Healesville - Koo Wee Rup Road - Flora and Fauna Issues, Desktop Review

Project 05 - 02

Prepared for:

Vic Roads

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Summary

Ecology Australia was commissioned by VicRoads to undertake a desktop review of the potential flora and fauna values of the Healesville – Koo Wee Rup Road reservation and immediate surrounds. The purpose of the review was to identify potential sites of flora and fauna significance, areas of sensitivity and habitat links, and thus, constraints to road upgrade.

1.1 Flora

Vegetation communities

Since the drainage of the Koo Wee Rup Swamp just after European settlement, indigenous vegetation has been extensively cleared and replaced with exotic species. Six plant communities were recorded within or around the study area: Swamp Scrub, Swampy Woodland, Swampy Riparian Woodland, Wetland Formation and Exotic Vegetation.

Small, fragmented remnants of indigenous vegetation occur throughout the study area. In most part, they are degraded and support a high cover of weeds. However, some larger, more significant patches of Swamp Scrub persist.

Wetland Formation is a default EVC label used to cover a wide range of freshwater wetlands (e.g. farm dams, drainage lines and modified creeks) found scattered throughout the study area. Emergent aquatic vegetation is present within drainage lines and creeks and may provide significant habitat for fauna (see below).

Significant flora

A total of 566 plant taxa have previously been recorded within 5 km of the proposed Healesville – Koo Wee Rup Road. Of these, two species are listed under the *EPBC Act* 1999 and 12 species are of State significance. Four additional *EPBC*-listed species were detected using the EPBC Protected Matters Search tool. Based on habitat attributes, location and the number of recent records of these significant species, three *EPBC*-listed (Matted Flax-lily, River Swamp Wallaby-grass and Maroon Leek-orchid) and four State significant species have a moderate - high likelihood of occurrence within the proposed corridor.

1.2 Fauna

Fauna habitat

Five habitat types are recognised within the study area: Swamp Scrub; Wetland Formation, Isolated Indigenous Trees; Horticultural plantings and/or shelter belts; and Open Pasture.

Swamp Scrub supports suitable foraging habitat for smaller passerine birds. Although degraded by weed invasion, larger remnants of Swamp Scrub (e.g. the southern end of the

Healesville - Koo Wee Rup Road) potentially provide a habitat link for the *EPBC*-listed Southern Brown Bandicoot and habitat for locally significant reptiles.

All wetlands provide breeding habitat for locally-common frogs, feeding and roosting habitat for small numbers of common wetland birds, and drinking opportunities for numerous birds. Numerous drainage lines within the study area are thought to be used by the *EPBC*-listed Growling Grass Frog as habitat links.

The complex of drainage lines that merge together at Koo Wee Rup, including the Bunyip River, provides habitat for a variety of species that can utilise open water, densely vegetated wetlands and watercourses with dense emergent vegetation. These may be utilised by National and State significant species.

Horticultural plantings and open pasture provide potential habitat and/or feeding resources for local – regionally significant birds and mammals.

Significant fauna

A total of 396 vertebrate fauna taxa have previously been recorded within 5 km of the proposed corridor. Of these, 18 species (4.5 %) are introduced, five species are of National and 32 species are of State significance. Based on potential habitat, location and the number of recent records of these species, four *EPBC*-listed (Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling) and 13 State significant species have a moderate - high likelihood of occurring within or directly neighbouring the proposed corridor.

1.3 Impacts and significant areas

Potential impacts to ecological values associated with the proposed corridor include:

- loss of habitat for significant fauna (particularly for the Growling Grass Frog and Southern Brown Bandicoot);
- loss of significant flora species and/or vegetation communities;
- loss of persistent native flora; and
- increased weed invasion.

Within the corridor, four areas have been identified as potentially Regional – National significance for flora and fauna: (1) Gippsland Railway; (2) Koo Wee Rup Drainage lines; (3) large patches of remnant Swamp Scrub; and (4) McDonalds Drain/Bunyip River. One site (Western Port Ramsar site) has been identified as a significant site outside the study area. Preliminary recommendations for reducing and mitigating impacts on these areas are addressed below. More detailed is given in Section 6.

Potential impact	Mitigation / Recommendation	Timing	Further work	Legislative / policy implications
Loss of remnant vegetation & significant flora	1. Corridor allocated to areas supporting the lowest quality vegetation. 2. Avoid removing vegetation outside the construction footprint. 3. Examine feasibility of translocating significant species. 4. Revegetate with local indigenous plants.	Design Post-construction	1. Survey area proposed for corridor. 2. Net Gain Assessments. 3. Site inspection for offset options. 4. Discuss & determine offsets with DSE. 5. Targeted surveys for seasonal & significant flora.	EPBC Act 1999 FFG Act 1988 Native Vegetation Management Framework
Loss of habitat or habitat links for significant fauna.	1. Corridor allocated to areas not supporting significant habitat. 2. Designate streambeds as no-go- zone for vehicles & machinery. 3. Avoid removing vegetation outside the construction footprint. 4. Avoid removing native trees 5. Run-off & sediment control to be designed in accordance with water sensitive road design principles. 6. Revegetate with local indigenous plants.	Design Post-construction	1. Habitat assessment of entire corridor. 2. Targeted surveys for significant species. 3. Fish habitat assessments and surveys in Bunyip River / McDonalds drain and Deep Creek.	EPBC Act 1999 FFG Act 1988 Planning & Environment Act Wildlife Act 1975
Increased weed invasion	1. Develop a weed management plan to control weeds from pre- to post-construction.	Design	1. Surveys to identify weed species to be controlled.	Catchment and Land Protection Management Act.
Indirect impact on Ramsar site	1. Designate streambeds as no-go- zone for vehicles & machinery. 2. Avoid removing vegetation outside the construction footprint. 3. Run-off & sediment control to be designed in accordance with water sensitive road design principles. 4. Revegetate with local indigenous plants.	Design Post-construction	1. Determine potential impacts of road upgrade on Ramsar site.	EPBC Act 1999 FFG Act 1988

2 Introduction

Ecology Australia was commissioned by VicRoads to undertake a desktop review of the potential flora and fauna values of the Healesville – Koo Wee Rup Road reservation and immediate surrounds. The purpose of the review was to identify:

- potential sites of flora and fauna significance;
- areas of sensitivity;
- habitat links; and
- constraints and issues relating to planning an upgraded roadway.

This review will assist VicRoads in determining options for the future upgrading of the Healesville – Koo Wee Rup Road along its current alignment. It is expected that options will be limited to widening and/or duplication.

3 Study Area

The study area comprises the existing road reservation for the Healesville – Koo Wee Rup Road and a 20 metre strip each side of the reservation boundary. The study is also bounded by McDonalds Drain, the South Gippsland Highway and Sybella Avenue plus a 40 metre wide strip along the north-western edge of the McDonald Drain reservation (Figures 1 and 2).

Soils of the study area are sedimentary soils formed during the Pleistocene, comprising stream alluvium, floodplain and low level terrace deposits. Soil types are comprised of Quaternary alluvium consisting predominantly of stream alluvium, sand, silt, clay and gravel (Geological Survey Map Warragul Series, Mines Department, Melbourne, 1971). Much of the study area and surrounds would have originally formed part of the Koo Wee Rup Swamp prior to drainage and clearance of an extensive area of the Swamp early in the 19th Century.

The study area falls within the Gippsland Plain Bioregion, which has a relatively uniform, temperate climate, with warm, dry summers and cool, wet winters. The pre-European Ecological Vegetation Classes (EVCs) which would have occurred within the study area are likely to have been Swampy Woodland, Swamp Scrub and Swampy Riparian Woodland (Oates and Taranto 2001).

The broader study area has been subjected to a history of disturbance following drainage (for agriculture) of the Koo Wee Rup Swamp and construction of drainage channels. It is characterised by a pastoral landscape with remnants of vegetation (e.g. degraded Swamp Scrub remnants in farm paddocks, along drainage lines, creeks and Koo Wee Rup Road), residential gardens and non-indigenous planted roadside trees (e.g. Southern Mahogany, Spotted Gum). With the exception of road and rail reserves, much of the study area is grazed by cattle and consequently dominated by pasture and other exotic plant species. Historically, extensive modification to all waterways in the study area occurred with the draining of the Koo Wee Rup Swamp. The area surrounding the Bunyip River and McDonalds Drain supports remnants of Swamp Scrub, and the watercourses support emergent aquatic vegetation.

Figure 1 The study area (yellow)

4 Methods

4.1 Desktop Review

The flora and fauna component of this study consisted predominantly of a review of databases (Table 1) and the literature (Table 2) documenting vegetation types, conservation reserves and sites supporting rare species along and adjoining the proposed corridor. This information was compiled to:

1. provide an overview of the flora and fauna values of previously researched or mapped sites;
2. identify significant flora and fauna; and
3. identify known or potential constraints within the proposed corridor.

Table 1 Databases used for the desktop review of Healesville – Koo Wee Rup Road

Database	Reference
Flora Information System	DSE 2004a
Victorian Fauna Display	DSE 2004b
EPBC Protected Matters Database	DEH 2005
Ecological Vegetation Class (EVC) mapping	DSE 2002

Table 2 Reports used for the desktop review of Healesville – Koo Wee Rup Road

Report	Author
Flora and fauna assessment of proposed Pakenham Bypass, Victoria	Costello et al. 2003
Indigenous vegetation survey - Pakenham growth corridor	McMillan et al. 2004 (Ecology Australia)
Berwick-Cranbourne Road / Clyde Fiveways Road: preliminary flora and fauna assessment	Quin et al. 2001 (Ecology Australia)
Biodiversity values at Yallock Creek and Drain Number 4, Bayles	Quin et al. 2004 (Ecology Australia)
Yallock Creek and Yallock Cut amphibian study	Robertson and Heard 2002
Seasonal survey for Southern Bell Frog, Yallock Creek, Bayles	Way and Quin 2003 (Ecology Australia)
Growling Grass Frog and rare plant survey along Yallock Creek, Bayles	Quin et al. 2005 (Ecology Australia)

Only the project group of VicRoads was consulted during the course of this desktop review. DSE and local government were not contacted during this stage of the project.

4.2 Site visit

A roadside field investigation was conducted on 17 March 2005 to determine constraints associated with route alignment options and key areas and sites to be avoided.

4.3 Species and Vegetation Significance

Levels of conservation 'significance' are commonly attributed to species, sites and EVCs. Categories of significance used in this report have been derived from the following sources:

- Flora species of State and National significance from the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (*EPBC Act*) and Victorian *Flora and Fauna Guarantee Act* 1988 (*FFG Act*) listings, DSE (2005), Ross and Walsh (2003), and/or Briggs and Leigh (1995);

- Fauna species of State and National significance from the *EPBC Act* and *FFG Act* listings, DSE (2003), 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); and

- The conservation status of Ecological Vegetation Classes (EVCs) in the Gippsland Plain bioregion is specified by DSE (2004 unpubl.).

4.4 Limitations

This study is a desktop review of previous records/reports and therefore some data may be outdated. The potential constraints and recommendations in this report are based on these results, and hence, the information presented should be used as a guide only. More intensive on-ground surveys will be required to firm the information and recommendations presented here.

5 Results

5.1 Plant communities

Six plant communities have been recorded within or around the study area (Figure 2), five of which are Ecological Vegetation Classes. These communities are:

1. Swamp Scrub;
2. Swampy Woodland;
3. Swampy Riparian Woodland;
4. Grassy Woodland;
5. Wetland Formation; and
6. Exotic vegetation.

Below is a summary of the description of each Ecological Vegetation Class (EVC) (based on Oates and Taranto 2001), including its conservation status (from DSE 2004 unpub.).

Swamp Scrub (EVC 53)

Description & floristics: Closed shrub on alluvial deposits along streams, drainage lines, water bodies or on poorly drained sites within the study area. Swamp Scrub characteristically lacks a eucalypt overstorey and is dominated by Swamp Paperbark (*Melaleuca ericifolia*) (or Prickly Tea-tree *Leptospermum continentale*) which often forms dense thickets.

Status in Study Area: Swamp Scrub originally occupied large areas of the Koo Wee Rup Swamp. Today it is much more restricted due to drainage of the Swamp and clearing for agriculture. The remnants persisting in the study area tend to be linear, isolated patches of vegetation which have been heavily disturbed by grazing and weed invasion (McMillan et al. 2004). Remnants are located within road reserves, drainage lines and creeks (Figure 2). Dominant species include: Swamp Paperbark, Blackwood (*Acacia melanoxylon*), Common Reed (*Phragmites australis*), Common Spike-sedge (*Eleocharis acuta*), Slender Knotweed (*Persicaria decipiens*), Water Ribbons (*Triglochin procera*), Blackberry (**Rubus* spp.), Broom (**Genista* spp.) and exotic grasses.

Conservation significance: Endangered in the Gippsland Plain bioregion.

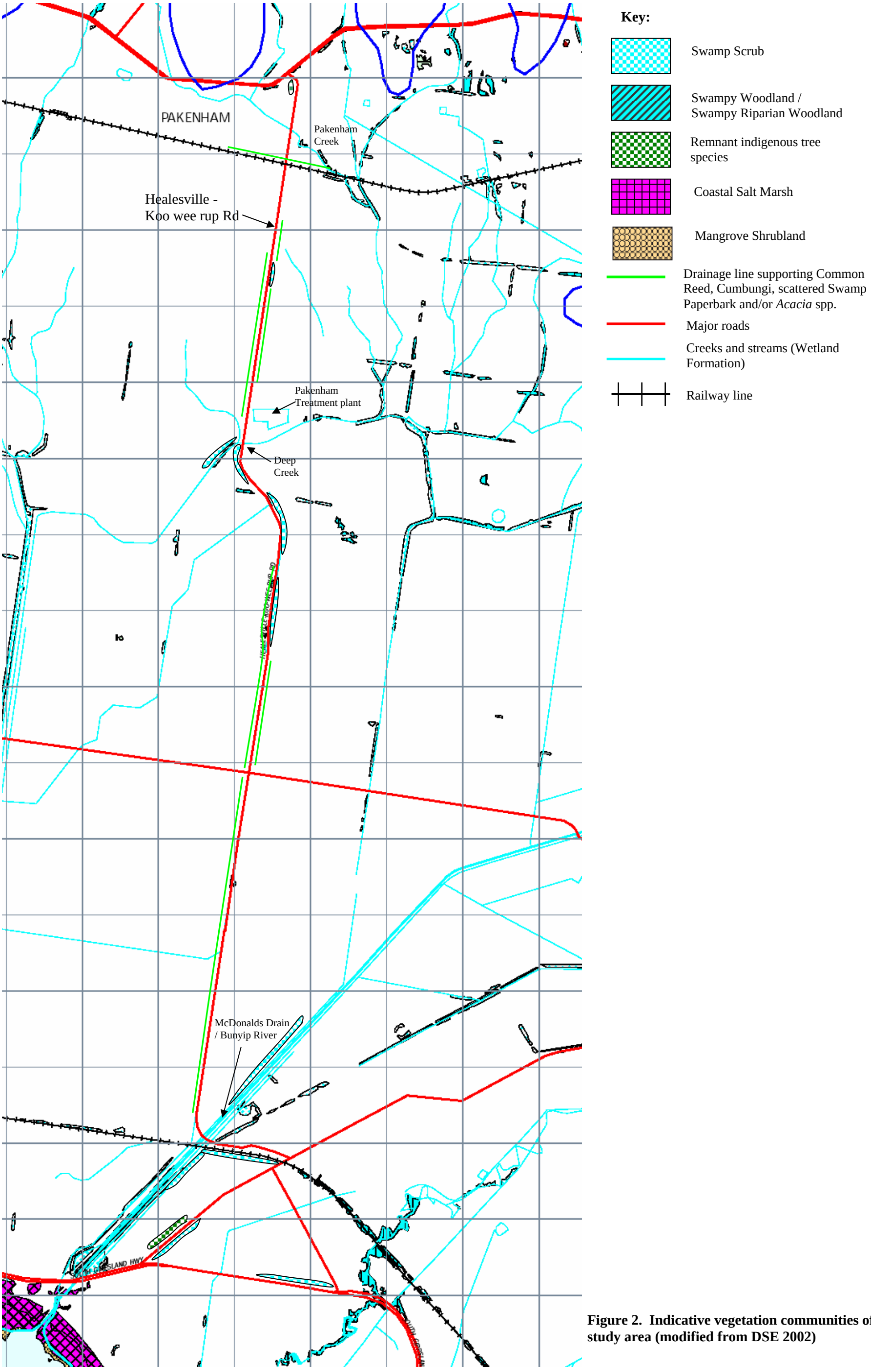

Figure 2. Indicative vegetation communities of the study area (modified from DSE 2002)

Swampy Woodland (EVC 937)

Description & floristics: Occurs in low gradient habitat on seasonally waterlogged soils. The overstorey is dominated by Swamp gum (*Eucalyptus ovata* var. *ovata*), with or without a relatively minor component of Messmate (*Eucalyptus obliqua*), Narrow-leaf Peppermint (*E. radiata* subsp. *radiata*), Yellow Box (*E. melliodora*) or Green Scentbark (*E. fulgens*). However, it can include treeless areas (shrubland, reedbed, or herbfield).

