ARMSTRONG CREEK URBAN GROWTH PLAN
FLORA AND FAUNA

Technical Report
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Armstrong Creek Urban Growth Plan.

Technical report: Flora and Fauna (EA Project # 05-77)

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Background

The City of Greater Geelong is looking to develop the Armstrong Creek – Mount Duneed area as an urban growth corridor and has commissioned the development of an Armstrong Creek Urban Growth Plan (ACUGP). Ecology Australia (EA) was commissioned, as a sub-consultant to David Lock and Associates, to contribute to the development of the Plan.

The objectives of this report are to:

- Provide an overview of the natural environment context of the study area;
- Review and summarise existing natural environment information available for the study area;
- Prepare an overview of the flora and fauna of the study area, including mapping and description of areas of biodiversity significance, based on available reports and databases;
- Describe natural environment issues affecting the study area that may influence its future planning and development; and
- Recommend options describing how the ACUGP could address the key natural environment issues affecting the study area.

Values

Flora

Database searches revealed 22 State or Nationally significant species previously recorded in a 5 km Data Review Area. Of these Creeping Rush, Spiny Peppercress and Austral Trefoil have a moderate likelihood of occurrence within the UGDA, and Bellarine Yellow-Gum was recorded during this study. Significant species, if present, are mostly likely to occur in remnant patches of vegetation along Armstrong Creek, Barwon River and floodplain, and along roadsides maintaining some remnant vegetation.

Native vegetation within the study area has been largely cleared and highly modified. The majority of the extant native vegetation consists of scattered trees or patches associated with roadsides, Armstrong's Creek and Barwon River and associated floodplains. Remnant vegetation is generally comprised of woodland, wetland vegetation and grassland. Scattered trees occur within private property; the degree to which native understorey species persist within these patches is unknown.

The woodland vegetation is often dominated by River Red Gum with understorey shrubs including Drooping Sheoke, Hedge Wattle and Black Wattle. Scattered populations of the endangered Bellarine Yellow Gum occur near Barwarre Road and possibly elsewhere. Understorey grasses such as Kangaroo Grass, Wallaby-grasses and Spear-grasses are occasionally present.

Stewart's Reserve is among one of the best remaining examples of Grassy Woodland in the Geelong region. It is dominated by Manna Gum with some Swamp Gum and Red Gum. Several plants recorded in the Reserve have regional significance.

Riparian vegetation is mostly woodland dominated by River Red Gum and Manna Gum with semi-aquatic species such as Poong'ort (*Carex tereticaulis*). Riparian vegetation occurs in patches along the Barwon River and much of Armstrong Creek. The quality of the vegetation, particularly the understorey, varies across the site.

Wetland vegetation occurs in swampy sections of Armstrong Creek and on seasonally wet sites throughout the study area. Sub-saline to saline wetlands supporting salt tolerant vegetation occupy the lower reaches of Armstrong Creek, and parts of the Barwon River floodplain. This vegetation represents a number of different Ecological Vegetation Classes and, in places, is in reasonable condition despite a long history of grazing.

Exotic grassland occurs across much of the study area. To what extent native species persist within these grasslands is unknown.

Most of the EVCs recorded in the study area have a conservation status of Endangered and all remnant vegetation in the region is considered to be of at least Local conservation significance. There are eight biosites within or potentially impacted by development within the Armstrong Creek UGDA. These sites range from Local to National conservation significance.

No plant species or communities listed under the EBPC Act have been recorded in the study area. One plant species, Spiny Peppercress, listed as Vulnerable under the Act has a moderate likelihood of occurring within the study area (in saltmarsh habitat).

One plant taxon, Bellarine Yellow-gum, listed under the FFG has been recorded and Plains Grassland, which is listed as a Threatened Community, has been modelled for the study area. Spiny Peppercress, which is also listed under the FFG, has a moderate likelihood of occurring (in saltmarsh habitat).

Fauna

There were 165 fauna species recorded within the 5km fauna Data Review Area, which included six species listed under the EPBC Act, and 9 listed under the FFG Act. The total consisted of 147 bird species (11 exotic), 4 mammal species (1 exotic), 4 reptile species, 2 frog species, 7 fish species and one invertebrate (Appendix 2). The number of fauna species identified within the Fauna DRA is relatively low, considering the size of the area involved and the diversity of habitat types that would have existed in this area.

Some species regularly or occasionally found in these adjacent areas but not yet recorded from the ACUGPA include a number of significant species which almost certainly also occur on the same basis in the study area (particularly on the Barwon River floodplain).

Six EPBC-listed Vulnerable fauna species – Australian Painted Snipe, Grey-headed Flying-fox, Growling Grass Frog, Australian Grayling and Yarra Pygmy Perch – are either known or regarded as at least moderately likely to occur in the study area.

Seventeen FFG-listed threatened fauna species – Lewin's Rail, Baillon's Crake, Great Egret, Little Egret, Intermediate Egret, Australian Little Bittern, Australasian Bittern, Australian Painted Snipe, Caspian Tern, Freckled Duck, Blue-billed Duck, White-bellied Sea-Eagle, Grey-headed Flying-fox, Growling Grass Frog, Australian Grayling, Yarra Pygmy Perch and Altona Skipper butterfly – are either known or regarded as at least moderately likely to occur in the study area. The FFG-listed Brolga has also been recorded in the study area, but it is regarded as of Low likelihood of regular occurrence.

Previous surveys conducted in Armstrong Creek for the Geelong Bypass Project concluded the creek showed poor aquatic habitat condition and low habitat diversity. This study found low species diversity at all sites along Armstrong Creek, with no species listed under the EPBC or FFG Act expected to occur. However, records of Yarra Pygmy Perch from the nearby Waurn Ponds Creek suggest that Armstrong Creek may also support this species given suitable habitat and conditions.

Ramsar wetlands

Lake Connewarre Reserve lies to the east of the study area and forms part of the larger 'Bellarine Peninsula and Port Phillip Bay (Western Shoreline)' Ramsar site. Also part of this ramsar site is Reedy Lake which lies to the north of the Armstrong Creek UGDA, and Hospital Swamps which lie to the south-east. These wetlands support significant numbers of shorebird species.

The EPBC Act sets out procedures for assessing actions with potentially significant impacts on Ramsar values, whether these actions are proposed within or outside site boundaries. Of relevance to this study, under the guidelines issued for the Act, an impact on the ecological character of a declared Ramsar wetland is significant if areas of the wetland are destroyed or substantially modified or there is a major and measurable change in the natural hydrological regime of the wetland.

Although the Armstrong Creek UGDA is situated outside the Reserve, it drains into the Ramsar site, and there is therefore the potential for indirect impacts to result from development within the Armstrong Creek UGDA.

Discussion

The most significant potential impacts to biodiversity values from development within the Armstrong Creek UGDA are associated with:

- Indirect impacts to the Ramsar site through altered hydrological regimes
- Impacts to values along Armstrong Creek and Barwon River
- Potential impacts to State and Nationally listed species
- Potential loss of woodland vegetation on roadsides and in riparian zones

Recommendations

The following recommendations are made in regards to conserving and enhancing the flora and fauna values within the Armstrong Creek UGDA:

- Avoid native vegetation removal along Armstrong Creek, Barwon River and associated floodplain
- Avoid works that will impact upon both the instream and surrounding habitat values of Armstrong Creek
- Where development is to occur investigate implementation of best-management erosion and storm-water control practices to prevent sediment, and pollution run-off into neighbouring areas of high conservation value
- Utilise the existing road network (containing a substantial portion of remnant vegetation within the study area) as a cycling/walking path network and to create landscape linkages
- Avoid the removal of stands of indigenous eucalypts and she-oaks where possible
- Undertake control of woody and other selected weed species
- Undertake pest animal control programs
- Undertake revegetation work along Armstrong Creek and roadsides to provide habitat corridors for local fauna
- Undertake more detailed flora and fauna surveys in areas proposed for development
- Undertake surveys for significant species (if suitable habitat is deemed to be present within areas proposed for development)

1 Introduction

1.1 Background

The City of Greater Geelong is looking to develop the Armstrong Creek – Mount Duneed area as an urban growth corridor and has commissioned the development of an Armstrong Creek Urban Growth Plan (ACUGP). The designation of Armstrong Creek – Mount Duneed as an urban growth corridor originated from planning work initiated in the 1980s by the Geelong Regional Commission including the *Geelong Region Development Strategy*. Further planning work undertaken for the area includes the *Mount Duneed Armstrong Creek Urban Development Study* and the City of Greater Geelong's *Urban Growth Strategy*. The ACUGP is to provide overall direction on infrastructure, built form and the type and location of land uses in the area.

Ecology Australia (EA) was commissioned, as a sub - consultant to David Lock and Associates, to contribute to the development of the ACUGP. The development of the ACUGP is to be undertaken in five stages:

Part A	Background Report
Part B	Vision
Part C	Development Objectives and Outcomes
Part D	Development Framework
Part E	Planning Scheme Implementation

The Flora and Fauna Technical Report presented here will form part of the Background Report produced for Part A. The objectives relevant to this report are to:

- Provide an overview of the natural environment context of the study area;
- Review and summarise existing natural environment information available for the study area;
- Prepare an overview of the flora and fauna of the study area, including mapping and description of areas of biodiversity significance, based on available reports and databases;
- Describe natural environment issues affecting the study area that may influence its future planning and development; and
- Recommend options describing how the ACUGP could address the key natural environment issues affecting the study area.

1.2 Study Area

The Armstrong Creek Urban Growth Development Area (ACUGDA) covers *c*. 4,300 hectares of land and includes land south of the Warrnambool – Melbourne Railway line at Grovedale, extending to the municipal boundary at Lower Duneed Road and west to east from Ghazeepore Road to the Barwon River (see Figure 1, p 13). Due to a number of natural and man made constraints including flood prone areas, there is potentially 2,300 hectares of developable land (Henshall Hansen 1994).

The ACUGDA covers a number of geologies. The geology of the northern end of Barwon River consists of Quaternary (Recent) stream alluvium deposits while at the southern end, the geology consists of Quaternary (Recent) dunes and aeolian siliceous sand sheets. Land to the north of the study area around Marshall is of Quaternary (Recent) origin and consists of fan deposits, fault aprons and high level alluvium. Immediately to the south in the Grovedale region are Tertiary (Oligocene) marine deposits of Waurn Ponds limestone and marl, with Tertiary (Pliocene) marine deposits of sand (including ferruginous and calcareous), limestone, gravel, with plant and marine fossils. The southern section of the study area is predominately olivine and iddingsite basalt of Quaternary (Pleistocene) origin. There is a small swamp and lagoonal deposit of Quaternary (Recent) origin in the south – east corner of the study area (Geological Survey of Victoria 1971).

The northern section of the study area is within the Otway Plains Bioregion and the southern section is within the Victorian Volcanic Plains Bioregion. Modelling of the pre-1750 vegetation predominately maps the Ecological Vegetation Classes (EVCs) Plains Grassland EVC 132 and Grassy Woodland EVC 175. The vegetation along Barwon River and associated floodplains is mapped as Floodplain Riparian Woodland EVC 56, Plains Sedgy Wetland EVC 647, Coastal Alkaline Scrub EVC 858, Lignum Wetland EVC 104, Cane Grass Lignum Halophytic Herbland EVC 898 and Coastal Saltmarsh / Mangrove Shrubland Mosaic EVC 302 (DSE 2005a).

The vegetation has been largely cleared and is generally highly modified. The majority of the native vegetation consists of scattered trees or patches associated with roadsides, and along Armstrong's Creek and Barwon River. Extant vegetation modelling maps small patches of Plains Grassland EVC 132 and Grassy Woodland EVC 175 scattered throughout the study area. Small patches of vegetation associated with Barwon River are mapped as Lignum Wetland EVC 104, Cane Grass Lignum Halophytic Herbland EVC 898, Plains Sedgy Wetland EVC 647, Coastal Alkaline Scrub EVC 858 and Coastal Saltmarsh / Mangrove Shrubland EVC 302 (DSE 2005a).

The area is generally rural with the exception of residentially zoned land at Marshall and small parcels of land zoned for Public Park and Recreation and Public Conservation and Resource. Other notable land uses in the area include the Geelong Airport and the Geelong Crematorium. Land west of Ghazeepore Road is utilised for mineral extraction, which may impact on the study area. A small section of land to the north – east of the Barwon Heads Road at Marshall is zoned Industrial 1 (City of Greater Geelong 2005).

Plate 1: Native vegetation along Armstrong Creek, Stewart's Reserve, ACUGDA (October 2005)

Plate 2: Plains Grassy Woodland, Stewarts Reserve, ACUGDA (October 2005)

Plate 3: Existing unsealed road networks such as these within the ACUGDA could be utilised as bike/walking tracks whilst simultaneously protecting vegetation remnants (October 2005)

2 Methods

2.1 Flora

2.1.1 Desktop review

Existing information was reviewed, including:

- Flora records within 5 km of the study area (referred to as the Data Review Area – DRA) held in the Victorian Flora Information System, a state-wide database maintained by the Department of Sustainability and Environment (DSE 2004a).
- Department of Environment and Heritage Protected Matters Database (DEH 2005), using a 5 km radius search area.
- Ecological Vegetation Class modelling of the study area (both extant and pre-1750) (DSE 2005a)
- Aerial photography supplied by the client or available on the mapping tool Tumaus (MTS 2003)
- Previous reports from the general study area (Ecology Australia 2001a, 2001b, Henshall Hansen 1994; Lee 1993; Pescott 1993)

2.1.2 Field Survey

The study area was visited on 20 October 2005 to obtain a broad overview of its existing biological values. Detailed surveys will be undertaken during later stages of this project.

2.1.3 Limitations

This report is primarily based on existing information relating to the site, and at this point no detailed field surveys have been undertaken to confirm the biological values. Significant species, not previously recorded, may have been overlooked; however it is envisaged that detailed surveys will be undertaken within areas chosen for development, and will overcome this limitation.

2.1.4 Terminology and Taxonomy

An asterisk (*) preceding plant names signifies non-indigenous (exotic) taxa, which are those that would not naturally occur in the particular habitat. A hash sign (#) is used to denote native plants that are not indigenous in the relevant vegetation types.

Plant taxonomy and the use of common names follow the accepted authorities – Ross and Walsh (2003) and DSE (2005b, 2004b).

2.1.5 Determination of significance

Categories of significance used in this report and how they are determined are explained in Appendix 3.

2.2 Fauna

2.2.1 Data review

The Victorian Fauna Display (DSE 2004b), a CD-ROM version of the Atlas of Victorian Wildlife (AVW), was searched for a list of fauna species previously recorded from an area of 5 km radius centred on the study area. This search area is hereafter referred to as the fauna Data Review Area (DRA).

2.2.2 Significance

Species of State and/or National significance are determined by reference to DSE's advisory list of threatened vertebrates for Victoria (DSE 2003), listings under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act) and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and by reference to National Action Plans for vertebrates and invertebrates. Further information regarding significance criteria can be found in Appendix 3.

2.2.3 Limitations

This is a preliminary study, not all fauna species in the study area will have been detected. This limitation is overcome to some extent through the information on species recorded from the DRA, sourced from the AVW database (DSE 2004b).

