Total	**248.7**	**132.44**	**19.53**	**4.01**

3. **Trust for Nature**: Trust for Nature also holds a list of landowners who are willing to sell vegetation offsets. Based on initial discussions with Trust for Nature, there are currently three Habitat hectares available within the Central Victorian Uplands bioregion and 13 Habitat hectares available within the Victorian Volcanic Plains bioregion. Trust for Nature does not currently have any vegetation offsets available within the Goldfields bioregion However, they have a large number of potential offset sites (approximately 500) within all three bioregions and across many different EVC's, which can be investigated further once the final offset requirements for the Project are determined. VicRoads would need to make a formal offset enquiry to Trust for Nature to determine any offset matches. Offsets secured by Trust for Nature are done so under the *Victorian Conservation Trust Act 1972*.

4. **Acquisition of adjacent land**: VicRoads could secure suitable offsets, including EVCs and Large Old Trees, through acquisition of land adjacent to or close by the Project alignment. This potentially includes areas of road reserve along the Western Highway, where offset may be negotiated between DSE and VicRoads. Land currently

available for purchase may also be investigated to determine the suitability and available gain present. Any identified offsets must be secured with a Section 69 agreement under the *Conservation, Forest and Land Act 1987* or a Trust for Nature Covenant under the *Victorian Conservation Trust Act 1972*.

5. **Private Offset Brokers**: VicRoads could engage private offset brokers concurrently to the above three methods in order to locate offsets. VicRoads insists that any possible offsets found must be secured with a Section 69 agreement under the *Conservation, Forest and Land Act 1987* or a Trust for Nature Covenant under the *Victorian Conservation Trust Act 1972*.

6. **Local Councils**: VicRoads also may contact local councils to seek availability of offsets. If matching offsets are nominated from council owned and managed land, the land manager must enter into an agreement with BushBroker under a Section 69 agreement of the *Conservation, Forest and Lands Act 1987*. If the nominated offset site is on private land, VicRoads may enter into an agreement with council and the landowner under Section 173 of the *Planning and Environment Act 1987*.

In summary, the required Net Gain offsets for the Project are achievable through a combination of sourcing offsets through the VicRoads NGB, Bushbroker, Trust for Nature, acquiring private land, securing road reserves, private offset brokers and local council.

8 IMPACT ASSESSMENT

8.1 Key Issues

The potential impacts to significant fauna associated with the Western Highway Project would arise from the removal of remnant native vegetation resulting in the direct loss of significant fauna, of habitat supporting significant fauna and of corridors and 'stepping stones' that facilitate significant fauna movements. The key concern is that these impacts, if not appropriately mitigated, could lead to local extinctions of significant fauna and thereby hinder an overall endeavour to prevent species extinctions in the region, the State and the country.

Any loss of ecological values should be viewed in the context of the overall ongoing loss, fragmentation and deterioration in the quality of remnant vegetation within the study area and the surrounding landscape. The Options Assessment for the Project has sought to minimise impacts to significant flora, fauna and ecological communities via a process of elimination, progressively excluding potential alignment options that support areas of high ecological value. This process is ongoing, with fine-scale alignment micro-siting wherever possible.

8.2 Impact Pathways

This section identifies and describes flora and fauna cause and effect pathways associated with the construction and operation of the Project (Table 16). Potential impacts associated with the construction and operation of the Project includes:

8.2.1 Flora (Risk Register FF1-3)

1. Potential removal of individuals of a known population of the EPBC Act-listed flora species, Trailing Hop-bush, located south of Stawell (Ch. 22900-23600). This may result in the salvage and translocation of 21 individuals from the population of Trailing Hop-bush present within the road reserve south of Stawell. See targeted flora map for exact locations (Figure 3).

2. Potential removal of individuals of known populations of DSE advisory listed flora. Emerald-lip Greenhood, Rising Star Guinea Flower and Rosemary Grevillea are present throughout the Project area and individuals of each species are likely to be removed during pre-clearance/clearance and construction work. See targeted flora map for exact locations (Figure 3).

3. Construction encounters unexpected listed flora species (species not known to be present from targeted survey). This may result in the removal of a small number of unknown listed flora species during pre-clearance/clearance and construction work within the Project area. This includes the permanent loss of potential habitat for the:

    - Nationally significant Button Wrinklewort, Large–headed Fireweed, Pomonal Leek-orchid and Tawny Leek-orchid; and,

- State significant Fringed Sun-orchid, Crimson Sun-orchid, Pale-flower Crane's-bill, Fitzgerald's Leek-orchid, Woodland Leek-orchid or Half-bearded Spear-grass.

The Project construction is also likely to result in the fragmentation of habitat for flora species (including those species listed above) and therefore limit to some extent the ability for plant species to reproduce and spread within suitable habitat in the area. Fragmentation of habitat is also likely to affect genetic diversity of plant populations in the area by reducing opportunities for dispersal.

8.2.2 Fauna (Risk Register FF4-8)

4. Construction encounters EPBC Act-listed Golden Sun Moth from known habitats (recorded locations: Ch. 1800-2800, 3700-5000) (Figure 3). This may result in the possible injury/death to GSM individuals during construction and removal of GSM habitat within the Project area.

5. Construction encounters FFG and DSE Advisory Act-listed Brush-tailed Phascogale, Brown Toadlet, Fat-tailed Dunnart, Black-chinned Honeyeater, Brown Treecreeper and Bearded Dragon, as well as FFG listed Victorian Temperate Woodland Bird community. This may result in possible injury or death to listed fauna individuals and remove key terrestrial fauna habitat during construction within the Project area.

6. Construction encounters unexpected listed fauna species (species not known to be present from targeted survey). This may result in removal or disturbance to a small number of unknown listed fauna species during clearance and construction work within the Project area. This includes the permanent loss of potential habitat for Southern Brown Bandicoot and Squirrel Glider and known habitat for the regionally significant Fat-tailed Dunnart and Black-chinned Honeyeater.

7. The Project removes or disrupts wildlife corridors or fauna habitat. This is evident at the Ararat Regional Park (Ch. 0-23000) and Sisters Rocks (Ch. 21000-23000) (Figure 3). This may fragment or reduce terrestrial fauna habitat and wildlife corridors including key habitat for Brown Toadlet, Brown Treecreeper and Brush-tailed Phascogale, as well as numerous locally common fauna species. There may also be an increase in the amount and frequency of hostile habitats for native fauna (e.g. construction zones, the highway itself, off ramps, on ramps, bridges, roadside culverts) in the landscape that act as barriers to significant fauna movements.