The understorey is generally open with small thickets of Swamp Papaerbark (*Melaleuca ericifolia*) or Tee-tree (*Leptospermum* spp.). The ground layer is usually dense with Common Tussock-grass (*Poa labillardierei*), Sedges (*Carex* spp.) and herbs shared with wetland habitats.

Status in Study Area: This EVC was once relatively abundant, but is now restricted to fragmented patches which are mostly outside the study area. Patches within the study area are highly modified and comprise indigenous trees (Figure 2) with an understorey that is dominated by exotic species.

Conservation significance: Endangered in the Gippsland Plain Bioregion.

Swampy Riparian Woodland EVC (83)

Description & floristics: The overstorey is dominated by Swamp Gum and lower strata by Scented Paperbark (*Melaleuca squarrosa*), Prickly Tea-tree, Woolly Tea-tree (*Leptospermum lanigerum*) and Common Reed. A range of shrub species can occur, including Hop Goodenia (*Goodenia ovata*), Prickly Current-bush (*Coprosma quadrifida*) and Wattles (*Acacia* spp.), mixed with Red-fruit Saw-sedge (*Gahnia sieberiana*), Tasman Flax-lily (*Dianella tasmanica*) and Slender Tussock-grass (*Poa tenera*).

Status in Study Area: Once a common vegetation type along broad drainage lines with slight gradients and on levees near streams, Swampy Riparian Woodland has been largely altered, particularly by drainage for agriculture. This vegetation now occurs predominantly outside the study area (Figure 2).

Conservation significance: Endangered in the Gippsland Plain Bioregion.

Grassy Woodland (EVC 175)

Description and floristics: The overstorey is variously dominated by Black Sheoak (*Allocasurina littoralis*), Drooping Sheoak (*A. verticillata*), Narrow-leaf Peppermint and Swamp Gum over a diverse ground layer. Other shrubs and small trees often include Black Wattle (*Acacia mearnssii*), Blackwood, Cherry Ballart (*Exocarpus cupressiformis*) and Prickly Tea-tree.

Status in Study Area: While reduced in area since European settlement, some small areas neighbouring the study area still support Grassy Woodland with a relatively intact understorey, including Kangaroo Grass (*Themeda triandra*), Blue Grass-lily *Caesia calliantha*, Milkmaids *Burchardia umbellata*, Bluebell *Wahlenberiga communis* and *Stylidium graminifolium* (Costello et al. 2003). Other remnants consist of scattered trees over an exotic grassy understorey (McMillan et al. 2003).

Conservation status: Grassy Woodland is considered to be Endangered within the Gippsland Plain Bioregion.

Wetland Formation (EVC 74)

Description & floristics: Wetland Formation is a default EVC label used to cover a wide range of freshwater wetlands scattered throughout the study area. These sites tend to be artificial wetlands (e.g. farm dams) or wetland areas that have been substantially modified/disturbed by alteration of drainage patterns and clearing for agriculture.

Status in Study Area: A number of examples of Wetland formation occur within and immediately surrounding the study area: drainage lines (particularly along the railway reserve, Healesville - Koo Wee Rup Road and Bunyip River), Deep Creek, Pakenham Sewage Treatment Plant, the Bunyip River and farm dams (Figure 2). The most common plant species include Common Reed, Cumbungi (*Typha* spp.), Common Spike-sedge, Slender Knotweed, Water Ribbons, Canary Grass (**Phalaris aquatica*), Drain Flat-sedge (**Cyperus eragrostis*) and many other exotic grasses.

Conservation significance: Endangered in the Gippsland Plain Bioregion.

Exotic Vegetation

Description & floristics: This vegetation type includes areas having predominantly non-indigenous plant species. Within the study area, this is usually associated with agriculture (e.g. exotic pasture grasses and weeds) and residential development (e.g. garden beds, road reserve plantings, non indigenous Eucalypts), though some indigenous species may persist.

Status in Study Area: Widespread and abundant.

Conservation significance: Negligible - local.

5.2 Significant plant species

A total of 566 plant taxa (Appendix 1) have previously been recorded within 5 km of the Healesville – Koo Wee Rup Road. Of these, 26 % are introduced (Table 3), two species are of National significance and 12 species of State significance (Table 4). Four additional EPBC listed species (River Swamp Wallaby-grass *Amphibromus fluitans*, Swamp Everlasting *Bracteantha palustris*, Green-striped Greenhood *Pterostylis chlorogramma*, Metallic Sun-orchid *Thelymitra epipactoides)* were detected using the EPBC Act Protected Matters Search Tool. Based on habitat attributes, location and number of recent records of these species, three National (Matted Flax-lily, River Swamp Wallaby-grass and Maroon Leek-orchid) and four State significant species have a moderate - high likelihood of occurrence within the road corridor (Table 4).

Table 3 A summary of plant taxa previously recorded within 5 km of the study area

	Indigenous	Exotic	Total
Ferns	8	0	8
Conifers	0	2	2
Moncots	158	57	215
Dicots	255	86	341
Total	**421**	**145**	**566**

Moncots: grasses, sedges, rushes, lilies etc.

Dicots: trees, shrubs and herbs.

Matted Flax-lily (*Dianella amoena*)

Matted Flax-lily is listed as Endangered under the *EPBC Act* and is under investigation for listing under *FFG Act* (A. Webster, Department of Sustainability and Environment, pers. comm.). It is a partially to fully summer - deciduous perennial forming loose mats to 5 m wide or more. Leaves are relatively small, to 43 cm long, and inflorescences (flower stalks) to 90 cm. Fruits are succulent, globular, off-white to dark blue-purple berries (Carr and Horsfall 1995).

Matted Flax-lily is known from Victoria (Midlands, Volcanic Plains and Gippsland Plain bioregions) and Tasmania, where it is recorded in grasslands and grassy woodlands. It is frequently associated with stony knolls and rises, red friable soil and greater than 50% surface rock cover (Carr and Horsfall 1995). All known populations are small, and most sites are extremely weedy. The species is in decline throughout its range.

It has previously been recorded within the Gippsland Rail Reserve near Ryans Road, and just outside the southern section of the study area around Dalmore. Thus, it potentially occurs within the road corridor, particularly the section that crosses the rail reserve.

Plate 1 *Dianella amoena* (Matted Flax-lily)

Maroon Leek-orchid (*Prasophyllum frenchii*)

Marron Leek-orchid is listed as Endangered under the *EPBC Act* and as threatened under Schedule 2 of the *FFG Act*. It has numerous fragrant varicoloured flowers and grows to 60 cm tall (Walsh and Entwistle 1994). It is found mostly as loose colonies in grassland, heathland and grassy woodland habitats (Blackhouse and Jeanes 1995).

Most of its remaining habitat occurs in railway reserves and rural airfields, where burning, herbicide spraying and heavy vehicle movement do not occur (Blackhouse and Jeans 1995). A population has recently been discovered in the Gippsland Railway Reserve (Costello et al. 2003), close to the study area. Therefore, it potentially occurs in the railway reserve where it crosses the Healseville – Koo Wee Rup Road.

Table 4 Significant plant species that have previously been recorded within 5 km of the study area*. Species in bold have a moderate – high likelihood of occurring within the study area.

Name Scientific	Common	Status	Listed	Records	Year/s	Approximate location
Carex chorantha	Green-top Sedge	k		1	1903	Princess Highway, Pakenham
Juncus revolutus	Creeping Rush	r		2	1973	Coast, between Tooradin & Koo Wee Rup
Prasophyllum frenchii	Maroon Leek-orchid	E e	FFG, EPBC	5	1930 - 2001	Princess Highway, Pakenham and Bald Hill Road (Rail reserve)
Pterostylis grandiflora	Cobra Greenhood	r		2	1946	Henry Street
Dianella amoena	Matted Flax-lily	E e	EPBC	6	1997 - 2002	Dalmore and Bald Hill Road (rail reserve)
Austrostipa rudis* ssp. *australis	Veined Spear-grass	r		1	2001	Bald Hill Road
Lachnagrostis robusta	Salt Blown-grass	r		2	1997, 1999	Tooradin (coast)
Craspedia canens	Grey Billy-buttons	e		1	2001	Bald Hill Road (Rail reserve)
Atriplex paludosa ssp. *paludosa*	Marsh Saltbush	r		12	1970 - 1973	Koo Wee Rup and Tooradin (coast)
Lotus australis	Austral Trefoil	k		1	1904	Koo Wee Rup
Geranium solanderi* var. *solanderi	Austral Cranesbill	v		4	2001 - 2004	Princess Highway and Bald Hill Rd (rail reserve)
Eucalyptus fulgens	Green Scentbark	r		14	1991 - 2004	North of Princess Highway and Bald Hill Rd.
Limonium australe	Yellow Sea-lavender	r		5	1973	Koo Wee Rup and Tooradin (coast)
Avicennia marina subsp. *australasica*	Grey Mangrove	r		2	1993, 2001	Koo Wee Rup and Tooradin (coast)

*Data from FIS, DSE 2004a

Legend:

E = Endangered in Australia

e = endangered in Victoria

r = rare in Victoria

k = unknown, but thought to be rare or threatened in Victoria

FFG = listed under the Flora and Fauna Guarantee Act

EPBC = listed under the Environment Protection and Biodiversity Conservation Act

LO = Likelihood of occurrence

River Swamp Wallaby Grass (*Amphibromus fluitans*)

River Swamp Wallaby Grass is listed under the *EPBC Act* 1999 as Vulnerable. It occurs naturally on floodplains, occupying off-stream wetlands (billabongs and lakes), along small perennial streams. However, it now also occurs widely in constructed wetlands, farm dams and impoundments throughout Victoria (Carr 2005).

River Swamp Wallaby Grass can occupy more-or-less permanently wet habitats with free water, or wetlands which dry completely over summer. The natural (pre-European) hydrological regime is assumed to be typically one of summer draw-down with dry conditions over summer and autumn. Plants are quiescent or dormant during dry conditions and resume vigorous growth with the autumn break and subsequent inundation. The plants however, do not need free water (inundation) to persist in a wetland, but effectively behave as amphibious opportunists (Carr 2005).

Around south-east Melbourne, this plant has been recorded near Cranbourne. Further a field, it has been recorded in the La Trobe Valley. There is suitable habitat within the study area for this species.

Veined Spear-grass (*Austrostipa rudis* subsp. *australis*)

Veined Spear-grass is listed as rare in Victoria (DSE 2005). It is a tufted, shortly-rhizomatous perennial, growing to 1.3 m, with scabrous leaves. The inflorescence is an open panicle to 50 cm long. It occurs mostly in cool areas of moderate altitude, on sandy or sandstone-derived soils and in open-forests (Walsh and Entwistle 1994).

There are records of Veined Spear-grass from north of Bald Hill Road in Pakenham (Table 4). It could potentially occur in the northern section of the study area.

Grey Billy-buttons (*Craspedia canens*)

Grey Billy-buttons are considered to be endangered in Victoria (DSE 2005). This species belongs to the Daisy (Asteraceae) family. Growing to 15 – 65 cm tall, this herb has predominantly basal woolly leaves and a yellow, globular inflorescence. It is known from grasslands at low altitude between Cranbourne and Traralgon (Entwisle and Walsh 1999).

The species has previously been recorded in the Gippsland Rail Reserve within Pakenham, and may potentially occur within the Rail Reserve.

Austral Cranesbill (*Geranium solanderi* var. *solanderi*)

Austral Cranesbill is listed as vulnerable in Victoria (DSE 2005). It is a perennial herb, characterised by long stem hairs, bright pink petals and stem leaves with narrow lobes (Entwisle and Walsh 1999). This species is found predominantly around Melbourne, especially in the east. It occurs in damp to dryish and usually sheltered sites, in grassy woodlands, often along drainage lines or in seepage areas (Entwisle and Walsh 1999).

Austral Cranesbill has been recorded in the Gippsland Rail Reserve within Pakenham (Costello et al. 2003). It could potentially occur throughout the proposed corridor.

Green Scent-bark (*Eucalyptus fulgens*)

Green Scent-bark is listed as rare in Victoria (DSE 2005). It is related to *Eucalyptus aromapholia*, grows to 20 m and has fibrous furrowed bark and glossy green leaves (Entwisle and Walsh 1996). It is known from south-eastern Melbourne and has regularly been recorded in the Pakenham area. While there are only a small number of indigenous eucalypt species remaining in the corridor, Green Scent-bark could potentially occur.

5.3 Fauna Habitat

Five habitat types are recognised within the study area, these include:

1. Swamp Scrub;
2. Wetland Formation;
3. Isolated Indigenous Trees;
4. Horticultural plantings and/or shelter belts; and
5. Open Pasture.

5.3.1 Swamp Scrub

Degraded remnant Swamp Scrub is scattered throughout much of the alignment, particularly along the Healseville - Koo Wee Rup Road, but also along various drainage lines found throughout the area. This supports suitable foraging, perching and nesting habitat for smaller passerine birds including Brown Thornbill, Silvereye, White-eared Honeyeaters, Willie Wagtails and Superb Fairy-wrens.

Although degraded by weed invasion, larger remnants of Swamp Scrub (e.g. the southern end of the Healseville - Koo Wee Rup Road) potentially provide a habitat link for the *EPBC*-listed Southern Brown Bandicoot. The remnants also provide habitat for locally significant reptiles (e.g. Lowland Copperhead, Blotched Blue-tongued Lizard, Garden Skink, Weasel Skink and Metallic Skink). Throughout the study area, the Swamp Scrub remnants are probably too degraded to provide habitat for the *FFG*-listed Swamp Skink (State significant). However, further surveys are needed to establish its status in the study area.

5.3.2 Wetland Formation

Wetland Formation includes a number of different wetland types, such as: Drainage Lines (adjoining the Gippsland Railway Line and Healesville – Koo Wee Rup Road, and McDonalds Drain), Deep Creek, Bunyip River, Pakenham Sewage Treatment Plant and farm dams (if they occur).

All wetlands occurring in the study area provide breeding habitat for locally-common frogs (e.g. Common Froglet, Southern Brown Tree Frog, Spotted Marsh Frog and Southern Bullfrogs), feeding and roosting habitat for small numbers of common wetland birds (e.g. White-faced Heron, Pacific Black Duck and Australian Wood Duck) and drinking water for numerous birds, especially locally significant seed-eating species (e.g. parrots, cockatoos,

Red-browed Finch), but also for honeyeaters (e.g. White-plumed Honeyeater, Brown-headed Honeyeaters, White-naped Honeyeaters).

Adjoining the Gippsland Railway line is a concrete drainage line supporting emergent and emergent native and exotic aquatic vegetation. This does provide habitat for the Regionally-significant Striped Marsh Frog and the Locally-significant Lowland Copperhead (both recorded during field visit in March 2005). It may potentially provide habitat for other Locally-Regionally significant frogs and reptiles and a habitat link for the EPBC-listed Growling Grass Frog (Costello et al. 2003) and to a lesser extent the Southern Brown Bandicoot.