2.2.4 Nomenclature

An asterisk (*) preceding the species' name is used to signify non-indigenous taxa, which are those that would not naturally occur in the particular habitat.

The scientific names, common names and systematic orders of vertebrates follow Christidis & Boles (1994) and Schodde & Mason (1999) for birds, and the 'Atlas of Victorian Wildlife' for all other taxa.

3 Values

3.1 Flora

3.1.1 Plant species significance

A search of the FIS and EPBC databases within 5km of the study area (the flora DRA) was undertaken. A search of the FIS database returned records of 16 State or Nationally significant species previously recorded in the DRA (Table 1). A complete list of species recorded within the DRA is given in Appendix 1. Two of the records for significance species are within the study area: Creeping Rush and Bellarine Yellow-Gum (Figure 3). A search of the EPBC database returned an additional six species which may have a likelihood of occurrence within the DRA (Table 2).

The majority of the significant plant species listed in Table 1and Table 2 are unlikely to occur in the study area due to a lack of suitable habitat. Branching Groundsel, Large-fruit Fireweed and Purple Clover have a low likelihood of occurrence, mainly because they are inherently rare (G.W. Carr, Ecology Australia, pers comm.). Creeping Rush, Spiny Peppercress and Austral Trefoil have a moderate likelihood of occurrence and Bellarine Yellow-Gum was recorded during this study. Significant species, if present, are mostly likely to occur in remnant patches of vegetation along Armstrong Creek, Barwon River and floodplain, and along roadsides maintaining some remnant vegetation.

Significant species recorded or with at least a moderate likelihood of occurrence are briefly described below.

Bellarine Yellow-gum (*Eucalyptus leucoxylon* ssp. *bellarinensis*) – FFG listed, endangered in Victoria and Australia

Bellarine Yellow-gum is a small, often mallee-like tree to c. 12 m tall. It has loose fine fibrous bark on the base of the trunk and smooth grey and white bark on the upper branches. Club-shaped buds occur in threes; the fruit is wineglass-shaped (DSE 2004a). The record for Bellarine Yellow-Gum is 16 years old and occurs just south of Reserve Road between the Geelong – Warrnambool Railway and Horsehoe-bend Road (DSE 2004a, Figure 3). During the site visit on 20 October, Bellarine Yellow-Gum was confirmed along the north of Barwarre Road (Figure 3). This species may occur elsewhere in the ACUGDA.

Spiny Peppercress (*Lepidium aschersonii*) – Vulnerable in Australia (EPBC), FFG listed, endangered in Victoria

Spiny Peppercress is an intricately branched shrubby perennial herb to 30 cm high covered in short hairs; branchlets end in a spine. Terminal racemes of small pale yellow to white flowers are produced from October to February (Gray and Knight 2001). This species was recorded in 2001

from the data review area and has a moderate likelihood of occurring in saltmarshes associated with the lower reaches and floodplain of the Barwon River and Armstrong Creek.

Creeping Rush (*Juncus revolutus*) – rare in Victoria

Creeping Rush is a perennial rush to 30 cm high x 1.5 m wide, with small tufts of leaves at intervals along the rhizomes. It has narrow leaves and a sparse open panicle of green chaffy leaves; flowering occurs from November to March (Gray and Knight 2001, DSE 2004a). It has been recorded once, more than 20 years ago, on the east boarder of the study area near Reedy Lake Swamp (DSE 2004a, Figure 3). This species has a moderate likelihood of occurring in saltmarshes associated with the lower reaches and floodplain of the Barwon River and Armstrong Creek.

Austral Trefoil (*Lotus australis*) – poorly known in Victoria

Austral Trefoil is an open rounded perennial herb with soft light green leaves and pale pink or white pea flowers in terminal umbels; flowering occurs from October to March (Gray and Knight 2001). This species was recorded in 1989 in the DRA and has a moderate likelihood of occurring in remnant grasslands or grassy woodlands in the study area.

Harlequin Mistletoe (*Lysiana exocarpi*) – disjunct distribution in Victoria

During the brief site visit in October, Harlequin Mistletoe (*Lysiana exocarpi*) was recorded growing on Drooping Sheoak (*Allocasuarina verticillata*). Harlequin Mistletoe is a woody parasitic plant with narrow, grey-green leaves, bright red and yellow flowers and fleshy red fruit. This species is mostly found in the north-west of the State, and its occurrence on the common boundary of the Otway Plain and Victorian Volcanic Plain bioregions around Geelong is its most south-easterly known distribution (DSE 2004b). Its presence in the study area is of high Regional significance.

Other regionally significant species

A number of other species of regional significance have been recorded in the DRA (see Appendix 1) and there is at least a moderate likelihood that some of these species may occur in the ACUGDA.

Table 1: State and Nationally significant plant species previously recorded within 5km of the study area (DRA), Armstrong Creek UGDA.

Scientific Name	Common Name	Significance			Location in Study Area				LRO
		EPBC	FFG	DSE	Outside		Inside		
					No. of records	Years	No. of records	Years	
Acacia retinodes var. *uncifolia*	Coast Wirilda			r	2	1881, 2000			N
Adriana quadripartita	Coast Bitter-bush			v	4	1984, 1987			N
Atriplex paludosa ssp. *paludosa*	Marsh Saltbush			r	6	1925, 26, 82, 83, 85			N
Austrofestuca littoralis	Coast Fescue			r	3	1885, 1989			N
Eucalyptus leucoxylon ssp. *bellarinensis*	Bellarine Yellow-gum		*f*	e	1	2000	1	1989	R
Eucalyptus leucoxylon ssp. *connata*	Melbourne Yellow-gum		*f*	v	1	1988			N
Juncus revolutus	Creeping Rush			r	1	1997	1	1984	M
Lachnagrostis robusta	Salt Blown-grass			r	1	1996			N
Lepidium aschersonii	Spiny Peppercress	V	*f*	e	1	2001			M
Lotus australis	Austral Trefoil			k	2	1989			M
Pleurosorus subglandulosus	Glandular Blanket-fern			k	1	unknown			N
Pomaderris halmaturina ssp. *continentis*	Glenelg Pomaderris			r	2	1993, 1994			N
Senecio cunninghamii var. *cunninghamii*	Branching Groundsel			r	1	unknown			L
Senecio macrocarpus	Large-fruit Fireweed	V	*f*	e	1	1853			L
Xerochrysum palustre	Swamp Everlasting	V	*f*	v	1	1995			N
Zygophyllum billardierei	Coast Twin-leaf			r	1	2000			N

Key:
EPBC: National *Environment Protection and Biodiversity Conservation Act 1999*
FFG: Victorian *Flora and Fauna Guarantee Act 1988*
DSE: Department of Sustainability and Environment (Victoria)
V: Vulnerable in Australia, listed under the EPBC Act
f: Listed under the FFG Act
e: Endangered in Victoria (DSE 2005b)
v: Vulnerable in Victoria (DSE 2005b)
r: Rare in Victoria (DSE 2005b)
k: Poorly known in Victoria (DSE 2005b)
LRO: Likelihood of regular occurrence
R: Recorded
H: High
M: Moderate
L: Low
N: Negligible

Table 2: Nationally significant plant species previously recorded or with a likelihood of regular occurrence within 5km of the study area (EPBC Protected Matters Database), Armstrong Creek UGDA.

Scientific Name	Common Name	Significance			LRO
		EPBC	FFG	DSE	
Carex tasmanica	Curly Sedge	V	*f*	v	N
Glycine latrobeana	Purple Clover	V	*f*	v	L
Pimelea spinescens ssp. *spinescens*	Plains Rice-flower	C	*f*	v	N
Prasophyllum frenchii	Maroon Leek-orchid	E	*f*	e	N
Thelymitra epipactoides	Metallic Sun-orchid	E	*f*	e	N
Thelymitra matthewsii	Spiral Sun-orchid	V	*f*	v	N

Key:
EPBC: National *Environment Protection and Biodiversity Conservation Act 1999*
FFG: Victorian *Flora and Fauna Guarantee Act 1988*
DSE: Department of Sustainability and Environment (Victoria)
C: Critically Endangered in Australia, listed under the EPBC Act
E: Endangered in Australia, listed under the EPBC Act
V: Vulnerable in Australia, listed under the EPBC Act
f: Listed under the FFG Act
e: Endangered in Victoria (DSE 2005b)
v: Vulnerable in Victoria (DSE 2005b)
r: Rare in Victoria (DSE 2005b)
k: Poorly known in Victoria (DSE 2005b)
LRO: Likelihood of regular occurrence
R: Recorded
H: High
M: Moderate
L: Low
N: Negligible

3.1.2 Vegetation communities

EVC mapping/modelling

The northern section of the study area is within the Otway Plain Bioregion and the southern section is within the Victorian Volcanic Plains Bioregion. Modelling for the area predominately maps the pre-1750 Ecological Vegetation Classes (EVCs) as Plains Grassland EVC 132 and Grassy Woodland EVC 175. The vegetation along Barwon River and associated floodplains is mapped as Floodplain Riparian Woodland EVC 56, Plains Sedgy Wetland EVC 647, Coastal Alkaline Scrub EVC 858, Lignum Wetland EVC 104, Cane Grass Lignum Halophytic Herbland EVC 898 and Coastal Saltmarsh / Mangrove Shrubland Mosaic EVC 302 (Figure 1).

The native vegetation within the study area has been largely cleared and highly modified. The majority of the extant native vegetation consists of scattered trees or patches associated with roadsides, Armstrong's Creek and Barwon River. Extant vegetation modelling maps small patches of Plains Grassland EVC 132 and Grassy Woodland EVC 175 scattered throughout the study area. Small patches of vegetation associated with Barwon River are mapped as Lignum Wetland EVC 104, Cane Grass Lignum Halophytic Herbland EVC 898, Plains Sedgy Wetland EVC 647, Coastal Alkaline Scrub EVC 858 and Coastal Saltmarsh / Mangrove Shrubland EVC 302 (Figure 2).

Eight Ecological Vegetation Communities (EVCs) in total have been modelled as occurring within the study area either pre – 1750 or currently (extant vegetation) (Table 3).

Table 3: Ecological Vegetation Communities mapped for the Armstrong Creek UGDA.

EVC No.	EVC Name	Bioregion	Mapped for:	
			Pre 1750	Extant
56	Floodplain Riparian Woodland	OtP	√	-
104	Lignum Wetland	OtP	√	√
132	Plains Grassland	OtP, VVP	√	√
175	Grassy Woodland	OtP, VVP	√	√
302	Coastal Saltmarsh/Mangrove Shrubland Mosaic	OtP, VVP	√	√
647	Plains Sedgy Wetland	OtP	√	√
858	Coastal Alkaline Scrub	OtP	√	√
898	Cane Grass Lignum Halophytic Herbland	OtP	√	√

Key:

EVC: Ecological Vegetation Class

OtP: Otway Plain Bioregion

VVP: Victorian Volcanic Plain Bioregion

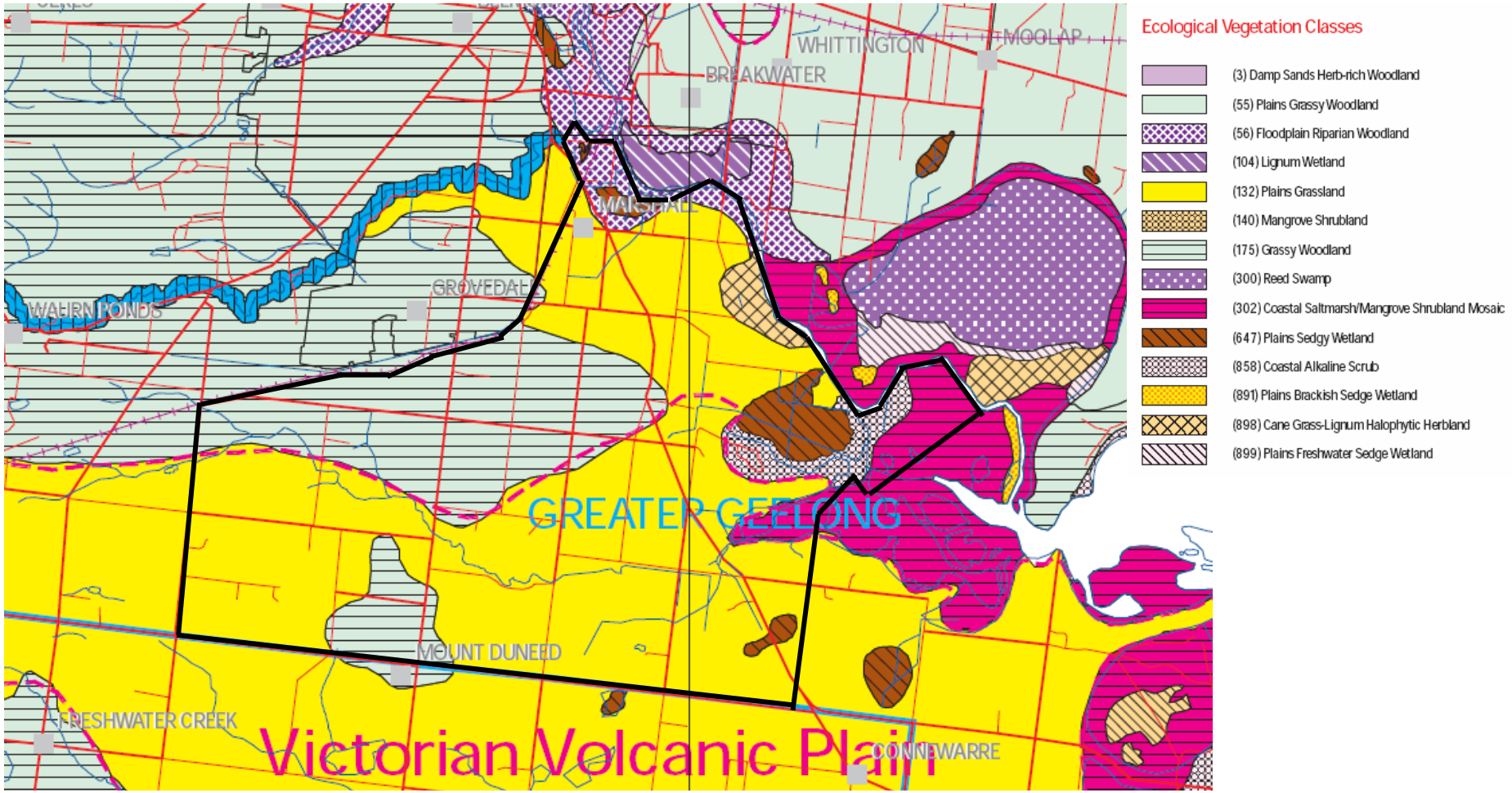

Figure 1: Pre – 1750 Ecological Vegetation Classes mapped for the Armstrong Creek Urban Growth Development Area and surrounds