8. Increased road kill and injury rates to arboreal native fauna from traffic on additional or new carriageways, particularly where the carriageway passes through heavily vegetated areas away from the existing road. The proposed carriageway would create an additional barrier to the movement of aquatic and terrestrial fauna within the Project area, resulting in fauna mortality. It is likely that fauna are more susceptible to vehicle collision during the dusk to dawn period, where the highway intercepts wildlife corridors (e.g. near and along key waterways) and in areas away from existing roads where fauna are unaccustomed to road traffic hazards.

8.2.3 Ecological Communities and Scattered Trees (Risk Register FF9-10)

9. Construction encounters Ecological Vegetation Communities (EVCs) located within the Project area. This may result in the removal of EVCs of high and very high conservation significance including: Grassy Dry Forest, Grassy Woodland, Creekline Grassy Woodland, Plains Grassy Woodland and Heathy Woodland.

10. Construction encounters Large and Very Large Scattered Trees and hollow-bearing trees located within the Project area. This may result in the removal of key terrestrial habitat for local fauna species including Brush-tailed Phascogale, Brown Treecreeper and Barking Owl.

8.2.4 Waterways (Risk Register FF11-12)

11. Construction of waterway crossings at Concongella Creek and confluence of creeks north of Great Western and other works associated with the waterway crossings. This may result in local destabilisation of the waterway banks and channel profile, degradation of river health values, and reduction of key aquatic and associated terrestrial habitat within the Project area.

12. Placement of bridge structures within a minor waterway (e.g.culverts). This may result in the degradation of river health values, and reduction of key aquatic and associated terrestrial habitat within the Project area. Construction of bridge structures may also create a temporary barrier for the movement of aquatic fauna.

8.2.5 Other Impacts (Risk Register FF13-20)

13. Construction activities occur outside of agreed construction zone. This may result in the loss or modification of native vegetation and/or fauna habitat that was intended to be retained as part of the Project.

14. Weeds and/or pathogens introduced or spread through construction activities. This may result in the displacement or invasion of native vegetation and/or fauna habitat within the Project area. The spread of weed species and/or pathogens may be increased due to movement of vehicles and soil throughout the Project area during construction activities. Potential pests or pathogens include:

- Cinnamon Fungus *Phytophthora cinnamomi:* This is an introduced water mould (Tregonnin and Fagg 1985), (though often referred to as a fungus) that attacks the susceptible root systems of some native plants, and thereby affects the local ecosystem and the fauna which relies on them. The risk to native vegetation is of the greatest concern, with several groups of native flora species having been established as susceptible to Cinnamon fungus. These include Xanthorrea spp, Hakea spp, Banksia spp, Eucalypt spp (Keane et al. 2000), and species from the Epacridacae family (heaths). However, Phytophthora is not exclusive to these (Weste and Taylor 1971; Marks and Smith 1991). Human activities have been

major facilitators in its spread through walkers and vehicles accessing infected areas and transporting it into unaffected areas, and the removal of infected soil and gravel which is then transported into unaffected areas causing rapid spread across the State (Buckley 2004). Cinnamon Fungus is not currently known to occur between Ararat and Stawell, however a key risk would be the introduction of the pest through the transportation of materials during the construction process.

- Bovine Johne's Disease (BJD) and Ovine Johne's Disease (OJD) *Mycobacterium paratuberculosis:* This is a chronic disease of the digestive system (instestine) found in cattle (DNRE 2001) and sheep (DPI 2009). Amongst cattle, it is generally more common in dairy herds than beef herds within the country (DPI 2008a). The disease is caused by bacteria called *Mycobacterium paratuberculosis* BJD was first recorded in Australian cattle over 70 years ago. It now occurs in the states of Victoria, New South Wales, Tasmania and South Australia. Approximately 1150 cattle herds are officially classified as infected in south-east Australia (Animal Health Australia 2009). For BJD, Australia is currently ranked into zones: Residual; Control; Protected or Free. Victoria is currently classified as a Control Zone (DPI 2007). For OJD, Australia is ranked in to High, Medium and Low prevalence areas, with Victoria currently ranked as a High prevalence area . All activities that involve movement of soil, water and plant material (whether deliberately or accidentally) have the potential to cause the spread of BJD. Moist soil and plant material readily adhere to machinery, equipment, tyres, tools, hooves, footwear and camping equipment.

- Grape Phylloxera *Daktulosphaira vitifoliae*: This is a destructive aphid pest that lives on the roots of grapevines. Phylloxera aphids feed by sucking fluids from grapevine roots, which causes a progressive decline in the vigour of infested vines (DPI 2011). European grapevines, which comprise the vast majority of Australian vineyards, have very little tolerance to phylloxera, which therefore represents a major threat to the industry (DPI 2011). Phylloxora is not currently known to occur between Ararat and Stawell, however a key risk would be the introduction of the pest through the transportation of materials during the construction process (DPI 2011). Phylloxera is most commonly spread through transportation of materials such as:
    - grapevines, including cuttings and rootlings;
    - whole grapes;
    - grape marc and must;
    - sample material for analysis;
    - soil;
    - machinery, packages or equipment used in the cultivation or harvesting of any of these materials.

- Potato Cyst Nematode (PCN) *Globodera rostochiensis*: This is a serious pest of potatoes world-wide and is subject to stringent quarantine and/or regulatory procedures wherever it occurs. PCN is a soil borne organism that affects potatoes (*Solanum* spp.), tomatoes (*Lycopersicon* spp.), eggplants (*Solanum* spp.) and some weed species (*Solanum* spp.). Four Control Areas have been declared to prevent the spread of PCN from the following areas: Thorpdale, Gembrook, Koo Wee Rup and Wandin (DPI 2011). PCN is not currently known to occur between Ararat and Stawell (*pers. comm.* Greg King, DPI, 31/01/2012), however a key risk would be the introduction of the pest through the transportation of materials during the construction process.

- Amphibian Chytrid Fungus *Batrachochytrium dendrobatidis*: Infection with the pathogenic fungus Amphibian Chytrid Fungus leading to infectious Chytridiomycosis is a major problem for frog populations nationwide. Control measures are available for limiting potential transfer of the fungus from one site to another via appropriate hygiene protocols. The prevention of the spread of the disease is particularly pertinent for personnel (ecologists) conducting surveys for the species, and also salvage and translocation measures within areas of known and potential frog habitat.

15. Sediment discharge to waterways resulting from soil erosion or spoil earthworks. This may result in a short-term negative impacts to aquatic ecosystems within the site and downstream of the Project area.

16. Construction modifies hydrological and surface water flows. This may result in a short-term negative impact on local fauna populations, retained native vegetation and local aquatic fauna habitats.