The open treatment plant along the Healesville - Koo Wee Rup Road potentially provides habitat for a number of locally-nationally significant migratory aquatic birds (e.g. Blue-billed Duck, Hardhead, Australasian Shoveler and Pacific Black-duck).

The complex of drainage lines that merge together at Koo Wee Rup, including the Bunyip River, provides habitat for a variety of species that can utilise open water, densely vegetated wetlands and watercourses with dense emergent vegetation. Species that can utilise these include the Nationally-significant Growling Grass Frog, Lewin's Rail, Dwarf Galaxias and Australian Grayling, and the State significant Baillon's Crake, Latham's Snipe, Great Egret, and Nankeen Night Heron.

5.3.3 Isolated Indigenous Trees

'Isolated indigenous trees' refers to the scattered indigenous Swamp Gums remaining after clearing of the Swampy Woodland EVC. They provide nectar for Locally-significant nectarivorous species, including various honeyeaters, Red Wattlebird and Rainbow Lorikeet. Older trees potentially provide nest sites for hollow-dependent species, including Eastern Rosella, Rainbow Lorikeet, Sulphur-crested Cockatoo and insectivorous bats. They also provide: perching substrate for hawking species and species which feed in adjoining open pasture (see below); nesting substrate for Locally-significant bird species that build stick-nests (e.g. White-plumed Honeyeater, Red Wattlebird, Little Raven, Magpie and Magpie-lark); and feeding substrate for insectivorous species that feed under decorticating bark (e.g. White-plumed Honeyeater, Red Wattlebird).

5.3.4 Horticultural planting and/or shelter belts

Horticultural plantings include introduced, nectar-producing plants (e.g. non-indigenous Eucalyptus, Bottlebrushes). These provide suitable feeding and nesting opportunities for Locally-significant bird species which feed on nectar (e.g. New Holland Honeyeaters, Eastern

Spinebill, Red Wattlebird, Rainbow and Musk Lorikeet) and from leaf-surfaces (e.g. Brown Thornbill, Silvereye) and construct nests in densely vegetated trees and shrubs (e.g. Superb Fairy-wrens, Magpie-lark, Red Wattlebird). These plants also provide nesting and feeding habitat for Common Ringtail Possums and Common Brushtail Possums.

This habitat category also includes Shelter Belts, which consist of plantings of cypress trees and Radiata Pines (scattered throughout the study area). These trees provide: food for seed-eating species (e.g. the Regionally-significant Yellow-tailed Black-cockatoos feed on the seeds of pine trees); perching substrate for hawking species and species which feed in adjoining open pasture (e.g. Locally-significant Willie Wagtail, Grey Fantail, Red Wattlebird, Little Raven); feeding substrate for some insectivorous species which feed from the surfaces of trunks and branches; nesting substrate for some raptor species (e.g. Locally-significant Brown Goshawk and Regionally-significant Australian Hobby) and Common Ringtail Possums (e.g. Common Ringtail Possum dreys in the pine trees); and dense roosting habitat for various birds (e.g. the State significant Nankeen Night Heron roosting in *Pinus radiata*, McMahon et al. 2001).

5.3.5 Open pasture

This is the dominant habitat type in the study area. Pasture or degraded grassland provides feeding habitat for mostly Locally-significant open country bird species, such as Red-rumped Parrot, Eastern Rosella, Sulphur-crested Cockatoo, Long-billed Corella, Galah, Masked Lapwing, Magpie, Magpie-lark, Richard's Pipit, as well as exotic species (e.g. European Goldfinch, Common Starling, Common Myna). Such species have expanded their ranges and increased in abundance with agricultural development. This habitat also provides food for grass-eating mammal species (e.g. the introduced European Rabbit).

5.4 Significant fauna species

A total of 396 vertebrate species has previously been recorded within 5 km of the proposed corridor. Of these, 18 species (4.5 %) are introduced (Appendix 2), five species are of National and 32 species are of State significance (Table 5). Forty-five additional species were detected with the EPBC database search tool (Appendix 3). Based on habitat attributes, location and number of recent records of these species, four National (Growling Grass Frog, Southern Brown Bandicoot, Dwarf Galaxias and Australian Grayling) and 13 State significant species have a moderate - high likelihood of occurring within or adjoining the proposed corridor (Table 5).

Table 5 Vertebrate fauna taxa recorded within 5 km of the study area. Species with a moderate – high likelihood of occurrence within or adjoining the study area are in bold.

Common Name	Scientific Name	EPBC	DSE status*	FFG	Year last recorded	Number of records
Lewin's Rail	*Rallus pectoralis*		VU	L	1981	1
Pied Cormorant	*Phalacrocorax varius*		NT		1997	3
Whiskered Tern	*Chlidonias hybridus*		NT		1997	1
Gull-billed Tern	*Sterna nilotica*		EN	L	1986	2
Caspian Tern	*Sterna caspia*		NT	L	1997	1
Pacific Gull	*Larus pacificus*		NT		1981	1
Grey Plover	*Pluvialis squatarola*		NT		1980	1
Pacific Golden Plover	*Pluvialis fulva*		NT		1997	4
Lesser Sand Plover	*Charadrius mongolus*		VU		1997	3
Eastern Curlew	*Numenius madagascariensis*		NT		1981	1
Whimbrel	*Numenius phaeopus*		VU		1985	1
Common Sandpiper	*Actitis hypoleucos*		VU		1998	1
Terek Sandpiper	*Xenus cinereus*		EN		1997	6
Great Knot	*Calidris tenuirostris*		EN	L	1985	1
Latham's Snipe	*Gallinago hardwickii*		NT		1999	2
Royal Spoonbill	*Platalea regia*		VU		1981	2
Great Egret	*Ardea alba*		VU	L	1981	2
Nankeen Night Heron	*Nycticorax caledonicus*		NT		1981	1
Cape Barren Goose	*Cereopsis novaehollandiae*		NT		1998	1
Australasian Shoveler	*Anas rhynchotis*		VU		1999	8
Hardhead	*Aythya australis*		VU		1999	7
Blue-billed Duck	*Oxyura australis*		EN	L	1996	2
Musk Duck	*Biziura lobata*		VU		1981	2
Spotted Harrier	*Circus assimilis*		NT		1997	1
Helmeted Honeyeater	*Lichenostomus melanops cassidix*	EN	CR	L	1948	1
Pectoral Sandpiper	*Calidris melanotos*		NT		1998	1
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	EN	NT		1991	4
Swamp Skink	*Egernia coventryi*		VU	L	1996	16
Glossy Grass Skink	*Pseudemoia rawlinsoni*		NT		1983	2
Growling Grass Frog	*Litoria raniformis*	VU	EN	L	2003	15
Australian Grayling	*Prototroctes maraena*	VU	VU	L	1998	1048
Dwarf Galaxias	*Galaxiella pusilla*	VU	VU	L	1976	36

*From advisory list of threatened vertebrate fauna in Victoria, DSE 2003.
Legend:
CR - Critically endangered
EN - Endangered
VU - Vulnerable
NT - Near threatened
L = listed as threatened

The Growling Grass Frog (*Litoria raniformis*)

The Growling Grass Frog (also known as the Warty Bell Frog and Southern Bell frog) is listed as 'Vulnerable' under the *EPBC Act* 1999. It is listed as Vulnerable in Victoria (DSE 2003), and as a threatened species under the *FFG Act* 1988.

The Growling Grass Frog is a relatively large and highly mobile species. The habitat requirements of the Frog are poorly understood. This species has generally been recorded in or around water that is shallow and still or slow-moving, usually with emergent aquatic vegetation, including sedges and cumbungi (Tyler 1997; Pyke 2002). However, the variety of reported breeding habitats is broad and thus provides no definitive information concerning preferred habitats. These include: lakes or reservoirs; lagoons; marshes; swamps; ponds, ditches and other artificial depressions; farm dams; areas which receive artificial flood-irrigation; and still back-waters and other sluggish areas of rivers and streams. It is thought that it breeds in permanent or near-permanent water bodies, and spends the non-breeding season (approximately May to August) sheltering in terrestrial environments (e.g. rocks, fallen timber or dense ground vegetation) some distance from water.

Research along Merri Creek in the north of Melbourne, and Pakenham and Yallock Creek in the southeast, suggests that waterbodies with an extensive cover of wetland vegetation, reasonable water quality and an absence of predatory fish are preferred by this species for breeding. The aquatic vegetation provides calling stages for male frogs, sites for egg deposition and development, and food and shelter for tadpoles. Dense submergent vegetation is important for protecting eggs and tadpoles from predation. The Growling Grass Frog will potentially be found where instream habitat is degraded if adjacent offstream waterbodies, such as farm dams or quarry pits, provide this breeding habitat (see Pyke 2002; Heard and Robertson 2003; Robertson et al. 2003; Christina Wilson, Ecology Australia, pers. comm.; Aaron Organ, Biosis Research, pers. comm.).

Growling Grass Frogs have been recorded recently (DSE 2004b) around Pakenham (Farm Dams, Gippsland Rail Reserve, Cardinia Creek and Bailleu Wetlands) and are known from McDonalds Drain and Yallock Creek (Way and Quin 2003; Quin et al. 2005). Within the proposed corridor, it could potentially occur along Deep Creek, the Bunyip River, McDonalds Drain, other drainage lines (e.g. drainage lines within the Gippsland Rail Reserve and adjoining the Healesville - Koo Wee Rup Road) and farm dams.

Plate 2 Growling Grass Frog

Southern Brown Bandicoot (*Isoodon obesulus obesulus*)

Listed under the EPBC Act 1999, the Southern Brown Bandicoot is predominantly nocturnal, but may be observed during the day. They are robust animals with a long snout, short thick tail and small round ears (Plate 3). They typically occur in coastal and near-coastal habitats, though range as far inland as the Grampians in western Victoria (Menkhorst 1995). In these areas, they occupy heath, shrubland, heathy forest, sedgy/grassy woodland, Swamp Scrub and grassy areas (e.g. pasture) bordering denser vegetation (e.g. thickets of blackberry; sedge tussocks, such as *Lomandra longifolia*) (Menkhorst 1995).

Potential sheltering habitat within the study area includes remnant (even degraded) Swamp Scrub and other vegetation along road reserves (e.g. Common Reed beds adjacent to the bridge, drainage lines and creeks). Feeding habitat is widely distributed throughout the area, including grassy/sedgy areas of Swamp Scrub and open grassy areas bordering dense vegetation, such as areas north and south of the study area, pasture and roadside reserves.

Plate 3 Southern Brown Bandicoot

Dwarf Galaxias (*Galaxiella pusilla*)

The Dwarf Galaxias is listed under the *FFG Act* 1988 and the *EPBC Act* 1999. It is a tiny, transparent olive-amber fish with three longitudinal black stripes along the trunk, a silvery white belly and clear fins. It has been recorded previously from southern Victoria, with major populations within Melbourne include Dandenong, Diamond, Cardinia and Balcombe Creeks (DEH 2005 unpub.). They are also known from Yallock Creek in Bayles (Quin et al. 2004).

The species prefers slow-flowing waters with aquatic and fringing vegetation, including swamps, drains and backwaters of creeks and streams (Wager and Jackson 1993). Little is known of the movement of Dwarf Galaxias under high stream flow conditions, but findings in the Cardinia Creek system have shown that adult Dwarf Galaxias move into floodplain wetlands at these times, spawn when water levels stabilise, and then proceed to new waters when additional high flow events occur (DEH 2005 unpub.).

The apparent random distribution of Dwarf Galaxias into intermittent and ephemeral localities during flood conditions allows for the spread of the species into new habitats (Quin et al. 2004). These sites are expected to provide appropriate food resources needed for successful recruitment and help with avoidance of predators and competition from other fish species, particularly during spawning periods.

Within the study area, the Dwarf Galaxias may occur within some areas of the Bunyip River and McDonalds Drain.

Plate 4 Dwarf Galaxias

Australian Grayling (*Prototroctes maraena*)

Listed under both the *FFG-* and *EPBC-Act*, the Australian Grayling is a small brown to olive-green fish growing to 19 cm. It is now patchily distributed throughout its former range due to loss of riparian vegetation and increase in stream barriers (e.g. dams, weirs and culverts) (Wagner and Jackson 2004). Populations are known from the Tambo, Barwon, Mitchell and Tarwin River systems (DEH 2005 unpubl.), the Bunyip River (Quin et al. 2004) and tributaries of Cardinia Creek (McMillian et al. 2004). Within the study area, there is potential for this species to occur in the Bunyip River and McDonalds Drain.

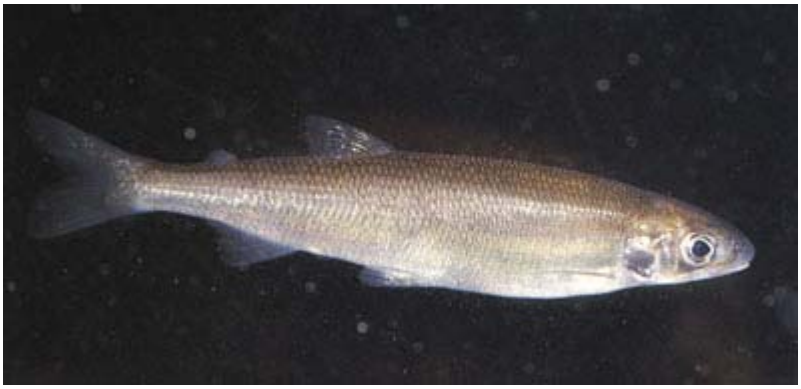

Plate 5 Australian Grayling

Great Egret (*Ardea alba)*

The Great Egret is classified as endangered in Victoria (DSE 2003b) and is listed under the *FFG Act* 1988. It is a large bird to 83 cm long, with a long neck and legs and has white plumage. Their nest is a structure of twigs and small branches, usually in a tree or shrub,

often some distance from water. They feed on a range of small, mostly aquatic, vertebrates and large invertebrates (DSE 2004b).

The Great Egret inhabits a variety of freshwater lakes, coastal shores, slow-moving waterways and open country near wetlands. Within and neighbouring the proposed corridor, this Great Egret potentially occurs in watercourses and wetlands along the Bunyip River and McDonalds Drain. It also potentially occurs at the Pakenham Sewage Treatment Plant.

Lewin's Rail (*Rallus pectoralis*)

Lewin's Rail is listed as vulnerable in Victoria (DSE 2003b) and is listed under the *FFG Act 1988*. It is a ground-dwelling bird to 23 cm long and has predominantly dark brown plumage with black mottling on the back. The nest is a cup made of grasses placed in dense cover on the ground, usually near water. It feeds on variety of invertebrates, seeds and soft plant material (DSE 2004b).

Lewin's Rails are secretive inhabitants of heavily vegetated swamps, such as coastal saltmarshes, rushy ditches and swampy streams, and occasionally they venture far from water (Emison et al. 1987). Their distribution is not well known in Melbourne. However, within the study area, the species potentially occurs along the Bunyip River, McDonalds Drain and some sections of the drainage lines which meet at Koo Wee Rup.

Australasian Shoveler (*Anas rhynchotis*)

The Australasian Shoveler is listed as vulnerable in Victoria (DSE 2003b). The males have brown plumage on the lower neck and breast, chestnut on the belly and a black tail and rump. The females are entirely brown with light brown edges to the feathers. Their nests are depressions in the ground lined with leaves and feathers. They feed on soft plant material, seeds, algae and small aquatic invertebrates.

This duck is found mainly on large, shallow lakes, including saline waters, and are most numerous on permanent, well vegetated freshwater swamps with areas of open water (Emison et al. 1987). It potentially occurs at the Pakenham Sewage Treatment Plant, and less likely along McDonalds Drain and the Bunyip River.

Hardhead (*Aythya australis*)

The Hardhead is considered to be vulnerable in Victoria (DSE 2003b). It is a duck with mostly dark brown plumage and a white belly. Nests comprise a woven bowl of fine twigs and grass-like plants, placed close to water and under dense cover. They feed on soft plant material, seeds, algae and small aquatic invertebrates.

