

# Healesville - Koo Wee Rup Road Upgrade - Southern Brown Bandicoot Surveys

Project: 08-30

Prepared for:

Vic Roads



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## Summary

### Background

Ecology Australia was commissioned by VicRoads, South East Metropolitan Region, to undertake a targeted survey for the Southern Brown Bandicoot (*Isodon obesulus obesulus*) as part of a planning study to determine options for the future upgrade of the Healesville – Koo Wee Rup Road, between the Pakenham Bypass and the South Gippsland Highway. The Southern Brown Bandicoot is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and classified as Near Threatened in Victoria (Department of Sustainability and Environment 2007).

The objectives of this study were to undertake habitat assessments and targeted hair-tube surveys for the Southern Brown Bandicoot in several locations which may be impacted by the proposed alignment of the Healesville - Koo Wee Rup Road.

Seven survey sites within the broader study area encompassing the proposed road upgrade alignments were selected to assess Southern Brown Bandicoot presence and habitat suitability:

1. the proposed interchange immediately to the south of Ballarto Road and along the current alignment of the Healesville - Koo Wee Rup Road (Site 1);
2. the disused Leongatha Railway Line and adjoining property on Railway Road, Koo Wee Rup, where they are intersected by the two proposed bypass options (Options 1 and 2) (Site 2 and 2a);
3. the area where the south-east bypass option (Option 1) crosses the five drains (e.g. McGregors Drain, McDonalds Drain, North West Drain, Bunyip River Drain and Southern Boundary Drain) (Site 3).
4. a proposed interchange location along the South Gippsland Highway, east of Rossiter Road, for the south-east bypass option (Option 1) (Site 4).
5. the area where the proposed south-east bypass (Option 1) to the South Gippsland Highway intersects Rossiter Road (Site 5).
6. the area where the south-west bypass option (Option 2) intersects with the South Gippsland Highway, east of Prestons Road (Site 6);
7. Deep Creek/Moodys Inlet, north and south of the South Gippsland Highway, where bridge works and road widening may be required for the south-west bypass option (Option 2) (Site 7).

## Results

### Hair-tube survey and predator scat analysis

Of the 105 hair-tubes, 55 (52%) yielded hair. No hairs from Southern Brown Bandicoots were identified in the hair-tubes.

Species recorded in the hair-tubes were the native Swamp Rat (*Rattus lutreolus*), and introduced \*Black Rat (*Rattus rattus*), \*House Mouse (*Mus musculus*), \*Cattle (*Bos taurus*), \*Cat (*Felis catus*) and \*European Rabbit (*Oryctolagus cuniculus*) [\* - denotes exotic species].

Seventeen predator scats [mainly \*Red Fox (*Vulpes vulpes*)] were collected from the study area and surrounds. Hair in these scats was identified as coming from eight species: the Southern Brown Bandicoot in four scats (scats were collected during the Growling Grass Frog and Swamp Skink surveys, Ecology Australia 2008b), Common Brushtail Possum (*Trichosurus vulpecula*) and Common Ringtail Possum (*Pseudocheirus peregrinus*), \*Cattle, \*House Mouse, \*Deer, and \*Dog (*Canis familiaris*).

### Habitat assessment

Site 1 (south of Ballarto Road) was mostly exotic vegetation along a drainage line adjoining Healesville - Koo Wee Rup Road and is considered too small and isolated to support Bandicoots.

Site 2 (disused Railway Line) supports highly suitable habitat and is largely contiguous with remnant vegetation along the Bunyip River Drain. Re-vegetation area of Site 2a was unsuitable, and too small and isolated for Bandicoots to use regularly.

Site 3 (drains) supports suitable habitat and vegetation along the length of the drains and is known to support Bandicoots. The vegetation links up to the Koo Wee Rup Swamp Lookout which is inhabited by Bandicoots.

Sites 4 and 5 (east of Rossiter Road and on Rossiter Road) are small isolated patches of vegetation dominated by exotic species with little ground cover. These patches are considered to be unsuitable and too small and isolated to support Bandicoots.

The northern section of Site 6 (South Gippsland Highway, east of Prestons Road) comprises small patches of revegetation/regeneration with little understorey, and is unsuitable for Bandicoots. The southern section of the Highway, supported suitable habitat attributes, but it is not known whether there would be movement of animals from the north-west side of the highway (where they have been recorded at Deep Creek), to the south. Considering the proximity of known recent records, this area is still considered to be potential habitat.

Site 7 (east of Deep Creek) supports suitable habitat for Bandicoots. It has a shrub cover of Swamp Paperbark and an understorey of sedges and grasses. Considering the habitat is largely suitable, and there are historical records from the area, we consider the habitat around Site 7 would be used regularly. The vegetation also extends upstream along the drains, however, it is not known if Bandicoots persist north of the Railway Line along the Cardinia and Deep Creek drains, but there is suitable habitat, at least northwards to Manks Road.

### **Potentials impacts and legislative requirements**

The greatest threat to the Southern Brown Bandicoot in relation to the Healesville - Koo Wee Rup Road upgrade is the loss and/or fragmentation of habitat. Direct impacts include habitat loss (e.g. remnant vegetation or dense exotic vegetation along the drains (e.g. Bunyip River Drain to McGregors Drain), and the disused Railway Line. An indirect impact usually associated with road projects is the fragmentation and isolation of animal populations and habitats. Ideally, the design would avoid areas where bandicoots occur.

There appear to be few issues in the north of the study area (i.e. where no bandicoots were recorded in October 2005 or this current study). This area where Bandicoots do not appear to be a concern runs along Healesville - Koo Wee Rup Road between Pakenham and north of McDonalds Drain Road.

Sensitive areas are those where the proposed bypass alignments (Options 1 and 2), south of Manks Road, cross known Bandicoot habitat (along the disused Railway Line and the drains). As well as the bridges over the area of Cardinia and Deep Creeks which are known to support Bandicoots.

For the proposed works associated with the Healesville – Koo Wee Rup Road Upgrade, it is recommended that VicRoads prepare an EPBC Act referral for DEWHA which includes consideration of the Southern Brown Bandicoot. The referral will need to consider the significance of the study area to ‘a population’ of the Southern Brown Bandicoot as defined under the EPBC Act for a species listed as Endangered.

The proposed road alignment (particularly Option 1 and 2 connections to the South Gippsland Highway) would be traversing an area that supports a population of Southern Brown Bandicoots as defined under the EPBC Act. A referral appears imminent, and the nature of the final alignment would determine whether the Road Upgrade should be referred as a ‘controlled’ or ‘not a controlled’ action.



## 1 Introduction

Ecology Australia Pty Ltd was commissioned by VicRoads, South East Metropolitan Region, to undertake a targeted survey for the Southern Brown Bandicoot (*Isoodon obesulus obesulus*) as part of a planning study to determine options for the future upgrade of the Healesville – Koo Wee Rup Road, between the Pakenham Bypass and the South Gippsland Highway. The Southern Brown Bandicoot is listed as Endangered under the Federal *Environment Protection and Biodiversity Conservation Act 1999* and classified as Near Threatened in Victoria (DSE 2007b).

### 1.1 Previous work undertaken for VicRoads

The initial work undertaken in early 2005 for VicRoads as part of the Healesville - Koo Wee Rup Road upgrade, investigated a strip of land adjoining both sides of the current alignment of the Road between the Princes Highway at Pakenham and South Gippsland Highway at Koo Wee Rup. This initial investigation included a broader area of land in the southern part of the study area bounded by Koo Wee Rup township in the north, the Koo Wee Rup Swamp Lookout (including the Bunyip River and a number of drains) in the southwest, the South Gippsland Highway near Koo Wee Rup in the south and Sybella Avenue in the south-east, to allow for possible alignments for a bypass of Koo Wee Rup. The work included:

- a desktop review of flora and fauna issues which identified the key issues as being the River Swamp Wallaby-grass (*Amphibromus fluitans*), Growling Grass Frog (*Litoria raniformis*) and Southern Brown Bandicoot (*Isoodon obesulus obesulus*), all listed under the EPBC Act (Ecology Australia 2005).

The three key issues identified during the desktop study were investigated in 2006 and involved:

- a Growling Grass Frog survey of the study area addressed during the desktop review (Ecology Australia 2006a);
- a Southern Brown Bandicoot survey of the same study area (Ecology Australia 2006b);  
and
- a rare plant survey focusing on River Swamp Wallaby-grass (Ecology Australia (2006c).

In 2007, Ecology Australia undertook a desktop review of flora and fauna values of a new area in the north to provide an alternative connection to the Pakenham Bypass. This area was bounded by the Pakenham Bypass in the north and Toomuc Creek in the west (near McGregor Road) and extended eastwards to the Healesville - Koo Wee Rup Road in the vicinity of the Deep Creek crossing and the Pakenham Sewage Treatment Plant (Ecology Australia 2007a). The key fauna issue identified was the Growling Grass Frog's potential occurrence at numerous farm dams in the study area (see Ecology Australia 2008a).

In addition, survey work was carried out in February and March 2008 for the Growling Grass Frog and the Swamp Skink, listed under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act),

in areas that would potentially be impacted on by the proposed Road Upgrade and Koo Wee Rup bypass options (Ecology Australia 2008b).

## 1.2 Objectives of this study

Apart from the new area in the north for an alternative connection to the Pakenham Bypass, a new area has also been targeted for detailed surveys in the south. This covers a larger area for one of the options for a bypass of Koo Wee Rup than investigated in earlier studies. This area extends from Manks Road (to the northwest of Koo Wee Rup) and runs in a south-westerly direction to the South Gippsland Highway in the vicinity of Prestons Road.

Proposed works for this bypass option pass near to, or over, Cardinia Creek, Moodys Inlet, Toomuc/Deep Creek and the drains and Bunyip River to the immediate west of the Koo Wee Rup Swamp Lookout. Vegetation adjoining these creeks and drains support vegetation which is habitat for the Southern Brown Bandicoot. Additional survey work was also undertaken at proposed interchange sites at Ballarto Road, where aerial photographic interpretation identified road side vegetation, and thus, potential Bandicoot habitat.