17. Noise or vibration disturbance to native fauna during construction (daytime) and operation (traffic). This may result in potential stress and ultimately, displacement of native fauna from affected habitats. This is unlikely to impact Golden Sun Moth (i.e. MNES) as these species were recorded within the study area in areas adjacent to existing sections of highway.

18. Light disturbance to native fauna (e.g., artificial light sources from street construction lights). This may result in potential stress and ultimately, displacement of native fauna from affected habitats.

19. Construction creates dust impacting on native fauna, native flora and surface water ecosystems. This may result in a short-term negative impact on local fauna populations, retained native vegetation and local aquatic fauna habitats.

20. Pollutants (including smoke, dust, petrochemicals, litter etc.) associated with construction activities, those potentially present within soils planned to be disturbed during construction activities, and those generated during the operation of the Project may have a negative impact on local fauna populations, retained native vegetation and local aquatic fauna habitats.

8.3 Risk Assessment

The Risk Assessment procedure (using methods described in Section 2.7) has informed both the impact assessment and formulation of the mitigation measures. VicRoads has a standard set of environmental protection measures which are typically incorporated into its construction contracts for road works and bridge works. These are described in VicRoads Contract Shell DC1: Design & Construct, April 2012, hereafter referred to as the "VicRoads standard environmental protection measures". These measures have been used as the starting point for the impact assessment. Those that are relevant to flora and fauna are included in the "planned controls" column of the risk assessment (Table 16) and outlined in more detail in Section 9.

As a result of the initial risk assessment, in some cases additional Project specific controls have been proposed to reduce risks. These are outlined in the "additional controls" column of the risk assessment (Table 16), and are described in more detail in Section 9.

Both VicRoads standard environmental protection measures and the additional Project specific controls have been included in the Environmental Management Framework for the Project.