This species is associated with a variety of freshwater wetlands, particularly deep, permanent open wetlands (Emison et al. 1987). The Hardhead was recorded at the Pakenham Sewage Treatment Plant (during site visit, March 2005), and could potentially occur (but far less likely) along the Bunyip River and McDonalds Drain.

Royal Spoonbill (*Platalea regia*)

The Royal Spoonbill is listed as vulnerable in Victoria (DSE 2003b). It is a large bird, to 75 cm tall, with a long neck and legs and a long spoon-shaped beak. The nest is a structure made of twigs and small branches, which is placed in a tree or large shrub, often near water. They feed on a range of small aquatic vertebrates and invertebrates.

This bird is found on a variety of freshwater and saline wetlands and slow-moving waterways and on open country near wetlands. Within or adjoining the study area, it potentially occurs along McDonalds Drain and the Bunyip River and at the Pakenham Sewage Treatment Plant.

Nankeen Night Heron (*Nycticorax caledonicus*)

The Nankeen Night Heron is classified a near threatened in Victoria (DSE 2003b). It is a stout, large bird, to 59 cm tall, with a short neck. The plumage is mostly a chestnut colour on the back and wings, with pale-beige to white on the breast and belly. Nankeen Night Herons are secretive birds which roost in small colonies amongst dense vegetation (e.g. in willow trees, pine trees) (McMillan et al. 2001). They feed on a range of small, mostly aquatic vertebrates and large invertebrates within shallow water. Nests are made of twigs and small branches, and are placed in a tree or shrub. This nocturnal bird is known to occur on a variety of freshwater lakes, coastal shores, slow-moving waterways and open country near wetlands.

A Nankeen Night Heron feather was found in a drainage line crossing the road corridor c. 1 km north of Ballarto Road during the site visit (March 2005). The species potentially feeds in most of the drainage lines occurring throughout the study area, including the Bunyip River, Deep Creek and McDonalds Drain. Suitable roosting habitat is available in the dense stands of cypress and pine trees occurring along the road corridor (see McMillan et al. 2001).

Latham's Snipe (*Gallinago hardwickii*)

Latham's Snipe is listed as near threatened in Victoria (DSE 2003b). It is a wading bird, with a long, narrow beak. The plumage is mostly brown with bold black and pale brown markings. Snipe feed on a variety of small invertebrates.

Latham’s Snipe are summer migrants to Australia from their breeding grounds in Japan and the nearby Kurile Islands. They occur in a variety of habitats, including heavily vegetated

freshwater swamps, pools, dams or drains in heaths, subalpine grasslands and herbfields. Concentrations of up to 100 birds gather at some drying freshwater swamps close to the Victorian coast (e.g. Seaford, Geelong and Sale).

Within the study area, Latham's Snipe potentially occur along McDonalds Drain, the Bunyip River and drainage lines which merge at Koo Wee Rup.

Pied Cormorant (*Phalacrocorax varius*)

The Pied Cormorant is listed as near threatened in Victoria (DSE 2003b). It occurs on large freshwater bodies and saline wetlands and is particularly abundant in tidal bays. They nest in colonies, building platform nests in mangroves or other trees. Suitable habitat for this species occurs adjoining the corridor at the Pakenham Sewage Treatment Plant (Emison et al. 1987).

Blue-billed Duck (*Oxyura australis*)

The Blue-billed Duck is listed as endangered in Victoria (DSE 2003b), and is also listed under the FFG Act 1988. They inhibit deep, permanent, well-vegetated swamps, but at times (especially in winter) may occur in large numbers on large open wetlands (Emison et al. 1987). They catch their food while diving or occasionally by feeding from the water surface. Their nests are built on low, trampled swamp vegetation (Emison et al. 1987). The Blue-billed Duck could potentially occur on wetlands at the Pakenham Sewage Treatment Plant.

Musk Duck (*Biziura lobata*)

The Musk Duck is listed as vulnerable in Victoria (DSE 2003b). Musk Ducks are usually seen in small numbers on deep water lakes, swamps and impoundments, and they catch their food while diving (Emison et al. 1987). Musk Ducks build their nests in dense reed beds and occasionally on tree stumps or in low branches of shrubs (Emison et al. 1987). Adjoining the study area, suitable habitat occurs at the Pakenham Sewage Treatment Plant.

5.5 Significant sites

5.5.1 Within the study area

Four areas within the study area have been identified as potentially regional – national significance for flora and fauna:

1. Gippsland Railway Reserve;
2. Koo Wee Rup Drainage lines;
3. Large patches of remnant Swamp Scrub; and
4. McDonalds Drain / Bunyip River.

Gippsland Railway Railway

The Gippsland Railway Reserve (particularly the section that passes through Pakenham) is known to support a population of the *EPBC*-listed Matted Flax-lily (*Dianella amoena*) and Maroon Leek-orchid (*Prasophyllum frenchii*), and the State significant Austral Cranesbill (*Geranium solandrei* var. *solandrei*) and Grey Billybuttons (*Craspeida canens*) (Vulnerable and Endangered respectively, DSE 2005).

The Railway Reserve (outside of the study area) also supports a small, but very diverse, remnant of Grassy Woodland (Endangered in the Gippsland Plain Bioregion), which would provide refuge for reptiles and grassland/woodland birds. The *EPBC*-listed and *FFG*-listed Growling Grass Frog has also been recorded using drainage lines that follow the Reserve, and are therefore thought to use the drainage line as a habitat link (see Costello et al. 2003).

A section of the Railway Reserve within Pakenham is considered to be of National significance (Costello et al. 2003). It is recommended that a thorough spring survey be undertaken along the section of the Railway Reserve potentially affected by road widening activities to determine the status of the *EPBC*-listed and State-significant species mentioned above.

Plate 6 South Gippsland Railway Reserve (within study area), view east (March 2005). The drainage line that follows the railway line supports a dense cover of Common Reed, providing suitable habitat for locally- to regionally-significant frog species and may potentially be a habitat link for the *EPBC*-listed Growling Grass Frog.

Koo Wee Rup Drainage Lines

Large and deep drainage lines follow the course of the Healesville - Koo Wee Rup Road (Plate 7). During a site visit in March 2005 these drains contained water and supported emergent aquatic vegetation (e.g. Common Starwort **Calltriche stagnalis*, Slender Knotweed, Cumbungi, Common Spike-sedge, Common Reed, Drain Flat-sedge). The road reserve adjoining the drain also supported scattered Swamp Paperbark and Blackwood, as well as many weed species (*Blackberry, *Broom, *Paspalum *Paspalum dilatatum*, *Kikuyu *Pennisetum clandestinum*, **Canary Grass* and *Prairie Grass *Bromus catharticus*).

Despite the degraded nature of the vegetation, these drainage lines potentially provide habitat links between areas supporting better quality vegetation/wetlands for the *EPBC*-listed Growling Grass Frog. Thus, it is recommended that targeted surveys for the Growling Grass Frog be undertaken throughout the drainage system. Furthermore, any road widening should occur in areas supporting the lowest quality vegetation/wetlands.

Plate 7 Drainage lines that run parallel to the Healesville - Koo Wee Rup Road, support a mixture of exotic and native species (Common Reed foreground, Swamp Paperbark background). Emergent aquatic vegetation is also present (e.g. *Triglochin procera* Water Ribbons pictured above). (Photo taken during site visit March 2005).

Large patches of Swamp Scrub

Large patches of Swamp Scrub along the Healesville - Koo Wee Rup Road between Deep Creek and Ballarto Road provide potential habitat for the Southern Brown Bandicoot, though the likelihood of occurrence of bandicoots in these patches is probably low (Plate 8). These patches are made up of dense tickets of Swamp Paperbark, with scattered Blackwood and Pine trees (**Pinus radiata*). The understorey consists of Spiny-headed Mat-rush (*Lomandra longifolia subsp. longifolia*), *Blackberry, *Broom, *Ivy (**Hedera helix*), exotic and native grasses. Targeted surveys for the Southern Brown Bandicoot will need to be undertaken in these areas. Any works required for the road corridor should be undertaken on the side of the road that supports the lowest quality habitat.

McDonalds Drain / Bunyip River

McDonalds Drain and the Bunyip River are part of a complex of drainage lines that pass through the study area (Figure 2). Patches of Swamp Scrub align the drainage lines, supporting a mixture of indigenous and exotic species (Plate 9). The most dominant species include: Swamp Paperbark, *Broom (**Genista linifolia* and **G. monspessulana*), Blackwood, *Canary Grass and *Blackberry. Aquatic vegetation predominately consists of: Water-ribbons (*Triglochin procera* and *T. striata*), Common Reed, *Drain Flat-sedge, *Common Star-wort and Slender Knotweed.

The quality of vegetation and habitat for fauna varies between the drains. Overall, they could potentially provide habitat for the *EPBC*-listed Growling Grass Frog, Australian Grayling, Dwarf Galaxias and Southern Brown Bandicoot. River Swamp Wallaby-grass (*EPBC*-listed) could also potentially occur. Thorough flora and fauna surveys will need to be conducted to determine the status of these species in the study area. If a bridge up-grade is required for the corridor, surface run-off will need to be collected and treated prior to entering the drains.

Plate 8 A dense sword of Swamp Scrub (view east, site visit March 2005), located just south of Deep Creek. In sections, it is estimated to be 20 m wide and supports Swamp Paperbark, Spiny-headed Mat-rush, Blackwood, *Blackberry and exotic grasses.

Plate 9 The southern most drain of the McDonalds Drain / Bunyip River drainage lines (March 2005). It supports an extensive cover of emergent aquatic vegetation (Common Reed and Knotweeds). The banks alternate between predominantly exotic (e.g. *Flax-leaf Broom) and indigenous (e.g. Swamp Scrub).

5.5.2 Outside the study area

Western Port Bay

The Bunyip River and McDonalds Drain flow into the Western Port ramsar site. Western Port is a large bay with extensive intertidal flats, mangroves, saltmarshes, and seagrass beds. It is of National significance for flora and avifauna, supporting 50% of Victoria's mangroves, State significant flora species (e.g. Creeping Rush *Juncus revolutus*, Tiny Arrow Grass *Triglochin minutissimum*, Coast Ballart *Exocarpus syticola*) and habitat for the EPBC-listed Orange-bellied Parrot and migratory birds (ANCA 1996). This site is protected under the *EPBC Act* 1998 and indirect impacts associated with upgrading roads in the study area will need to be addressed. In particular, sediment loads and surface run-off are a major threat to this ramsar site (ANCA 1996).

6 Potential Impacts and Legislative Implications

6.1 Potential Impacts

Potential impacts to ecological values associated with the proposed corridor include:

- loss of habitat for significant fauna (particularly for the Growling Grass Frog and Southern Brown Bandicoot);
- loss of significant flora species and/or vegetation communities;
- loss of persistent native flora; and
- increased weed invasion.

The most common threats are likely to be the loss of persistent native flora species, increased weed invasion on areas supporting higher quality vegetation and loss of habitat links for fauna. Clearance of native vegetation will need a permit for removal under the Victorian Planning Provisions and/or the *FFG* Act and may also be subject to Net Gain (addressed below).

Table 8 addresses impacts at sites that have the highest ecological values

6.2 Legislation and Policy

Legislation and policy most relevant to the proposed Healesville – Koo Wee Rup Road upgrade is addressed below (Table 6). It outlines the scope of the act/policy, when it applies, to the project, and relevance to the study area.

Table 6 Legislation and policy most relevant to the study area

Name of legislation or policy	Scope	When it applies	Relevance to study area
Federal			
Environment Protection and Biodiversity Conservation Act 1999	Pertains to matters of national environmental significance including Ramsar Wetlands, listed threatened species and Ecological communities[1], listed migratory species and Commonwealth Marine Areas. The proponent is obliged to refer matters to the Commonwealth Environment Minister if such values may be affected by a proposed action. The Department of Environment and Heritage decides whether there will be a significant impact and if it needs to be a 'controlled action'. The commonwealth can intervene to modify or block an action if it deems this necessary for the protection of a species or community of national significance.	Public and Private land. A referral is necessary whenever a proposed action is considered likely to impact on a species or ecological community listed in the Act.	If any *EPBC*-listed species under the act occur, or are likely to occur (e.g. tables 4 & 5), within the proposed corridor, the project will need to be referred to the Commonwealth. The Western Port Ramsar site will also need to be addressed in the referral.
State			
Flora and Fauna Guarantee Act 1988	Lists species and ecological communities recognized as rare or threatened in Victoria[1]. There are also provisions for listing of threatening processes. This is the State's primary legislature for flora and fauna; however, it is dated and poorly tied to the planning process. It effectively does not apply to private land.	Public land (may have implications for private to the extent planning authorities enforce).	Once purchased, private land will become public land. Therefore, the proposed corridor may require a permit from DSE if State listed or protected species are affected.
Wildlife Act 1975	Lists protected fauna species.	Public and private	If targeted surveys are undertaken as part of the project, a permit will be required from DSE to undertake trapping and/or handling of protected fauna.
Catchment and Land Protection Act 1994 (CaLP Act) (amended 2003)	Provides a legislative framework for the management of land including the control of declared noxious weeds and pest animals. The 2003 amendments include increased maximum penalties for poor land management.	Private and public land. If pest plants or animals are detected (or other poor land management practices identified) land managers are given notice and fined if no action is taken.	Noxious weeds that are declared under the Act and found within the corridor (e.g. Table 7) will require control.
Victoria's Native Vegetation Framework	Is a policy for the protection, enhancement and revegetation of native vegetation in Victoria. The Framework is based on the	Private and public land.	Net Gain calculations and offset options will need to be considered for areas supporting greater than 10%

[1] The EPBC & FFG Acts apply only to species and ecological communities that have been formally listed. Additional species may be recognized as rare or threatened at the National level (e.g. DSE 2005) but are not covered by the Act.

	principle of 'Net Gain'. Net Gain is the outcome for native vegetation and habitat where individual losses are avoided where possible. The losses and gains are determined by a combined quality-quantity measure over a specified area and period of time. Three steps need to be addressed in order to fulfil the requirements of Net Gain: (i) To avoid adverse impacts; (ii) If impacts cannot be avoided, to minimise impacts through appropriate consideration in planning; & (iii) Identify appropriate offset options.		native vegetation, or supporting medium - large indigenous trees.
Planning and Environment Act 1987 (Amended 2003)	Sets out objectives for planning in Victoria. One of these objectives is 'to provide for the protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity'. This Act established Native Vegetation retention controls: these require a planning permit to remove, destroy or lop native vegetation (subject to certain exemptions).	Private or public land of greater than 0.4 ha. DSE is a mandatory referral authority for applications to clear 10 or more hectares of native vegetation.	Is implemented through local councils and permits will be required to remove native vegetation for the corridor.
Regional			
Port Phillip & Western Port Native Vegetation Plan	This plan: (i) provides a reference document on the status of native vegetation across all land tenures; (ii) determines strategic directions and priorities for the protection, management, & replanting of indigenous vegetation; (iii) establishes regional goals and targets; & (iv) provides a regional framework for the application and assessment of Native Vegetation Retention controls.	This plan is a key action of the Port Phillip & Westernport Catchment Strategy, Victorian Planning Provisions and Victorian Native Vegetation Management Framework.	Considered under the FFG Act, CaLP Act, Planning and Environment Act and Net Gain system.
Local			
Local Planning Policy	Contains the Municipal Strategic Statement (MSS) and Local Planning Policies. MSS encapsulates significant planning directions for the municipality and in turn provides the strategic basis for the application of the zones, overlays and particular provisions in the planning scheme.	Public and private land. A planning scheme is binding on all people and corporations on every Minister, government department, public authority and municipal council.	Permits are required to remove native vegetation and to undertake construction in any areas that have a significant overlay on them (e.g. Environmental Significance Overlay, ESO). No ESOs occur within the proposed corridor.

7 Recommendations

Broad concepts for avoiding or reducing impacts outlined in Section 6 are addressed below. Areas potentially supporting high ecological values are addressed in Table 8.