The objectives of this study are to undertake habitat assessments and targeted hair-tube surveys for the Southern Brown Bandicoot at several locations which may be impacted by the alignment (i.e. either by the road or interchanges) of the Healesville-Koo Wee Rup Road. This involved undertaking surveys for the Bandicoot at the following locations:

1. the proposed interchange immediately to the south of Ballarto Road and along the current alignment of the Healesville - Koo Wee Rup Road (Site 1);
2. the disused Leongatha Railway Line and adjoining property on Railway Road, Koo Wee Rup, where they are intersected by the two proposed bypass options (Options 1 and 2) (Site 2 and 2a);
3. the area where the south-east bypass option (Option 1) crosses the five drains (e.g. McGregors Drain, McDonalds Drain, North West Drain, Bunyip River Drain and Southern Boundary Drain) (Site 3).
4. a proposed interchange location along the South Gippsland Highway, east of Rossiter Road, for the south-east bypass option (Option 1) (Site 4).
5. the area where the proposed south-east bypass (Option 1) to the South Gippsland Highway intersects Rossiter Road (Site 5).
6. the area where the south-west bypass option (Option 2) intersects with the South Gippsland Highway, east of Prestons Road (Site 6);
7. Deep Creek/Moodys Inlet, north and south of the South Gippsland Highway, where bridge works and road widening may be required for the south-west bypass option (Option 2) (Site 7).

### 1.3 Conservation Status

The conservation status of the Southern Brown Bandicoot (*Isoodon obesulus obesulus*) is as follows:

#### Australia

- ❖ Federal *Environment Protection and Biodiversity Conservation Act 1999* - Endangered
- ❖ National Action Plan for Marsupials and Monotremes (Maxwell 1996) – Near Threatened

#### Victoria

- ❖ Victorian *Flora and Fauna Guarantee Act 1988* - ineligible for listing
- ❖ Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2007b) - Near Threatened

## 2 Study Area

### 2.1 Broader study area

The study area forms part of the original Koo Wee Rup Swamp prior to drainage and clearance of extensive areas of the Swamp vegetation in the early 19<sup>th</sup> Century (Yugovic and Mitchell 2006). It would have originally supported reed- and rush-dominated vegetation in an inner swamp, Swamp Paperbark (*Melaleuca ericifolia*) Scrub on the outskirts of seasonally inundated areas, Swampy Riparian Woodland on natural levees along watercourses and sand ridges, and grassland and Acacia woodland outside the band of Melaleuca (Yugovic and Mitchell 2006; DSE 2007c and 2007d). Remnant Swampy Riparian Woodland and Swamp Scrub habitats can be found at the Bayles Fauna Park and Koo Wee Rup Swamp Lookout, respectively.

The study area has been highly modified and subjected to a long history of disturbance since the drainage of the Koo Wee Rup Swamp, construction of drainage channels, and land clearance for agriculture. The majority of the study area and surrounding landscape comprises pastoral land, predominantly used for grazing. Smaller areas of land are used for crop cultivation. Relatively, small patches of remnant vegetation remain along roadsides, Cardinia, Toomuc and Deep Creeks, the Bunyip River and numerous drains (e.g. McDonalds Drain). Larger patches of remnant vegetation persist along Healesville – Koo Wee Rup Road, around Yallock Creek and Bayles in the surrounding areas. Adjoining the study area, and immediately to the north of the Pakenham Bypass, is the residential area of Pakenham. The areas north of Key Lane (west of McGregor Road) and south of Greenhills Road (east of McGregor Road), now forms part of the Casey - Cardinia Urban Growth Area (DSE 2005b).

The study area falls within the Gippsland Plain Bioregion, which experiences a relatively uniform, temperate climate of warm, dry summers and cool, wet winters. The mean daily maximum temperatures at Tooradin, the closest weather station, ranges between 13.1°C in July and 26.0°C in January (Bureau of Meteorology data). Mean daily minimum temperatures range between 3.8°C in July to 12.1°C in February. Mean annual rainfall is 853 mm at Tooradin.

The soils are sedimentary, formed during the Pleistocene, comprising stream alluvium, floodplain and low level terrace deposits. They are comprised of Quaternary alluvium consisting primarily of stream alluvium, sand, silt, clay and gravel (Geological Survey Map Warragul Series, Mines Department, Melbourne 1971).

Cardinia Creek, Moodys Inlet, Toomuc/Deep Creek, and the Bunyip River and associated drains to the immediate west of the Koo Wee Rup Swamp Lookout flow into the Westernport Ramsar Wetland Site on the south side of the South Gippsland Highway (ANCA 1996; DSE 2003) and immediately downstream of the study area. The south side of the South Gippsland Highway forms the Ramsar boundary. Ramsar wetlands are internationally important wetlands listed under the International Convention on Wetlands (i.e. the Ramsar Convention), and are also matters of national environmental significance listed under the EPBC Act 1999. The Westernport Ramsar

site is important in regards to total numbers and/or numbers of species of waterbird and the integrity of the saltmarsh-mangrove-seagrass wetland ecosystems. The bay supports about half of Victoria's mangrove communities, which comprise a single species of state significance, the White Mangrove (ANCA 1996; DSE 2003).

The broader area has also been described in previous reports (see Ecology Australia 2002, 2003, 2004a, 2004b, 2004c, 2005a, 2005b, 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2007a and 2007b).

## 2.2 Survey sites

The broader study area has been separated into seven discrete survey sites according to proposed road upgrade/construction works to assess Southern Brown Bandicoot presence and habitat suitability.

One of the new areas under assessment for the Bandicoot are the interchanges that are proposed for various roads intersecting the Healesville Koo Wee Rup Road, including Hall Road and Ballarto Road. In a previous assessment (Ecology Australia 2006b), a hair-tube survey for the Bandicoot was undertaken along the Healesville – Koo Wee Rup Road near Hall Road. No Bandicoots were recorded and this area was considered too small and isolated to support the species (Ecology Australia 2006b). As such, this area was not re-surveyed.

The new areas to be targeted included areas intersected by the proposed alignment and supporting potential habitat (e.g. dense vegetation) (see Figure 1):

1. the proposed interchange immediately to the south of Ballarto Road and along the current alignment of the Healesville - Koo Wee Rup Road (Site 1);
2. the disused Leongatha Railway Line and adjoining property on Railway Road, Koo Wee Rup, where they are intersected by the two proposed bypass options (Options 1 and 2) (Site 2 and 2a);
3. the area where the south-east bypass option (Option 1) crosses the five drains (e.g. McGregors Drain, McDonalds Drain, North West Drain, Bunyip River Drain and Southern Boundary Drain) (Site 3).
4. a proposed interchange location along the South Gippsland Highway, east of Rossiter Road, for the south-east bypass option (Option 1) (Site 4).
5. the area where the proposed south-east bypass (Option 1) to the South Gippsland Highway intersects Rossiter Road (Site 5).
6. the area where the south-west bypass option (Option 2) intersects with the South Gippsland Highway, east of Prestons Road (Site 6);
7. Deep Creek/Moodys Inlet, north and south of the South Gippsland Highway, where bridge works and road widening may be required for the south-west bypass option (Option 2) (Site 7).

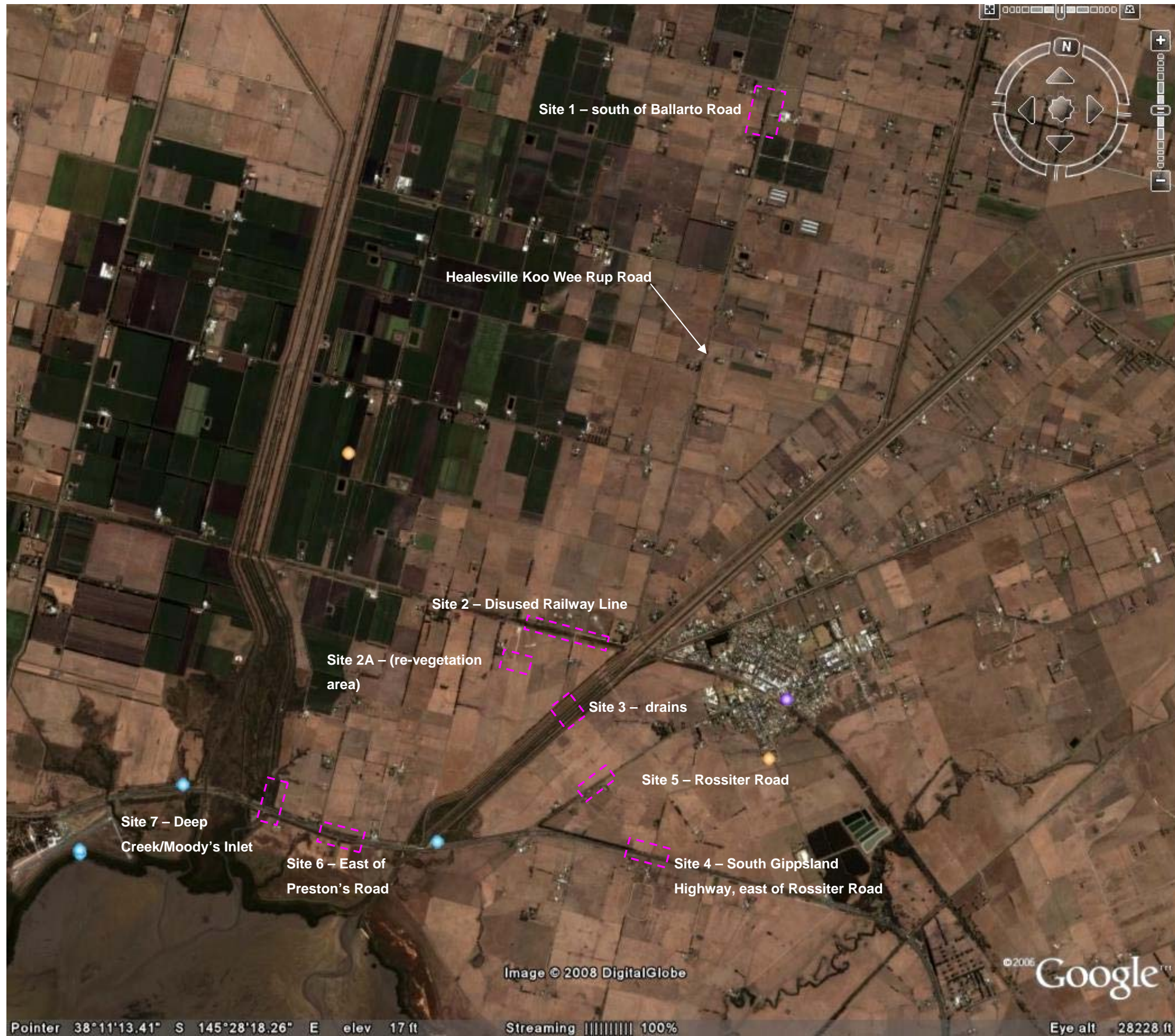


Figure 1 Healesville Koo Wee Rup Road study area and study sites outlined in pink

## **3 Methods**

### **3.1.1 Desktop review**

This step was undertaken in order to place the proposed alignment in context of contemporary Southern Brown Bandicoot records and to facilitate the determination of a likelihood of occurrence (in conjunction with the results of the current survey and habitat assessment). Three sources were interrogated to develop a map/aerial photograph of the distribution of Southern Brown Bandicoot records within the Pakenham – Koo Wee Rup, Cardinia and Dalmore area. The map is presented in Section 5.1. The sources included:

- the Atlas of Victorian Wildlife (AVW) database (DSE 2007a);
- the results of the initial Ecology Australia (2006a) survey as part of the Healesville – Koo Wee Rup Road upgrade and other surveys (see Ecology Australia 2008); and
- Rolf Willig, Department of Sustainability and Environment South Gippsland Region; Sarah McClagen, Cardinia Environment Coalition; David Nicholls, Mornington Peninsula and Western Port Biosphere Research Committee.