Table 16. Risk Assessment for Impact Pathways

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (low = good)		Consequence	Likelihood	Risk Rating
FF1	Potential removal of individuals of a known population of EPBC listed flora - South of Stawell (Ch. 22900-23600).	A population of Trailing Hop-bush is present south of Stawell. 21 plants intercept the proposed alignment.	Biodiversity & Habitat	1200.13	Vegetation/habitat sites and areas of significance, and native flora/fauna sites or habitat discovered during works under the Contract shall not be damaged, disturbed or otherwise adversely impacted without prior approval of the Superintendent and obtaining all relevant permits. Plant, equipment, material or debris shall not be placed or stored within the limit of the root zone of vegetation to be retained. Fencing and signage to protect populations during construction.	Moderate	Almost Certain	High	Low	Further targeted survey to be completed on final alignment prior to construction to identify all existing individuals. Potential for detailed design or construction planning to avoid impact at known locations (e.g. micro alignment change to construction corridor). Implement salvage and translocation program for any individuals to be removed. Translocation to be undertaken in accordance with a formal translocation plan approved by SEWPaC, which would include post-translocation monitoring.	Minor	Almost Certain	Medium
FF2	Potential removal of individuals of a known population of the DSE advisory listed flora (Ch. 500-2300, 20900-23500).	Emerald-lip Greenhood, Rising Star Guinea Flower and Rosemary Grevillea are present throughout alignment. See targeted flora map for exact locations.	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Almost Certain	High	Low	As for FF1.	Minor	Almost Certain	Medium
FF3	Construction encounters unexpected listed flora species (species not known to be present from targeted survey).	Removal of small number of unknown listed flora species during pre-clearance / clearance work	Biodiversity & Habitat	1200.13	In the event that a significant flora or fauna site, species or habitat is discovered, the Contractor shall immediately notify the Superintendent. The Contractor shall submit to the Superintendent for approval the proposed actions to manage the site, species or habitat.	Minor	Possible	Low	High	Avoid impacts if possible, by altering the construction area. Otherwise where applicable, implement a translocation plan for these individuals.	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF4	Construction encounters EPBC listed Golden Sun Moth from known habitats. (Recorded locations at Ch. 1800-2800, 3700-5000).	Removal of fauna habitat, possible injury/death to listed fauna species individuals during construction.	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Almost Certain	High	Medium	Potential for detailed design or construction planning to avoid impact at known locations (e.g. micro alignment change to construction corridor). Revegetate ROW with grassland species favoured as food source by GSM (e.g. Rytidosperma sp.) where GSM populations are known to be present.	Moderate	Almost Certain	High
FF5	Construction encounters FFG and DSE Advisory Act-listed Brush-tailed Phascogale, Barking Owl, Brown Toadlet, Fat-tailed Dunnart, Black-chinned Honeyeater and Brown Treecreeper, as well as FFG listed Victorian Temperate Woodland Bird community (Recorded locations at Ch. 300, 600, 3700, 4700, 6300, 8300, 14700, 17300, 18000, 18200, 21800, 22600).	Removal of fauna habitat, possible injury/death to listed fauna species individuals during construction.	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Almost Certain	High	Medium	Conduct further targeted surveys for Brown Toadlet within final alignment. Potential for detailed design or construction planning to avoid impact at known locations/habitats (e.g. micro alignment change to construction corridor). Prepare and implement a salvage and translocation plan. Where potential habitat for listed fauna species is identified to be removed a qualified ecologist would need to conduct a pre-clearance survey and attempt relocation where necessary/possible.	Minor	Almost Certain	Medium
FF6	Construction encounters unexpected listed fauna species (species not known to be present from targeted survey).	Removal/disturbance to small number an unknown number of listed fauna species during pre-clearance / clearance work	Biodiversity & Habitat	1200.13	As for FF3.	Minor	Possible	Low	High	As for FF3.	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF7	The duplication removes or disrupts wildlife corridors or fauna habitat. This is evident at the Ararat Regional Park (Ch. 0-2300) and Sisters Rocks (Ch. 21000-23000), as well as numerous riparian and roadside corridors.	Impacts on habitat or wildlife corridors may affect Brown Toadlet, Brown Treecreeper and Brush-tailed Phascogale, as well as numerous locally common fauna species.	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Likely	High	Low	Potential for detailed design or construction planning to avoid impact at known locations/habitats (e.g. micro alignment change to construction corridor). Install warning signs for potential fauna crossings. Investigate appropriate design response and implement recommendations, for example: - Installation of fauna sensitive road design features at wildlife corridors. - Implement before/after comparison study for fauna road mortality to investigate a) the impact of the road; b) the efficacy of crossing structures.	Minor	Likely	Medium
FF8	Increased road kill and injury rates to arboreal native fauna from traffic on additional / new carriageway, particularly where the carriageway passes through wooded areas away from the existing road (e.g. quarry area north of Great Western).	The proposed carriageway would create an additional barrier to the movement of aquatic and terrestrial fauna. This would result in a reduction of fauna populations due to increased mortality, particularly for predatory birds, reptiles, amphibians, and mammals. It is likely that fauna are more susceptible to vehicle collision during the dusk and dawn period, where the highway intercepts wildlife corridors (e.g. near and along key waterways) and in areas away from existing roads where fauna are unaccustomed to road traffic hazards.	Biodiversity & Habitat		-	Minor	Likely	Medium	Medium	As for FF7.	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF9	Construction encounters Ecological Vegetation Communities (EVCs) (Native vegetation and fauna habitat)	Removal of EVCs of high and very high conservation significance including: Grassy Dry Forest, Grassy Woodland, Creekline Grassy Woodland, Plains Grassy Woodland and Heathy Woodland.	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Likely	High	Medium	Potential for detailed design or construction planning to avoid impact at known locations/habitats (e.g. micro alignment change to construction corridor). Revegetation or landscape plantings to include species appropriate to the local EVC.	Moderate	Likely	High
FF10	Construction encounters Large and Very Large Scattered Trees/Hollow-bearing trees/fauna habitat	Removal of scattered trees	Biodiversity & Habitat	1200.13	As for FF1.	Moderate	Almost Certain	High	Low	Detailed design and construction planning to minimise loss of trees, particularly MOTs, LOTs and VLOTs and those which are hollow bearing, with the advice of an aborist.	Moderate	Likely	High
FF11	Construction of waterway crossings at Concongella Creek and confluence of creeks north of Great Western , and other works associated with the waterway crossing.	Local destabilisation of waterway banks and channel profile. Degraded river health values, reduction of key aquatic and associated terrestrial habitat.	Surface Water Biodiversity & Habitat	1200.04, 1200.08 and 1200.11	Implementation of a Construction EMP detailing: • Erosion and sediment control measures. • Fuel and chemical management procedures.	Moderate	Likely	High	Low	No structures within the stream, and consistent with CMA requirements. Ensure fish sensitive design of structures to ensure safe fish passage. Schedule construction to no-flow or low-flow periods.	Minor	Likely	Medium
FF12	Placement of bridge structures within a minor waterway (e.g.culverts).	Degraded river health values, reduction of key aquatic and associated terrestrial habitat . Construction creates temporary barrier to movement of aquatic fauna.	Surface Water Biodiversity & Habitat	1200.04, 1200.08 and 1200.11	As for FF10.	Moderate	Possible	Medium	Low	Implement fish sensitive design of structures to provide for safe fish passage. Schedule construction to no-flow or low-flow periods.	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF13	Construction activities occur outside of agreed construction zone.	Potential loss or modification of native vegetation and/or fauna habitat that was intended to retained	Biodiversity & Habitat	1200.13	Existing vegetation and native fauna habitat identified in the Contract to be retained, shall be identified as 'No Go Zones' and protected by temporary fencing and signage erected outside the limit of the canopy of the vegetation or the habitat site. Plant, equipment, material or debris not to be placed or stored within the limit of the root zone of vegetation to be retained.	Minor	Possible	Low	Low	-	Minor	Possible	Low
FF14	Weeds and/or pathogens introduced or spread through construction activities.	Displacement/invasion of native vegetation and/or fauna habitat and increased spread of weed species or pathogens. Potential pathogens include Cinnamon Fungus Phytophthora cinnamomi, Bovine Johne's Disease Mycobacterium paratuberculosis, Grape phylloxera Daktulosphaira vitifoliae, Potato Cyst Nematode Globodera rostochiensis and Amphibian Chytrid Fungus Batrachochytrium dendrobatidis.	Biodiversity & Habitat	1200.14	The Contractor shall develop a procedure to prevent the spread of declared weeds, pests and diseases within the Site and off-site.	Minor	Possible	Low	Medium	A weed management and control program to control invasions would be implemented for 2 years following construction. Pathogen management procedures developed to prevent spread.	Minor	Possible	Low
FF15	Sediment discharge to waterways resulting from soil erosion or spoil earthworks.	Impacts to aquatic ecosystems at the site and downstream of the site.	Surface Water Biodiversity & Habitat Soils & Geology	1200.04, 1200.08	Implementation of a Construction EMP detailing erosion and sediment control measures.	Minor	Possible	Low	Low	Installation of sediment fencing adjacent to waterways	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF16	Construction modifies hydrological/surface water flows	Impact to retained native vegetation and fauna habitats	Surface Water Biodiversity & Habitat Soils & Geology	1200.04, 1200.08	As for FF11.	Minor	Possible	Low	Low	Installation of appropriate drainage systems. Schedule construction to no-flow or low-flow periods.	Minor	Possible	Low
FF17	Noise or vibration disturbance to native fauna during construction (daytime) and operation (traffic).	Potential for stress, and ultimately displacement of native fauna from affected habitats.	Biodiversity & Habitat Noise & Vibration	3110.01	Traffic noise levels shall not exceed the objectives specified in VicRoads Traffic Noise Reduction Policy for new and improved roads within and outside of the limit of works.	Minor	Possible	Low	Low	-	Minor	Possible	Low
FF18	Light disturbance to native fauna (e.g., artificial light sources from street construction lights).	Potential for stress, and ultimately displacement of native fauna from affected habitats.	Biodiversity & Habitat Visual & Landscape			Minor	Possible	Low	Low	-	Minor	Possible	Low

Risk No.	Impact pathway	Description of consequences	Linkages	Contract Shell DC1 Reference	Planned Controls to Manage Risk (as per Project Description, and VicRoads Contract Shell DC1: Design & Construct, April 2012).	Initial Risks				Controls Recommended to Reduce Risk	Residual Risks		
						Consequence	Likelihood	Risk Rating	Level of Uncertainty (Low = good)		Consequence	Likelihood	Risk Rating
FF19	Construction creates dust impacting on native fauna, native flora and surface water ecosystems.	Impact to retained native vegetation and fauna habitats	Biodiversity & Habitat	1200.07	Implementation of a Construction EMP detailing air quality control measures and strict monitoring procedures.	Insignificant	Possible	Negligible	Low	Implement methods and management systems consistent with EPA Best Practice Environmental Management: 'Environmental Guidelines for Major Construction Sites' (EPA, 1996). Minimise land disturbance by using phased approach, rehabilitate cleared areas promptly. Keep vehicles to well-defined haul roads, limit vehicle speed and seal haul roads and other exposed areas by means of concrete or paving where necessary. Employ dust suppression methods such as watering down the ROW	Insignificant	Possible	Negligible
FF20	Creation of pollutants (including smoke, dust, petrochemicals, litter etc.) during construction and operation.	Impact to retained native vegetation and fauna habitats.	Biodiversity & Habitat	1200.07	As for FF11.	Insignificant	Possible	Negligible	Low		Insignificant	Possible	Negligible