Habitat for significant fauna

- Survey the corridor to determine habitat values (especially for the EPBC-listed Southern Brown Bandicoot, Dwarf Galaxias, Australian Grayling, Growling Grass Frog and FFG-listed water birds).
- Undergo targeted surveys for significant fauna likely to occur.
- Avoid or minimise loss of habitat for significant fauna.
- Avoid removal of indigenous trees.
- Designate streambed of Deep Creek, Bunyip River and McDonalds Drain and other drainage lines as no-go-zones for machinery and vehicles.
- Re-vegetate disturbed areas with locally indigenous species.

Indigenous flora species and/or vegetation communities

- Survey the corridor to determine the quality of vegetation.
- Design corridor so as upgrade works occur in areas supporting the lowest quality vegetation.
- Undertake targeted surveys during spring for significant flora (e.g. *EPBC*-listed River Swamp Wallaby-grass), and examine the feasibility of translocating plants that road works can not avoid (permit will be required).
- Avoid removing vegetation outside of the construction footprint.
- During flora survey, undertake Net Gain assessments and discuss offset options with the Department of Sustainability and Environment (DSE).
- Develop a plan to control water and sediment run-off (guidelines are provided in Wong et al. 1998, CSIRO 1999, EPA 1991 and 1995, and Melbourne Water 2002).
- Revegetate disturbed areas with locally indigenous plant species. A list of suitable plant species for planting should be provided once field surveys have been undertaken.

- Develop a management plan for any significant roadside reserves once the corridor design has been confirmed.

Increased weed invasion

- During field surveys determine the weed species that need to be controlled and develop a weed management plan to control weed species from pre-construction to post-construction stages.

- Revegetate disturbed areas with locally indigenous plant species.

A list of very serious agricultural and environmental weeds (either listed under the *Catchment and Land Protection Act* CaLP Act, or otherwise considered as important to control) that could potentially occur within the proposed corridor is given in Table 7.

Table 7 Very serious agricultural and environmental weeds that potentially may occur within the corridor.

Scientific Name	Common Name	Status
**Spartina anglica*	Common Cord-grass	A
**Allium triquetrum*	Three-corner Garlic	C
**Juncus acutus* ssp. *acutus*	Sharp Rush	C
**Feoniculum vulgare*	Fennel	C
**Senecio jacobaea*	Ragwort	C
**Genista linifolia*	Flax-leaf Broom	C
**Genista monspessulana*	Montpellier Broom	C
**Crataegus monogyna*	Hawthorn	C
**Rosa rubiginosa*	Sweet Briar	C
**Lycium ferocissimum*	African Box-thorn	C
**Cirsium vulgare*	Spear Thistle	C
**Watsonia meriana* var. *bulbillifera*	Bulbil Watsonia	C
**Echium plantagineum*	Paterson's Curse	C
**Dittrichia graveolens*	Stinkwort	C
**Salix babylonica*	Weeping Willow	N
**Salix cinerea*	Grey Sallow	N
**Salix* spp.	Willow	N
**Chrysanthemoides monilifera*	Boneseed	N, C
**Rubus anglocandicans*	Blackberry	N, C
**Rubus fruticosus* spp. agg.	Blackberry	N, C
**Ulex europaeus*	Gorse	N, C
**Marrubium vulgare*	Horehound	P
**Pinus pinaster*	Cluster Pine	O
**Pinus radiata*	Radiata Pine	O
**Leucojum aestivum*	Snowflake	O
**Zantedeschia aethiopica*	White Arum-lily	O
**Tradescantia fluminensis*	Tradescantia	O
**Lonicera japonica*	Japanese Honeysuckle	O
**Acacia longifolia* ssp. *longifolia*	Sallow Wattle	O
**Fraximus angustifolia*	Desert Ash	O
**Phytolacca octandra*	Red-ink Weed	O
**Pittosporum undulatum*	Sweet Pittosporum	O

**Cotoneaster glaucophyllus* var. *serotinus*	Large-leaf Cotoneaster	O
**Coprosma repens*	Mirrow Bush	O
**Populus* spp.	Poplar	O
**Crocosmia* x *crocosmiiflora*	Montbretia	O
**Acacia decurrens*	Early Black-wattle	O

Legend:
A = Declared noxious aquatic weed under the CaLP Act
N = Weeds of National significance
P = Regionally Prohibited under CaLP Act
C = Regionally Controlled under CaLP Act
O = other invasive weed

Table 8 Key values, potential impacts and preliminary mitigation/management strategies for ecologically important sites along, or adjoining, the corridor.

Key: Area 1 = Gippsland Railway reserve
Area 2 = Koo Wee Rup Road drainage lines
Area 3 = Large patches of Swamp Scrub
Area 4 = McDonalds Drain/Bunyip River
Area 5 = Western Port Ramsar site

Area	Key values	Potential Impact/threat	Mitigation / Recommendation	Proposed timing	Further work (in order priority)	Legislative / policy implications	Permits / referrals
1	• **Significant plant species** (EPBC, FFG) • **Growling Grass Frogs** (EPBC, FFG) • **Wetland Formation EVC** (Endangered)	• Loss of significant flora • Loss of habitat for significant fauna. • Loss of endangered EVC. • Sediment run-off.	• Construction to take place in areas supporting lowest quality vegetation. • Avoid removing vegetation outside construction footprint. • Examine feasibility of translocating significant species if unavoidable. • Run-off & sediment control to be designed in accordance with water sensitive road design principles[1]. • Revegetate using seed from local provenance.	Design Post-construction	• Targeted survey for Growling Grass Frog. • Conduct spring survey for seasonal flora & targeted surveys for Matted Flax-lily, Maroon Leek-orchid, Austral Cranesbill and Grey Billybuttons. • Net Gain: Habitat hectare assessment if indigenous cover above 10%; • Site inspection for offset options. • Discuss & determine appropriate offset options with DSE.	• EPBC Act • FFG Act • Wildlife Act • Native Vegetation Management Framework	• Submit EPBC Act referral to Commonwealth. • Permit from DSE to undertake surveys on protected fauna. • Permit from DSE for removal of protected flora & listed species. • Obtain planning Permit from City of Cardinia.
2	• **Growling Grass Frogs** (EPBC, FFG) • **Swamp Scrub EVC** (Endangered) • **Wetland Formation EVC** (Endangered)	• Loss of endangered EVCs. • Loss of habitat link for significant fauna. • Sediment run-off	• The proposed corridor should be widened on the side that supports no remnant or aquatic vegetation, or widened on the side that supports the lowest quality vegetation. • Avoid removing vegetation outside construction footprint. • Revegetate using seed from local provenance. • Run-off & sediment control to be designed in accordance with water sensitive road design principles[1].	Design Post-construction	• Target survey for Growling Grass Frog • Survey area proposed for corridor to determine if significant flora are present. • Determine habitat values. • Net Gain: Habitat hectare assessment if indigenous cover above 10% • Site inspection for offset options. • Discuss & determine appropriate offset options with DSE.	• FFG Act • EPBC Act • Wildlife Act • Native Vegetation Management Framework	• If EPBC listed species are found, or likely to occur, refer to Commonwealth. • Obtain planning Permit from City of Cardinia. • Permit from DSE for removal of protected flora if present and to undertake surveys on protected fauna.

3	• **Southern Brown Bandicoot** (EPBC) • **Swamp Scrub EVC** (Endangered)	• Loss of habitat link for significant fauna. • Loss of endangered EVC.	• The proposed corridor should be widened on the side that supports no remnant or aquatic vegetation, or widened on the side that supports the lowest quality vegetation. • Avoid removing vegetation outside construction footprint. • Revegetate using seed from local provenance.	Design Post-construction	• Targeted survey for Southern Brown Bandicoot • Survey area proposed for corridor to determine habitat values & significant flora. • Net Gain: Habitat hectare assessment if indigenous cover above 10% • Site inspection for offset options. • Discuss & determine appropriate offset options with DSE.	• EPBC Act • FFG Act • Native Vegetation Management Framework • Wildlife Act	• If EPBC listed species are found, or likely to occur, refer to Commonwealth. • Permit from DSE for removal of protected flora if present and to undertake surveys on protected fauna. • Obtain planning Permit from City of Cardinia.
4	• **Growling Grass Frog** (FFG, EPBC) • **Dwarf Galaxias** (EPBC, FFG) • **Australian Grayling** (EPBC, FFG) • **Water birds** (EPBC, FFG) • **Southern Brown Bandicoot** (EPBC) • **River Swamp Wallaby-grass** (EPBC) • **Swamp Scrub EVC** (Endangered) • **Wetland Formation EVC** (Endangered)	• Loss of endangered EVCs. • Loss of habitat for significant fauna. • Loss of significant flora • Sediment run-off.	• Widening of bridge should occur in direction that will have least impact on flora and fauna. • Designate streambed/channels as a no-go-zone for vehicles and machinery. • Avoid removing vegetation outside construction footprint. • Run-off & sediment control to be designed in accordance with water sensitive road design principles[1]. • Revegetate using seed from local provenance.	Design Post-construction	• Targeted surveys for Southern Brown Bandicoot, Growling Grass Frog, Australian Grayling and Dwarf Galaxias. • Targeted survey for River Swamp Wallaby-grass • Survey proposed corridor for habitat values and significant flora • Net Gain: Habitat hectare assessment if indigenous cover above 10%. • Site inspection for offset options. • Discuss & determine appropriate offset options with DSE.	• EPBC Act • FFG Act • Native Vegetation Management Framework • Wildlife Act	• Submit EPBC Act referral to Commonwealth. • Permit from DSE to undertake surveys on protected fauna. • Permit from DSE for removal of protected flora & listed species. • Obtain planning Permit from City of Cardinia.

5	• Ramsar site (EPBC) • Fauna species listed under the EPBC and FFG Acts. • State significant flora species	Indirect impacts: • Degradation of Nationally significant site • Loss of habitat for significant fauna. • Loss of significant flora species • Sediment run-off.	• Designate streambed/channels as a no-go-zone for vehicles and machinery. • Run-off & sediment control to be designed in accordance with water sensitive road design principles[1]. • Revegetate using seed from local provenance. • Avoid removing vegetation outside construction footprint.	Design Post-construction	• Determine potential impacts of proposed road up-grade on Ramsar site.	• EPBC Act • FFG Act	• Submit EPBC Act referral to Commonwealth.

[1.] These have been set out by Wong et al. 1998, CSIRO 1999, EPA 1991 & 1995, and Melbourne Water 2002.

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Appendix 1 *Plant taxa recorded from within 5 km of the study area (data from DSE 2004a)*

* = exotic taxa

= taxa indigenous to Victoria, but found outside its former geographic range

E = Endangered in Australia and listed under the EPBC Act 1999, e = endangered in Victoria, r = rare in Victoria, k = unknown, but thought to be rare in Victoria, f = listed under the FFG Act 1988.

Mosses	
Hypnaceae	
Hypnum cupressiforme	Common Plait-moss
Algae	
Cladophoraceae	
Rhizoclonium spp.	Filamentous Green Alga
Ferns and Fern-like Plants	
Adiantaceae	
Adiantum aethiopicum	Common Maidenhair
Azollaceae	
Azolla filiculoides	Pacific Azolla
Blechnaceae	
Blechnum cartilagineum	Gristle Fern
Blechnum minus	Soft Water-fern
Culcitaceae	
Calochlaena dubia	Common Ground-fern
Cyatheaceae	
Cyathea australis	Rough Tree-fern
Dennstaedtiaceae	
Pteridium esculentum	Austral Bracken
Lindsaeaceae	
Lindsaea linearis	Screw Fern
Conifers	
Pinaceae	
* *Pinus pinaster*	Cluster Pine
* *Pinus radiata*	Radiata Pine
Monocotyledons	
Alliaceae	
* *Agapanthus praecox subsp. orientalis*	Agapanthus
* *Allium triquetrum*	Three-corner Garlic
Amaryllidaceae	
* *Leucojum aestivum*	Snowflake
Anthericaceae	
Arthropodium milleflorum s.l.	Pale Vanilla-lily
Arthropodium strictum	Chocolate Lily
Arthropodium strictum s.l.	Chocolate Lily
Chamaescilla corymbosa var. corymbosa	Blue Stars
Thysanotus patersonii	Twining Fringe-lily
Thysanotus tuberosus	Common Fringe-lily
Araceae	
* *Zantedeschia aethiopica*	White Arum-lily
Asparagaceae	
* *Asparagus asparagoides*	Bridal Creeper

Asphodelaceae		
	Bulbine bulbosa	Bulbine Lily
Colchicaceae		
	Burchardia umbellata	Milkmaids
	Wurmbea dioica	Common Early Nancy
Commelinaceae		
*	*Tradescantia fluminensis*	Wandering Jew
Cyperaceae		
	Baumea rubiginosa s.l.	Soft Twig-rush
	Bolboschoenus medianus	Marsh Club-sedge
	Carex appressa	Tall Sedge
	Carex breviculmis	Common Grass-sedge
	Carex brownii	Stream Sedge
k	*Carex chlorantha*	Green-top Sedge
	Carex fascicularis	Tassel Sedge
	Carex gaudichaudiana	Fen Sedge
	Carex inversa	Knob Sedge
*	*Cyperus eragrostis*	Drain Flat-sedge
	Cyperus gunnii subsp. gunnii	Flecked Flat-sedge
*	*Cyperus tenellus*	Tiny Flat-sedge
	Eleocharis acuta	Common Spike-sedge
	Eleocharis sphacelata	Tall Spike-sedge
	Gahnia filum	Chaffy Saw-sedge
	Gahnia radula	Thatch Saw-sedge
	Gahnia sieberiana	Red-fruit Saw-sedge
	Isolepis cernua var. cernua	Nodding Club-sedge
*	*Isolepis hystrix*	Awned Club-sedge
	Isolepis inundata	Swamp Club-sedge
	Lepidosperma elatius	Tall Sword-sedge
	Lepidosperma laterale var. laterale	Variable Sword-sedge
	Lepidosperma laterale var. majus	Variable Sword-sedge
	Lepidosperma longitudinale	Pithy Sword-sedge
	Lepidosperma spp.	Sword Sedge
	Schoenus apogon	Common Bog-sedge
	Schoenus brevifolius	Zig-zag Bog-sedge
	Schoenus tesquorum	Soft Bog-sedge
Hydrocharitaceae		
*	*Elodea canadensis*	Canadian Pondweed
Hypoxidaceae		
	Hypoxis hygrometrica var. hygrometrica	Golden Weather-glass
	Hypoxis vaginata var. vaginata	Yellow Star
Iridaceae		
*	*Crocosmia X crocosmiiflora*	Montbretia
*	*Gladiolus undulatus*	Wild Gladiolus
*	*Romulea rosea*	Onion Grass
*	*Sisyrinchium iridifolium*	Blue Pigroot
*	*Watsonia meriana var. bulbillifera*	Bulbil Watsonia
Juncaceae		
*	*Juncus acutus subsp. acutus*	Sharp Rush
	Juncus amabilis	Hollow Rush
*	*Juncus articulatus*	Jointed Rush
	Juncus australis	Austral Rush
	Juncus bufonius	Toad Rush
*	*Juncus capitatus*	Capitate Rush
	Juncus gregiflorus	Green Rush
	Juncus holoschoenus	Joint-leaf Rush
	Juncus kraussii subsp. australiensis	Sea Rush
	Juncus pallidus	Pale Rush