### **3.2 Field survey**

The study area was visited on the 8, 9, 21 and 22 May 2008. Two methods were employed to survey for the Southern Brown Bandicoot: hair-tube sampling and predator scat analysis. A habitat assessment was also undertaken at all sites to determine habitat suitability and gain an appreciation of quality and connectivity of habitats or potential habitat.

#### **3.2.1 Habitat assessment**

A habitat assessment was undertaken at each site to assess suitability, value, key features and the likelihood of regular occurrence of Southern Brown Bandicoots. The following habitat attributes were recorded and assessed which are key features in determining habitat suitability for Bandicoots (see habitat Proforma – Appendix 1):

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- Approximate size/area of site
- Time since fire (habitat mosaic) – [if applicable]
- EVC(s) (if present, e.g. Swamp Scrub, Swampy Riparian Woodland, Saltmarsh, Estuarine Flats Grassland)
- Exotic plantings
- Landscape context
  - Dispersal and movement links/corridors
  - Proximity to roads
  - Degree of isolation/proximity to recent Bandicoot records
- Size of vegetation patch (m2 or ha):
- Understorey
  - Sedges (e.g. Lomandra, Gahnia, Juncus)
  - Grass tussocks (e.g. Poa, Austrostipa)
  - Exotic grasses (e.g. Phalaris, Kikuyu)
  - Blackberry
  - Common Reeds
- Dominant plant species
- Overstorey
- Trees (e.g. Eucalypts, Pine, Cypress, Acacia)
- Dominant tree/shrub species
- Bandicoot diggings (AMG's)
- Fox Scats (AMG's)
- Degrading factors
- Key features
  - Combination of dense understorey/open areas
  - Dense vegetation bordering open areas
- Location: Road reserve/drainage reserve
- Mid-storey
  - Melaleuca
  - Broome
  - Gorse
  - Boxthorn
  - Other
- Substrate
  - Open areas (e.g. bare ground, open grassy areas)
  - Leaf litter
  - Woody debris, logs
  - Soils (e.g. sandy, well drained, mud)

### 3.3 Hair-tube sampling

Hair-tubes are injection-moulded 'half-tubes', with glue-covered plastic wafers placed, and secured, across their ceiling. The funnel is baited with salami. Fauna attracted to the scent of the bait enter the funnel leaving behind hairs that brush against the sticky wafer. Mammals have a unique hair structure and hair samples may be identified to species level (Brunner and Coman 1974; Brunner and Triggs 2002).

One hundred and five (105) hair-funnels (Faunatech Pty Ltd) were set along 13 transect lines (see Figure 2). Funnels were spaced at 10 – 20 m intervals and placed on the ground. All wafers were forwarded to Dr. Hans Brunner (Consulting Scatologist, Frankston) for identification of hair samples.



### **3.4 Predator Scat Analysis**

Analysis of predator (Fox, Cat and Dog) scats is also a useful means of detecting mammal (prey) species. Hair samples (and bone fragments) of mammals are teased apart from scats, and identified to species level via their unique hair structure (Brunner and Coman 1974; Brunner and Triggs 2002). Predator scats collected from the study area were forwarded to Dr. Hans Brunner for identification of mammal species. The main limitation with the technique is that carnivores have large home ranges. Subsequently, caution must be exercised when assessing the prey species distribution in an area from such records, as species appearing in predator scats may not necessarily occur where scats are deposited.

## 4 Results

### 4.1 Hair-tube survey

Of the 105 hair-tubes, 55 (52%) yielded hair. No hairs from Southern Brown Bandicoots were identified in the hair-tubes.

Species recorded in the hair-tubes were the native Swamp Rat (*Rattus lutreolus*) - 11 hair-tubes (10%), and five exotic species: \*Black Rat (*Rattus rattus*) – 23 hair-tubes (21%); \*House Mouse (*Mus musculus*) – 22 hair-tubes (20%); \*Cattle (*Bos taurus*) – 1 hair-tube (< 1%); \*Cat (*Felis catus*) – 4 hair-tubes (< 1%); and \*European Rabbit (*Oryctolagus cuniculus*) – 1 hair-tube (< 1%).

### 4.2 Predator scat analysis

Seventeen predator scats [mainly \*Red Fox (*Vulpes vulpes*)] were collected from the study area and surrounds (see Table 1). Hair in these scats was identified as coming from seven species. These were the Southern Brown Bandicoot in four scats (scats were collected during the Growling Grass Frog and Swamp Skink surveys, Ecology Australia 2008b), Common Brushtail Possum (*Trichosurus vulpecula*) and Common Ringtail Possum (*Pseudocheirus peregrinus*), plus four exotic species: \*Cattle, \*House Mouse, \*Deer, and \*Dog (*Canis familiaris*) (Table 1; Figure 2).

\* - denotes exotic/introduced species

Healesville - Koo Wee Rup Road Upgrade - Southern Brown  
Bandicoot Surveys



Table 1 Healesville - Koo Wee Rup Road Upgrade: results from Southern Brown Bandicoot surveys (May 2008)

Site No.	Site Name	Date	Start AMG	Habitat suitability	No. of hair-tubes	Records of Southern Brown Bandicoot	Other species recorded
<b>Hair-tube survey results</b>							•
1	South of Ballarto Road (Plates 1 & 2)	8-5-08	367271 5775970	Low	15	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• Cattle</li> <li>• House Mouse</li> <li>• Cat</li> </ul>
2	Disused Railway Line (Plates 3 & 4)	8-5-08	366036 5771277	High	15	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• Rabbit</li> <li>• House Mouse</li> <li>• Black Rat</li> </ul>
2A	Private property (re-vegetation area) (Plates 5 & 6)	9-5-08	366137 5770574	Low	10	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• Cat</li> </ul>
3	Drains – McGregors Drain and Bunyip River Main Drain (Plates 7 & 8)	9-5-08	366792 5769514	Moderate-High	15	Nil	<ul style="list-style-type: none"> <li>• House Mouse</li> <li>• Cat</li> <li>• Black Rat</li> </ul>
4	South Gippsland Highway, east of Rossiter Road Plates (Plates 9 & 10)	8-5-08	366792 5769514	Low	10	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• House Mouse</li> <li>• Black Rat</li> </ul>
5	Rossiter Road (Plates 11 & 12)	9-5-08	3664141 5770060	Low	10	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• House Mouse</li> <li>• Black Rat</li> </ul>
6	South Gippsland Highway, east of Prestons Road (Plates 13 – 16)	9-5-08	364259 5769367	Moderate	15	Nil	<ul style="list-style-type: none"> <li>• Swamp Rat</li> <li>• House Mouse</li> <li>• Black Rat</li> </ul>
7	Deep Creek (Plates 17 – 21)	9-5-08	-	High	15	Nil	<ul style="list-style-type: none"> <li>• House Mouse</li> <li>• Black Rat</li> </ul>
<b>Predator scat analysis results</b>							•
	Koo Wee Rup Swamp lookout	11-2-08	365156 5769487	High	0	Possible diggings	<ul style="list-style-type: none"> <li>• House Mouse</li> </ul>

Healesville - Koo Wee Rup Road Upgrade - Southern Brown  
Bandicoot Surveys



Site No.	Site Name	Date	Start AMG	Habitat suitability	No. of hair-tubes	Records of Southern Brown Bandicoot	Other species recorded
	East side of Deep Creek, upstream of South Gippsland Highway	11-2-08	363651 5769670	High		Hair identified in fox scat	
	West side of Cardinia Creek, upstream of South Gippsland Highway	11-2-08	363082 5769771	High	0	Lots of diggings and hair identified in fox scat	
	East side of Cardinia Creek, upstream of South Gippsland Highway	11-2-08	363130 5769732	High	0	Hair identified in fox scat	
	Private property adjoining Railway Line	11-2-08	365930 5771220	Low on property, but remnant vegetation on Railway Line – moderate-high suitability	0	Hair identified in fox scat	