9 MITIGATION MEASURES

9.1 Construction

VicRoads would require the construction contractor to develop and implement a Construction Environmental Management Plan (CEMP) for the Project. VicRoads standard environmental protection measures, and some additional Project specific controls identified below, have been incorporated into the Environmental Management Framework for the Project which is documented in the Project Environment Protection Strategy (PEPS). The PEPS is a VicRoads Document that details the environmental management arrangements for the design, construction and operation of the Project. VicRoads would require the construction contractor to incorporate all of these measures into the CEMP. Refer to Chapter 21 of the EES for further explanation of the environmental management framework and documentation proposed for the project.

9.1.1 VicRoads Standard Environmental Protection Measures

VicRoads standard environmental protection measures for Flora and Fauna that would be adopted for this Project include:

9.1.1.1 Flora and Fauna (1200.13)

(a) General

All work under the Contract shall comply with the following requirements:

- 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,
- The discovery of significant flora and fauna sites, species or habitat not previously identified shall be managed to protect flora and fauna.

(b) Permits and Approvals

The permits and/or approvals identified in Table 1200.131 have already been obtained, or are being obtained by VicRoads. Works under the Contract shall comply with all permits and approvals and associated conditions. Permits from relevant authorities must be obtained prior to disturbance of flora/fauna sites or relocation of native fauna affected by works under the Contract.

(c) Protection of Flora and Fauna Sites

Works shall not damage, disturb or otherwise adversely impact:

- Vegetation/habitat sites and areas of significance listed in Table 1200.132;
- Any other significant vegetation/habitat sites, not listed in Table 1200.132, that are not required to be removed for permanent works; and,
- Any significant native flora/fauna sites or habitat discovered during works under the Contract without prior approval from the Superintendent and obtaining all relevant permits.

All personnel working on site shall be trained in the identification of:

- Flora or habitat sites listed in Table 1200.132, and other vegetation/habitat sites that are not to be damaged or disturbed; and,
- Likely significant flora and fauna species which may be present and the actions required for their management if encountered.

All sites nominated in Table 1200.132 and any additional existing vegetation and native fauna habitat identified to be retained, shall be identified as 'No Go Zones' and protected by temporary fencing and signage. All fencing of 'No Go Zones' shall as a minimum be:

- Erected a minimum of 1 m beyond the boundary of the habitat to be protected, or the drip line of the trees, or as agreed by the Superintendent;
- Constructed of star picket, paraweb one wire support;
- Communicated by signage installed on the temporary fencing at intervals no less than 20 m apart stating 'Protected Area – No Unauthorised Access'; and,
- Retained in place for the duration of the construction period (until Practical Completion).

Prior to removing any vegetation or habitat, the Contractor shall:

- Arrange an on-site inspection with the Superintendent and other relevant authorities to confirm and clearly identify and mark trees, vegetation or habitat to be removed, consistent with the Contract drawings and any relevant permits; and
- Fence and sign all sites nominated as No Go Zones.

Plant, equipment, material or debris shall not be placed or stored within the limit of the root zone of vegetation to be retained.

(d) Removal of Flora and Protection of Fauna

A suitably qualified ecologist with the appropriate permits/licences shall be present on Site during the removal of vegetation to:

- Identify and examine any trees (including hollow bearing trees) and/or fallen logs affected by works under the Contract to identify, capture and relocate fauna identified within the zone to be cleared; and,
- Provide advice on alternative fauna habitat sites.

If appropriate, relocation of any fauna or nests shall be made to adjacent habitat and shall be undertaken in accordance with the requirements of the Department of Sustainability and Environment. Where practicable, any nests found to be inhabited by native birds or by mammals (e.g. possums or gliders) shall be removed outside of the species' breeding season.

(e) Discovery of Significant Flora or Fauna

In the event that significant flora or fauna is discovered, the Contractor shall immediately cease operation and notify the Superintendent.

An appropriately qualified ecologist shall be engaged to accurately identify and provide advice for the management of the discovered significant flora or fauna species.

The Contractor shall submit to the Superintendent a procedure/management plan that has been approved by the relevant authority to manage the flora or fauna species.

(f) Damage to Protected Vegetation

Where damage to flora or fauna habitat has occurred as the result of work under the Contract, the Superintendent reserves the right to direct the Contractor to repair or offset the vegetation and/or provide fauna habitat to an equivalent or better quality in accordance with the document 'Victoria's Native Vegetation: A Framework for Action' and 'Native Vegetation Revegetation Planning Standards June 2006'.

The removal or damage of protected vegetation and/or habitat listed in Table 1200.132 as a result of the works under the Contract would cause a deduction to be applied and deducted in accordance with Section 4010.

(g) Monitoring

The Contractor shall undertake monitoring of the condition of flora and fauna habitat sites and protective measures at the sites at pre-defined intervals.

9.1.1.2 Weeds, Pests and Diseases (1200.14)

(a) General

Declared weeds, pests and diseases (also referred to as pathogens) shall not be introduced to the Site, spread through the Site, or removed from the Site (if present) as a consequence of work under the Contract.

The Contractor shall prevent the spread of declared weeds, pests and diseases within the Site and off-site through the implementation of controls that as a minimum shall include:

- treatment of declared weeds prior to the commencement of any ground disturbing activities and in response to their identification through monitoring of the site;
- management of weed and soil pathogen potential within imported materials;
- provision for cleaning plant and equipment prior to:
    - arrival on Site
    - departure from Site
    - movement within the Site from infested to non-infested areas;
- location of cleaning areas; and,
- use of a vehicle and machinery hygiene log book.

(b) Cinnamon Fungus (this clause only applies to projects that are to be undertaken in high risk infested zone/area, as such does not apply)

(c) Phylloxera (this clause only applies to projects that are to be undertaken in Phylloxera Infected Zones (PIZ) as identified by the Phylloxera and Grape Industry Board of South Australia website mapping, as such does not apply)

(d) Monitoring

The Site shall be monitored for the presence of weeds and pests at pre-defined intervals.

VicRoads standard environmental protection measures for water (1200.04), air quality (1200.07), and erosion and sediment control (1200.08) are presented in Appendix 5.1.