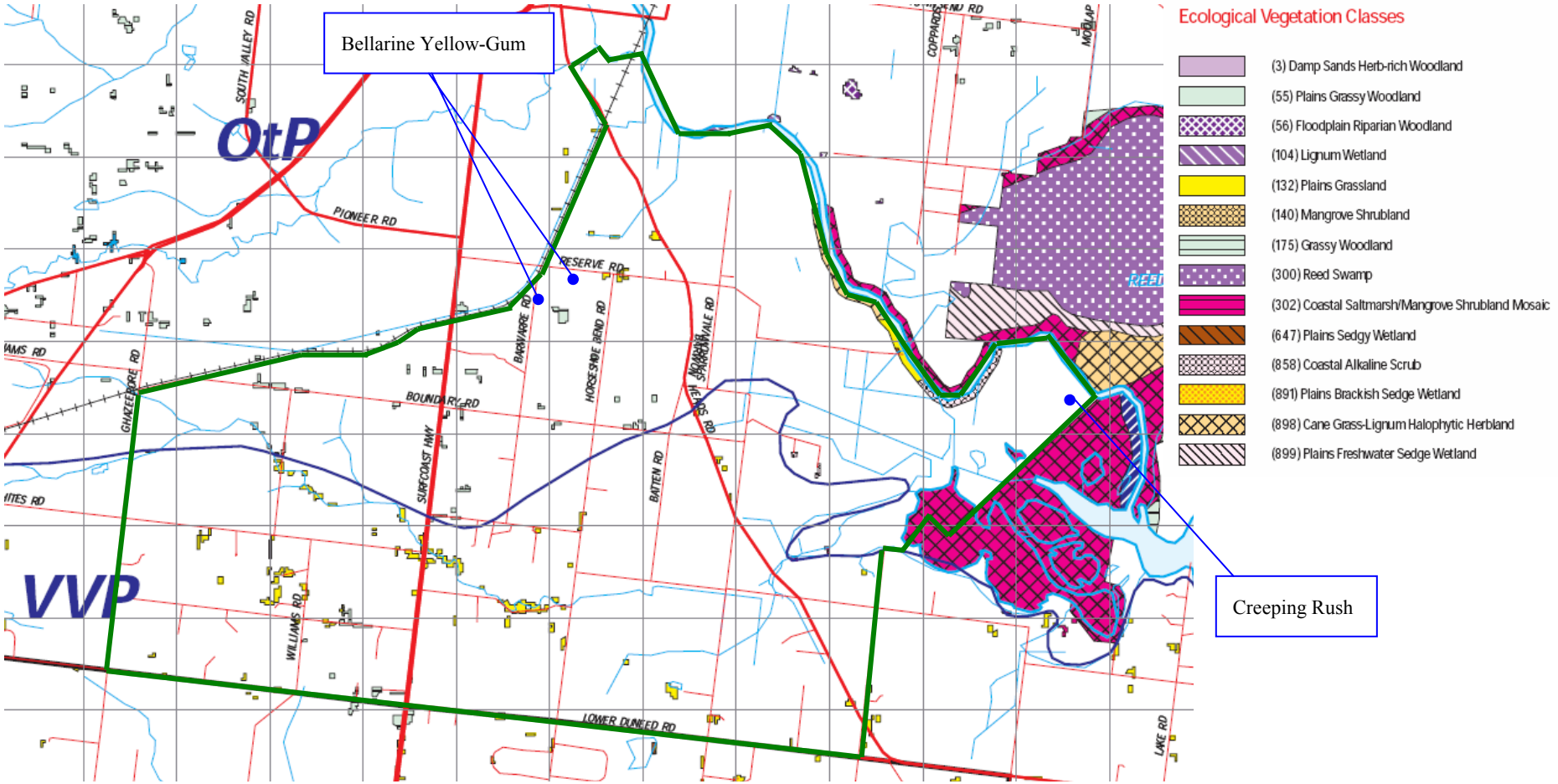

Figure 2: Extant Ecological Vegetation Class mapping and locations of significant plant species records, Armstrong Creek Urban Growth Development Area and surrounds

Vegetation characteristics of the Armstrong Creek UGDA and surrounds

Several previous studies have been undertaken within the Armstrong Creek UGDA and surrounds.

Armstrong Creek UGDA

The following descriptions of vegetation are based on an analysis of available literature. It is likely that certain vegetation types, such as wetlands and grasslands have been underreported. The following gives an overview of vegetation communities within the study area. For further detail refer to Ecology Australia (2001a, 2001b), Henshall Hansen (1994) and Pescott (1991, 1993).

Remnant vegetation within the Armstrong Creek UGDA is generally comprised of woodland, wetland vegetation and grassland. Much of the vegetation has been cleared and is highly modified. The vast majority of remnant vegetation occurs along roadsides or on the banks of Armstrong Creek and Barwon River and associated floodplains. Scattered trees occur within private property; the degree to which native understorey species persist within these patches is unknown.

The woodland vegetation is often dominated by River Red Gum with understorey shrubs including Drooping Sheoke, Hedge Wattle and Black Wattle. Scattered populations of the endangered Bellarine Yellow Gum occur near Barwarre Road and possibly elsewhere. Understorey grasses such as Kangaroo Grass, Wallaby-grasses and Spear-grasses are occasionally present.

Stewart's Reserve is among one of the best remaining examples of Grassy Woodland in the Geelong region. It is dominated by Manna Gum with some Swamp Gum and Red Gum. Several plants recorded in the Reserve have regional significance (Ecology Australia 2001a).

Riparian vegetation is mostly woodland dominated by River Red Gum and Manna Gum with semi-aquatic species such as Poong'ort (*Carex tereticaulis*). Riparian vegetation occurs in patches along the Barwon River and much of Armstrong Creek. The quality of the vegetation, particularly the understorey, varies across the site.

Wetland vegetation occurs in swampy sections of Armstrong Creek and on seasonally wet sites throughout the study area. Sub-saline to saline wetlands supporting salt tolerant vegetation occupy the lower reaches of Armstrong Creek, and parts of the Barwon River floodplain. This vegetation represents a number of different Ecological Vegetation Classes (see Figure 2, Ecology Australia 2001a) and, in places, is in reasonable condition despite a long history of grazing.

Exotic grassland occurs across much of the study area. To what extent native species persist within these grasslands is unknown.

Lake Connewarre State Game Reserve

While Lake Connewarre Reserve (part of the larger 'Bellarine Peninsula and Port Phillip Bay (Western Shoreline)' Ramsar site) is situated outside the Armstrong Creek UGDA, the site drains

into the Reserve and due consideration needs to be given to potential off-site impacts of development within the UGDA on hydrology and water supply within the Reserve. A very brief summary of the flora values of the Reserve is given below; for more information refer to Lee (1993) and Yugovic (1985). In 1993 a Management Plan for Lake Connewarre State Game Reserve was prepared which identified large areas of diverse and unusual vegetation interspersed with bodies of open water, much of it in a natural or relatively natural condition. Yugovic (1985) identified more than 20 floristic associations with 137 native and 78 exotic plant species, and he described the area as being of considerable scientific and educational value. Eighteen of the plant species recorded were considered to have high conservation significance (Lee 1993).

3.1.3 Vegetation community significance

Ecological Vegetation Communities (EVCs) are assigned a bioregional conservation status based on the level of depletion and rarity of occurrence, degree of threat and importance for supporting other significant features (DNRE 2002). The study area crosses the border of the Otway Plain Bioregion and the Victorian Volcanic Plain Bioregion. The conservation status of EVCs mapped for the Armstrong Creek UGDA is given in Table 4.

Table 4: Conservation status of Ecological Vegetation Classes mapped for the Armstrong Creek UGDA.

EVC No.	EVC Name	Conservation Status	
		OtP	VVP
56	Floodplain Riparian Woodland	E	E
104	Lignum Wetland	E	E
132	Plains Grassland	E	E
175	Grassy Woodland	E	E
302	Coastal Saltmarsh/Mangrove Shrubland Mosaic	E	E
647	Plains Sedgy Wetland	X	E
858	Coastal Alkaline Scrub	E	n/a
898	Cane Grass - Lignum Halophytic Herbland	V	n/a

Key:

OtP: Otway Plain Bioregion

VVP: Victorian Volcanic Plain Bioregion

V: Vulnerable

E: Endangered

X: Presumed Extinct

n/a: Not applicable

Most of the EVCs recorded in the study area have a conservation status of Endangered and all remnant vegetation in the region is considered to be of at least Local conservation significance. It has been conservatively estimated that only 5 % of former vegetation remains in the City of Greater Geelong and that much of what remains is severely degraded (Ecology Australia 2001a).

The Biodiversity Management Plan for the City of Greater Geelong identified a number of sites of biodiversity significance. Those within the Armstrong Creek UGDA include: Armstrong Creek, Floodplain of the lower Barwon River and estuary, Stewart's Reserve and records of Bellarine Yellow Gums. These sites were considered to have Regional to State conservation significance (Ecology Australia 2001a).

3.1.4 Biosites

DSE mapping also indicates Sites of Biodiversity Significance or 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' (DSE 2005a).

There are eight biosites within or potentially impacted by development within the Armstrong Creek UGDA (Table 5, Figure 3). These sites range from Local to National conservation significance.

Table 5: Description of biosites within or neighbouring the Armstrong Creek UGDA.

BioSite No.	BioSite Name	Significance	Location		Bioregion	Local Government Authority
			SA	N		
1250	Lake Connewarre	National	-	√	OtP	Greater Geelong
1301	Connewarre - Altona Skipper	Regional	-	√	VVP	Greater Geelong
1332	Goat Island	Local	-	√	OtP	Greater Geelong
1373	Williams Road	Local	-	√	VVP	Surf Coast
1392	Airport Rd, Grovedale	Regional	√	-	VVP	Greater Geelong
1393	Stewarts Rd	Regional	√	-	VVP	Greater Geelong
3509	Waurn Ponds Road Reserve (Grass PPBL001)	Yet to be determined	√	-	OtP	Surf Coast
4257	Lake Connewarre Wildlife Reserve (Grass VVP129)	Yet to be determined	-	√	VVP	Greater Geelong

Source: DSE (2005a)

Key:

SA: Within the study area

N: Neighbouring the study area and may be impacted by future development

OtP: Otway Plain Bioregion

VVP: Victorian Volcanic Plain Bioregion

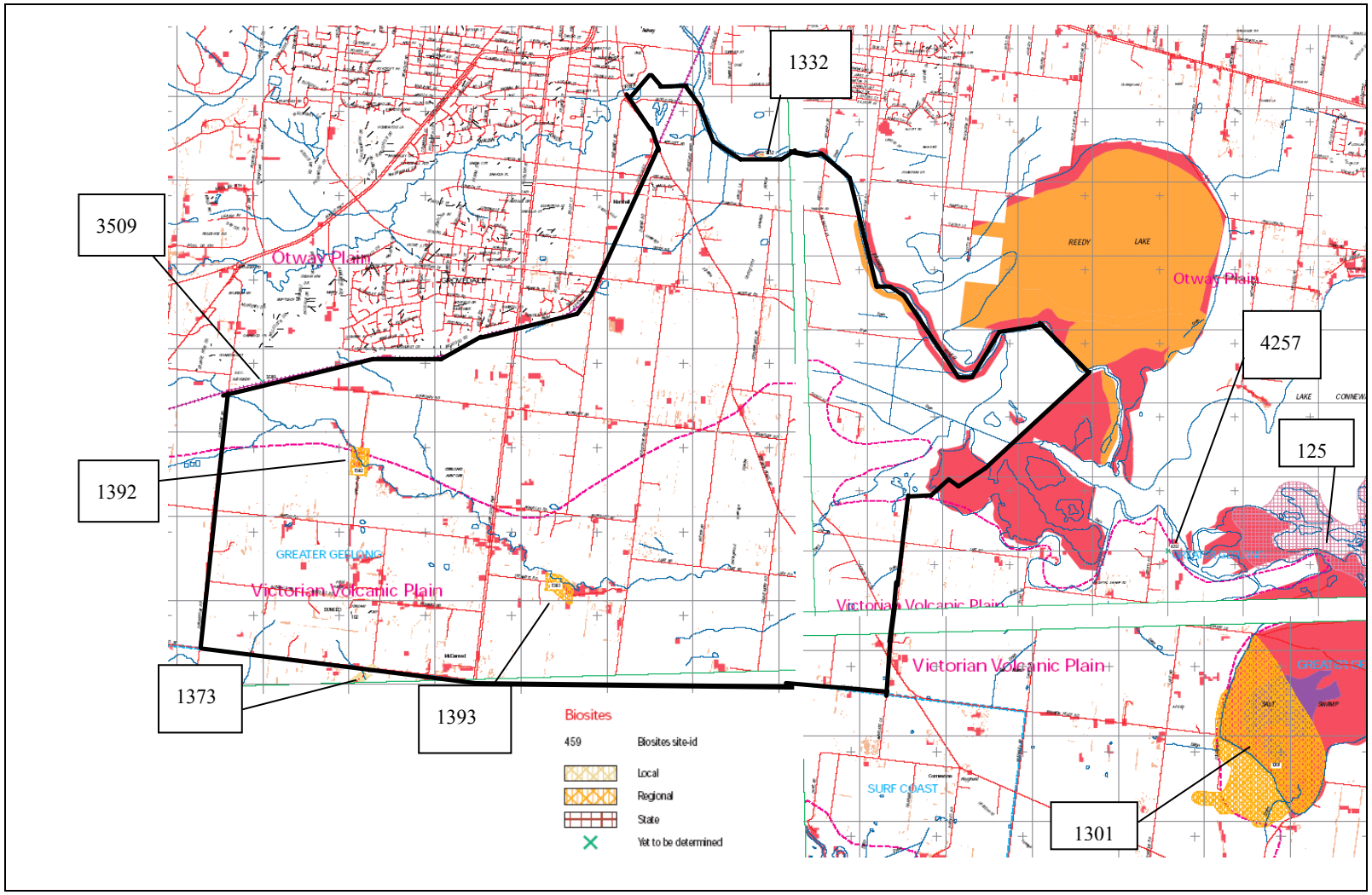

Figure 3: Location of Biosites within and neighbouring the Armstrong Creek Urban Growth Development Area.

3.1.5 Significant Roadsides

In 2001 Ecology Australia (2001b) undertook a Roadside Vegetation Management Plan (VMP) for the City of Greater Geelong, including areas that are within the Armstrong Creek UGDA. The aims of the Roadside VMP were to preserve, enhance and properly manage roadsides for their conservation and landscape values while maintaining their functional roles. Vegetation on roadsides is important for land protection, flora and fauna habitat and landscape character. Vegetated roadsides can provide important links between larger areas of native vegetation, and where larger remnants no longer exist, roadside vegetation can provide the only functional habitat for native flora and fauna (Ecology Australia 2001b). The conservation significance of remnant roadside vegetation (Low to High) was assigned to all roadsides in the City of Greater Geelong. The conservation significance of roadsides within the Armstrong Creek UGDA is shown in Figure 4. A section of Lake Road is deemed to be of High conservation significance and sections of road of Medium conservation significance are scattered throughout. The report by Henshall Hansen (1994) also identified roadside vegetation of high and medium conservation significance.