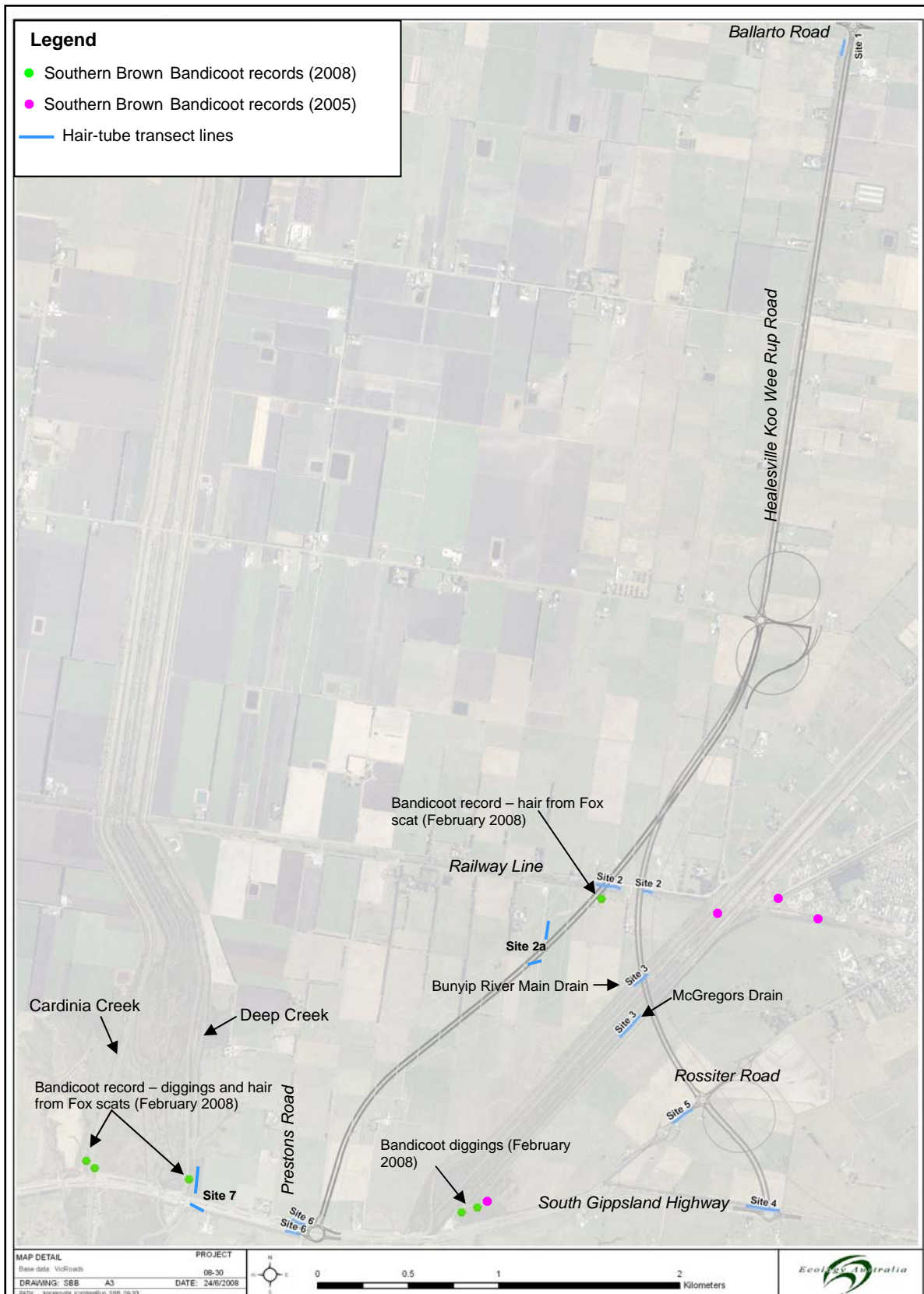


Figure 2 Healesville - Koo Wee Rup Road Upgrade: survey results for the Southern Brown Bandicoot survey (Ecology Australia May 2008 and October 2005)

### 4.3 Habitat assessment

The following is a summary of the habitat attributes and landscape context of each survey site.

#### **Site 1: Healesville – Koo Wee Rup Road immediately south of Ballarto Road**

The narrow strip of vegetation at Site 1 adjoins a drain running parallel to the Healesville - Koo Wee Rup Road and is approximately 12 m wide (Plate 1). This vegetation strip is of low botanical value; the under-storey is dominated by the exotic \*Flax-leaf Broome (*Genista linifolia*), with a ground-layer comprising exotic grasses such as \*Toowoomba Canary-grass (*Phalaris aquatica*), \*Blackberry (*Rubus* spp.) and a sparse cover of Common Reeds (*Phragmites australis*) associated with the drain (Plate 2). On the western edge, there is a sparse overstorey of planted Southern Mahogany (*Eucalyptus botryoides*). Adjoining the site, to the west, is grazed pastoral land.

This patch of vegetation is c. 600 m long but does not have a contiguous understorey. There are no other patches of vegetation which are connected to Site 1.

In some areas the vegetation is quite dense. For example, dense areas of Blackberry which could support potential shelter habitat for the Southern Brown Bandicoot. However, considering the absence of records from the hair-tube survey and the isolation and degradation of the vegetation, Site 1 is considered to be of low habitat suitability for the bandicoot.

Four mammals were recorded from the surveys at this site: the native Swamp Rat, and introduced \*House Mouse, \*Cat and \*Cattle.



Plate 1 Site 1: Healesville – Koo Wee Rup Road, immediately south of Ballarto Road, Koo Wee Rup. Note position of the site between the Road and open pasture, with a dense cover of Flax-leaf Broome and a sparse overstorey of Southern Mahogany (May 2008).



Plate 2 Site 1: Healesville – Koo Wee Rup Road, immediately south of Ballarto Road, Koo Wee Rup. Note exotic grasses, \*Flax-leaf Broom and the adjoining open pasture in the background (May 2008)

**Site 2: the disused Leongatha Railway Line and adjoining Property on Railway Road, Koo Wee Rup**

Site two was spilt up into two areas (east and west of a property driveway). The western side of the driveway is shown in Plate 3. The western patch is a linear strip of vegetation adjoining the disused Railway Line and a drain (dry at time of survey) which runs parallel to the road. The overstorey comprised a sparse cover of Swamp Gum (*Eucalyptus ovata*) and a dense understorey of \*Gorse (*Ulex europaeus*), \*Blackberry and exotic grasses. There was also a moderate cover of leaf litter. The dense vegetation borders open pasture to the south.

This western patch is c. 550 m in length and 5 – 10 m wide. The roadside vegetation continues for nearly 2 km, however, it becomes patchy and is segregated by cleared areas and driveways.

The patch of vegetation on the eastern side of the driveway had an overstorey which was dominated by Swamp Paperbark (*Melaleuca ericifolia*) with a grassy (mostly exotic) and sedgey (e.g. Spiny-headed Mat-rush *Lomandra longifolia*) understorey (Plate 4). There were also some sections of \*Blackberry, \*Sweet Pittosporum (*Pittosporum undulatum*) and Common Reed. The dense vegetation borders pasture land to the south.

The eastern patch of vegetation is c. 390 m in length and c. 10 m wide. This patch is contiguous with vegetation which runs parallel along McGregors Drain. This vegetation continues south to the South Gippsland Highway for c. 1.2 km.

No bandicoots were recorded at Site 2 during the hair-tube surveys. However, during the Growling Grass Frog surveys in February 2008, fox scats were collected on the property to the south and hair in the scats was identified as being Southern Brown Bandicoot. Although not recorded during the surveys, considering the recent record from the fox scats, the habitat suitability plus the continuity of habitat with the McGregor Road drain vegetation, we consider the Bandicoot has a high likelihood of regular occurrence, but are probably in low abundance which makes detection difficult.

Other species recorded at Site 2 were Swamp Rat, and introduced \*Rabbit, \*House Mouse and \*Black Rat and from fox scats, Common Brushtail Possum.





Plate 3 Site 2: vegetation adjacent to Railway Line, Koo Wee Rup, western side. View to the east. Note the sparse overstorey of Swamp Gum and an understorey comprised of grasses, \*Gorse and \*Blackberry (May 2008).



Plate 4 Site 2: vegetation adjacent to Railway Line, Koo Wee Rup, eastern side. Note the Swamp Paperbark overstorey and an understorey dominated by grasses and sedges (May 2008).

**Site 2a: revegetation patches in pasture land on private property adjacent to the disused Railway Line**

The re-vegetation patches on private property south of the Railway Line are c. 5 m wide by c. 100 m long. These patches do not support high quality bandicoot habitat as there is generally a sparse understorey and patches were not connected to existing remnant vegetation (Plates 5 and 6). The understorey comprises a sparse cover of exotic pasture grasses and exotic herbs. The plantings are mostly shrubs and trees of a young age (e.g. Swamp Paperbark, Eucalypts, Bottlebrush *Callistemon* sp. and Wattle *Acacia* sp.). No Bandicoots were recorded during the hair-tube survey. The landowner stated that he has seen diggings which were thought to be bandicoots, however, considering the absence of a suitable understorey component and isolation, we consider the Bandicoot to have a low likelihood of regular occurrence. Once the vegetation becomes more established and if a grassy and/or sedge understorey was introduced and the re-vegetation area was extended to connect with remnant vegetation along the disused Railway Line (in the north), it may be more suitable for Bandicoots in the long-term.

The Swamp Rat and \*Cat were recorded at this site.



Plate 5 Site 2a: re-vegetation area on private property south of the disused Railway Line, Koo Wee Rup (May 2008).



Plate 6 Site 2a: close up of re-vegetation area on private property south of the disused Railway Line, Koo Wee Rup. Note the understorey component is largely absent (May 2008).

**Site 3: the southeast bypass option crosses five drains** (McGregors Drain, McDonalds Drain, North West Drain, Bunyip River Drain and Southern Boundary Drain)

Site 3 was split into two parts: the first transect was along McGregors Drain and the second was along Bunyip River Drain (Figure 2). The long linear vegetation patches adjacent to the drains are largely contiguous from Healesville - Koo Wee Rup Road to the Koo Wee Rup Swamp lookout in the south-west. With the exception of the Southern Boundary Main Drain (which extends to the north-east of the Bunyip River Main Drain, see Figure 2), upstream of the Healesville - Koo Wee Rup Road, the vegetation adjoining the drains is not continuous and most of it is mown grass, supporting little Bandicoot habitat.

The overstorey vegetation at Site 3 was dominated by Swamp Paperbark, Silver Wattle (*Acacia dealbata*) and \*Sweet Pittosporum, with an understorey of Kangaroo Grass (*Themeda triandra*), Spiny-headed Mat-rush, rushes (*Juncus* sp.), exotic grasses, \*Blackberry, \*Bridal Creeper (*Asparagus asparagoides*) and \*Flax-leaf Broome.

No bandicoots were recorded here during the recent surveys. However, in hair-tube surveys undertaken in 2005 (Ecology Australia 2006), there were four records in vicinity of the drains (Figure 2). These were: one along the Southern Boundary Drain immediately north-east of Healesville - Koo Wee Rup Road; one record along Healesville - Koo Wee Rup Road, just outside the Koo Wee Rup Township; one record below Healesville - Koo Wee Rup Road along

the Bunyip River Drain (hair from fox scat) and at the Koo Wee Rup Swamp lookout, above the South Gippsland Highway (see Figure 3).