9.1.2 Project Specific Controls

Additional Project specific controls are also proposed to reduce risks to Flora and Fauna, including:

1. Conduct further targeted surveys on final alignment prior to construction to identify all existing flora individuals listed under the EPBC Act, FFG Act or DSE Advisory List;

2. Conduct further targeted surveys for Brown Toadlet within final alignment to locate all populations present;

3. Where possible, avoid impacts to significant species and communities as well as areas of key fauna habitat (e.g. hollow bearing trees and waterways) and wildlife corridors through construction and micro-siting techniques during the planning phase of the Project. This has been undertaken throughout the planning phase, through minor adjustments and modifications to the alignment location and design to avoid significant species and communities, and would continue through to finalisation of the alignment design;

4. Prepare and implement a Conservation Management Plan (CMP) for any significant flora, fauna and ecological communities likely to be impacted by construction activities. The plan would include a salvage and translocation program and post-translocation monitoring for flora and fauna that would be directly impacted by the development, as approved by SEWPaC and/or DSE. Persons undertaking any inspection, removal or relocation of fauna species within the Project area must be authorised and hold a current permit under the *Wildlife Act 1975*;

5. Prepare and implement a Construction Environment Management Plan (CEMP) to introduce environmental controls with a view to protect ecological values during the construction process. The CEMP would include requirements to regularly inspect and maintain environmental controls that are implemented;

6. Where the construction footprint falls in close proximity to areas of ecological significance, protective fencing should be installed around the boundary of the construction area to clearly define 'no-go zones' and maintain construction activities within the approved footprint. 'No-go zones' would be clearly identified within the CEMP and demarcated on-site by a qualified ecologist prior to commencement of construction. This is particularly important to protect surrounding areas against accidental damage during the construction process including damage to the root systems (from activities such as vehicle parking, access and stockpiling of materials and waste). All protective fencing should remain in place until the completion of all construction activities and should be fitted with signs to clearly indicate that the surrounding vegetation is a 'no-go zone' for construction vehicles, machinery, personnel, equipment, materials and waste. Any areas nominated as 'no-go zones' would remain in place unless removal is authorised by the Superintendent;

7. In areas of known or possible habitat for listed threatened flora and fauna species, protective fencing should be supplemented with a high-visibility component to indicate the sensitivity of the area.

8. Where disturbance of remnant native vegetation cannot be avoided, native vegetation loss should be as minimal as possible with priority for avoidance attributed to:
    a. known significant flora and fauna habitats,
    b. large and intact remnant vegetation patches,
    c. wide corridors of native remnant vegetation in good condition that clearly offer connectivity through the landscape; and,
    d. large and very large-hollow bearing trees.
9. Minimise all disturbance to soil, vegetation and fauna habitat as far as possible, by minimizing the construction footprint and protecting retained vegetation and habitat;
10. Clearing prior to construction should be done carefully to prevent mechanical or other damage (i.e. fuel spills) to retained vegetation. No windrows, soil or other debris should be pushed into retained vegetation;
11. Locate material stockpiles, construction buildings and other infrastructure and access roads within cleared land rather than in areas of native vegetation;
12. Retain appropriate habitat features/structure within the construction alignment. Shrubs and other understorey species should be retained or re-established (to the allowable height limit) post-construction. Logs and any felled trees should be left in the area to provide additional fauna habitat. Trees should be lopped or trimmed rather than removed;
13. Revegetation of the Project area, rehabilitation of redundant sections of the existing Western Highway and landscape plantings:
    a. When all construction activities have been completed, the construction sites would be rehabilitated as close as possible to their original condition according to the measures outlined in the Environmental Management Plan including guidelines regarding the promotion of 'natural regeneration' and when to implement more active rehabilitation techniques such as revegetation and direct seeding (how, when, which species and techniques to use);
    b. Flora species appropriate to the local EVC including a suite of overstorey, understorey and ground cover species should be used in all revegetation and landscape plantings;
    c. Grassland species favoured as a food source by Golden Sun Moth (e.g. *Rytidosperma* spp.) where Golden Sun Moth populations are known to be present;
    d. Ongoing maintenance of rehabilitated areas should also be addressed in the Environmental Management Plan (e.g. ongoing weed management up to and beyond the point where native vegetation becomes established);

e. Redundant sections of the existing Western Highway should be progressively rehabilitated through appropriate fencing, weed management, monitoring and revegetation as required; and,

f. Where revegetation occurs in proximity to bridges and large culverts, consideration should be given to the facilitation of fauna passage under the roadway.

14. All contractors should be aware of areas of ecological values through a site induction by a qualified botanist (see figures attached for locations of remnant native vegetation) to minimise the likelihood for damage to areas scheduled to be retained and include EVC polygons (areas of sensitivity) on detailed surveying drawings and check for accuracy;

15. It is recommended that a Weed Management Plan is prepared prior to commencement of construction within the Project area. This plan would follow the guidelines set out in the CALP Act 1994, and fulfil any obligations by the Project team in relation to minimising the spread of weeds as a result of construction. Weed management procedures as a minimum would include:

a. Consideration of weed treatment prior to commencement of ground disturbing activities;

b. The management of weed potential within imported materials;

c. Provisions for cleaning of plant and equipment at the following times:

i. prior to arrival on Site;

ii. prior to departure from Site; and,

iii. prior to movement within the Site from infested to non-infested areas.

d. Monitoring for at least two years after completion of construction; and,

e. Undertake weed control following monitoring (if required).

16. Construction of all waterway crossings should proceed with the following considerations:

a. Ensure fish sensitive design of structures to ensure safe fish passage;

b. Bridge to span waterway (no structures in-stream), no structures to be installed in low-flow channels;

c. Establish a water quality monitoring regime to assess and limit any construction impacts. This should include a before/after sampling design, including several upstream and downstream sites;

d. Establish a set of site specific criteria that would trigger intervention of works in the event of a noticeable deterioration in habitat, water quality or observed direct death or injury of aquatic fauna. Establish appropriate response actions in case of such an event based on these site specific criteria;

e. Ensure that best practice sedimentation and pollution control measures are undertaken at all times, in accordance with EPA guidelines, to prevent impacts to waterways and wetlands;

f. All waterways disturbed during Project construction to be revegetated and restored (to a condition equal to or better than pre-construction) after completion of construction;

g. Any snags and/or logs that are removed from any waterways to be replaced in similar locations after completion of construction;

h. The storage of fuel and chemicals (including the refuelling of vehicles and machinery) at a minimum of 50 m away from all waterways;

i. Site toilets to be a minimum of 50 m away from all waterways;

j. Construction activities to be consistent with Wimmera and Glenelg Hopkins CMA requirements; and,

k. Schedule construction to no-flow or low-flow periods.