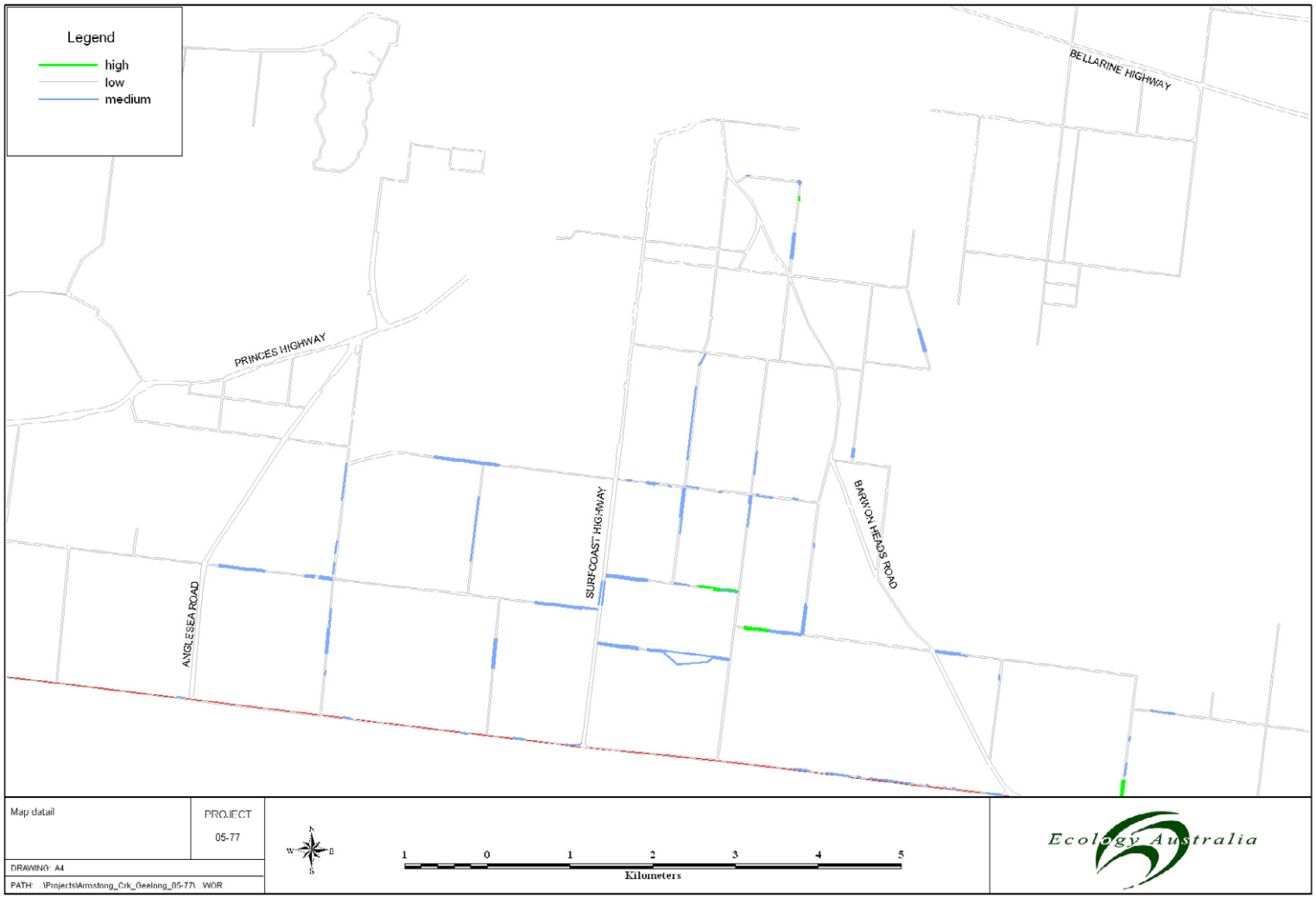

Figure 4: Roadside vegetation conservation significance in the Armstrong Creek UGDA

3.2 Fauna

Introduction

There were 165 fauna species recorded within the fauna Data Review Area (DRA). This total consisted of 147 bird species (11 exotic), 4 mammal species (1 exotic), 4 reptile species, 2 frog species, 7 fish species and one invertebrate (Appendix 2).

The number of fauna species identified within the Fauna DRA is relatively low, considering the size of the area involved and the diversity of habitat types that exist or would have existed in this area. This probably reflects the patchy distribution of survey effort that has been undertaken in the area (evidenced by the clear bias towards records of wetland birds), and also the high degree of natural habitat reduction in the area generally.

Fish surveys were recently conducted in Armstrong Creek for the preliminary stages of the Geelong Bypass project (VicRoads) by WBM Oceanics. Findings of this work are discussed.

Significance

Of the 165 species in the database search, there were six fauna species listed under the EPBC Act, and 17 listed under the FFG Act. The numbers of taxa within each fauna group considered of National or State significance within the fauna DRA is given in table 6, and a list of these species in table 7.

The two seabirds that were recorded within the Fauna DRA, Southern Giant-Petrel and Black-browed Albatross are coastal sea-birds and their presence within the fauna DRA is an artefact of the inaccuracies of the database records themselves. Their likelihood of regular occurrence (LRO) within the ACUGDA is considered negligible. Likewise the LRO of Speckled Warbler is considered negligible, as this species is now locally extinct in this area.

Table 6: Fauna species of National or State significance recorded from the Armstrong Creek 5km radius Data Review Area.

Common Name	Scientific Name	Last	Recs	EPBC	DSE	FFG	LRO
Southern Giant-Petrel	*Macronectes giganteus*	1972	1	EN,M	VU	L	N
Black-browed Albatross	*Thalassarche melanophris*	1972	1	M	EN		N
Pied Cormorant	*Phalacrocorax varius*	1999	1	M	NT		H
Pectoral Sandpiper	*Calidris melanotos*	1952	1	M	NT		M
Whiskered Tern	*Chlidonias hybridus*	1999	2	M	NT		H
Pacific Gull	*Larus pacificus*	1972	1	M	NT		M
Brolga	*Grus rubicunda*	2000	1	M	VU	L	L
Glossy Ibis	*Plegadis falcinellus*	1999	1	M	NT		M
Royal Spoonbill	*Platalea regia*	1999	5		VU		H
Great Egret	*Ardea alba*	1999	3	M	VU	L	H
Australasian Bittern	*Botaurus poiciloptilus*	2000	1	M	EN	L	H
Australasian Shoveler	*Anas rhynchotis*	2000	2	M	VU		H
Hardhead	*Aythya australis*	2000	1	M	VU		H
Musk Duck	*Biziura lobata*	1999	1	M	VU		M
Azure Kingfisher	*Alcedo azurea*	1999	1		NT		L
Speckled Warbler	*Chthonicola sagittata*	1886	2		VU	L	N
Grey-headed Flying-fox	*Pteropus poliocephalus*	2002	1	VU	VU	L	H
Growling Grass Frog	*Litoria raniformis*	1770	1	VU	EN	L	M
Australian Grayling	*Prototroctes maraena*	1986	4	VU	VU	L	M
Yarra Pigmy Perch	*Nannoperca obscura*	1991	45	VU	NT	L	M

Key:

Last	Most recent record from the 'Atlas of Victorian Wildlife' (AVW) (DSE 2004b).
Recs	Number of records from the 'Atlas of Victorian Wildlife' (AVW) (DSE 2004b).
EPBC	Federal *Environment Protection & Biodiversity Conservation Act 1999* (EPBC). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, CD = Conservation Dependant, M = migratory or marine-overfly.
DSE	Advisory list of Victorian threatened fauna (DSE 2003). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened.
FFG	Victorian *Flora & Fauna Guarantee Act 1988* (FFG). L = Listed threatened species.
LRO	Likelihood of regular occurrence. H = High, M = Moderate, L = Low, N = Negligible. Species of Low or Negligible LRO include those that are locally very rare or extinct, or vagrants to the area (unshaded above).

Growling Grass Frog (*Litoria raniformis)* – National significance

Though the most recent record from the study area in the State database for this species is given as '1770' (DSE 2004b), indicating a very old record of uncertain date, there are much more recent records from immediately outside the study area (eg. Jerringot/Belmont Common Golf Course, October 1995, L.E. Conole unpubl. data; Reedy Lake near Leopold, November 1997, AVW (DSE 2004b)).

In addition there is much suitable habitat for the species within and immediately adjacent to the study area, and apparently little targeted survey effort has been directed to the area for the Growling Grass Frog.

For these reasons we regard the likelihood that this species will occur in natural and artificial waterbodies within the Armstrong Creek UGP as at least Moderate, and in some sections probably High.

Other significant fauna species

As mentioned previously, the dataset for the study area found in the State fauna database (AVW) is manifestly incomplete, and reflects a relatively small and spatially biased survey effort. Other

areas immediately adjacent to the ACUGPA which have received relatively large amounts of survey effort include such sites as the Lake Connewarre – Reedy Lake section of the Ramsar site, the saltmarsh areas of the Breamlea FFR, Horseshoe Bend, and Jerringot Reserve on the Belmont Common.

Some species regularly or occasionally found in these adjacent areas but not yet recorded from the ACUGPA include a number of significant species which almost certainly also occur on the same basis in the study area (particularly on the Barwon River floodplain) (see Table 8).

Table 7: Fauna species of National or State significance recorded in areas adjacent to the Armstrong Creek UGDA.

EPBC	DSE	FFG	LRO	Common Name	Scientific Name
	NT		H	Brown Quail	*Coturnix ypsilophora*
	VU	L	M	Lewin's Rail	*Rallus pectoralis*
	VU	L	H	Baillon's Crake	*Porzana pusilla*
	NT		H	Latham's Snipe	*Gallinago hardwickii*
V	CE	L	M	Australian Painted Snipe	*Rostratula australis*
	NT		M	White-winged Black Tern	*Chlidonias leucopterus*
	EN	L	L	Gull-billed Tern	*Sterna nilotica*
	NT	L	M	Caspian Tern	*Sterna caspia*
	NT		L	Pacific Gull	*Larus pacificus*
	VU		M	Wood Sandpiper	*Tringa glareola*
	EN	L	H	Little Egret	*Egretta garzetta*
	CR	L	M	Intermediate Egret	*Ardea intermedia*
	NT		H	Nankeen Night Heron	*Nycticorax caledonicus*
	EN	L	M	Australian Little Bittern	*Ixobrychus dubius*
	NT		H	Cape Barren Goose	*Cereopsis novaehollandiae*
	VU		M	Magpie Goose	*Anseranas semipalmata*
	EN	L	M	Freckled Duck	*Stictonetta naevosa*
	EN	L	H	Blue-billed Duck	*Oxyura australis*
	VU	L	M	White-bellied Sea-Eagle	*Haliaeetus leucogaster*
	VU		M	Black Falcon	*Falco subniger*
	EN	L	L	Masked Owl	*Tyto novaehollandiae*
EN	CR	L	L	Orange-bellied Parrot	*Neophema chrysogaster*
EN	EN	L	L	Swift Parrot	*Lathamus discolor*
	NT		M	Glossy Grass Skink	*Pseudemoia rawlinsoni*
VU	VU	L	H	Australian Grayling	*Prototroctes maraena*
VU	NT	L	M	Yarra Pygmy Perch	*Nannoperca obscura*
			M	Altona Skipper butterfly	*Hesperilla flavescens flavescens*

EPBC	Federal *Environment Protection & Biodiversity Conservation Act 1999* (EPBC). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, CD = Conservation Dependant, M = migratory or marine-overfly.
DSE	Advisory list of Victorian threatened fauna (DSE 2003). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened.
FFG	Victorian *Flora & Fauna Guarantee Act 1988* (FFG). L = Listed threatened species.
LRO	Likelihood of regular occurrence. H = High, M = Moderate, L = Low, N = Negligible. Species of Low or Negligible LRO include those that are locally very rare or extinct, or vagrants to the area (unshaded above).

Armstrong Creek Fish Fauna

As mentioned previously surveys were conducted in Armstrong Creek as part of the ecological assessment process for the Geelong Bypass Project. The survey showed poor aquatic habitat condition and low habitat diversity. Riparian vegetation was sparse, comprised of a discontinuous fringe of overhanging trees, which would provide marginal habitat for locally common fauna resilient of highly disturbed environments (WBM 2005a). Low species diversity was observed at all sites along Armstrong Creek, species detected mainly consisted of Southern Pygmy Perch and Short-finned Eel (WBM 2005b). No species listed under the EPBC or FFG Act are expected to occur in Armstrong Creek (WBM 2005b).

Records of Yarra Pygmy Perch from the nearby Waurn Ponds Creek suggest that Armstrong Creek may also support this species given suitable habitat and conditions.

Other Fauna species

There are relatively recent records of Platypus and Water Rat from the Barwon River, but currently no records from Armstrong Creek. Most recent sighting of Platypus occurred around Winchelsea and Buckley's Falls (Overman, 2003). Water Rats are typically recorded in relatively urbanised streams and rivers as compared to systems deemed more rural (Australian Platypus Conservancy 2004). Neither of these species are listed under the EPBC or FFG Acts.

Fauna habitat values

The habitats of the Armstrong Creek UGDA can be broadly defined as a dichotomy of wetland and dryland types.

The dryland areas constitute ~ 80 % of the UGDA, and are generally situated to west of the study area. These areas are highly modified and have undergone a substantial loss of habitat values.

The wetland areas include the Barwon River and Armstrong Creek channels and floodplains, and although representing a relatively small part of the UGDA, hold significant values for fauna. Threatened bird species such as the Nankeen Night Heron and Azure Kingfisher are likely to occur along the Barwon River and Armstrong Creek where suitable habitat exists, whereas a range of other wetland species are more likely to be associated with marshes and open water habitats.

Consequently, faunal habitat values are substantially clustered in the study area.

Wetland habitats occur largely in the Barwon River channel and its attendant floodplain, with lesser occurrences in and adjacent to Armstrong Creek. Some farm dams in the study area are likely to have developed wetland characteristics.

Dryland habitats occupy most of the study area west of the Geelong – Barwon Heads Road. Grassy woodland remnants and isolated native trees are principally clustered around the Armstrong Creek and the network of secondary roads. Grassland of varying quality and modification, ranging from that containing some native vegetation all the way through to fully

converted exotic pasture, cover the remainder of the dryland area. The extent to which these farmland areas contain important or useful fauna habitat is not yet clear, but will be investigated and documented during the next phase of the study in areas which are targeted for development within the UDF.

Wetlands of national and international significance (including Ramsar)

As mentioned previously Lake Connewarre Reserve lies to the east of the study area and forms part of the larger 'Bellarine Peninsula and Port Phillip Bay (Western Shoreline)' Ramsar site. Also part of this Ramsar site is Reedy Lake which lies to the north of the Armstrong Creek UGDA, and Hospital Swamps which lie to the south-east.

Lake Connewarre, Reedy Lake and the Hospital Swamps support significant numbers of four shorebird species i.e. Sharp-tailed Sandpiper, Curlew Sandpiper, Marsh Sandpiper and Red-necked Stint (see Table 9) (Watkins 1993).

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), implemented on 16 July 2000, identifies Ramsar sites as matters of national environmental significance for which the Commonwealth has a significant responsibility. Wise use principles extend beyond the Ramsar site boundaries. The EPBC Act sets out procedures for assessing actions with potentially significant impacts on Ramsar values, whether these actions are proposed within or outside site boundaries. Protecting the values on adjacent land and in important nearby wetland areas contributes to maintaining Ramsar site values (DSE 2003).