Therefore, we still consider that bandicoots have a high likelihood of regular occurrence within the vegetation adjoining the drains. However, considering predator pressure (e.g. from foxes and cats), it is likely that they are in low numbers which makes detection difficult.

Other species recorded along the drains in hair-tubes were the exotic \*Black Rat, \*Cat, \*Fox and \*House Mouse, and from fox scats - a species of Deer.



Plate 7 Site 3: close up of vegetation along Bunyip River Drain, Koo Wee Rup. Note Swamp Paperbark and Silver Wattle overstorey with a grassy and sedge-dominated understorey (May 2008).



Plate 8 Site 3: vegetation adjoining McGregors Drain, Koo Wee Rup. Note Swamp Paperbark overstorey and regeneration amongst exotic grasses and \*Blackberry (May 2008).

#### **Site 4: South Gippsland Highway, east of Rossiter Road**

The vegetation along Site 4 was mostly exotic and unsuitable for Bandicoots. There was very little understorey and the patch of vegetation was narrow, degraded (e.g. weed invaded) and largely isolated from other more intact remnants. The understorey comprised a sparse layer of exotic grasses and Common Reed with an overstorey of pine trees and scattered eucalypts (Plates 9 and 10).

No Bandicoots were recorded at this site. Due to the isolation and absence of suitable habitat attributes, the Bandicoot has a low likelihood of regular occurrence in this area. Three species were recorded at this site: Swamp Rat, \*Black Rat and \*House Mouse.



Plate 9 Site 4: vegetation adjoining South Gippsland Highway, east of Rossiter Road, Koo Wee Rup. Note there is a very sparse understorey and the overstorey is dominated by exotic pine trees (May 2008).



Plate 10 Site 4: vegetation adjoining South Gippsland Highway, east of Rossiter Road, Koo Wee Rup. Note there is a very sparse understorey with scattered eucalypts (May 2008).

**Site 5: the proposed southeast bypass option where it crosses Rossiter Road**

The vegetation at Site 5 was a long (c. 700 m), linear, narrow patch running parallel to a drain along Rossiter Road (north-west side of the road) which lies between open pasture and the road (Plates 11 and 12). The south-east side of the road supports planted exotic trees (e.g. Pines and Poplars) with no understorey. The width of the vegetation is between 2 - 3 metres, and extends to the South Gippsland Highway. The patch continues south-west along the northern side of the Highway, and continues to the Koo Wee Rup Swamp lookout. Within the patch there are gaps in the understorey, but the canopy is largely contiguous.

The dominant plant species within Site 5 are Swamp Paperbark, Slender Knotweed (*Persecaria decipiens*) and Common Reed in the drain. The dominant exotic species are \*African Boxthorn (*Lycium ferrocissimum*), \*Blackberry, \*Toowomba Canary-grass, \*Bridal Creeper and other exotic grasses.

No bandicoots were recorded at this site. As this site represents the end of a long linear patch, it is unlikely to be used regularly by Bandicoots. It is very narrow, and there is no other vegetation to the north-east or surrounds for Bandicoots to move or disperse to and from. In addition, previous surveys of this location in October 2005 failed to detect the species (Ecology Australia 2006). Therefore, the Bandicoot has a low likelihood of regular occurrence at this site. Two species were recorded at this site: Swamp Rat and \*House Mouse.



Plate 11 Site 5: vegetation adjoining Rossiter Road (north-west side), view to the south. Note the very narrow band of vegetation lies between Rossiter Road (left hand side) and open pasture (right hand side) (May 2008).



Plate 12 Site 5: close up of vegetation adjoining Rossiter Road (north-west side). Note narrow band of Swamp Paperbark overstorey with Slender Knotweed and Common Reed (in the drain), adjoining mown exotic grasses along the road side and grazed pasture on the other side (May 2008).



**Site 6: the area of vegetation along the South Gippsland Highway, east of Prestons Road**

Site 6 was split into two parts: half of the transect was on the northern side of the South Gippsland Highway, the other was on the south (Figure 2).

The northern side comprised two to three patches of revegetated areas along the Highway. The overstorey was mostly planted and/or regenerating Swamp Paperbark with scattered Swamp Gums (Plate 13 and 14). The understorey was comprised of exotic grasses and regenerating Swamp Paperbark. The patches were located between the Highway and cropped agricultural land. These small patches are mostly isolated from other areas of vegetation and are unlikely to support the Bandicoot. Therefore, it has a low likelihood of regular occurrence on the northern side of this site.

The southern section of the site supported more intact remnant vegetation, with an overstorey of Swamp Paperbark and Hedge Wattle (*Acacia paradoxa*) (Plates 15 and 16). The understorey was generally quite dense with mostly Common Reed, exotic grasses, \*Bridal Creeper and \*Toowoomba Canary-grass. The patch is just over 600 m long and c. 15 m wide and extends west along the South Gippsland Highway to Deep Creek. The patch is largely contiguous, apart from a driveway and a cleared area near Deep Creek.

No bandicoots were recorded at this site. However, considering the structure of the vegetation (shrub cover, a dense understorey with some open areas), plus the size of the patch, we consider the Bandicoot to have a low-moderate likelihood of regular occurrence. Other species recorded at Site 6 in hair-tubes were the Swamp Rat, \*Black Rat and \*House Mouse, and from fox scat, a Deer sp.



Plate 13 Site 6: small patches of vegetation on the northern side of the South Gippsland Highway, east of Prestons Road (May 2008).



Plate 14 Site 6: close up of small patch of vegetation on the northern side of the South Gippsland Highway, east of Prestons Road (May 2008).



Plate 15 Site 6: linear patch of vegetation on the southern side of the South Gippsland Highway, east of Prestons Road (May 2008).



Plate 16 Site 6: close up of vegetation on the southern side of the South Gippsland Highway, east of Prestons Road (May 2008).

#### **Site 7: North and south of the South Gippsland Highway, east of Deep Creek**

Site 7 was split into two separate areas: one transect was located to the north of the South Gippsland Highway, east of Deep Creek. The other was located on the south side.

The vegetation on the northern side supported a Swamp Paperbark and Prickly Tea-tree shrub layer with a relatively open understorey comprising sedges (*Gahnia* sp.), exotic grasses and \*Bridle Creeper (Plate 17 and 18). There were two drainage-lines which ran through the site: one was tidally influenced and thus supported mostly salt-tolerant plant species, such as Australian Salt-grass (*Distichlis distichophylla*), Beaded Glasswort (*Sarcocornia quinqueflora*), Chaffy Saw-sedge (*Gahnia filum*) and Bare Twigrush (*Baumea juncea*) (Plate 19).

This patch is contiguous with vegetation along Deep Creek which extends north and adjoins Swampy Riparian Woodland and Swamp Scrub remnants along the other creeks and drains.

The southern part of Site 7 is a continuation of Site 6, the linear patch of vegetation on the southern side of the South Gippsland Highway, east and west of Prestons Road (Figure 2). Site 7 extends from the edge of Deep Creek, along a tributary drain heading east for c. 40 m. The vegetation was dominated by a Swamp Paperbark overstorey (Plate 20) and was adjacent to the drain which supported mostly salt-tolerant species such as Australia Salt-grass, Chaffy Saw-sedge, Coast Tussock-grass (*Poa poiformis*), Beaded Glasswort, Shrubby Glasswort

(*Sclerostegia arbuscula*) and Marsh Saltbush (*Atriplex paludosa* subsp. *paludosa*), classified as rare by DSE (2005b) (Plate 21).

No bandicoots were recorded at this site. However, considering the structure of the vegetation (shrub cover, a sedge dominated understorey amongst more open areas), size of the patches, particularly the northern section, and proximity of recent records (i.e. bandicoot hair from fox scats c. 50 m west of the northern transect of the site along Deep Creek and c. 500 m west along Cardinia Creek, Figure 2), we consider the Bandicoot to have a high likelihood of regular occurrence. Other species recorded at Site 7 from hair-tubes were the \*Black Rat and \*House Mouse, and from fox scats Common Ringtail Possum, \*Cattle and \*Dog.



Plate 17 Site 7: Swamp Paper bark dominates the overstorey on the northern side of the South Gippsland Highway, east of the Deep Creek. Note the sparse understorey in areas and the adjacent pasture in the background (May 2008).



Plate 18 Site 7: close up view of the understorey vegetation in Site 7, northern side of the South Gippsland Highway, east of Deep Creek. The sedge component provides potential shelter habitat for Bandicoots (May 2008).



Plate 19 Site 7: this drain runs through Site 7 on the northern side of the South Gippsland Highway, east of Deep Creek. It supports salt-tolerant plant species. The Chaffy Saw-sedge on the edge of the drain provides potential shelter habitat for Bandicoots (May 2008).



Plate 20 Site 7: vegetation on the southern side of the South Gippsland Highway, immediately east of Deep Creek. This site is a continuation of Site 6 (south side). Note the dense Swamp Paperbark thickets (May 2008).



Plate 21 Site 7: this drain runs to the south of the vegetation seen in Plate 20, south of the South Gippsland Highway, east of Deep Creek. It is a tidally influenced drain; the dense sedges and grasses (e.g. Chaffy Saw-sedge and Common Tussock-grass) on the edge provide potential shelter habitat for Bandicoots (May 2008).

## 5 Discussion

### 5.1 Southern Brown Bandicoot distribution

#### 5.1.1 Victoria

In Victoria, the Southern Brown Bandicoot is a predominantly coastal species of the coastal or fluviatile plains, with a range that extends along the entire coast of Victoria, with gaps in areas of the Volcanic Plain and Latrobe Valley. It is rarely found more than 50 km from the coast line, except for in the Glenelg Plain, in the south-west of the state where its range extends 100 km inland along a band of sandy coastal plain, and for populations at Mt William in the Grampians and in the Dandenong Ranges (Menkhorst and Seebeck 1990, Opie et al. 1990, Menkhorst 1995). Although it occurs at altitudes of up to 1000 m in the Grampians (Menkhorst and Seebeck 1990), the species is generally absent from eastern and western Victorian Uplands. Southern Brown Bandicoots are also known from Wilson's Promontory and the Yarra Ranges, and there are scattered records elsewhere in Victoria. Although large areas of apparently suitable habitat exist, it is absent from islands, such as French, Phillip, Snake and Sunday Islands (Menkhorst and Seebeck 1990).