17. Pathogen management procedures developed to prevent the spread of Cinnamon Fungus, Bovine Johne's Disease (BJD), Grape Phylloxera, Potato Cyst Nematode (PCN) and Amphibian Chytrid Fungus. Construction planning procedures would identify vehicle, plant equipment, personal hygiene regime required to prevent spread of fungus between waterways during the works, including at a minimum the following:

a. Cinnamon Fungus, Grape Phylloxera and PCN are not currently known to occur between Ararat and Stawell; however a key risk would be their introduction through the transportation of materials (e.g. gravel, soil) during the construction process. The following procedures would be followed to reduce the risk of introduction:

i. All vehicles, equipment and footwear are to be clean of any organic material (soil, water and plant material) prior to commencement of construction and prior to entering the construction zone. Vehicles, equipment or footwear suspected to have been in areas which support Cinnamon Fungus would be washed down with Phyto-clean (diluted according to labelled ratio, generally 1:10). Boots should be immersed in a bath for minimum 30 seconds;

ii. Avoid the use of infected gravel and soils in construction works, by attempting to use certified pathogen-free materials; and,

iii. Avoid transportation of materials within the construction site.

b. Follow a "Clean on Entry and Exit" policy to assist in the control of BJD at properties which have supported cattle in the last 12 months (BJD bacteria can survive in the environment for up to 12 months (DPI 2011c)). All vehicles and equipment are to be clean of any organic material prior to entering identified at-risk properties (DPI 2008b). Vehicles would also be confined to formed tracks where possible if driving onto site is necessary. The wash-down of vehicles would be recorded in the respective vehicles log book and the landholder notified of control procedures employed. Footwear is to be washed down in a footbath of Hibitane (or similar Chlorhexidine based disinfectant) and visibly dirty skin is also washed with soap and water;

c. All measures and survey techniques involving the handling of frogs or personnel moving into areas known to support frogs would be be conducted in accordance with the hygiene protocol for the control of disease in frogs to prevent the spread of Amphibian Chytrid Fungus (NPWS 2001).

18. Installation of sediment fencing adjacent to waterways to limit sediment discharge from soil erosion or spoil earthworks. Sediment fences must be inspected on a weekly basis to ensure they are functioning correctly;

19. Implement methods and management systems consistent with EPA Best Practice Environmental Management: 'Environmental Guidelines for Major Construction Sites' (EPA, 1996); and,

20. Reduce impacts to flora and fauna from dust by implementing the following:

a. Minimise land disturbance by using phased approach and rehabilitate cleared areas promptly;

b. Keep vehicles to well-defined haul roads, limit vehicle speed and seal haul roads and other exposed areas by means of concrete or paving where necessary; and,

c. Employ dust suppression methods such as watering down the haul roads, unvegetated stockpiles and key movement areas during construction.

9.2 Operation

The study area supports many areas of remnant vegetation which would be considered to be wildlife corridors, namely remnant woodland along roadsides (particularly along the existing Western Highway) and riparian vegetation along creeks and rivers. The removal or fragmentation of these corridors may restrict local movement of native fauna, which can have short and long-term impacts. Such impacts can range from increased road mortalities and inability to access vital resources through to population-wide impacts such as the restriction of gene flow and the associated reduction in genetic variation amongst populations. In areas where impacts to woodland habitat or wildlife corridors cannot be avoided, the following mitigation measures should be adopted:

- Install warning signs for potential fauna crossings;
- Investigate appropriate mitigation measures to reduce impacts to fauna at operational stage:
    - Fauna sensitive road features at wildlife corridors (e.g. road crossing structures, see Section 9.2.1.2);
    - Implement a before/after comparison study for fauna road mortality to investigate a) the impact of the road on fauna road mortality; b) the efficacy of crossing structures; and,
    - Use the results of the above study to determine whether additional crossing structures should be installed.

9.2.1.1 Site rehabilitation and revegetation

The vegetation, topography and habitat features within key sections within the Project area should be rehabilitated as soon as possible after the construction phase is complete. Topsoil excavated during construction should be replaced over the disturbed zone after construction, in accordance with the relevant Environmental Management Program. This should be undertaken throughout the construction area.

If native vegetation recolonisation is not successful by returning the retained topsoil, revegetation would be undertaken using a suite of flora species appropriate to the cleared EVC. The advice of experienced zoologists and botanists should be sought during this process to determine fauna habitat requirements and an appropriate planting schedule. The Environmental Management Plan should provide further details on these measures.

While natural regeneration of indigenous trees and shrubs is preferred, revegetation is typically used if there are no indigenous species present. Further, revegetation would only be undertaken in areas where the overstorey or other indigenous flora is unlikely to regenerate or expand naturally. Only locally indigenous trees, shrubs and understorey vegetation (associated with the known, or likely EVC present in a particular area) would be used. Revegetation

works including monitoring would continue for at least two years after completion of construction to ensure adequate survival is achieved. Redundant sections of the existing Western Highway should be progressively rehabilitated through appropriate fencing, weed management, monitoring and revegetation as required.

Areas of retained remnant native vegetation following construction would face increased pressures from weed invasion, increased disturbance and edge effects from the newly constructed areas. Consequently, a management procedure must be implemented in order to ensure the long-term survival of these remnants. A Weed Management Plan would be prepared prior to commencement of construction within the Project area (Section 9.1.2).

Weed management procedures and monitoring would continue for at least two years after completion of construction.

9.2.1.2 Road Crossing Structures

Road crossing structures facilitate the crossing of linear infrastructure by wildlife and increase the permeability of the landscape. Examples of crossing structures include underpasses/culverts, wooden poles (used by gliders to glide between patches) and overpasses or rope bridges. Underpasses have been successfully used to facilitate the movement of significant fauna species such as bandicoots (Taylor and Goldingay 2003; Hunt et al. 1987) and Mountain Pygmy-possum *Buramys parvus* (Mansergh and Scotts 1989), as well as a range of common species including Bush Rat *Rattus fuscipes*, Black Wallaby *Wallabia bicolour*, and the introduced Feral Cat *Felis cattus* and Cane Toad *Bufo marinus* (ibid). Gliding poles have been used to allow road crossings by Squirrel Gliders *Petaurus norfolcencis* (Ball and Goldingay 2008) and overpasses or rope bridges have facilitated the movement of several possum (Goosem 2005) and glider species (Australian Museum Business Services 2001).