Under the guidelines issued for the EPBC Act, an impact on the ecological character of a declared Ramsar wetland is significant if:

- Areas of the wetland are destroyed or substantially modified; or
- There is a major and measurable change in the natural hydrological regime of the wetland (eg change to the timing, duration and frequency of ground and surface water flows to and within the wetland); or
- The habitat or lifecycle of native species dependant upon the wetland is seriously affected; or
- There is a major and measurable change in the physico-chemical status of the wetland (eg salinity, pollutants, nutrients, temperature, turbidity); or
- Invasive species are introduced into the wetland.

Table 8: Internationally and Nationally significant shorebirds in Lake Connewarre, Reedy Lake and Hospital Swamp (source Watkins 1993).

(I – Internationally significant, N – Nationally significant)

	Lake Connewarre	Reedy Lake	Hospital Swamp
Sharp-tailed Sandpiper	I	I	I
Curlew Sandpiper	I	-	N
Marsh Sandpiper	N	N	N
Red-necked Stint	N	-	N

Lake Connewarre lies at the bottom of the Barwon River catchment and the ecological character of the wetland system depends greatly on water quality and flows in this river. The extensive Barwon River catchment contains some of the most intensively farmed land in Victoria as well as much of the City of Geelong, land uses that directly affect the quality and quantity of water entering the river, and associated wetlands (DSE 2003).

Although the Armstrong Creek UGDA is situated outside the Reserve, most of it drains directly into the Ramsar site, and there is therefore the potential for indirect impacts to result from development within the Armstrong Creek UGDA.

Due consideration needs to be given to potential off-sites impacts of development within the UGDA on hydrology and water supply within the Lake Connewarre Reserve.

4 Legislation

4.1 Federal *Environment Protection & Biodiversity Conservation Act* 1999 (EPBC)

The EPBC Act pertains to matters of national environmental significance including Ramsar Wetlands, listed threatened species and ecological communities, listed migratory species and commonwealth marine areas. It applies to public and private land and a referral is necessary whenever a proposed action is considered likely to significantly impact on any matters of national environmental significance (MNES) listed under the Act.

No plant species or communities listed under the EBPC Act have been recorded in the study area. One plant species, Spiny Peppercress (*Lepidium aschersonii*), listed as Vulnerable under the Act has a moderate likelihood of occurring within the study area (in saltmarsh habitat).

Six EPBC-listed Vulnerable fauna species – Australian Painted Snipe, Grey-headed Flying-fox, Growling Grass Frog, Australian Grayling and Yarra Pygmy Perch – are either known or regarded as at least moderately likely to occur in the study area.

4.2 Victorian *Flora & Fauna Guarantee Act* 1988 (FFG)

The FFG Act lists species and ecological communities that are recognised to be rare or threatened in Victoria. It also identifies threatening process. The full extent of the FFG Act only applies to public land, but the intent of the Act also applies to other land tenures through action statements, Victoria's biodiversity policy, and through the planning scheme referral process.

One plant taxon, Bellarine Yellow-gum (*Eucalyptus leucoxylon* ssp. *bellarinensis*), listed under the FFG has been recorded and Plains Grassland, which is listed as a Threatened Community, has been modelled for the study area. Spiny Peppercress, which is also listed under the FFG, has a moderate likelihood of occurring (in saltmarsh habitat).

17 FFG-listed threatened fauna species – Lewin's Rail, Baillon's Crake, Great Egret, Little Egret, Intermediate Egret, Australian Little Bittern, Australasian Bittern, Australian Painted Snipe, Caspian Tern, Freckled Duck, Blue-billed Duck, White-bellied Sea-Eagle, Grey-headed Flying-fox, Growling Grass Frog, Australian Grayling, Yarra Pygmy Perch and Altona Skipper butterfly – are either known or regarded as at least moderately likely to occur in the study area. The FFG-listed Brolga has also been recorded in the study area, but it is regarded as of Low likelihood of regular occurrence.

4.3 Victorian *Catchment & Land Protection Act* 1994 (CaLP)

The *Catchment and Land Protection Act* 1994 (CALP) provides a legislative framework for the management of land including the control of declared noxious weeds and pest animals.

The Act sets out the responsibilities of private and public 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,
- conserve soil,
- protect water resources,
- 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.

For details on serious environmental weeds in the City of Greater Geelong refer to Ecology Australia (2001a).

4.4 Victoria's *Native Vegetation Management Framework*

In Victoria, where a permit is required for the removal of native vegetation, the proponent is required to offset the loss with appropriate 'gains' - as defined in Victoria's *Native Vegetation Management – A Framework for Action* (DNRE 2002) (hereafter referred to as the Framework). After options for avoidance and minimisation of loss have been considered, the extent of vegetation loss is calculated based on an assessment of its condition (H) and area of loss (ha): the losses are thus expressed as habitat hectares (hha). The offsets required are determined by consideration of the vegetation lost (hha) and the conservation status of the Ecological Vegetation Class (EVC).

The Net Gain approach is summarised in the Framework document as follows:

"*Net Gain is the outcome for native vegetation and habitat where overall gains are greater than overall losses and where individual losses are avoided where possible. The losses and gains are determined by a combined quality-quantity measure and over a specified area and period of time*." (DNRE 2002)

Fundamental to vegetation management is the concept that remnant indigenous vegetation is of greater ecological value and inherently more important than that achieved through revegetation. Therefore, emphasis is given in the Framework to avoiding or minimising losses, as reflected in the three-step approach:

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

Any loss of native vegetation in the Armstrong Creek UGDA will need to be assessed under Net Gain and offsets will need to be met on-site or locally.

5 Discussion

5.1 Potential impacts and constraints to development

The most significant potential impacts to biodiversity values from development within the Armstrong Creek UGDA are associated with:

- Indirect impacts to Lake Connewarre State Game Reserve through altered hydrological regimes
- Impacts to values along Armstrong Creek and Barwon River
- Potential impacts to State and Nationally listed species
- Potential loss of woodland vegetation on roadsides and in riparian zones

Recommendations are given in section 6 to ameliorate these impacts. Areas of constraint to proposed development within the project area are shown in Figure 5.

5.2 Potential opportunities to enhance biodiversity values

As discussed previously, the greater proportion of this study area is situated in dryland areas in which the habitat values have been greatly reduced, principally due to land clearing and agricultural practices. Remnant vegetation along roadside corridors (both along unmade roads and along road easements) has therefore become valuable in terms of its value to biodiversity.

There is an opportunity for development within the ACUGDA to take advantage of these roadsides areas to develop linkages that enhance habitat values and provide movement corridors for fauna. These linkages could also provide amenity value to other user groups i.e. bike paths/walking trails.

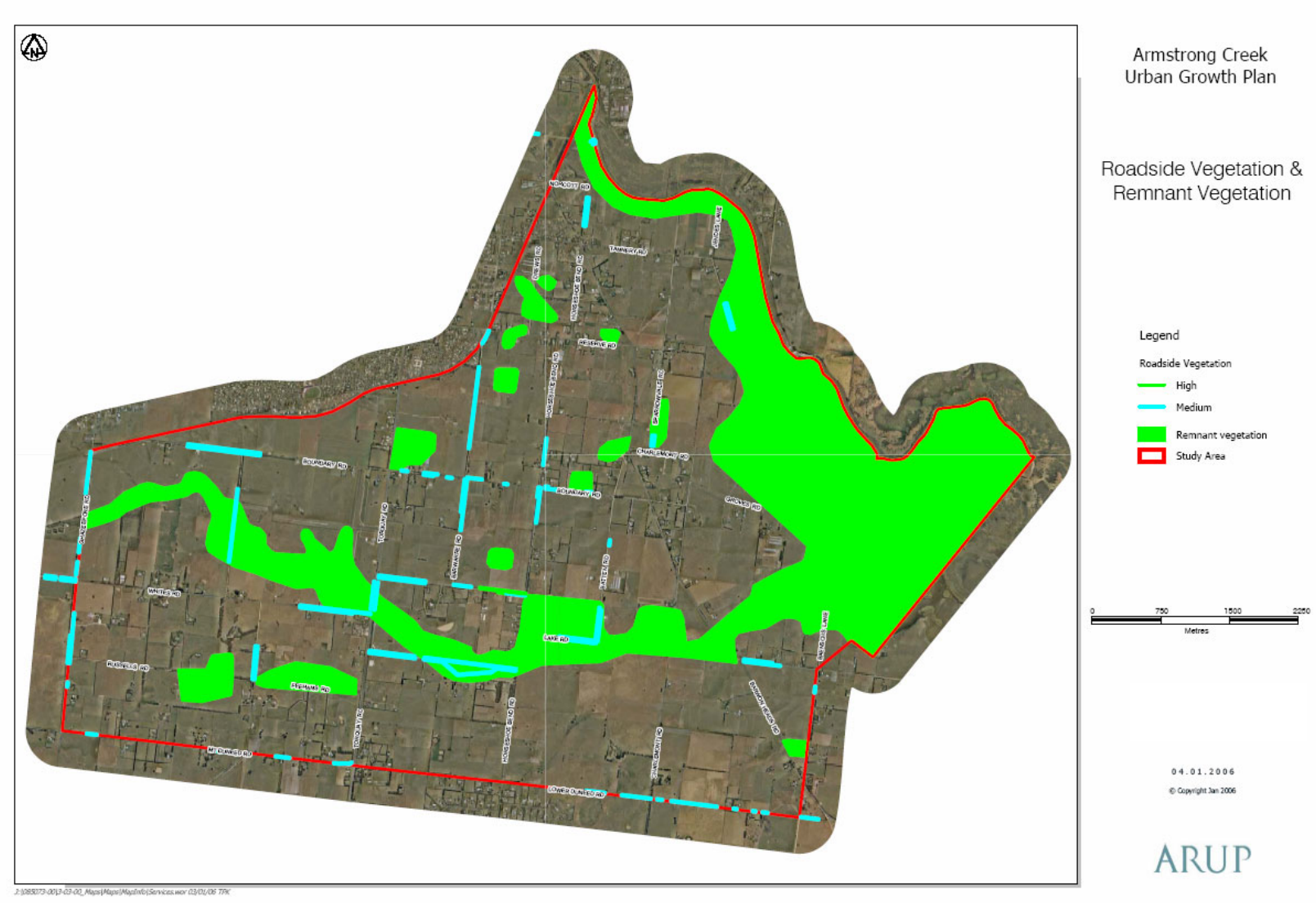

Figure 5: Areas of potential constraint to proposed development within the Armstrong Creek UGP Project area.

6 Recommendations

The following recommendations are made in regards to conserving and enhancing the flora and fauna values within the Armstrong Creek UGDA:

- Avoid native vegetation removal along Armstrong Creek, Barwon River and associated floodplain
- Avoid works that will impact upon both the instream and surrounding habitat values of Armstrong Creek
- Where development is to occur investigate implementation of best-management erosion and storm-water control practices to prevent sediment, and pollution run-off into neighbouring areas of high conservation value
- Utilise the existing road network (containing a substantial portion of remnant vegetation within the study area) as a cycling/walking path network and to create landscape linkages
- Avoid the removal of stands of indigenous eucalypts and she-oaks where possible
- Undertake control of woody and other selected weed species
- Undertake pest animal control programs
- Undertake revegetation work along Armstrong Creek and roadsides to provide habitat corridors for local fauna
- Undertake more detailed flora and fauna surveys in areas proposed for development
- Undertake surveys for significant species (if suitable habitat is deemed to be present within areas proposed for development)

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9 Abbreviations

ACUGP	Armstrong Creek Urban Growth Plan
ACUGDA	Armstrong Creek Urban Growth Development Area
CoGG	City of Greater Geelong
DEH	Commonwealth Department of the Environment and Heritage
DRA	Data Review Area
DSE	Victorian Department of Sustainability and Environment
EVC	Ecological Vegetation Class
OtP	Otway Plain Bioregion
UGDA	Urban Growth Development Area
VVP	Victorian Volcanic Plain Bioregion

Appendix 1: Plant species previously recorded within the Armstrong Creek Data Review Area, December 2005

* Exotic	k poorly known
# Potentially weedy native	r rare
R regionally significant	e endangered
f listed under the *Flora and Fauna Act* 1988	
V vulnerable under the *Environment Protection Biodiversity Conservation Act* 1999	

1: Mosses		
Brachytheciaceae		
	**** Brachythecium albicans***	Whitish Feather-moss
Polytrichaceae		
R	***Polytrichum juniperinum***	Juniper Haircap
6: Ferns and Fern-like Plants		
Adiantaceae		
R	***Cheilanthes sieberi subsp. sieberi***	Narrow Rock-fern
Aspleniaceae		
k	***Pleurosorus subglandulosus***	Glandular Blanket-fern
Azollaceae		
R	***Azolla filiculoides***	Pacific Azolla
Marsileaceae		
R	***Marsilea hirsuta***	Short-fruit Nardoo
	Marsilea spp.	Nardoo
Selaginellaceae		
R	***Selaginella uliginosa***	Swamp Selaginella
7: Conifers		
Cupressaceae		
	**** Cupressus spp.***	Cypress
Pinaceae		
	**** Pinus radiata***	Radiata Pine
8: Monocotyledons		
Alismataceae		
R	***Alisma plantago-aquatica***	Water Plantain
Alliaceae		
	**** Allium vineale***	Crow Garlic
Anthericaceae		
R	***Arthropodium strictum***	Chocolate Lily
Aponogetonaceae		
	**** Aponogeton distachyos***	Cape Pond-lily
Asparagaceae		
	**** Asparagus officinalis***	Asparagus
Asphodelaceae		

	**** Asphodelus fistulosus***	Onion Weed
Colchicaceae		
	Burchardia umbellata	Milkmaids
Cyperaceae		
	Bolboschoenus caldwellii	Salt Club-sedge
	Bolboschoenus spp.	Club Sedge
	Carex appressa	Tall Sedge
	Carex breviculmis	Common Grass-sedge
	Carex spp.	Sedge
R	***Carex tereticaulis***	Poong'ort
	**** Cyperus eragrostis***	Drain Flat-sedge
	Cyperus spp.	Flat Sedge
	Eleocharis acuta	Common Spike-sedge
R	***Gahnia filum***	Chaffy Saw-sedge
	Isolepis cernua var. cernua	Nodding Club-sedge
R	***Isolepis marginata***	Little Club-sedge
	Isolepis spp.	Club Sedge
R	***Lepidosperma congestum***	Clustered Sword-sedge
R	***Lepidosperma curtisiae***	Little Sword-sedge
	Lepidosperma spp.	Sword Sedge
	Schoenoplectus spp.	Club Sedge
R	***Schoenoplectus tabernaemontani***	River Club-sedge
	Schoenus apogon	Common Bog-sedge
Hypoxidaceae		
	Hypoxis spp.	Hypoxis
Iridaceae		
	**** Moraea flaccida***	One-leaf Cape-tulip
	**** Romulea minutiflora***	Small-flower Onion-grass
	**** Romulea rosea***	Onion Grass
Juncaceae		
	**** Juncus articulatus***	Jointed Rush
	Juncus bufonius	Toad Rush
	Juncus gregiflorus	Green Rush
	Juncus pallidus	Pale Rush
r	***Juncus revolutus***	Creeping Rush
	Juncus spp.	Rush
	Luzula meridionalis	Common Woodrush
	Luzula meridionalis var. meridionalis	Common Woodrush
Juncaginaceae		
R	***Triglochin procera s.l.***	Water Ribbons
R	***Triglochin procera s.s.***	Common Water-ribbons
	Triglochin striata	Streaked Arrowgrass
Lemnaceae		