There are believed to be five main population clusters of Bandicoots in Victoria; East Gippsland, the far west (close to the South Australian border), Grampians, Anglesea and south-central (Melbourne south to the Mornington Peninsula and to Western Port and Wilsons Promontory). The Southern Brown Bandicoot now has a patchy distribution over a much reduced range.

#### 5.1.2 South-east of Melbourne

Prior to intensive agricultural or urban development, Southern Brown Bandicoots were formerly more widespread southeast of Melbourne (Menkhorst and Seebeck 1990; Menkhorst 1995; AVW, DSE 2004). Two of the major threats to the persistence of the Southern Brown Bandicoot, and reasons for their decline, are loss of suitable habitat and predation by Foxes.

Records presented in earlier Ecology Australia studies, the AVW (DSE 2004) and anecdotal accounts suggest that the Southern Brown Bandicoot is sparsely scattered in areas surrounding the Healesville – Koo Wee Rup Road study area and there appears to be three main clusters within a 25 km radius of the study area. These are:

- Koo Wee Rup – Dalmore area;
- Bayles – centred on Yallock Creek and Bayles Fauna Park; and
- Longwarry Road - between Longwarry and Nar Nar Goon (Figure 3).

More recent records presented to Ecology Australia by David Nicholls of the Chisholm Institute highlights another cluster of Bandicoots around Cardinia and Rythdale (Figure 3)

There are also many more scattered (recent and old) records of Bandicoots around Tooradin, Pearcedale, Lang Lang and Langwarrin/Frankston.

There is currently no evidence that these clusters are connected. In some cases there is limited habitat between the clusters (e.g. predominantly agricultural land with no suitable vegetation), or little survey effort has been directed in areas between the clusters.

While there were no records of Bandicoots in the hair-tubes during this survey, the results of the predator scat analysis obtained during the Growling Grass Frog and Swamp Skink survey are significant. It demonstrates that Bandicoots persist in the study area, but are under increased pressure from predators, which is likely to have reduced population numbers, thus making the probability of detection low.

Considering these records were from the southern section of Cardinia Creek and Deep Creek, and there are previous and recent records further east and north, it is likely that Bandicoots are continuously distributed between Dalmore, Koo Wee Rup Swamp Lookout and around the Koo Wee Rup Township, predominantly along the drains and roadside and railway reserves in remnant vegetation (Figure 3). Though narrow in parts and interspersed with the drainage lines, these strips of vegetation run for c. 2.5 km between the South Gippsland Highway and Koo Wee Rup.

Whether the Bandicoot occurs to the north along the drains and north of Station Street is not known. This area does not support contiguous vegetation along all of the drains.

The absence of records from along the Healesville-Koo Wee Rup Road from between Pakenham and Koo Wee Rup North, does suggest the species does not occur there (Ecology Australia 2006b). This is based on:

- a. the results of the previous and current survey;
- b. the absence of records from such a heavily utilised road that if the species was present, records would surely have been collected;
- c. the high risk of mortality (road kill) of Bandicoots if it was present; and
- d. The sparse scattering of suitable habitat (see Section 5.3).



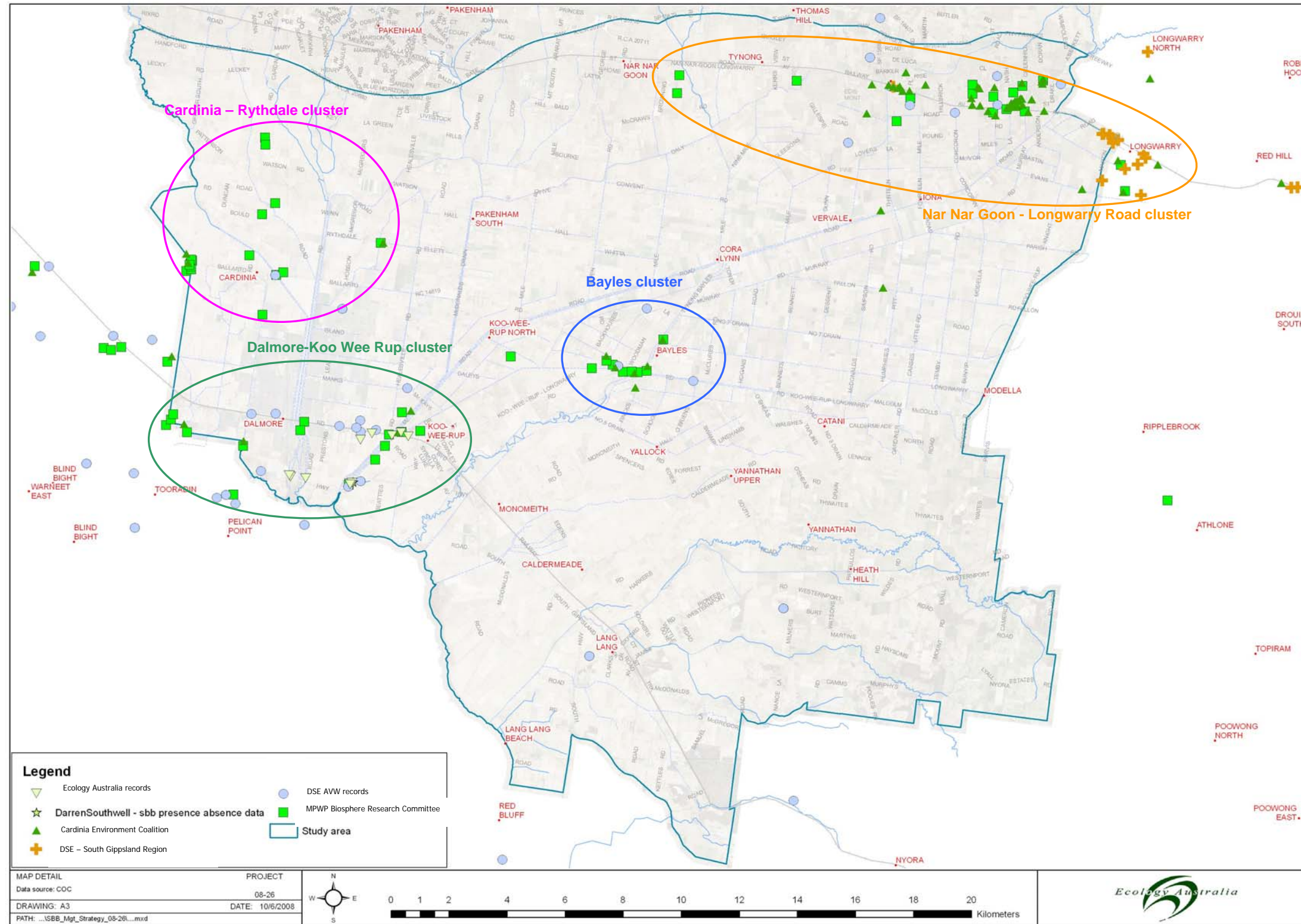


Figure 3 Healesville - Koo Wee Rup Road Upgrade: Southern Brown Bandicoot distribution in the study area and surrounds (May 2008)

## 5.2 Southern Brown Bandicoot habitat

Low, dense cover is a key habitat requirement for the Southern Brown Bandicoot (Heinsohn 1966, Friend 1990, Moro 1991, Paull 1995, Claridge and Barry 2000, Sanderson and Kraehenbuehl 2006, Southwell 2006, Penman and Slade 2007). The species occupies a variety of habitats with this structural characteristic, ranging from heathland communities, shrubland, and heathy open forests and woodlands, to sedgeland along drainage lines (Braithwaite and Gullan 1978, Stoddart and Braithwaite 1979, Menkhorst and Seebeck 1990, Menkhorst 1995), and temperate rainforest in Tasmania (Green 1979). Bandicoots are usually associated with deep, well drained, sandy soils and 'dry' heath communities (Braithwaite and Gullan 1978, Opie et al 1990, Menkhorst 1995, Paull 1999, Rees and Paull 2000, Southwell et al. in press), and are typically absent from wet forests or tall open forests (Quin 1985, Menkhorst 1995).

In eastern Victoria, the Southern Brown Bandicoot has been recorded in Swamp Scrub, Heathy Woodland, Coastal Heathland, Silky Tea-tree (*Leptospermum myrsinoides*) Heathland, Lowland Sclerophyll Forest and Banksia Woodlands (Braithwaite and Gullan 1978, Stoddart and Braithwaite 1979, Opie et al. 1990).

In many areas of outer south-east Melbourne, where these habitats have been severely reduced in extent and/or heavily degraded, Bandicoots are confined to remnants of vegetation in highly disturbed areas and have used market gardens, rough pasture, roadside reserves (Seebeck 1977, Bennett 1990, 1993) and golf courses, presumably for foraging (Quin 1985, Rees and Paull 2000). In suburban and semi-rural areas of south-east Melbourne, Bandicoots occupy gardens and make use of anthropogenic debris, such as scrap woodpiles, for shelter (A. Rowe, Tooradin, pers. comm.).

Where native vegetation cover is low, Bandicoots inhabit thickets of \*Blackberry, \*Gorse, and \*African Boxthorn, particularly around waterways and drainage lines (Heinsohn 1966, Quin 1985, Friend 1990, Alessio 2002, Sanderson and Kraehenbuehl 2006). However, the use of \*Blackberry by bandicoots has also been observed in National Parks, where other intact and presumably suitable habitat is available (Richardson 2003, Sanderson and Kraehenbuehl 2006). Such weeds are likely to provide a degree of protection from predators, not provided by native vegetation.

Dense vegetation reduces the chances of detection and habitat access by aerial and terrestrial predators. It also ameliorates local environmental conditions and provides shelter (Bennett 1993). Early studies of bandicoot ecology revealed a preference for habitats with low ground cover, sufficiently open to permit free movement (Heinsohn 1966). This structure allows animals to escape rapidly from predators. A study modelling the habitat preferences and distribution of Southern Brown Bandicoots of NSW found that their probability of occurrence increased with the percentage of ground cover that was 0.5-2.0 m, and was highest in areas with cover greater than 50% (Claridge and Barry 2000). Further modelling studies emphasized the density of shrub cover and ground cover as important variables influencing their presence

(Southwell et al. in press, Penman and Slade 2007). In Tasmania, they have been observed in a variety of habitats but never far from dense cover (Quin 1985).