	Juncus planifolius	Broad-leaf Rush
	Juncus procerus	Tall Rush
r	*Juncus revolutus*	Creeping Rush
	Juncus sarophorus	Broom Rush
	Juncus sp. (sect genuini)	No Common Name
	Juncus spp.	Rush
	Juncus subsecundus	Finger Rush
	Juncus vaginatus	Clustered Rush
	Luzula campestris spp. agg.	Field Woodrush
	Luzula meridionalis	Common Woodrush
	Luzula meridionalis var. meridionalis	Common Woodrush
Juncaginaceae		
	Triglochin procera s.l.	Water Ribbons
	Triglochin procera s.s.	Common Water-ribbons
	Triglochin striata	Streaked Arrowgrass
Lemnaceae		
	Lemna disperma	Common Duckweed
	Lemna spp.	Duckweed
Orchidaceae		
	Acianthus caudatus	Mayfly Orchid
	Acianthus exsertus s.l.	Gnat Orchid
	Acianthus pusillus	Small Mosquito-orchid
	Chiloglottis valida	Common Bird-orchid
	Corunastylis despectans	Sharp Midge-orchid
	Dipodium punctatum s.l.	Hyacinth Orchid
	Gastrodia sesamoides s.s.	Cinnamon Bells
	Leptoceras menziesii	Hare Orchid
	Microtis parviflora	Slender Onion-orchid
	Microtis spp.	Onion Orchid
	Microtis unifolia	Common Onion-orchid
f Ee	*Prasophyllum frenchii*	Maroon Leek-orchid
	Pterostylis concinna	Trim Greenhood
r	*Pterostylis grandiflora*	Cobra Greenhood
	Pterostylis melagramma	Tall Greenhood
	Pterostylis parviflora s.l.	Tiny Greenhood
	Thelymitra arenaria	Forest Sun-orchid
	Thelymitra pauciflora s.l.	Slender Sun-orchid
	Thelymitra spp.	Sun Orchid
Phormiaceae		
	Caesia calliantha	Blue Grass-lily
Ee	*Dianella amoena*	Matted Flax-lily
	Dianella caerulea s.l.	Paroo Lily
	Dianella laevis	Smooth Flax-lily
	Dianella longifolia s.l.	Pale Flax-lily
	Dianella longifolia var. longifolia s.l.	Pale Flax-lily
	Dianella revoluta s.l.	Black-anther Flax-lily
	Dianella revoluta var. revoluta s.l.	Black-anther Flax-lily
	Dianella spp.	Flax Lily
	Dianella tasmanica	Tasman Flax-lily
	Tricoryne elatior	Yellow Rush-lily
Poaceae		
	* *Agrostis capillaris s.l.*	Brown-top Bent
	* *Agrostis capillaris s.s.*	Brown-top Bent
	* *Agrostis stolonifera*	Creeping Bent
	* *Aira caryophyllea*	Silvery Hair-grass
	* *Aira elegantissima*	Delicate Hair-grass
	* *Aira spp.*	Hair Grass
	Amphibromus nervosus	Common Swamp Wallaby-grass

	Amphibromus spp.	Swamp Wallaby-grass
*	*Anthoxanthum odoratum*	Sweet Vernal-grass
	Austrodanthonia bipartita s.l.	Leafy Wallaby-grass
	Austrodanthonia caespitosa	Common Wallaby-grass
	Austrodanthonia eriantha	Hill Wallaby-grass
	Austrodanthonia geniculata	Kneed Wallaby-grass
	Austrodanthonia laevis	Smooth Wallaby-grass
	Austrodanthonia penicillata	Slender Wallaby-grass
	Austrodanthonia pilosa	Velvet Wallaby-grass
	Austrodanthonia racemosa var. racemosa	Stiped Wallaby-grass
	Austrodanthonia setacea	Bristly Wallaby-grass
	Austrodanthonia spp.	Wallaby Grass
	Austrostipa muelleri	Wiry Spear-grass
	Austrostipa nodosa	Knotty Spear-grass
	Austrostipa pubinodis	Tall Spear-grass
	Austrostipa rudis	Veined Spear-grass
r	*Austrostipa rudis subsp. australis*	Veined Spear-grass
	Austrostipa spp.	Spear Grass
	Austrostipa stipoides	Prickly Spear-grass
*	*Avena barbata*	Bearded Oat
*	*Avena fatua*	Wild Oat
*	*Briza maxima*	Large Quaking-grass
*	*Briza minor*	Lesser Quaking-grass
*	*Bromus catharticus*	Prairie Grass
*	*Bromus diandrus*	Great Brome
*	*Bromus hordeaceus subsp. hordeaceus*	Soft Brome
	Chloris truncata	Windmill Grass
*	*Cortaderia selloana*	Pampas Grass
	Cynodon dactylon	Couch
*	*Cynodon dactylon var. dactylon*	Couch
*	*Cynosurus cristatus*	Crested Dog's-tail
*	*Cynosurus echinatus*	Rough Dog's-tail
*	*Dactylis glomerata*	Cocksfoot
	Danthonia s.l. spp.	Wallaby Grass
	Deyeuxia quadriseta	Reed Bent-grass
	Dichelachne crinita	Long-hair Plume-grass
	Dichelachne rara	Common Plume-grass
	Dichelachne sciurea spp. agg.	Short-hair Plume-grass
	Distichlis distichophylla	Australian Salt-grass
*	*Echinochloa colona*	Awnless Barnyard-grass
*	*Echinochloa crus-galli*	Barnyard Grass
	Echinopogon ovatus	Common Hedgehog-grass
*	*Ehrharta erecta var. erecta*	Panic Veldt-grass
*	*Ehrharta longiflora*	Annual Veldt-grass
	Elymus scaber var. scaber	Common Wheat-grass
	Eragrostis brownii	Common Love-grass
*	*Festuca arundinacea*	Tall Fescue
*	*Gaudinia fragilis*	Fragile Oat
	Glyceria australis	Australian Sweet-grass
*	*Hainardia cylindrica*	Common Barb-grass
	Hemarthria uncinata var. uncinata	Mat Grass
*	*Holcus lanatus*	Yorkshire Fog
*	*Hordeum marinum*	Sea Barley-grass
	Imperata cylindrica	Blady Grass
	Joycea pallida	Silvertop Wallaby-grass
	Lachnagrostis billardierei s.l.	Coast Blown-grass
	Lachnagrostis filiformis	Common Blown-grass
r	*Lachnagrostis robusta*	Salt Blown-grass

* *Lolium perenne*	Perennial Rye-grass
* *Lolium rigidum*	Wimmera Rye-grass
* *Lolium spp.*	Rye Grass
Microlaena stipoides var. stipoides	Weeping Grass
Notodanthonia semiannularis	Wetland Wallaby-grass
* *Paspalum dilatatum*	Paspalum
* *Paspalum distichum*	Water Couch
* *Pennisetum clandestinum*	Kikuyu
Pentapogon quadrifidus var. quadrifidus	Five-awned Spear-grass
* *Phalaris aquatica*	Toowoomba Canary-grass
Phragmites australis	Common Reed
* *Poa annua*	Annual Meadow-grass
Poa australis spp. agg.	Tussock Grass
* *Poa bulbosa*	Bulbous Meadow-grass
Poa ensiformis	Sword Tussock-grass
Poa labillardierei	Common Tussock-grass
Poa labillardierei var. labillardierei	Common Tussock-grass
Poa morrisii	Soft Tussock-grass
Poa sieberiana	Grey Tussock-grass
Poa tenera	Slender Tussock-grass
Puccinellia stricta	Australian Saltmarsh-grass
Puccinellia stricta var. stricta	Australian Saltmarsh-grass
* *Setaria viridis*	Green Pigeon-grass
* *Sorghum halepense*	Johnson Grass
* *Spartina anglica*	Common Cord-grass
* *Sporobolus africanus*	Rat-tail Grass
Tetrarrhena juncea	Forest Wire-grass
Themeda triandra	Kangaroo Grass
* *Vulpia bromoides*	Squirrel-tail Fescue
* *Vulpia spp.*	Fescue
Pontederiaceae	
* *Pontederia cordata*	Pickerel Weed
Potamogetonaceae	
Potamogeton spp.	Pondweed
Typhaceae	
Typha domingensis	Narrow-leaf Cumbungi
Typha spp.	Bulrush
Xanthorrhoeaceae	
Lomandra filiformis	Wattle Mat-rush
Lomandra filiformis subsp. coriacea	Wattle Mat-rush
Lomandra filiformis subsp. filiformis	Wattle Mat-rush
Lomandra longifolia	Spiny-headed Mat-rush
Lomandra longifolia subsp. longifolia	Spiny-headed Mat-rush
Lomandra multiflora subsp. multiflora	Many-flowered Mat-rush
Xanthorrhoea minor subsp. lutea	Small Grass-tree
Zannichelliaceae	
Lepilaena cylindrocarpa	Long-fruit Water-mat
Lepilaena spp.	Water Mat
Dicotyledons	
Aizoaceae	
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower
* *Galenia pubescens var. pubescens*	Galenia
Amaranthaceae	
Hemichroa pentandra	Trailing Hemichroa
Apiaceae	
Apium annuum	Annual Celery
Apium prostratum subsp. prostratum	Sea Celery

	Centella cordifolia	Centella
*	*Daucus carota*	Carrot
*	*Foeniculum vulgare*	Fennel
	Hydrocotyle foveolata	Yellow Pennywort
	Hydrocotyle verticillata	Shield Pennywort
	Platysace heterophylla var. heterophylla	Slender Platysace
Apocynaceae		
*	*Vinca major*	Blue Periwinkle
Araliaceae		
*	*Hedera helix*	English Ivy
	Polyscias sambucifolia	Elderberry Panax
Asteraceae		
*	*Arctotheca calendula*	Cape Weed
*	*Aster subulatus*	Aster-weed
	Cassinia aculeata	Common Cassinia
	Cassinia longifolia	Shiny Cassinia
*	*Chrysanthemoides monilifera*	Boneseed
	Chrysocephalum apiculatum s.s.	Common Everlasting
*	*Cirsium vulgare*	Spear Thistle
*	*Conyza bonariensis*	Flaxleaf Fleabane
*	*Conyza sumatrensis*	Tall Fleabane
*	*Cotula coronopifolia*	Water Buttons
e	*Craspedia canens*	Grey Billy-buttons
	Craspedia paludicola	Swamp Billy-buttons
*	*Dittrichia graveolens*	Stinkwort
	Euchiton collinus s.s.	Creeping Cudweed
	Euchiton involucratus s.l.	Common Cudweed
	Euchiton involucratus s.s.	Star Cudweed
	Euchiton sphaericus	Annual Cudweed
*	*Gamochaeta purpurea s.s.*	Spiked Cudweed
	Helichrysum scorpioides	Button Everlasting
*	*Helminthotheca echioides*	Ox-tongue
*	*Hypochoeris radicata*	Cat's Ear
*	*Lactuca serriola*	Prickly Lettuce
	Lagenophora gracilis	Slender Bottle-daisy
	Lagenophora stipitata	Common Bottle-daisy
*	*Leontodon taraxacoides subsp. taraxacoides*	Hairy Hawkbit
	Leptorhynchos squamatus	Scaly Buttons
	Leptorhynchos squamatus subsp. squamatus	Scaly Buttons
	Leptorhynchos tenuifolius	Wiry Buttons
	Olearia argophylla	Musk Daisy-bush
	Olearia lirata	Snowy Daisy-bush
	Olearia phlogopappa	Dusty Daisy-bush
	Olearia ramulosa var. ramulosa	Twiggy Daisy-bush
	Ozothamnus ferrugineus	Tree Everlasting
	Pseudognaphalium luteoalbum	Jersey Cudweed
	Senecio glomeratus	Annual Fireweed
	Senecio hispidulus s.l.	Rough Fireweed
*	*Senecio jacobaea*	Ragwort
	Senecio minimus	Shrubby Fireweed
	Senecio pinnatifolius	Variable Groundsel
	Senecio quadridentatus s.l.	Cotton Fireweed
	Senecio spp.	Groundsel
	Senecio squarrosus s.l.	Leafy Fireweed
	Senecio tenuiflorus s.l.	Slender Fireweed
*	*Senecio vulgaris*	Common Groundsel
	Solenogyne dominii	Smooth Solenogyne
*	*Sonchus asper s.l.*	Rough Sow-thistle

	* *Sonchus asper s.s.*	Rough Sow-thistle
	* *Sonchus oleraceus*	Common Sow-thistle
	Sonchus spp.	Sow Thistle
	* *Taraxacum officinale spp. agg.*	Garden Dandelion
	* *Vellereophyton dealbatum*	White Cudweed
Bignoniaceae		
	Pandorea pandorana	Wonga Vine
Boraginaceae		
	* *Echium plantagineum*	Paterson's Curse
Brassicaceae		
	* *Brassica fruticulosa*	Twiggy Turnip
	* *Cardamine hirsuta s.s.*	Common Bitter-cress
	* *Lepidium africanum*	Common Peppercress
	* *Nasturtium officinale*	Watercress
	* *Raphanus raphanistrum*	Wild Radish
	* *Rapistrum rugosum*	Giant Mustard
Brunoniaceae		
	Brunonia australis	Blue Pincushion
Callitrichaceae		
	* *Callitriche hamulata*	Thread Water-starwort
	* *Callitriche stagnalis*	Common Starwort
Campanulaceae		
	Lobelia anceps	Angled Lobelia
	Wahlenbergia communis s.l.	Tufted Bluebell
	Wahlenbergia gracilenta s.l.	Annual Bluebell
	Wahlenbergia gracilis	Sprawling Bluebell
	Wahlenbergia gymnoclada	Naked Bluebell
	Wahlenbergia multicaulis	Branching Bluebell
	Wahlenbergia stricta subsp. stricta	Tall Bluebell
Caprifoliaceae		
	* *Lonicera japonica*	Japanese Honeysuckle
Caryophyllaceae		
	* *Cerastium glomeratum s.l.*	Common Mouse-ear Chickweed
	* *Cerastium glomeratum s.s.*	Sticky Mouse-ear Chickweed
	* *Sagina maritima*	Sea Pearlwort
	* *Silene spp.*	Catchfly
	* *Stellaria media*	Chickweed
Casuarinaceae		
	Allocasuarina littoralis	Black Sheoak
	Allocasuarina spp.	Sheoak
Chenopodiaceae		
r	*Atriplex paludosa subsp. paludosa*	Marsh Saltbush
	* *Atriplex prostrata*	Hastate Orache
	Rhagodia candolleana subsp. candolleana	Seaberry Saltbush
	Sarcocornia quinqueflora	Beaded Glasswort
	Sclerostegia arbuscula	Shrubby Glasswort
	Suaeda australis	Austral Seablite
Clusiaceae		
	Hypericum gramineum	Small St John's Wort
Convolvulaceae		
	Dichondra repens	Kidney-weed
Crassulaceae		
	Crassula decumbens var. decumbens	Spreading Crassula
Cunoniaceae		
	Bauera rubioides	Wiry Bauera
Droseraceae		
	Drosera peltata	Pale Sundew
	Drosera peltata subsp. auriculata	Tall Sundew

Drosera peltata subsp. peltata	Pale Sundew
Drosera spp.	Sundew
Drosera whittakeri subsp. aberrans	Scented Sundew
Elatinaceae	
Elatine gratioloides	Waterwort
Epacridaceae	
Acrotriche prostrata	Trailing Ground-berry
Acrotriche serrulata	Honey-pots
Astroloma humifusum	Cranberry Heath
Epacris impressa	Common Heath
Leucopogon ericoides	Pink Beard-heath
Ericaceae	
* *Erica lusitanica*	Spanish Heath
Euphorbiaceae	
Poranthera microphylla	Small Poranthera
Fabaceae	
Bossiaea prostrata	Creeping Bossiaea
Daviesia latifolia	Hop Bitter-pea
Desmodium gunnii	Southern Tick-trefoil
Dillwynia cinerascens s.l.	Grey Parrot-pea
Dillwynia glaberrima	Smooth Parrot-pea
Dillwynia sericea	Showy Parrot-pea
* *Genista linifolia*	Flax-leaf Broom
* *Genista monspessulana*	Montpellier Broom
Glycine clandestina	Twining Glycine
Glycine microphylla	Small-leaf Glycine
Gompholobium huegelii	Common Wedge-pea
# *Hardenbergia violacea*	Purple Coral-pea
Hovea heterophylla	Common Hovea
Indigofera australis	Austral Indigo
Kennedia prostrata	Running Postman
* *Lotus angustissimus*	Slender Bird's-foot Trefoil
k *Lotus australis*	Austral Trefoil
* *Lotus corniculatus*	Bird's-foot Trefoil
* *Lotus corniculatus var. corniculatus*	Bird's-foot Trefoil
* *Lotus spp. (naturalised)*	Trefoil
* *Lotus subbiflorus*	Hairy Bird's-foot Trefoil
* *Lotus uliginosus*	Greater Bird's-foot Trefoil
* *Medicago polymorpha*	Burr Medic
Platylobium obtusangulum	Common Flat-pea
Pultenaea gunnii	Golden Bush-pea
Pultenaea gunnii subsp. gunnii	Golden Bush-pea
Pultenaea hispidula	Rusty Bush-pea
Pultenaea pedunculata	Matted Bush-pea
Pultenaea stricta	Rigid Bush-pea
* *Trifolium campestre var. campestre*	Hop Clover
* *Trifolium dubium*	Suckling Clover
* *Trifolium repens var. repens*	White Clover
* *Trifolium spp.*	Clover
* *Trifolium striatum*	Knotted Clover
* *Trifolium subterraneum*	Subterranean Clover
* *Ulex europaeus*	Gorse
* *Vicia hirsuta*	Tiny Vetch
* *Vicia sativa*	Common Vetch
* *Vicia sativa subsp. nigra*	Narrow-leaf Vetch
* *Vicia tetrasperma*	Slender Vetch
Fumariaceae	
* *Fumaria muralis subsp. muralis*	Wall Fumitory