R	***Lemna disperma***	Common Duckweed
Orchidaceae		
R	***Caladenia cardiochila***	Heart-lip Spider-orchid
R	***Caladenia latifolia***	Pink Fairies
R	***Diuris orientis***	Wallflower Orchid
R	***Glossodia major***	Wax-lip Orchid
R	***Leptoceras menziesii***	Hare Orchid
R	***Microtidium atratum***	Yellow Onion-orchid
R	***Microtis arenaria***	Notched Onion-orchid
R	***Microtis unifolia***	Common Onion-orchid
R	***Pheladenia deformis***	Bluebeard Orchid
R	***Thelymitra antennifera***	Rabbit Ears
R	***Thelymitra flexuosa***	Twisted Sun-orchid
Phormiaceae		
R	***Caesia calliantha***	Blue Grass-lily
	Dianella brevicaulis	Small-flower Flax-lily
	Dianella revoluta s.l.	Black-anther Flax-lily
R	***Tricoryne elatior***	Yellow Rush-lily
Poaceae		
	**** Agrostis capillaris s.l.***	Brown-top Bent
	**** Agrostis stolonifera***	Creeping Bent
	**** Aira elegantissima***	Delicate Hair-grass
R	***Amphibromus neesii***	Southern Swamp Wallaby-grass
	Amphibromus spp.	Swamp Wallaby-grass
	Amphipogon strictus	Grey-beard Grass
	**** Anthoxanthum odoratum***	Sweet Vernal-grass
	Austrodanthonia caespitosa	Common Wallaby-grass
R	***Austrodanthonia eriantha***	Hill Wallaby-grass
	Austrodanthonia racemosa var. racemosa	Stiped Wallaby-grass
	Austrodanthonia setacea	Bristly Wallaby-grass
	Austrodanthonia spp.	Wallaby Grass
r	***Austrofestuca littoralis***	Coast Fescue
	Austrostipa oligostachya	Fine-head Spear-grass
	Austrostipa scabra	Rough Spear-grass
	Austrostipa spp.	Spear Grass
	**** Avena spp.***	Oat
	**** Brachypodium distachyon***	False Brome
	**** Briza maxima***	Large Quaking-grass
	**** Briza minor***	Lesser Quaking-grass
	**** Bromus catharticus***	Prairie Grass
	**** Bromus diandrus***	Great Brome
	**** Bromus hordeaceus subsp. hordeaceus***	Soft Brome
	**** Catapodium rigidum***	Fern Grass

	**** Cortaderia selloana***	Pampas Grass
	**** Cynodon dactylon var. dactylon***	Couch
	**** Dactylis glomerata***	Cocksfoot
	Danthonia s.l. spp.	Wallaby Grass
	Dichelachne crinita	Long-hair Plume-grass
	Dichelachne spp.	Plume Grass
	Distichlis distichophylla	Australian Salt-grass
	**** Ehrharta longiflora***	Annual Veldt-grass
	Elymus scaber var. scaber	Common Wheat-grass
R	***Eragrostis infecunda***	Southern Cane-grass
	**** Festuca arundinacea***	Tall Fescue
	**** Holcus lanatus***	Yorkshire Fog
	**** Hordeum glaucum***	Northern Barley-grass
	**** Hordeum leporinum***	Barley-grass
	**** Hordeum marinum***	Sea Barley-grass
	**** Hordeum secalinum***	Knotted Barley-grass
	Lachnagrostis filiformis	Common Blown-grass
	**** Lagurus ovatus***	Hare's-tail Grass
	**** Lolium perenne***	Perennial Rye-grass
	**** Lolium rigidum***	Wimmera Rye-grass
	**** Lolium spp.***	Rye Grass
	Microlaena stipoides var. stipoides	Weeping Grass
	**** Nassella neesiana***	Chilean Needle-grass
	**** Nassella trichotoma***	Serrated Tussock
	**** Paspalum dilatatum***	Paspalum
	**** Paspalum distichum***	Water Couch
	**** Pennisetum clandestinum***	Kikuyu
	**** Phalaris aquatica***	Toowoomba Canary-grass
	**** Phalaris minor***	Lesser Canary-grass
	Phragmites australis	Common Reed
	**** Piptatherum miliaceum***	Rice Millet
	**** Poa annua***	Annual Meadow-grass
	Poa labillardierei	Common Tussock-grass
	Poa labillardierei var. labillardierei	Common Tussock-grass
	**** Poa pratensis***	Kentucky Blue-grass
	Poa sieberiana var. sieberiana	Grey Tussock-grass
	**** Polypogon monspeliensis***	Annual Beard-grass
	Puccinellia stricta var. perlaxa	Plains Saltmarsh-grass
	Puccinellia stricta var. stricta	Australian Saltmarsh-grass
	**** Secale cereale subsp. cereale***	Rye
	**** Setaria parviflora***	Slender Pigeon Grass
	**** Setaria verticillata***	Whorled Pigeon-grass
	**** Sporobolus africanus***	Rat-tail Grass

	Themeda triandra	Kangaroo Grass
	**** Tribolium acutiflorum s.l.***	Desmazeria
	**** Vulpia bromoides***	Squirrel-tail Fescue
	**** Vulpia muralis***	Wall Fescue
	**** Vulpia spp.***	Fescue
Potamogetonaceae		
R	***Potamogeton pectinatus***	Fennel Pondweed
R	***Potamogeton tricarinatus s.l.***	Floating Pondweed
Typhaceae		
	Typha domingensis	Narrow-leaf Cumbungi
	Typha orientalis	Broad-leaf Cumbungi
	Typha spp.	Bulrush
Xanthorrhoeaceae		
	Lomandra filiformis	Wattle Mat-rush
R	***Lomandra micrantha subsp. micrantha***	Small-flower Mat-rush
R	***Lomandra nana***	Dwarf Mat-rush
	Lomandra spp.	Mat-rush
Zosteraceae		
R	***Zostera capricorni***	Dwarf Grass-wrack
r	***Zostera tasmanica***	Tasman Grass-wrack
9: Dicotyledons		
Aizoaceae		
	**** Galenia pubescens var. pubescens***	Galenia
Amaranthaceae		
	Alternanthera denticulata s.s.	Lesser Joyweed
R	***Ptilotus spathulatus f. spathulatus***	Pussy Tails
Anacardiaceae		
	**** Schinus molle***	Pepper Tree
Apiaceae		
	**** Conium maculatum***	Hemlock
R	***Eryngium ovinum***	Blue Devil
	**** Foeniculum vulgare***	Fennel
	Lilaeopsis polyantha	Australian Lilaeopsis
Asclepiadaceae		
	**** Araujia sericifera***	White Bladder-flower
Asteraceae		
	Actites megalocarpa	Dune Thistle
	**** Arctotheca calendula***	Cape Weed
R	***Argentipallium obtusifolium***	Blunt Everlasting
	**** Aster subulatus***	Aster-weed
	**** Berkheya rigida***	African Thistle
R	***Brachyscome dentata***	Lobe-seed Daisy
R	***Brachyscome diversifolia***	Tall Daisy

R	***Brachyscome perpusilla***	Rayless Daisy
R	***Calocephalus citreus***	Lemon Beauty-heads
R	***Calocephalus lacteus***	Milky Beauty-heads
R	***Calotis scapigera***	Tufted Burr-daisy
	**** Carduus nutans subsp. nutans***	Musk Thistle
	Chrysocephalum apiculatum s.l.	Common Everlasting
	Chrysocephalum apiculatum s.s.	Common Everlasting
R	***Chrysocephalum semipapposum***	Clustered Everlasting
	**** Cirsium vulgare***	Spear Thistle
	**** Conyza bonariensis***	Flaxleaf Fleabane
	**** Conyza spp.***	Fleabane
	**** Cotula coronopifolia***	Water Buttons
	**** Cynara cardunculus***	Spanish Artichoke
R	***Euchiton collinus s.s.***	Creeping Cudweed
	**** Hedypnois cretica***	Cretan Hedypnois
	Helichrysum scorpioides	Button Everlasting
	**** Helminthotheca echioides***	Ox-tongue
	Hyalosperma demissum	Moss Sunray
	**** Hypochoeris glabra***	Smooth Cat's-ear
	**** Hypochoeris radicata***	Cat's Ear
	**** Lactuca serriola***	Prickly Lettuce
	Lagenophora gracilis	Slender Bottle-daisy
	**** Leontodon taraxacoides subsp. taraxacoides***	Hairy Hawkbit
	Leptinella longipes	Coast Cotula
	Leptinella reptans s.l.	Creeping Cotula
	Leptinella reptans s.s.	Creeping Cotula
R	***Leptorhynchos squamatus***	Scaly Buttons
R	***Leptorhynchos squamatus subsp. squamatus***	Scaly Buttons
R	***Leptorhynchos tenuifolius***	Wiry Buttons
	**** Matricaria matricarioides***	Rounded Chamomile
	Minuria leptophylla	Minnie Daisy
R	***Olearia teretifolia***	Cypress Daisy-bush
	**** Oncosiphon piluliferum***	Globe Chamomile
	Pseudognaphalium luteoalbum	Jersey Cudweed
r	***Senecio cunninghamii var. cunninghamii***	Branching Groundsel
f Ve	***Senecio macrocarpus***	Large-fruit Fireweed
	Senecio quadridentatus s.l.	Cotton Fireweed
R	***Senecio spathulatus s.l.***	Dune Groundsel
	Senecio spp.	Groundsel
	**** Senecio vulgaris***	Common Groundsel
	**** Soliva sessilis***	Jo Jo
	**** Sonchus asper subsp. asper***	Rough Sow-thistle
	**** Sonchus oleraceus***	Common Sow-thistle

R	***Stuartina muelleri***	Spoon Cudweed
	**** Taraxacum Sect. Hamata***	Garden Dandelion
	**** Taraxacum officinale spp. agg.***	Garden Dandelion
	**** Tolpis barbata***	Yellow Hawkweed
	Triptilodiscus pygmaeus	Common Sunray
	**** Vellereophyton dealbatum***	White Cudweed
R	***Vittadinia gracilis***	Woolly New Holland Daisy
	Vittadinia spp.	New Holland Daisy
Boraginaceae		
	**** Echium plantagineum***	Paterson's Curse
	**** Nonea lutea***	Yellow Alkanet
Brassicaceae		
	**** Brassica fruticulosa***	Twiggy Turnip
	**** Diplotaxis tenuifolia***	Sand Rocket
	**** Hirschfeldia incana***	Buchan Weed
	**** Lepidium africanum***	Common Peppercress
	**** Raphanus raphanistrum***	Wild Radish
	**** Rapistrum rugosum***	Giant Mustard
Callitrichaceae		
	**** Callitriche hamulata***	Thread Water-starwort
	**** Callitriche spp. (naturalised)***	Water Starwort
Campanulaceae		
R	***Wahlenbergia luteola***	Bronze Bluebell
	Wahlenbergia spp.	Bluebell
Caryophyllaceae		
	**** Petrorhagia spp.***	Pink
	**** Silene nocturna***	Mediterranean Catchfly
	**** Silene spp.***	Catchfly
	**** Spergula arvensis***	Corn Spurrey
	Spergularia marina s.s.	Lesser Sea-spurrey
R	***Stellaria angustifolia***	Swamp Starwort
Casuarinaceae		
R	***Allocasuarina littoralis***	Black Sheoak
	Allocasuarina misera	Slender Sheoak
R	***Allocasuarina verticillata***	Drooping Sheoak
Chenopodiaceae		
R	***Atriplex australasica***	Native Orache
r	***Atriplex paludosa subsp. paludosa***	Marsh Saltbush
	**** Atriplex prostrata***	Hastate Orache
	**** Beta vulgaris***	Beet
	**** Beta vulgaris subsp. vulgaris***	Beet
	**** Chenopodium album***	Fat Hen
	**** Chenopodium murale***	Sowbane

	Einadia nutans subsp. nutans	Nodding Saltbush
R	***Maireana brevifolia***	Short-leaf Bluebush
R	***Maireana decalvans***	Black Cotton-bush
	Sarcocornia quinqueflora	Beaded Glasswort
	Sarcocornia quinqueflora subsp. quinqueflora	Beaded Glasswort
R	***Sclerolaena muricata var. villosa***	Grey Roly-poly
	Suaeda australis	Austral Seablite
R	***Threlkeldia diffusa***	Coast Bonefruit
Clusiaceae		
	**** Hypericum perforatum subsp. veronense***	St John's Wort
Convolvulaceae		
R	***Calystegia sepium subsp. roseata***	Large Bindweed
	Convolvulus erubescens spp. agg.	Pink Bindweed
	Dichondra repens	Kidney-weed
Crassulaceae		
	Crassula decumbens var. decumbens	Spreading Crassula
	Crassula helmsii	Swamp Crassula
	Crassula sieberiana s.l.	Sieber Crassula
Cucurbitaceae		
	**** Ecballium elaterium***	Squirting Cucumber
Dipsacaceae		
	**** Scabiosa atropurpurea***	Pincushion
Droseraceae		
	Drosera peltata subsp. auriculata	Tall Sundew
Epacridaceae		
	Astroloma humifusum	Cranberry Heath
	Epacris impressa	Common Heath
	Leucopogon parviflorus	Coast Beard-heath
Euphorbiaceae		
	**** Euphorbia helioscopia***	Sun Spurge
	**** Euphorbia peplus***	Petty Spurge
Fabaceae		
	Bossiaea prostrata	Creeping Bossiaea
R	***Dillwynia cinerascens s.l.***	Grey Parrot-pea
R	***Dillwynia cinerascens s.s.***	Grey Parrot-pea
R	***Dillwynia glaberrima***	Smooth Parrot-pea
	**** Genista monspessulana***	Montpellier Broom
R	***Glycine clandestina***	Twining Glycine
	Kennedia prostrata	Running Postman
	**** Medicago minima***	Little Medic
	**** Medicago polymorpha***	Burr Medic
	**** Medicago truncatula***	Barrel Medic
	**** Melilotus indicus***	Sweet Melilot