There are opportunities to implement the use of road crossing structures as part of the Project. Key areas are likely to include the riparian vegetation along the Concongella Creek, areas adjacent to Ararat Regional Park, Stawell Quarry, Sisters Rocks and other wooded patches as well as at strategic intervals along the existing Western Highway where there is a high density of large hollow-bearing trees.

9.3 Mitigation Summary

The primary impact of the proposed development to ecological values would arise from the removal of Very High and High conservation significance vegetation. The residual consequence of this impact has been classified as Moderate (within the context of the broader landscape and after mitigation measures have been applied - see the Risk Assessment residual consequence, Section 8.3), with between 0.1 and 1% of the EVCs within the bioregion proposed for removal. With the avoidance and minimisation measures applied at the design phase of the Western Highway Project, and with the implementation of mitigation measures outlined in Section 9, the residual consequence for the majority of impacts has been classified

as either Insignificant or Minor (based on Risk Assessment residual consequence, Section 8.3). The exceptions to this are impacts to Golden Sun Moth and scattered trees, which are both classified as Moderate.

The Options Assessment for the Project has sought to minimise impacts to significant flora, fauna and ecological communities via a process of elimination, progressively excluding potential alignment options that support areas of high ecological value. The final alignment has been progressively refined, to minimise impacts to remnant vegetation, with particular consideration for vegetation of High and Very High conservation significance, as well as flora and fauna species listed under the EPBC Act and FFG Act.

A summary of the mitigation measures that have been identified to avoid, reduce or minimise impact risk (Table 16). The measures comprise both relevant requirements of VicRoads' standard environmental protection measures as well as the additional measures identified by this impact assessment. The aim is to achieve the relevant EES Objectives described in Section 1.3.

10 CONCLUSION

The draft EES evaluation objective relevant to the flora and fauna assessment outlined in the Scoping Requirements is as follows:

- To avoid or minimise effects on flora and fauna species and ecological communities listed under the *Flora and Fauna Guarantee Act 1975* (FFG Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and to comply with requirements under Victoria's Native Vegetation Management: A Framework for Action (2002).

The current assessment was required to identify any flora or fauna species or vegetation communities of national or State significance, to record any potential areas of indigenous vegetation that may have Net Gain implications within the study area, and to provide advice in relation to potential impacts and mitigation measures associated with the Western Highway Project.

One flora species listed under the EPBC Act (Trailing Hop-bush - Vulnerable) and three flora species listed on the DSE Advisory list (Rising Star Guinea-flower – rare, Emerald-lip Greenhood – vulnerable and Rosemary Grevillea - rare) were present within the final alignment.

One fauna species listed under the EPBC Act (Golden Sun Moth), four fauna species listed under the FFG Act (Barking Owl, Brush-tailed Phascogale, Brown Toadlet and Brown Treecreeper) and two species listed under the DSE Advisory List (Fat-tailed Dunnart and Black-chinned Honeyeater) were recorded within the final alignment.

With the avoidance and minimisation measures applied at the design phase of the Western Highway Project, and with the implementation of mitigation measures outlined in Section 9, the Project would have only a minor impact on significant species and communities listed above (except Golden Sun Moth). However, based on the EPBC Act Significant Impact Guidelines (DEWHA 1999, 2009) and Carter (2010), the Project would have a significant impact on Golden Sun Moth and Trailing Hop-bush.

Legislative and Policy Implications

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Two species listed under the EPBC Act, Trailing Hop-bush and Golden Sun Moth, were recorded within the final alignment. Based on the EPBC Act Significant Impact Guidelines (DEWHA 1999, 2009) and Carter (2010), the Project would have a significant impact on both of these species. An EPBC Act referral has been submitted for the proposed construction works and VicRoads was advised by SEWPaC on 17 December 2010 that the proposed project is a controlled action.

Flora and Fauna Guarantee Act 1988 (FFG Act)

Four FFG Act-listed fauna species were recorded within the proposed alignment options during the current assessment and there is a possibility for additional species to occur within the study area. No legal implications relating directly to FFG Act-listed fauna species recorded within the study area exist, however DSE and local authorities may impose conditions relating to these species under other permits (e.g. *Planning and Environment Act 1987*). An FFG Act permit to remove or disturb native vegetation on public land would be required for the Western Highway Project: Ararat to Stawell.

Planning and Environment Act 1987

A Planning Permit or Planning Scheme Amendment is required to remove/disturb native vegetation on private land within the study area. In this instance, DSE is a mandatory referral authority.

Wildlife Act 1975

Persons undertaking any inspection, removal or relocation of fauna species located in vegetation to be impacted upon as part of the project must be authorised and hold a current permit under the *Wildlife Act 1975*.

Catchment and Land Protection Act 1994

VicRoads is responsible for controlling any infestation of noxious or environmental weeds that may become established. As such, weeds should be appropriately controlled to minimise their spread.

Impacts and Mitigation Measures

A total of 116.62 hectares (64.54 habitat hectares) of Very High conservation significance vegetation, and 16.52 hectares (5.19 habitat hectares) of High conservation significance vegetation is proposed for removal. If the Best or Remaining 50% assessment is excluded, the total amount of Very High conservation significance vegetation decreases to 55.53 hectares (28.81 habitat hectares), while the total amount of High conservation significance vegetation increases to 57.72 hectares (30.30 habitat hectares).

The primary impact of the Project to ecological values arises from the removal of Very High and High conservation significance vegetation. The Risk Assessment residual consequence of this impact has been classified as Moderate, with between 0.1 and 1% of the EVCs within the Bioregion proposed for removal. The removal of this vegetation would have implications for the threatened flora and fauna populations that have been recorded within the study area.

With the avoidance and minimisation measures applied at the design phase of the Western Highway Project, and with the implementation of mitigation measures outlined in Section 9, the Risk Assessment residual consequence for the majority of impacts has been classified as either Insignificant or Minor. The exceptions to this are impacts to Golden Sun Moth and scattered trees, which are both classified as Moderate.

The Options Assessment for the Project has sought to minimise impacts to significant flora, fauna and ecological communities via a process of elimination, progressively excluding potential alignment options that support areas of high ecological value. The final alignment has been progressively refined, to minimise impacts to vegetation, with particular consideration for vegetation of High and Very High conservation significance, as well as flora and fauna species listed under the EPBC Act and FFG Act.

Any loss of ecological values should be viewed in the context of the overall ongoing loss, fragmentation and deterioration in the quality of remnant vegetation within the study area and the surrounding landscape. The mitigation measures outlined in Section 9 seek to minimise these impacts, providing a framework for managing environmental effects and hazards in order to achieve an acceptable environmental outcome.