Gentianaceae		
	* *Centaurium erythraea*	Common Centaury
	* *Centaurium tenuiflorum*	Slender Centaury
Geraniaceae		
	Erodium spp.	Heron's Bill
	* *Geranium dissectum*	Cut-leaf Cranesbill
	Geranium homeanum	Northern Cranesbill
	* *Geranium molle var. molle*	Dovesfoot
	Geranium potentilloides	Cinquefoil Cranesbill
	Geranium potentilloides var. potentilloides	Soft Cranesbill
	Geranium retrorsum s.s.	Grassland Cranesbill
	Geranium solanderi s.l.	Austral Cranesbill
	v Geranium solanderi var. solanderi s.s.	Austral Cranesbill
	Geranium sp. 2	Variable Cranesbill
	Geranium sp. 4	Rough Cranesbill
	Geranium sp. 5	Naked Cranesbill
	Geranium spp.	Crane's Bill
	Pelargonium rodneyanum	Magenta Stork's-bill
Goodeniaceae		
	Dampiera stricta	Blue Dampiera
	Goodenia geniculata	Bent Goodenia
	Goodenia humilis	Swamp Goodenia
	Goodenia lanata	Trailing Goodenia
	Goodenia ovata	Hop Goodenia
	Selliera radicans	Shiny Swamp-mat
Haloragaceae		
	Gonocarpus tetragynus	Common Raspwort
	Haloragis heterophylla	Varied Raspwort
Lamiaceae		
	* *Marrubium vulgare*	Horehound
	Prostanthera lasianthos	Victorian Christmas-bush
	Prostanthera lasianthos var. lasianthos	Victorian Christmas-bush
	* *Prunella vulgaris*	Self-heal
	* *Stachys arvensis*	Stagger Weed
Lauraceae		
	Cassytha melantha	Coarse Dodder-laurel
	Cassytha pubescens s.s.	Downy Dodder-laurel
Linaceae		
	Linum marginale	Native Flax
	* *Linum trigynum*	French Flax
Loranthaceae		
	Amyema pendula	Drooping Mistletoe
Lythraceae		
	Lythrum hyssopifolia	Small Loosestrife
Malvaceae		
	Gynatrix pulchella s.s.	Hemp Bush
	* *Malva parviflora*	Small-flower Mallow
	* *Modiola caroliniana*	Red-flower Mallow
Menyanthaceae		
	Villarsia reniformis	Running Marsh-flower
Mimosaceae		
	* *Acacia decurrens*	Early Black-wattle
	Acacia genistifolia	Spreading Wattle
	# *Acacia longifolia subsp. longifolia*	Sallow Wattle
	Acacia mearnsii	Black Wattle
	Acacia melanoxylon	Blackwood
	Acacia myrtifolia	Myrtle Wattle
	Acacia paradoxa	Hedge Wattle

	Acacia stricta	Hop Wattle
	Acacia verticillata	Prickly Moses
	Acacia verticillata subsp. verticillata	Prickly Moses
Myoporaceae		
#	*Myoporum insulare*	Common Boobialla
Myrsinaceae		
	Rapanea howittiana	Mutton-wood
Myrtaceae		
#	*Eucalyptus botryoides*	Southern Mahogany
	Eucalyptus cephalocarpa s.s.	Mealy Stringybark
*	*Eucalyptus cladocalyx*	Sugar Gum
	Eucalyptus cypellocarpa	Mountain Grey-gum
	Eucalyptus dives	Broad-leaved Peppermint
r	*Eucalyptus fulgens*	Green Scentbark
r #	*Eucalyptus globulus subsp. globulus*	Southern Blue-gum
	Eucalyptus goniocalyx s.l.	Bundy
	Eucalyptus goniocalyx s.s.	Bundy
#	*Eucalyptus leucoxylon*	Yellow Gum
	Eucalyptus obliqua	Messmate Stringybark
	Eucalyptus ovata	Swamp Gum
	Eucalyptus ovata var. ovata	Swamp Gum
	Eucalyptus radiata s.l.	Narrow-leaf Peppermint
	Eucalyptus radiata subsp. radiata	Narrow-leaf Peppermint
	Eucalyptus rubida	Candlebark
	Eucalyptus spp.	Eucalypt
	Eucalyptus viminalis	Manna Gum
	Eucalyptus viminalis subsp. viminalis	Manna Gum
	Kunzea ericoides spp. agg.	Burgan
	Leptospermum continentale	Prickly Tea-tree
	Leptospermum lanigerum	Woolly Tea-tree
	Leptospermum spp.	Tea Tree
r #	*Melaleuca armillaris subsp. armillaris*	Giant Honey-myrtle
	Melaleuca ericifolia	Swamp Paperbark
	Melaleuca squarrosa	Scented Paperbark
Oleaceae		
*	*Fraxinus angustifolia*	Desert Ash
*	*Ligustrum spp.*	Privet
Onagraceae		
	Epilobium billardierianum	Variable Willow-herb
	Epilobium billardierianum subsp. cinereum	Grey Willow-herb
*	*Epilobium ciliatum*	Glandular Willow-herb
	Epilobium hirtigerum	Hairy Willow-herb
Oxalidaceae		
	Oxalis corniculata s.l.	Yellow Wood-sorrel
*	*Oxalis corniculata s.s.*	Creeping Wood-sorrel
	Oxalis exilis	Shady Wood-sorrel
*	*Oxalis incarnata*	Pale Wood-sorrel
	Oxalis perennans	Grassland Wood-sorrel
*	*Oxalis pes-caprae*	Soursob
*	*Oxalis spp. (naturalised)*	Wood Sorrel
Papaveraceae		
*	*Papaver dubium*	Long-headed Poppy
Phytolaccaceae		
*	*Phytolacca octandra*	Red-ink Weed
Pittosporaceae		
	Billardiera scandens	Common Apple-berry
	Billardiera scandens var. scandens	Common Apple-berry
	Bursaria spinosa subsp. spinosa	Sweet Bursaria

	# *Pittosporum undulatum*	Sweet Pittosporum
Plantaginaceae		
	* *Plantago coronopus*	Buck's-horn Plantain
	* *Plantago lanceolata*	Ribwort
	* *Plantago major*	Greater Plantain
Plumbaginaceae		
	r *Limonium australe*	Yellow Sea-lavender
Polygalaceae		
	Comesperma volubile	Love Creeper
Polygonaceae		
	* *Acetosella vulgaris*	Sheep Sorrel
	* *Fallopia convolvulus*	Black Bindweed
	Persicaria decipiens	Slender Knotweed
	* *Persicaria maculosa*	Redshank
	* *Polygonum aviculare s.s.*	Hogweed
	* *Rumex conglomeratus*	Clustered Dock
	* *Rumex crispus*	Curled Dock
	* *Rumex pulcher subsp. pulcher*	Fiddle Dock
	* *Rumex spp. (naturalised)*	Dock (naturalised)
Portulacaceae		
	Neopaxia australasica	White Purslane
Primulaceae		
	* *Anagallis arvensis*	Pimpernel
	Samolus repens	Creeping Brookweed
Proteaceae		
	Banksia marginata	Silver Banksia
Ranunculaceae		
	Clematis aristata	Mountain Clematis
	Clematis microphylla	Small-leaved Clematis
	Ranunculus amphitrichus	Small River Buttercup
	Ranunculus glabrifolius	Shining Buttercup
	Ranunculus lappaceus	Australian Buttercup
	Ranunculus plebeius s.s.	Forest Buttercup
	* *Ranunculus repens*	Creeping Buttercup
	Ranunculus spp.	Buttercup
	* *Ranunculus trilobus*	Large Annual Buttercup
Resedaceae		
	* *Reseda lutea*	Cut-leaf Mignonette
Rosaceae		
	Acaena agnipila	Hairy Sheep's Burr
	Acaena echinata	Sheep's Burr
	Acaena novae-zelandiae	Bidgee-widgee
	Acaena ovina	Australian Sheep's Burr
	* *Cotoneaster glaucophyllus var. serotinus*	Large-leaf Cotoneaster
	* *Crataegus monogyna*	Hawthorn
	* *Malus pumila*	Apple
	* *Prunus cerasifera*	Cherry Plum
	* *Prunus spp.*	Prunus
	* *Rosa rubiginosa*	Sweet Briar
	* *Rubus anglocandicans*	Blackberry
	* *Rubus fruticosus spp. agg.*	Blackberry
	Rubus parvifolius	Small-leaf Bramble
	Rubus spp.	Bramble
Rubiaceae		
	Asperula conferta	Common Woodruff
	Asperula scoparia	Prickly Woodruff
	Coprosma quadrifida	Prickly Currant-bush
	* *Coprosma repens*	Mirror Bush

	* *Galium aparine*	Cleavers
	Galium binifolium	Reflexed Bedstraw
	Galium gaudichaudii	Rough Bedstraw
	Galium propinquum	Maori Bedstraw
	Opercularia ovata	Broad-leaf Stinkweed
	Opercularia varia	Variable Stinkweed
Salicaceae		
	* *Populus spp.*	Poplar
	* *Salix babylonica s.l.*	Weeping Willow
	* *Salix cinerea*	Grey Sallow
	* *Salix spp.*	Willow
Santalaceae		
	Exocarpos cupressiformis	Cherry Ballart
	Exocarpos strictus	Pale-fruit Ballart
Scrophulariaceae		
	Gratiola pubescens	Glandular Brooklime
	* *Parentucellia viscosa*	Yellow Bartsia
	Veronica calycina	Hairy Speedwell
	Veronica gracilis	Slender Speedwell
	Veronica plebeia	Trailing Speedwell
Solanaceae		
	* *Lycium ferocissimum*	African Box-thorn
	Solanum laciniatum	Large Kangaroo Apple
	* *Solanum nigrum s.s.*	Black Nightshade
	* *Solanum nigrum sensu Willis (1972)*	Black Nightshade
Stylidiaceae		
	Stylidium graminifolium s.l.	Grass Triggerplant
	Stylidium graminifolium s.s.	Grass Triggerplant
Thymelaeaceae		
	Pimelea humilis	Common Rice-flower
	Pimelea linifolia	Slender Rice-flower
Urticaceae		
	Urtica incisa	Scrub Nettle
	* *Urtica urens*	Small Nettle
Verbenaceae		
r	*Avicennia marina subsp. australasica*	Grey Mangrove
	* *Verbena bonariensis var. bonariensis s.s.*	Purple-top Verbena
Violaceae		
	Viola cleistogamoides	Hidden Violet
	Viola hederacea s.s.	Ivy-leaf Violet
	Viola hederacea sensu Willis (1972)	Ivy-leaf Violet
	Viola sieberiana spp. agg.	Tiny Violet

Appendix 2 Fauna recorded from within 5 km of the study area, data from DSE 2004b.

Code	Last record (year)	Number of records	EPBC	DSE	FFG	Common Name	Scientific Name
34	2000	2				Common Bronzewing	*Phaps chalcoptera*
45	1981	2		VU	L	Lewin's Rail	*Rallus pectoralis*
56	1998	2				Dusky Moorhen	*Gallinula tenebrosa*
58	1981	1				Purple Swamphen	*Porphyrio porphyrio*
59	2001	10				Eurasian Coot	*Fulica atra*
60	1985	1				Great Crested Grebe	*Podiceps cristatus*
61	2002	6				Australasian Grebe	*Tachybaptus novaehollandiae*
62	1999	11				Hoary-headed Grebe	*Poliocephalus poliocephalus*
96	1999	11				Great Cormorant	*Phalacrocorax carbo*
97	1998	3				Little Black Cormorant	*Phalacrocorax sulcirostris*
99	1997	3		NT		Pied Cormorant	*Phalacrocorax varius*
100	1999	4				Little Pied Cormorant	*Phalacrocorax melanoleucos*
106	1999	16				Australian Pelican	*Pelecanus conspicillatus*
110	1997	2		NT		Whiskered Tern	*Chlidonias hybridus*
111	1986	2		EN	L	Gull-billed Tern	*Sterna nilotica*
112	1997	6		NT	L	Caspian Tern	*Sterna caspia*
115	1997	5				Crested Tern	*Sterna bergii*
125	2001	13				Silver Gull	*Larus novaehollandiae*
126	1997	4		NT		Pacific Gull	*Larus pacificus*
130	1981	1				Pied Oystercatcher	*Haematopus longirostris*
132	1999	1				Red-kneed Dotterel	*Erythrogonys cinctus*
133	2000	34				Masked Lapwing	*Vanellus miles*
136	1980	1		NT		Grey Plover	*Pluvialis squatarola*
137	1997	4		NT		Pacific Golden Plover	*Pluvialis fulva*
139	1997	3		VU		Lesser Sand Plover	*Charadrius mongolus*
140	1998	9				Double-banded Plover	*Charadrius bicinctus*
143	1997	6				Red-capped Plover	*Charadrius ruficapillus*
144	1999	11				Black-fronted Dotterel	*Elseyornis melanops*
146	1999	5				Black-winged Stilt	*Himantopus himantopus*
149	1997	6		NT		Eastern Curlew	*Numenius madagascariensis*
150	1985	1		VU		Whimbrel	*Numenius phaeopus*
157	1998	1		VU		Common Sandpiper	*Actitis hypoleucos*
158	1997	13				Common Greenshank	*Tringa nebularia*
159	1986	2				Marsh Sandpiper	*Tringa stagnatilis*
160	1997	6		EN	L	Terek Sandpiper	*Xenus cinereus*
161	1999	14				Curlew Sandpiper	*Calidris ferruginea*
162	1999	12				Red-necked Stint	*Calidris ruficollis*
163	1999	16				Sharp-tailed Sandpiper	*Calidris acuminata*
165	1985	1		EN	L	Great Knot	*Calidris tenuirostris*
167	1997	2				Broad-billed Sandpiper	*Limicola falcinellus*
168	1999	3		NT		Latham's Snipe	*Gallinago hardwickii*
172	1974	1				Oriental Pratincole	*Glareola maldivarum*
179	2001	26				Australian White Ibis	*Threskiornis molucca*
180	2001	12				Straw-necked Ibis	*Threskiornis spinicollis*
181	1997	17		VU		Royal Spoonbill	*Platalea regia*
182	1982	3				Yellow-billed Spoonbill	*Platalea flavipes*
187	1996	17		VU	L	Great Egret	*Ardea alba*
188	1999	37				White-faced Heron	*Egretta novaehollandiae*
189	1994	2				White-necked Heron	*Ardea pacifica*