### 5.3 Habitat within the study area

The areas supporting potential Bandicoot habitat which were targeted during the surveys mostly included degraded Swamp Scrub remnants, Swampy Riparian Woodland remnants (along drainage lines, roadsides or railway reserves), and also large thickets of exotic \*Blackberry. In the study area, Swamp Scrub habitat is generally dominated by: Swamp Paperbark, Wattles and Common Reed, with Blackberry, \*Flax-leaf Broom and exotic grasses. Swamp Scrub remnants within the study area are significantly reduced in size and some heavily disturbed by grazing.

Site 1 (south of Ballarto Road) was comprised of mostly exotic species along a drainage line adjoining Healesville - Koo Wee Rup Road and is considered too small and isolated to support Bandicoots. Site 2 (Railway Line) forms part of the Dalmore – Koo Wee Rup cluster and the habitat is highly suitable and largely contiguous with remnant vegetation along the drains (Site 3). Bandicoots have historically and currently been recorded along the railway reserve and the vegetation along the drains (see Figure 3 and Ecology Australia 2006b). Though the vegetation is narrow in parts and interspersed with the drainage lines, these strips of vegetation run for c. 2.5 km to the South Gippsland Highway which link up to the Koo Wee Rup Swamp Lookout, another site inhabited by Bandicoots (Ecology Australia 2006b).

Sites 4 and 5 (east of Rossiter Road and Rossiter Road) are small isolated patches of vegetation dominated by exotic species with little ground cover. These patches are considered to be too small and isolated to support Bandicoots.

Site 6 (South Gippsland Highway, east of Prestons Road) is located between records of Bandicoots from the Koo Wee Rup Swamp Lookout (to the east) and the southern end of Deep Creek and Cardinia Creek (in the west). The northern section of the Highway comprises small patches of revegetation/regeneration with little understorey, and is largely unsuitable for Bandicoots. However, the southern reserve of the Highway, supports suitable habitat attributes, such as a Swamp Paperbark shrub cover and a relatively dense understorey. It is not known whether there would be movement of animals from the north-west side of the highway (where they have been recorded around Deep Creek), to the south (i.e. movement under bridges). However, considering the proximity of known recent records, this area is still considered to be potential habitat.

Site 7 (east of Deep Creek) supports suitable habitat for Bandicoots. It has a shrub cover of Swamp Paperbark and an understorey of sedges and grasses. The understorey is not uniformly dense, so some areas are likely to be more suitable than others. The recent record (hairs in fox scat, February 2007) adjacent to Deep Creek needs to be considered with some caution as foxes have large home ranges, and subsequently prey species distribution in an area from such records, may not necessarily occur where scats are deposited. However, considering the habitat is suitable, and there are historical records from the area, we consider the habitat around Site 7

would be used regularly. The vegetation also extends upstream along the drains, however, it is not known if Bandicoots persist north of the Railway Line along Cardinia and Deep Creek, but there is suitable habitat, at least northwards to Manks Road.

High quality habitat also occurs at the Koo Wee Rup Swamp Lookout. This habitat has a canopy of Swamp Paperbark and a sedgy understorey dominated by Spiny-headed Mat-rush (*Lomandra longifolia*), *Gahnia* sp. and tall grass tussocks. Many conical diggings (typical of Bandicoots) were found here and five of the eight hair-tubes had bandicoot hair in October 2005. This is likely to be a stronghold for the species in the Dalmore – Koo Wee Rup cluster.

## 6 Potential Impacts

The greatest threat to the Southern Brown Bandicoot in relation to the Healesville - Koo Wee Rup Road upgrade is the loss and/or fragmentation of habitat. Direct impacts include habitat loss (e.g. remnant vegetation or dense exotic vegetation along the drains south-west of Koo Wee Rup and the disused Railway Line). This vegetation is likely to be used as shelter, dispersal and/or movement links in the landscape, with adjoining open, or partially open areas, potentially used as foraging habitat. Dense areas of vegetation also represent potential nesting habitat.

An indirect impact usually associated with road projects is the fragmentation and isolation of animal populations and habitats. Thus, roads may present a physical (or psychological) barrier to the movement of animals, resulting in isolation and reduction in sizes of populations, which increases the stochastic risk of extinction. Roads may also increase the dispersal distances between populations and increase mortality due to road kill (e.g. see Andrews 1990; Forman 1995; Forman et al. 1995; Forman and Alexander 1998; Biosis 2005; Ecology Australia 2006a, 2006f and 2008b; Bond and Jones 2008). As such, 'fauna underpasses' or wildlife crossing structures (e.g. land bridges) have been specifically designed and built to mitigate barrier effects and maintain continuity of animal populations and habitat links (e.g. Mansergh and Scotts 1989; Forman 1995; Forman et al. 1995; AMBS 1997; Robertson 2002; Biosis 2005, Bond and Jones 2008).

Ideally, the road design would avoid areas where bandicoots occur (see Figure 2 and 3). These areas include the Swamp Scrub remnants along Station Street, Boundary Drain Road (runs eastwards, perpendicular to the Healesville-Koo Wee Rup Road), the five drainage lines (i.e. McGregors Drain, McDonalds Drain, North West Drain, Bunyip River Drain and Southern Boundary Drain), remnant vegetation along the Railway Line, the Koo Wee Rup Swamp Lookout and the vegetation associated with the Cardinia and Deep Creek areas, west of Prestons Road. If the alignment was designed to avoid these areas, impacts to Bandicoots would probably not occur.

There appear to be few issues in the north of the study area along the current road alignment (i.e. where no bandicoots were recorded in October 2005 or this current study). This area which does not appear to be of concern runs from Pakenham to Koo Wee Rup north (north of McDonalds Drain Road). There is one historical record north of this road close to the road alignment from 1979 (AVW, DSE 2007b). However, considering the two surveys conducted along this stretch of Road, the collation of the most up to date records for the area, and the lack of suitable, connected habitat, we consider the likelihood of impacts to Bandicoots in this area to be low.

The most sensitive areas are those where the options for a bypass of Koo Wee Rup cross known Bandicoot habitat (Figure 4).

For both bypass options, the area where they cross the Railway Line is classified as high habitat suitability and there are recent records from this patch of vegetation that runs parallel to the road and railway line (Ecology Australia 2008b, AVW, DSE 2007a, and other records, Figure 4).

Option 1 also crosses the five drains. The vegetation along the drains are known to support Bandicoots and habitat is contiguous with the Koo Wee Rup Swamp lookout.

The area of impact on the habitat along the Railway Line could be reduced by spanning the vegetation and the adjoining road. This span would maintain the vegetation underneath and create a 'fauna underpass' that would allow the continuity of habitat and potential movement of Bandicoots and other fauna.

The proposed interchange area of Option 1 with the South Gippsland Highway (east of Rossiter Road) is considered to be of low habitat value for Bandicoots. Therefore, the potential for impacts on the species in this area is also considered to be low.

The other area of concern for Option 2 is the interchange proposed with the South Gippsland Highway, on the southern side, east of Prestons Road. While Bandicoots have not been recorded here, there is suitable habitat and recent records in the vicinity from Deep Creek (Figures 3 and 4). The vegetation along Cardinia and Deep Creek and other associated drains (particularly north of the Highway) is known habitat for the Bandicoot and may provide shelter and/or habitat links to the south side of the South Gippsland Highway where the interchange of Option 2 is proposed (Figure 4). Further survey work would be recommended if this habitat is impacted (e.g. bridge upgrades, road widening and Option 2 interchange).

It is also important to note the importance of the Koo Wee Rup Swamp lookout and the area of vegetation between Cardinia and Deep Creek (Figure 4). If works are required in these areas further survey work would be recommended.

Once the alignment is refined, further habitat assessments may be required to assess the significance of patches of vegetation proposed for removal, and therefore the potential impacts from the road upgrade. Further refinement could be undertaken to minimise impacts as far as is possible. For example, a zoological assessment could be undertaken and the road alignment moved slightly where possible to avoid certain areas of Bandicoot habitat. A set of criteria could be developed to assess vegetation within the alignment and if deemed to be of high quality and important to the population, suggestions to avoid these areas could be undertaken.