	**** Melilotus siculus***	Mediterranean Melilot
	Platylobium obtusangulum	Common Flat-pea
	Pultenaea daphnoides	Large-leaf Bush-pea
R	***Pultenaea tenuifolia***	Slender Bush-pea
R	***Sphaerolobium minus***	Eastern Globe-pea
	**** Trifolium angustifolium var. angustifolium***	Narrow-leaf Clover
	**** Trifolium cernuum***	Drooping-flower Clover
	**** Trifolium fragiferum var. fragiferum***	Strawberry Clover
	**** Trifolium glomeratum***	Cluster Clover
	**** Trifolium repens var. repens***	White Clover
	**** Trifolium scabrum***	Rough Clover
	**** Trifolium spp.***	Clover
	**** Trifolium subterraneum***	Subterranean Clover
	**** Ulex europaeus***	Gorse
	**** Vicia sativa***	Common Vetch
	**** Vicia sativa subsp. sativa***	Common Vetch
Frankeniaceae		
	**** Frankenia pulverulenta***	Mediterranean Sea-heath
Fumariaceae		
	**** Fumaria muralis subsp. muralis***	Wall Fumitory
Gentianaceae		
	**** Centaurium tenuiflorum***	Slender Centaury
Geraniaceae		
	**** Erodium cicutarium***	Common Heron's-bill
R	***Geranium solanderi s.l.***	Austral Cranesbill
Goodeniaceae		
	Goodenia geniculata	Bent Goodenia
	Goodenia ovata	Hop Goodenia
	Goodenia spp.	Goodenia
R	***Scaevola albida***	Small-fruit Fan-flower
	Selliera radicans	Shiny Swamp-mat
Haloragaceae		
	Gonocarpus tetragynus	Common Raspwort
R	***Haloragis heterophylla***	Varied Raspwort
	Myriophyllum crispatum	Upright Water-milfoil
R	***Myriophyllum salsugineum***	Lake Water-milfoil
	Myriophyllum spp.	Water-milfoil
Loganiaceae		
R	***Phyllangium distylis***	Tiny Mitrewort
Loranthaceae		
	Amyema pendula subsp. pendula (s.s.)	Drooping Mistletoe
R	***Lysiana exocarpi***	Harlequin Mistletoe
R	***Muellerina eucalyptoides***	Creeping Mistletoe

Lythraceae			
		Lythrum hyssopifolia	Small Loosestrife
Malvaceae			
	R	***Gynatrix pulchella s.s.***	Hemp Bush
		**** Malva nicaeensis***	Mallow of Nice
		**** Malva parviflora***	Small-flower Mallow
		**** Modiola caroliniana***	Red-flower Mallow
Mimosaceae			
	R	***Acacia implexa***	Lightwood
		Acacia mearnsii	Black Wattle
		Acacia melanoxylon	Blackwood
		Acacia myrtifolia	Myrtle Wattle
		Acacia paradoxa	Hedge Wattle
		Acacia pycnantha	Golden Wattle
	r	***Acacia retinodes var. uncifolia***	Coast Wirilda
		Acacia verticillata subsp. verticillata	Prickly Moses
		**** Paraserianthes lophantha subsp. lophantha***	Cape Wattle
Myoporaceae			
		# Myoporum insulare	Common Boobialla
Myrtaceae			
	R	***Calytrix tetragona***	Common Fringe-myrtle
		Eucalyptus camaldulensis	River Red-gum
		**** Eucalyptus cladocalyx***	Sugar Gum
	f e	***Eucalyptus leucoxylon subsp. bellarinensis***	Bellarine Yellow-gum
		Eucalyptus ovata var. ovata	Swamp Gum
	R	***Eucalyptus viminalis subsp. viminalis***	Manna Gum
		# Leptospermum laevigatum	Coast Tea-tree
		Leptospermum myrsinoides	Heath Tea-tree
	r	***# Melaleuca armillaris subsp. armillaris***	Giant Honey-myrtle
	R	***Melaleuca lanceolata subsp. lanceolata***	Moonah
Oleaceae			
		**** Fraxinus angustifolia***	Desert Ash
Onagraceae			
	R	***Epilobium billardierianum***	Variable Willow-herb
		**** Epilobium hirsutum***	Great Willow-herb
	R	***Epilobium hirtigerum***	Hairy Willow-herb
Oxalidaceae			
		Oxalis exilis	Shady Wood-sorrel
		Oxalis perennans	Grassland Wood-sorrel
		**** Oxalis pes-caprae***	Soursob
		Oxalis spp.	Wood Sorrel
Phytolaccaceae			
		**** Phytolacca octandra***	Red-ink Weed

Pittosporaceae		
R	***Bursaria spinosa subsp. spinosa***	Sweet Bursaria
	# Pittosporum undulatum	Sweet Pittosporum
Plantaginaceae		
	**** Plantago coronopus***	Buck's-horn Plantain
	**** Plantago lanceolata***	Ribwort
	**** Plantago major***	Greater Plantain
Polygonaceae		
R	***Muehlenbeckia adpressa***	Climbing Lignum
	Muehlenbeckia florulenta	Tangled Lignum
	Persicaria decipiens	Slender Knotweed
	Persicaria lapathifolia	Pale Knotweed
	**** Polygonum aviculare s.l.***	Prostrate Knotweed
R	***Rumex bidens***	Mud Dock
	**** Rumex conglomeratus***	Clustered Dock
	**** Rumex crispus***	Curled Dock
Portulacaceae		
R	***Neopaxia australasica***	White Purslane
Primulaceae		
	**** Anagallis arvensis***	Pimpernel
Proteaceae		
	Banksia marginata	Silver Banksia
Ranunculaceae		
	**** Batrachium trichophyllum***	Water Fennel
R	***Ranunculus amphitrichus***	Small River Buttercup
Resedaceae		
	**** Reseda luteola***	Weld
Rosaceae		
	Acaena agnipila	Hairy Sheep's Burr
	Acaena echinata	Sheep's Burr
	Acaena ovina	Australian Sheep's Burr
	**** Cotoneaster pannosus***	Velvet Cotoneaster
	**** Crataegus monogyna***	Hawthorn
	**** Pyracantha spp.***	Firethorn
	**** Rosa rubiginosa***	Sweet Briar
	**** Rubus fruticosus spp. agg.***	Blackberry
Rubiaceae		
R	***Asperula conferta***	Common Woodruff
	**** Coprosma repens***	Mirror Bush
	**** Galium aparine***	Cleavers
Salicaceae		
	**** Salix cinerea***	Grey Sallow
	**** Salix spp.***	Willow

Santalaceae		
	Exocarpos cupressiformis	Cherry Ballart
Scrophulariaceae		
	**** Cymbalaria muralis subsp. muralis***	Ivy-leaf Toadflax
R	***Mimulus repens***	Creeping Monkey-flower
R	***Veronica gracilis***	Slender Speedwell
Solanaceae		
	**** Lycium ferocissimum***	African Box-thorn
	**** Salpichroa origanifolia***	Pampas Lily-of-the-Valley
R	***Solanum aviculare***	Kangaroo Apple
	Solanum laciniatum	Large Kangaroo Apple
Thymelaeaceae		
R	***Pimelea glauca***	Smooth Rice-flower
	Pimelea humilis	Common Rice-flower
	Pimelea octophylla	Woolly Rice-flower
R	***Pimelea serpyllifolia subsp. serpyllifolia***	Thyme Rice-flower
Urticaceae		
	**** Urtica urens***	Small Nettle
Violaceae		
	**** Viola odorata***	Common Violet
Zygophyllaceae		
R	*Zygophyllum spp.*	Twin-leaf

Appendix 2: Fauna species recorded from the Armstrong Creek 5km radius Data Review Area. Source: Atlas of Victorian Wildlife (DSE 2004b)

Armstrong Creek 5 km DRA - all AVW datasets
Species list from irregular area bounded by the rectangle :
Latitude: -38°11'23" to -38°16'07" Longitude: +144°17'31" to +144°23'39"
Number of Surveys in Search Area = 219
Species range : 1 - 5999 Number of species found = 165
Data from Atlas of Victorian Wildlife - 24 March 2004

Common Name	Scientific Name	Last	Recs	EPBC	DSE	FFG
Stubble Quail	*Coturnix pectoralis*	2000	2	M		
Painted Button-quail	*Turnix varia*	1886	2			
Common Bronzewing	*Phaps chalcoptera*	1999	2			
Buff-banded Rail	*Gallirallus philippensis*	1886	2	M		
Australian Spotted Crake	*Porzana fluminea*	2001	2			
Spotless Crake	*Porzana tabuensis*	1904	1	M		
Dusky Moorhen	*Gallinula tenebrosa*	2000	9			
Purple Swamphen	*Porphyrio porphyrio*	1999	6			
Eurasian Coot	*Fulica atra*	1999	3			
Australasian Grebe	*Tachybaptus novaehollandiae*	1972	3			
Hoary-headed Grebe	*Poliocephalus poliocephalus*	1999	3			
Southern Giant-Petrel	*Macronectes giganteus*	1972	1	EN	VU	L
Cape Petrel	*Daption capense*	1972	1	M		
Black-browed Albatross	*Thalassarche melanophris*	1972	1	M	EN	
Little Black Cormorant	*Phalacrocorax sulcirostris*	2000	6	M		
Pied Cormorant	*Phalacrocorax varius*	1999	1	M	NT	
Little Pied Cormorant	*Phalacrocorax melanoleucos*	2000	7			
Australasian Gannet	*Morus serrator*	1972	2	M		
Australian Pelican	*Pelecanus conspicillatus*	1999	3	M		
Whiskered Tern	*Chlidonias hybridus*	1999	2	M	NT	
Crested Tern	*Sterna bergii*	1972	1	M		
Silver Gull	*Larus novaehollandiae*	2001	8	M		
Pacific Gull	*Larus pacificus*	1972	1	M	NT	
Red-kneed Dotterel	*Erythrogonys cinctus*	1999	3	M		
Masked Lapwing	*Vanellus miles*	2001	16	M		
Banded Lapwing	*Vanellus tricolor*	1972	2	M		
Red-capped Plover	*Charadrius ruficapillus*	2000	4	M		
Black-fronted Dotterel	*Elseyornis melanops*	2000	4	M		
Black-winged Stilt	*Himantopus himantopus*	1999	3	M		
Red-necked Avocet	*Recurvirostra novaehollandiae*	1999	1	M		
Bar-tailed Godwit	*Limosa lapponica*	1999	1	M		
Common Greenshank	*Tringa nebularia*	1999	1	M		
Curlew Sandpiper	*Calidris ferruginea*	2000	2	M		
Red-necked Stint	*Calidris ruficollis*	2000	5	M		
Pectoral Sandpiper	*Calidris melanotos*	1952	1	M	NT	
Sharp-tailed Sandpiper	*Calidris acuminata*	2000	2	M		
Brolga	*Grus rubicunda*	2000	1	M	VU	L
Glossy Ibis	*Plegadis falcinellus*	1999	1	M	NT	
Australian White Ibis	*Threskiornis molucca*	2000	8	M		
Straw-necked Ibis	*Threskiornis spinicollis*	2000	9	M		
Royal Spoonbill	*Platalea regia*	1999	5		VU	

Common Name	Scientific Name	Last	Recs	EPBC	DSE	FFG
Yellow-billed Spoonbill	*Platalea flavipes*	1999	5			
Great Egret	*Ardea alba*	1999	3	M	VU	L
White-faced Heron	*Egretta novaehollandiae*	2001	15			
White-necked Heron	*Ardea pacifica*	1978	1			
Australasian Bittern	*Botaurus poiciloptilus*	2000	1	M	EN	L
Black Swan	*Cygnus atratus*	2000	10	M		
Australian Shelduck	*Tadorna tadornoides*	2000	3	M		
Pacific Black Duck	*Anas superciliosa*	2001	19	M		
Chestnut Teal	*Anas castanea*	2000	4	M		
Grey Teal	*Anas gracilis*	2000	3	M		
Australasian Shoveler	*Anas rhynchotis*	2000	2	M	VU	
Hardhead	*Aythya australis*	2000	1	M	VU	
Musk Duck	*Biziura lobata*	1999	1	M	VU	
Swamp Harrier	*Circus approximans*	2000	6	M		
Wedge-tailed Eagle	*Aquila audax*	1972	1	M		
Whistling Kite	*Haliastur sphenurus*	2001	5	M		
Black-shouldered Kite	*Elanus axillaris*	2001	12	M		
Australian Hobby	*Falco longipennis*	2000	3	M		
Brown Falcon	*Falco berigora*	2001	7	M		
Nankeen Kestrel	*Falco cenchroides*	2000	2	M		
Rainbow Lorikeet	*Trichoglossus haematodus*	1999	3			
Musk Lorikeet	*Glossopsitta concinna*	2000	3			
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	2000	3			
Little Lorikeet	*Glossopsitta pusilla*	1998	1			
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	2001	8			
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2001	4			
Sulphur-crested Cockatoo	*Cacatua galerita*	1999	2			
Galah	*Cacatua roseicapilla*	2000	10			
Cockatiel	*Nymphicus hollandicus*	1937	1			
Australian King-Parrot	*Alisterus scapularis*	1998	1			
Crimson Rosella	*Platycercus elegans*	1999	3			
Eastern Rosella	*Platycercus eximius*	2000	6			
Red-rumped Parrot	*Psephotus haematonotus*	2000	6			
Azure Kingfisher	*Alcedo azurea*	1999	1		NT	
Laughing Kookaburra	*Dacelo novaeguineae*	1886	2			
Sacred Kingfisher	*Todiramphus sanctus*	1904	3	M		
Pallid Cuckoo	*Cuculus pallidus*	1999	3	M		
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	1999	3	M		
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	2001	8	M		
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	1886	2	M		
Welcome Swallow	*Hirundo neoxena*	2001	34	M		
Tree Martin	*Hirundo nigricans*	1999	1	M		
Grey Fantail	*Rhipidura fuliginosa*	1973	5			
Willie Wagtail	*Rhipidura leucophrys*	2001	24			
Jacky Winter	*Microeca fascinans*	1972	3			
Scarlet Robin	*Petroica multicolor*	2001	5			
Flame Robin	*Petroica phoenicea*	2000	1	M		
Eastern Yellow Robin	*Eopsaltria australis*	1972	1			
Golden Whistler	*Pachycephala pectoralis*	1972	1			
Rufous Whistler	*Pachycephala rufiventris*	1972	3	M		
Grey Shrike-thrush	*Colluricincla harmonica*	1999	3			
Magpie-lark	*Grallina cyanoleuca*	2001	48	M		
Crested Shrike-tit	*Falcunculus frontatus*	1972	1			
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	2000	5	M		