192	1981	1	NT		Nankeen Night Heron	*Nycticorax caledonicus*
198	1998	1	NT		Cape Barren Goose	*Cereopsis novaehollandiae*
202	2002	9			Australian Wood Duck	*Chenonetta jubata*
203	1999	35			Black Swan	*Cygnus atratus*
207	1999	41			Australian Shelduck	*Tadorna tadornoides*
208	2001	26			Pacific Black Duck	*Anas superciliosa*
210	2002	21			Chestnut Teal	*Anas castanea*
211	1999	23			Grey Teal	*Anas gracilis*
212	1999	9	VU		Australasian Shoveler	*Anas rhynchotis*
213	2001	12			Pink-eared Duck	*Malacorhynchus membranaceus*
215	1999	7	VU		Hardhead	*Aythya australis*
216	1996	2	EN	L	Blue-billed Duck	*Oxyura australis*
217	1997	9	VU		Musk Duck	*Biziura lobata*
218	1997	1	NT		Spotted Harrier	*Circus assimilis*
219	1999	5			Swamp Harrier	*Circus approximans*
221	1991	1			Brown Goshawk	*Accipiter fasciatus*
225	1981	1			Little Eagle	*Hieraaetus morphnoides*
232	1999	2			Black-shouldered Kite	*Elanus axillaris*
237	1999	1			Peregrine Falcon	*Falco peregrinus*
239	1998	2			Brown Falcon	*Falco berigora*
240	1997	3			Nankeen Kestrel	*Falco cenchroides*
242	1991	1			Southern Boobook	*Ninox novaeseelandiae*
249	1999	2			Barn Owl	*Tyto alba*
267	2002	6			Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*
268	2001	1			Gang-gang Cockatoo	*Callocephalon fimbriatum*
269	2000	7			Sulphur-crested Cockatoo	*Cacatua galerita*
272	2002	1			Long-billed Corella	*Cacatua tenuirostris*
273	2000	6			Galah	*Cacatua roseicapilla*
281	1981	1			Australian King-Parrot	*Alisterus scapularis*
282	2000	9			Crimson Rosella	*Platycercus elegans*
288	2000	8			Eastern Rosella	*Platycercus eximius*
306	1981	1			Blue-winged Parrot	*Neophema chrysostoma*
313	1991	1			Tawny Frogmouth	*Podargus strigoides*
322	2000	8			Laughing Kookaburra	*Dacelo novaeguineae*
334	1991	2			White-throated Needletail	*Hirundapus caudacutus*
337	1998	1			Pallid Cuckoo	*Cuculus pallidus*
342	1999	1			Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*
357	2001	12			Welcome Swallow	*Hirundo neoxena*
361	2000	19			Grey Fantail	*Rhipidura fuliginosa*
364	2000	12			Willie Wagtail	*Rhipidura leucophrys*
377	1981	1			Jacky Winter	*Microeca fascinans*
380	1991	6			Scarlet Robin	*Petroica multicolor*
381	1991	1			Red-capped Robin	*Petroica goodenovii*
382	1981	2			Flame Robin	*Petroica phoenicea*
392	2000	12			Eastern Yellow Robin	*Eopsaltria australis*
398	2000	9			Golden Whistler	*Pachycephala pectoralis*
401	1991	8			Rufous Whistler	*Pachycephala rufiventris*
408	2000	10			Grey Shrike-thrush	*Colluricincla harmonica*
415	2001	10			Magpie-lark	*Grallina cyanoleuca*
416	1991	1			Crested Shrike-tit	*Falcunculus frontatus*
424	1998	3			Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
448	1997	3			White-fronted Chat	*Epthianura albifrons*
470	2000	10			Striated Thornbill	*Acanthiza lineata*
475	2001	10			Brown Thornbill	*Acanthiza pusilla*

486	1981	2				Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
488	1991	6				White-browed Scrubwren	*Sericornis frontalis*
500	1981	1				Striated Fieldwren	*Calamanthus fuliginosus*
522	1981	1				Little Grassbird	*Megalurus gramineus*
524	2002	1				Clamorous Reed Warbler	*Acrocephalus stentoreus*
525	1999	8				Golden-headed Cisticola	*Cisticola exilis*
529	2001	21				Superb Fairy-wren	*Malurus cyaneus*
547	1991	1				Dusky Woodswallow	*Artamus cyanopterus*
549	1991	2				Varied Sittella	*Daphoenositta chrysoptera*
558	2000	7				White-throated Treecreeper	*Cormobates leucophaeus*
564	1991	2				Mistletoebird	*Dicaeum hirundinaceum*
565	1991	8				Spotted Pardalote	*Pardalotus punctatus*
574	1991	5				Silvereye	*Zosterops lateralis*
578	1991	7				White-naped Honeyeater	*Melithreptus lunatus*
591	1999	1				Eastern Spinebill	*Acanthorhynchus tenuirostris*
614	1991	1				Yellow-faced Honeyeater	*Lichenostomus chrysops*
617	2000	11				White-eared Honeyeater	*Lichenostomus leucotis*
618	1948	1	EN	CR	L	Helmeted Honeyeater	*Lichenostomus melanops cassid*
625	1999	7				White-plumed Honeyeater	*Lichenostomus penicillatus*
633	2001	7				Bell Miner	*Manorina melanophrys*
634	2000	4				Noisy Miner	*Manorina melanocephala*
638	2001	5				Red Wattlebird	*Anthochaera carunculata*
647	1999	5				Richard's Pipit	*Anthus novaeseelandiae*
662	2002	7				Red-browed Finch	*Neochmia temporalis*
694	2000	3				Pied Currawong	*Strepera graculina*
702	2001	3				Grey Butcherbird	*Cracticus torquatus*
705	2000	7				Australian Magpie	*Gymnorhina tibicen*
930	2000	9				Australian Raven	*Corvus coronoides*
954	1991	3				Little Raven	*Corvus mellori*
976	1981	1				Striated Pardalote	*Pardalotus striatus*
977	1999	3				Cattle Egret	*Ardea ibis*
978	1998	1		NT		Pectoral Sandpiper	*Calidris melanotos*
989	2000	10		*		Spotted Turtle-Dove	*Streptopelia chinensis*
991	2001	7		*		Common Blackbird	*Turdus merula*
993	1999	7		*		Skylark	*Alauda arvensis*
995	1999	3		*		House Sparrow	*Passer domesticus*
996	2002	4		*		European Goldfinch	*Carduelis carduelis*
997	1999	1		*		European Greenfinch	*Carduelis chloris*
998	2001	13		*		Common Myna	*Acridotheres tristis*
999	2001	12		*		Common Starling	*Sturnus vulgaris*
1003	2003	2				Short-beaked Echidna	*Tachyglossus aculeatus*
1028	2003	5				Agile Antechinus	*Antechinus agilis*
1033	1981	1				Dusky Antechinus	*Antechinus swainsonii*
1092	1991	7	EN	NT		Southern Brown Bandicoot	*Isoodon obesulus obesulus*
1113	1981	6				Common Brushtail Possum	*Trichosurus vulpecula*
1129	1991	10				Common Ringtail Possum	*Pseudocheirus peregrinus*
1138	1991	1				Sugar Glider	*Petaurus breviceps*
1162	1970	1				Koala	*Phascolarctos cinereus*
1242	1991	7				Black Wallaby	*Wallabia bicolor*
1265	1991	1				Eastern Grey Kangaroo	*Macropus giganteus*
1324	1991	2				White-striped Freetail Bat	*Tadarida australis*
1335	1991	7				Lesser Long-eared Bat	*Nyctophilus geoffroyi*
1349	1991	2				Gould's Wattled Bat	*Chalinolobus gouldii*
1379	1991	2				Little Forest Bat	*Vespadelus vulturnus*

1381	1991	1				Large Forest Bat	*Vespadelus darlingtoni*
1395	1991	3				Bush Rat	*Rattus fuscipes*
1398	1991	1				Swamp Rat	*Rattus lutreolus*
1408	1981	1		*		Black Rat	*Rattus rattus*
1412	1991	2		*		House Mouse	*Mus musculus*
1510	1991	8		*		European Rabbit	*Oryctolagus cuniculus*
1531	1991	1		Cmp		Dingo/Dog (feral)	*Canis familiaris*
1532	2003	8		*		Red Fox	*Canis vulpes*
1536	1991	1		*		Cat (feral)	*Felis catus*
2407	1996	16		VU	L	Swamp Skink	*Egernia coventryi*
2451	1981	2				Garden Skink	*Lampropholis guichenoti*
2452	1904	4				Weasel Skink	*Saproscincus mustelinus*
2462	1986	9				Metallic Skink	*Niveoscincus metallicus*
2578	2000	1				Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*
2665	1998	1				White-lipped Snake	*Drysdalia coronoides*
2683	1983	2		NT		Glossy Grass Skink	*Pseudemoia rawlinsoni*
2938	1770	1				Black Rock Skink	*Egernia saxatilis intermedia*
2973	1996	74				Lowland Copperhead	*Austrelaps superbus*
2995	1981	1				unidentified grass skink	*Pseudemoia sp.*
3033	1992	1				Victorian Smooth Froglet	*Geocrinia victoriana*
3058	1998	2				Southern Bullfrog	*Limnodynastes dumerilii*
3061	1998	1				Striped Marsh Frog	*Limnodynastes peronii*
3063	2003	4				Spotted Marsh Frog	*Limnodynastes tasmaniensis*
3134	1998	10				Common Froglet	*Crinia signifera*
3182	2003	5				Southern Brown Tree Frog	*Litoria ewingii*
3207	2003	13	VU	EN	L	Growling Grass Frog	*Litoria raniformis*
3215	1991	1		Cmp		Verreaux's Tree Frog	*Litoria verreauxii*
3906	1998	1				Whistling Tree Frog	*Litoria verreauxii verreauxii*
4001	1998	1473				Short-headed Lamprey	*Mordacia mordax*
4015	1998	1943				Shortfin Eel	*Anguilla australis*
4028	1998	1048		*		Brown Trout	*Salmo trutta*
4031	1998	1048	VU	VU	L	Australian Grayling	*Prototroctes maraena*
4032	1997	324				Broadfin Galaxias	*Galaxias brevipinnis*
4035	1998	2343				Common Galaxias	*Galaxias maculatus*
4038	1997	648				Spotted Galaxias	*Galaxias truttaceus*
4041	1976	36	VU	VU	L	Dwarf Galaxias	*Galaxiella pusilla*
4043	1998	61		*		Goldfish	*Carassius auratus*
4069	1998	25		*		Mosquitofish	*Gambusia holbrooki*
4101	1998	436				Southern Pigmy Perch	*Nannoperca australis*
4138	1998	2273				Tupong	*Pseudaphritis urvillii*
5055	1998	1448				Common Freshwater Shrimp	*Paratya australiensis*

Legend:
EPBC = listed under EPBC Act 1999
FFG = listed under FFG Act 1988
L = listed under FFG Act
DSE = DSE status (DSE 2003)
CR = Critically endangered
EN = Endangered
VU = Vulnerable
NT = Near threatened

Appendix 3 EPBC species from protected matters search tool.

Species Common Name	Scientific Name	EBPC status
Birds		
Southern Royal Albatross	*Diomedea epomophora*	VU
Gibson's Albatross	*Diomedea gibsoni*	VU
Northern Royal Albatross	*Diomedea sanfordi*	EN
Swift Parot	*Lathamus discolor*	EN
Southern Giant-Petrel	*Macronectes giganteus*	EN
Northern Giant-Petrel	*Macronectes halli*	VU
Australian Painted Snipe	*Rostratula australis*	VU
Buller's Albatross	*Thalassarche bulleri*	VU
Shy Albatross	*Thalassarche cauta*	VU
Campbell Albatross	*Thalassarche impavida*	VU
Salvin's Albatross	*Thalassarche salvini*	VU
Regent Honeyeater	*Xanthomyza phrygia*	EN
Fish		
Dwarf Galaxias	*Galaxiella pusilla*	VU
Australian Grayling	*Prototroctes maraena*	VU
Frogs		
Growling Grass Frog	*Litoria raniformis*	VU
Mammals		
Spotted Quoll	*Dasyurus maculatus maculatus*	EN
Southern Right Whale	*Eubalaena australis*	EN
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	EN
Humpback Whale	*Megaptera novaeangliae*	VU
Long-nosed Potoroo	*Potorous tridactylus tridactylus*	VU
Smoky Mouse	*Pseudomys fumeus*	EN
Grey-headed Flying-fox	*Pteropus poliocephalus*	VU
Sharks		
Great White Shark	*Carcharodon carcharias*	VU
Migratory Terrestrial Species		
Birds		
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Mi
White-throated Needletail	*Hirundapus caudacutus*	Mi
Black-faced Monarch	*Monarcha melanopsis*	Mi
Satin Flycatcher	*Myiagra cyanoleuca*	Mi
Rufous Fantail	*Rhipidura rufifrons*	Mi
Regent Honeyeater	*Xanthomyza phrygia*	Mi
Migratory Wetland Species		
Birds		
Curlew Sandpiper	*Calidris ferruginea*	Mi
Red-necked Stint	*Calidris ruficollis*	Mi
Double-banded Plover	*Charadrius bicinctus*	Mi
Latham's Snipe	*Gallinago hardwickii*	Mi
Eastern Curlew	*Numenius madagascariensis*	Mi
Pacfic Golden Plover	*Pluvialis fulva*	Mi
Painted Snipe	*Rostratula benghalensis s. lat.*	Mi
Common Greenshank	*Tringa nebularia*	Mi
Migratory Marine Birds		
Southern Royal Albatross	*Diomedea epomophora*	Mi
Gibson's Albatross	*Diomedea gibsoni*	Mi
Northern Royal Albatross	*Diomedea sanfordi*	Mi

Southern Giant-Petrel	*Macronectes giganteus*	Mi
Northern Giant-Petrel	*Macronectes halli*	Mi
Buller's Albatross	*Thalassarche bulleri*	Mi
Shy Albatross	*Thalassarche cauta*	Mi
Campbell Albatross	*Thalassarche impavida*	Mi
Salvin's Albatross	*Thalassarche salvini*	Mi
Migratory Marine Species		
Mammals		
Bryde's Whale	*Balaenoptera edeni*	Mi
Pygmy Right Whale	*Caperea marginata*	Mi
Southern Right Whale	*Eubalaena australis*	Mi
Humpback Whale	*Megaptera novaeangliae*	Mi
Sharks		
Great White Shark	*Carcharodon carcharias*	Mi
Others Protected by the EPBC Act		
Birds		
Fork-tailed Swift	*Apus pacificus*	Ma
Great Egret	*Ardea alba*	Ma
Cattle Egret	*Ardea ibis*	Ma
Curlew Sandpiper	*Calidris ferruginea*	Ma
Red-necked Stint	*Calidris ruficollis*	Ma
Double-banded Plover	*Charadrius bicinctus*	Ma
Southern Royal Albatross	*Diomedea epomophora*	Ma
Gibson's Albatross	*Diomedea gibsoni*	Ma
Northern Royal Albatross	*Diomedea sanfordi*	Ma
Latham's Snipe	*Gallinago hardwickii*	Ma
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Ma
White-throated Needletail	*Hirundapus caudacutus*	Ma
Swift Parot	*Lathamus discolor*	Ma
Southern Giant-Petrel	*Macronectes giganteus*	Ma
Northern Giant-Petrel	*Macronectes halli*	Ma
Rainbow Bee-eater	*Merops ornatus*	Ma
Black-faced Monarch	*Monarcha melanopsis*	Ma
Satin Flycatcher	*Myiagra cyanoleuca*	Ma
Eastern Curlew	*Numenius madagascariensis*	Ma
Pacific Golden Plover	*Pluvialis fulva*	Ma
Rufous Fantail	*Rhipidura rufifrons*	Ma
Painted Snipe	*Rostratula benghalensis s. lat.*	Ma
Buller's Albatross	*Thalassarche bulleri*	Ma
Shy Albatross	*Thalassarche cauta*	Ma
Campbell Albatross	*Thalassarche impavida*	Ma
Salvin's Albatross	*Thalassarche salvini*	Ma
Common Greenshank	*Tringa nebularia*	Ma
Mammals		
Fur-seal	*Arctocepyhalus pusillus*	Li
Bryde's Whale	*Balaenoptera edeni*	Cet
Pygmy Right Whale	*Caperea marginata*	Cet
Common Dolphin	*Delphinus delphis*	Cet
Southern Right Whale	*Eubalaena australis*	Cet
Humpback Whale	*Megaptera novaeangliae*	Cet
Dusky Dolphin	*Lagenorhynchus obscurus*	Cet
Spotted Bottlenose Dolphin	*Tursiops aduncus*	Cet

Legend:

EN = Endangered
VU = Vulnerable
Mi = Migratory
Ma = Marine
Cet = Cetacean