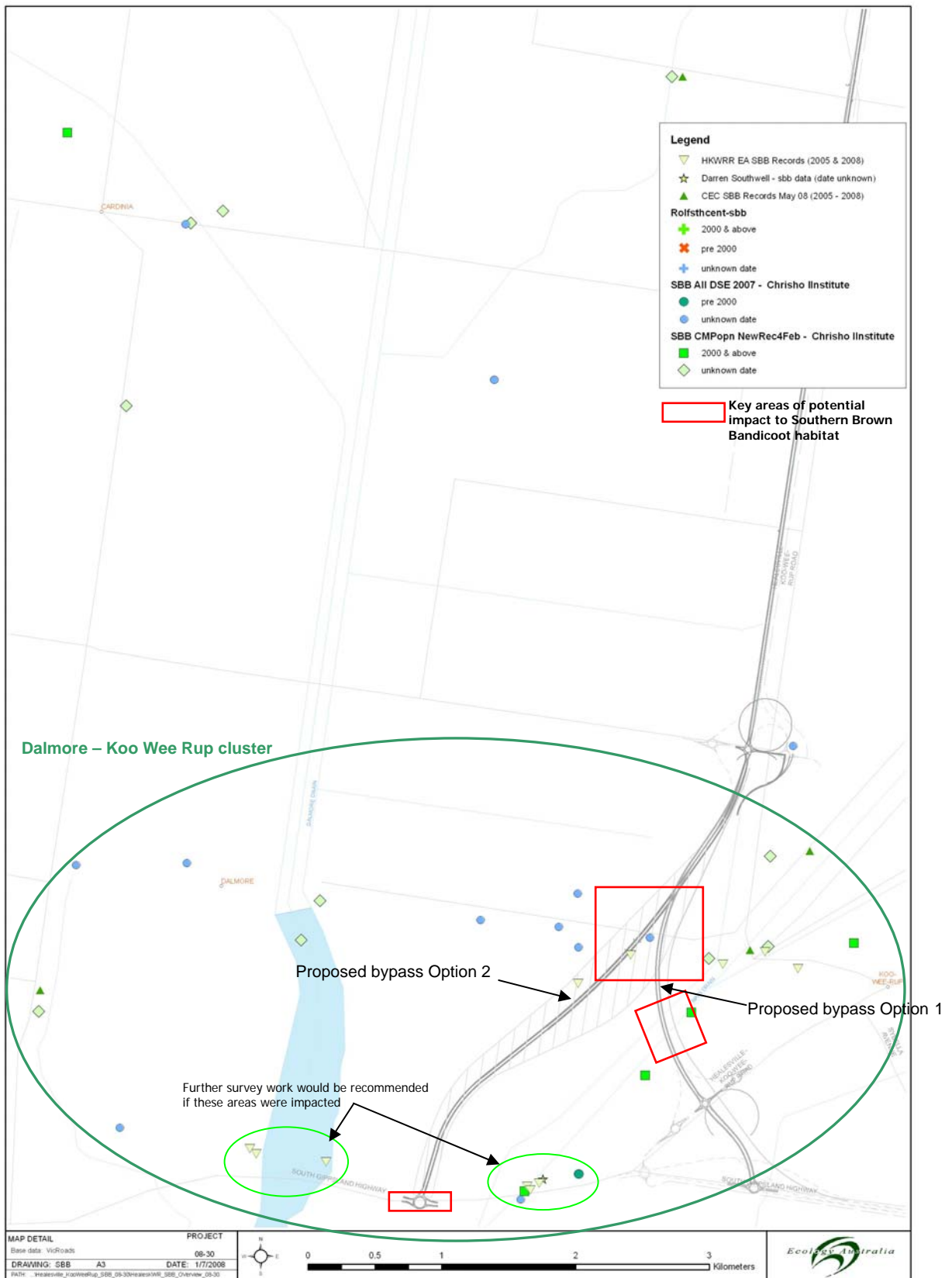


Figure 4 Healesville - Koo Wee Rup Road Upgrade: key areas of potential impacts to Southern Brown Bandicoot habitat in the study area (May 2008)

## 7 Legislative Implications

### 7.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* – Southern Brown Bandicoot

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) pertains to matters of national environmental significance, including Ramsar Wetlands, listed threatened species and ecological communities, listed migratory species and Commonwealth Marine Areas. It applies to both public and private land.

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, Water, Heritage and the Arts (DEWHA) decides whether there will be a significant impact and if it needs to be a ‘controlled action’ and require a formal assessment under the Act. 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.

For the proposed works associated with the Healesville – Koo Wee Rup Road Upgrade, it is recommended that VicRoads prepare an EPBC Act referral for DEWHA which includes consideration of the Southern Brown Bandicoot (and Growling Grass Frog and Westernport Ramsar site). The referral will need to consider the significance of the study area to a population of the Southern Brown Bandicoot.

A population defined under the EPBC Act for a species listed as Endangered is:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion (DEWHA 2006).

The area (Dalmore – Koo Wee Rup cluster) described in Section 5.1 and 6 and shown in Figure 4 demonstrates that the proposed road alignment (particularly Bypass Options 1 and 2) would traverse an area that supports a population, or at least part of a population, of Southern Brown Bandicoots as defined under the EPBC Act (see above). The area which supports a population of Bandicoots extends from Cardinia and Deep Creek, along the South Gippsland Highway the disused Railway Line, the drains (e.g. McGregor Drain to Bunyip River Drain) and includes the Koo Wee Rup Swamp lookout area.

A referral appears imminent, and the nature of the final alignment would determine whether the Road Upgrade should be referred as a ‘controlled’ or ‘not a controlled’ action.



## 7.2 Wildlife Act 1975

The *Wildlife Act 1975* lists protected fauna species and applies to both public and private land. Targeted surveys were undertaken as part of the study under a wildlife permit held by Ecology Australia. If salvage and translocation of animals (e.g. Southern Brown Bandicoot) associated with loss of habitat is required at a later date, an application for a Management Authorisation under the *Wildlife Act* will need to be submitted to DSE.

## 7.3 Local Planning Policy

The Local Planning Policy (Cardinia Shire) 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. It applies to both public and private land. A planning scheme is binding on all people and corporations, on every Minister, government department, public authority and municipal council. Further information can be found on the DSE web page (Planning Schemes On-line).

Relevant overlays include Floodway (FO), Land Subject to Inundation (LSIO), Environmental Significance (ESO) and Significant Landscape (SLO) Overlays.

The purposes of a FO are to: identify waterways, major floodpaths, drainage depressions and high hazard areas which have the greatest risk and frequency of being affected by flooding; ensure any development maintains the free passage of temporary flood water; and protect water quality and waterways as a natural resource in accordance with State Environment Protection Policies (SEPP). FOs apply to the following waterways/drains and adjoining properties in the study area: Cardinia Creek, Moodys Inlet, Toomuc/Deep Creek, and the watercourse and drains adjacent to the Koo Wee Rup Swamp Lookout (e.g. Bunyip River Drain, McDonalds Drain). A permit is required to construct or carry out works, including buildings, fences and roadworks.

The purposes of a LSIO are to: identify land in a flood storage or flood fringe area affected by the 1 in 100 year flood or any other area determined by the floodplain authority; ensure any development maintains the free passage of temporary flood water; and protect water quality and waterways as a natural resource in accordance with SEPP. LSIOs apply to most of the study area, excluding areas bordering the Healesville – Koo Wee Rup Road and situated between the Pakenham Bypass and Greenhills Road. A permit is required to construct or carry out works, including buildings, fences and roadworks.

Cardinia Creek, Moodys Inlet, Toomuc/Deep Creeks and adjoining properties downstream of the South Gippsland Highway, and areas of these watercourses and adjoining properties upstream to the South Gippsland Railway Line, are covered by an ESO Schedule 2 (ESO2). The ESO2 covers the saltmarsh and mangrove communities of Westernport Bay, and aims to protect these significant features of Westernport Bay through sensitive design and development. A permit may be required from the Shire of Cardinia if works are planned for these areas.

Eight kilometres of shoreline of Westernport Bay between Tooradin and Koo Wee Rup (adjoining the south side of the South Gippsland Highway) have been recognised by the National Trust as a significant landscape. This area is covered by a SLO Schedule 2 (SLO2). The aims of the SLO2 are to: conserve and enhance landscape quality of Western Port; conserve and enhance the flora, fauna and ecological processes of Westernport Bay; and encourage harmonious development. An application may need to be lodged with the Shire of Cardinia to construct or build, including works which will involve removal, destruction or lopping of vegetation.

## 8 Summary and Recommendations

The most significant issue is the occurrence of known Southern Brown Bandicoot habitat along the proposed alignments for a bypass of Koo Wee Rup - Option 1 and 2 (Figure 4). This southern section of the study area supports a 'population' of Southern Brown Bandicoots, and as such needs to be assessed under the EPBC Act criteria for significant impacts on a population of an Endangered species. The population inhabiting the southern section of the study area, appears to fulfil definitions of a population (DEWHA 2006).

Impacts to habitat supporting Southern Brown Bandicoots could be minimised by selecting the option with the least amount of habitat loss and fragmentation and appropriate design measures. For example, this may be done by spanning the disused Railway Line and adjoining vegetation so that no pylons or machinery enter this vegetation and it maintains connectivity of habitat and allows potential movement of bandicoots and other fauna. The construction width of bridges should also be minimised (also see Ecology Australia 2008a and b).

Once the alignment is refined, and to minimise impacts as far as is possible, further habitat assessments may be required to assess the significance of vegetation patches within or adjoining the alignment, and therefore the potential impacts from the road upgrade. Further alignment refinement, where possible, to avoid known bandicoot habitat, could be undertaken. A set of criteria could be developed to assess vegetation patches within and adjoining the alignment and if deemed to be of high quality and important to the population, suggestions to avoid these areas could be undertaken.

Once the alignment is finalised, an Environmental Management Plan (EMP) will need to be produced. The EMP would address conservation measures for the Southern Brown Bandicoot, Growling Grass Frog, Swamp Skink and any other significant flora and fauna species and vegetation communities. The EMP would also include measures to avoid impacts from sedimentation and pollution of creeks and drains and potential downstream impacts to the Westernport Ramsar site.

A referral to the Commonwealth DEWHA will be required, and the nature of the final alignment will determine whether the project is referred as 'a controlled action' or 'not a controlled action'.

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Appendix 1 Southern Brown Bandicoot Habitat Proforma

<b>Southern Brown Bandicoot Habitat Assessment</b>			
<b>Date:</b>		<b>Personnel:</b>	
<b>Site:</b>			
<b>AMG:</b>	<b>Number of hair-tubes:</b>		
	<b>Approximate size/area of site:</b>		
<b>Time since fire (habitat mosaic) - if applicable:</b>			
<b>EVC(s)</b> (if present, e.g. Swamp Scrub, Saltmarsh, Mangroves, Estuarine Flats Grasslands):			
<b>Exotic plantings:</b>			
<b>Degrading factors:</b>			
<b>Landscape context:</b>			
Size of vegetation patch (m <sup>2</sup> or ha):			
Dispersal and movement links/corridors:			
Proximity to roads:			
How isolated:			
<b>Key features</b>			
Combination of dense understorey/open areas:			
Dense vegetation bordering open areas:			
Location: Road reserve/drainage reserve:			
<b>Understorey</b>	<b>Presence</b>	<b>Cover/density (sparse, moderate, rank)</b>	<b>Average height (cm)</b>
Sedges (e.g. <i>Lomandra</i> , <i>Gahnia</i> , <i>Juncus</i> )			
Grass tussocks (e.g. <i>Poa</i> , <i>Austrostipa</i> )			
Exotic grasses (e.g. <i>Phalaris</i> , <i>Kikuyu</i> )			
Blackberry			
Common Reeds			
<b>Midstorey</b>			
Melaleuca			
Tea-tree Shrubs			
Broome			
Gorse			
Boxthorn			
Other			
<b>Dominant plant species:</b>			
<b>Overstorey</b>			
Trees (e.g. Eucalypts, Pine, Cypress, Acacia)			
Dominant tree species:			
<b>Substrate</b>			
Open areas (e.g. bare ground, open grassy areas)			
Leaf litter			
Woody debris, logs			
Soils (e.g. sandy, well drained, mud)			
<b>Bandicoot Evidence</b>	<b>AMG's</b>		
Bandicoot diggings			
Fox Scats			

**Comments**