Common Name	Scientific Name	Last	Recs	EPBC	DSE	FFG
White-winged Triller	*Lalage sueurii*	2000	1			
White-fronted Chat	*Epthianura albifrons*	2000	7			
Southern Whiteface	*Aphelocephala leucopsis*	1903	1			
Yellow Thornbill	*Acanthiza nana*	1999	4			
Brown Thornbill	*Acanthiza pusilla*	1999	4			
Buff-rumped Thornbill	*Acanthiza reguloides*	1999	1			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	2001	25			
White-browed Scrubwren	*Sericornis frontalis*	1999	5			
Striated Fieldwren	*Calamanthus fuliginosus*	1999	2			
Speckled Warbler	*Chthonicola sagittata*	1886	2		VU	L
Rufous Songlark	*Cincloramphus mathewsi*	1886	2	M		
Little Grassbird	*Megalurus gramineus*	2000	4	M		
Clamorous Reed Warbler	*Acrocephalus stentoreus*	2001	15	M		
Golden-headed Cisticola	*Cisticola exilis*	2001	18			
Superb Fairy-wren	*Malurus cyaneus*	2001	41			
Masked Woodswallow	*Artamus personatus*	1886	2			
White-browed Woodswallow	*Artamus superciliosus*	1902	3			
Dusky Woodswallow	*Artamus cyanopterus*	2000	5			
Mistletoebird	*Dicaeum hirundinaceum*	1903	1			
Striated Pardalote	*Pardalotus striatus*	1999	2			
Spotted Pardalote	*Pardalotus punctatus*	1999	2			
Silvereye	*Zosterops lateralis*	2001	6	M		
White-naped Honeyeater	*Melithreptus lunatus*	1972	2			
Eastern Spinebill	*Acanthorhynchus tenuirostris*	1966	1			
Yellow-faced Honeyeater	*Lichenostomus chrysops*	1966	1			
White-eared Honeyeater	*Lichenostomus leucotis*	1972	1			
White-plumed Honeyeater	*Lichenostomus penicillatus*	2001	20			
Crescent Honeyeater	*Phylidonyris pyrrhoptera*	1973	1			
New Holland Honeyeater	*Phylidonyris novaehollandiae*	2001	39			
Noisy Miner	*Manorina melanocephala*	2000	4			
Little Wattlebird	*Anthochaera chrysoptera*	2000	1			
Red Wattlebird	*Anthochaera carunculata*	2001	26			
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	2000	4			
Richard's Pipit	*Anthus novaeseelandiae*	2001	19			
Singing Bushlark	*Mirafra javanica*	1972	2			
Red-browed Finch	*Neochmia temporalis*	1972	1			
Pied Currawong	*Strepera graculina*	1999	2			
Grey Butcherbird	*Cracticus torquatus*	2000	7			
Australian Magpie	*Gymnorhina tibicen*	2001	57			
Little Raven	*Corvus mellori*	2001	21	M		
*Mallard	*Anas platyrhynchos*	1998	1			
*Spotted Turtle-Dove	*Streptopelia chinensis*	2001	29			
*Common Blackbird	*Turdus merula*	2001	39			
*Song Thrush	*Turdus philomelos*	1999	2			
*Skylark	*Alauda arvensis*	2001	25			
*Eurasian Tree Sparrow	*Passer montanus*	2001	2			
*House Sparrow	*Passer domesticus*	2001	41			
*European Goldfinch	*Carduelis carduelis*	2001	43			
*European Greenfinch	*Carduelis chloris*	2001	19			
*Common Myna	*Acridotheres tristis*	2001	20			
*Common Starling	*Sturnus vulgaris*	2001	21			
Short-beaked Echidna	*Tachyglossus aculeatus*	1975	1			
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	1981	1	EN	NT	
Grey-headed Flying-fox	*Pteropus poliocephalus*	2002	1	VU	VU	L

Common Name	Scientific Name	Last	Recs	EPBC	DSE	FFG
*Red Fox	*Canis vulpes*	2000	1			
Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*	1959	1			
Eastern Three-lined Skink	*Bassiana duperreyi*	1991	1			
Southern Water Skink	*Eulamprus tympanum tympanum*	1999	1			
Lowland Copperhead	*Austrelaps superbus*	1992	1			
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2001	1			
Growling Grass Frog	*Litoria raniformis*	1770	1	VU	EN	L
Shortfin Eel	*Anguilla australis*	1991	36			
Australian Smelt	*Retropinna semoni*	1987	9			
Australian Grayling	*Prototroctes maraena*	1986	4	VU	VU	L
Common Galaxias	*Galaxias maculatus*	1991	45			
Yarra Pigmy Perch	*Nannoperca obscura*	1991	45	VU	NT	L
Southern Pigmy Perch	*Nannoperca australis*	1991	36			
Tupong	*Pseudaphritis urvillii*	1991	36			
Freshwater Crab	*Amarinus lacustris*	1989	9			

Key:

*****	Introduced or feral species
Last	Most recent record from the 'Atlas of Victorian Wildlife' (AVW) (DSE 2004b).
Recs	Number of records from the 'Atlas of Victorian Wildlife' (AVW) (DSE 2004b).
EPBC	Federal *Environment Protection & Biodiversity Conservation Act 1999* (EPBC). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, CD = Conservation Dependant, M = migratory or marine overfly species (included on CAMBA, JAMBA or Bonn treaty schedules).
DSE	Advisory list of Victorian threatened fauna (DSE 2003). CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened.
FFG	Victorian *Flora & Fauna Guarantee Act 1988* (FFG). L = Listed threatened species.

Appendix 3: Criteria used by Ecology Australia for assessment of conservation significance of flora and fauna values

In the context of the present study the following areas apply to the scale of significance for indigenous plant species and biodiversity of a site:

Local: City of Greater Geelong

Regional: Victorian Volcanic Plain and Otway Plain Bioregions

State: Victoria

National: Australia

Significance of plant species

Species significance is generally an indication of rarity or population decline. The assessment of significance of plant species recorded during this study is determined according to the following criteria for each geographic scale:

Local All indigenous flora is considered significant at a local level because of the overall decline native vegetation since European settlement, and the continued incremental loss of habitat and reductions in abundance due to development.

Regional For the Victorian Volcanic Plain and Otway Plain Bioregions, plant species are considered to be of regional significance when the species has a recording rate of less than 1%, as determined by interrogation of the Flora Information System database. However, this approach is influenced by sampling bias on particular vegetation types, so species may be included or excluded from the regional significance category where common sense and knowledge of the regional flora indicates.

State A taxon is considered significant at a State level if it is:

- listed under the *Victoria Flora and Fauna Guarantee Act 1988*; or
- considered to be rare, vulnerable, or endangered in Victoria by DSE 2005b, or Ross and Walsh 2003.

National A taxon is considered significant at a National level if it is:

- listed as Vulnerable, Endangered, Critically Endangered, or Presumed Extinct under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*; or
- considered to be rare, vulnerable, or endangered in Australia by DSE 2005b or Ross and Walsh 2003.
- endemic to Victoria and is considered to be rare, vulnerable, or endangered in Victoria by DSE 2005b, or Ross and Walsh 2003.

Significance of Vegetation Communities and Ecological Vegetation Classes (EVCs)

Significance of vegetation types has been determined in two ways in this report:

1. Significance of a remnant according to its condition and the status of the EVC within the Bioregion (the Net Gain approach to significance: explained further below)
2. Listing of a vegetation community as rare or threatened under the Victorian *Flora and Fauna Guarantee Act 1988* or the Federal *Environment Protection and Biodiversity Conservation Act 1999.*

Determination of significance according to Net Gain

Victoria is implementing a new approach to the assessment of remnant vegetation through the 'habitat hectare' system (a measure of size and condition), as set out in Victoria's Native Vegetation Management – A Framework for Action (DNRE 2002). Of particular relevance is Table 5 (Appendix 3) of that document which is largely summarised in Table A, below.

To assist in planning for biodiversity conservation, Victoria is divided into 27 'bioregions' - geographic units based on a common suite of biophysical characteristics (DNRE 2002). The Ecological Vegetation Classes occurring within each bioregion have been assessed, based on the degree of depletion / clearing that has occurred since European settlement and the area of extant vegetation secured in a conservation reserve, to determine their conservation status. Criteria for each conservation status are given in Table B.

The condition score (h) of a particular remnant is then combined with the bioregional conservation status of the relevant EVC to determine the conservation significance of the EVC at the site.

Table A. The relationship between EVC Conservation Status, Vegetation Condition, and Conservation Significance (Low – Very High)

Conservation Status*	Condition Score (h)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Endangered	HIGH			VERY HIGH**						
Vulnerable	MEDIUM		HIGH		VERY HIGH					
Rare	MEDIUM		HIGH			VERY HIGH				
Depleted	LOW		MEDIUM			HIGH				
Least Concern	LOW					MEDIUM				

* As determined by reference to relevant bioregional plan / EVC database

** Other attributes (such as population size of a threatened taxon) may over-ride condition score alone.

Table B. Criteria for the Bioregional Conservation Status categories of EVCs

Status		Criteria
Presumed Extinct	X	Probably no longer present in the bioregion
Endangered	E1	Contracted to less than 10% of former range; or Less than 10% of the pre-European extent remains;
	E2	Combination of depletion, degradation, current threats and rarity is comparable overall to E1: ▪ 10 to 30% pre-European extent remains and severe degradation over a majority of this area; or ▪ naturally restricted EVC reduced to 30% or less of former range and subject to moderate degradation and/or a threatening process over a majority of remaining area; or ▪ rare EVC cleared and / or subject to moderate degradation and/or a threatening process over a majority of former area.
Vulnerable	V1	10 to 30% pre-European extent remains;
	V2	Combination of depletion, degradation, current threats and rarity is comparable overall to V1: ▪ greater than 30% and up to 50% pre-European extent remains and subject to moderate degradation and/or a threatening process over a majority of this area; or ▪ greater than 50% pre-European extent remains and severely degraded over a majority of this area; or ▪ naturally restricted EVC where greater than 30% pre-European extent remains and subject to moderate degradation and/or a threatening process over majority of this area; or ▪ rare EVC cleared and/or subject to moderate degradation and/or a threatening process over a minority of former area.
Depleted	D1	Greater than 30% and up to 50% pre-European extent remains;
	D2	Combination of depletion, degradation and current threats is comparable overall to D1, and: Greater than 50% pre-European extent remains moderately degraded over a majority of this area;
Rare	R	Rare EVC
Least Concern	LC	Greater than 50% pre-European extent remains and subject to little to no degradation over a majority of this area

Table C. Criteria for assessing zoological significance of taxa

Local	All indigenous fauna is considered significant at a Local level, because of the overall decline in the fauna since European settlement, and the continued incremental loss of habitat and reduction in abundance due to development.
Regional	A taxon is considered significant at a Regional level if: ▪ it has a disjunct distribution in the bioregion; or ▪ it is represented in high concentrations in terms of colonial nesting, roosting or feeding sites; or

	▪ it is substantially depleted or restricted in the bioregion; or ▪ it has an unusual ecological or biogeographical occurrence, ▪ if the study area is within the Melbourne metropolitan area, the above four points pertain to the region of 'Greater Melbourne' as described by Beardsell (1997).
State	A taxon is considered significant at a State level if it is: ▪ listed under Schedule 2 of the Victorian ***Flora and Fauna Guarantee Act 1988***; or ▪ listed under the ***Advisory List of Threatened Vertebrate Fauna in Victoria – 2003*** (DSE 2003); or ▪ Listed as Data Deficient or Insufficiently Known under the following **Australian Action Plans**: Bannister *et al*. (1996), Cogger *et al.* (1993), Duncan *et al.* (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al.* (1996), Pogonoski *et al.* (2002), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003).
National	A taxon is considered significant at a National level if it is: ▪ listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant or Presumed Extinct on the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999***; or ▪ listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable Rare or Lower Risk (near threatened or conservation dependent) under the following **Australian Action Plans**: Bannister *et al*. (1996), Cogger *et al.* (1993), Duncan *et al.* (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al.* (1996), Pogonoski *et al.* (2002), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003).

Table D. Guidelines for determining significant sites for fauna

Local	All sites are generally considered at least Locally significant if they contain indigenous and/or exotic vegetation which supports indigenous fauna. A site is also designated as being of Local significance if: ▪ it has moderate to high potential for serving as a habitat link between two sites of Regional significance or as a link to suburban areas to enable native taxa to disperse into such areas; or ▪ it has moderate to high potential for rehabilitation and management for the public appreciation of fauna values.
Regional	A site is designated as being of Regional significance if: ▪ it regularly supports taxa that are classified as Regionally significant; or ▪ it regularly supports individuals of a disjunct population, unusual ecological or biogeographical occurrence or extraordinary concentration in a regional context of a naturally restricted (eg. colonial nesting, roosting or feeding) or substantially depleted or restricted taxon in the region; or ▪ it supports a high level of species richness for the bioregion[1]; or ▪ it contains a partial habitat link between two sites of state fauna significance, or a Regional and State site, or a primary habitat link between two sites of regional significance, or between a site of State significance and large urban areas.
State	A site is designated as being of State significance if: ▪ it, at least occasionally, supports individuals of a taxon listed under the ***Flora and Fauna Guarantee Act 1988*** or listed as Critically Endangered or Endangered in Victoria (DSE 2003); or ▪ it regularly supports taxa listed as Vulnerable in Victoria (DSE 2003). For birds this only includes records of breeding, a single sighting of a large population or repeated sightings of individuals; or ▪ it regularly supports individuals of a taxon listed as Low Risk – near threatened or Data Deficient in

	Victoria (DSE 2003), or listed as Data Deficient or Insufficiently Known under the following **Australian Action Plans**: Bannister *et al*. (1996), Cogger *et al.* (1993), Duncan *et al.* (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al.* (1996), Pogonoski *et al.* (2002), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003), or supports a roosting colony of cave-dwelling bats; or ▪ it supports very high species richness in the bioregion[2]; or ▪ it regularly supports 5% or more of the Victorian population, or an extraordinary concentration in a State context of any taxa; or ▪ it represents an intact primary habitat link containing comparable habitat attributes to two connecting sites or series of sites of State or higher zoological significance; or ▪ it has high scientific significance, eg. it forms a long-term study or monitoring site.
National	A site is designated as being of National significance if: ▪ it supports individuals of a taxon listed as Critically Endangered or Endangered under the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999***, or the following **Australian Action Plans**: Bannister *et al*. (1996), Cogger *et al.* (1993), Duncan *et al.* (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al.* (1996), Pogonoski *et al.* (2002), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003); or ▪ it regularly supports taxa listed as Vulnerable under the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999***, or the following **Australian Action Plans**: Cogger *et al.* (1993), Duncan *et al.* (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al.* (1996), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003); or ▪ it regularly supports a large population (exceeding 5% of the total known population) of a taxon listed as Conservation Dependant under the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999***, or listed as Rare or Lower Risk (near threatened, conservation dependent or least concern) in the following **Australian Action Plans**: Bannister *et al.* (1996), Cogger *et al*. (1993), Duncan *et al*. (1999), Garnett and Crowley (2000), Lee (1995), Maxwell *et al*. (1996), Pogonoski *et al.* (2002), Tyler (1997), Wager and Jackson (1993), or Sands and New (2003) ▪ it contains areas declared as 'Critical Habitat' under the Commonwealth ***Environment Protection and Biodiversity Conservation Act 1999***.

[1]The number of taxa required to fulfil this criterion will vary depending on the size, scope and season of the survey. For the Greater Melbourne region Schulz *et al.* (1991) used 2' latitude by 2' longitude blocks with a six year survey period. Their species richness criteria required 7 to 21 native mammal taxa, 50 to 100 native bird taxa, or 8 to 24 taxa of native frogs and reptiles.

[2] For the Greater Melbourne region, Schulz *et al.* (1991) specified 22 or more native mammal species, 110 to 150 native bird species, or 25 or more species of native frogs and reptiles for 2' latitude by 2' longitude blocks surveyed over six years. The number of species required to fulfil this criterion will vary depending on the size, scope and season of the survey, and a knowledge of the fauna of the region.