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Threatened Fauna Monitoring Program

ALBURY-WODONGA NATIONAL HIGHWAY MAINTENANCE PROGRAM

YEAR 3 REPORT

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ACRONYMS AND ABBREVIATIONS

AWDC	Albury Wodonga Development Corporation
AWNHP	Albury-Wodonga National Highway Project
BOM	Australian Bureau of Meteorology
COA	Condition of Approval
DECCW	Refer to OEH
DP&I	(NSW) Department of Planning and Infrastructure
EEC	Endangered ecological community – as defined under relevant law applying to the proposal
EIA	Environmental impact assessment
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cwth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
ESD	Ecologically Sustainable Development
ha	hectares
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007* (NSW)
km	kilometres
LEP	Local Environment Plan
m	Metres
NES	Matters of National environmental significance under the EPBC Act (*c.f.*)
Noxious Weeds Act	*Noxious Weeds Act 1993* (NSW)
NPW Act	*National Parks And Wildlife Act 1974* (NSW)
NSW	New South Wales
NV Act	*Native Vegetation Act 2003* (NSW)
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
OEMP	Operational Environmental Management Plan
REF	Review of Environmental Factors
REP	Regional Environmental Plan
SEPP	State Environmental Planning Policy (NSW)
SIS	Species Impact Statement
sp/spp	Species/multiple species
TSC Act	*Threatened Species Conservation Act 1995* (NSW)

1 BACKGROUND

1.1 PROJECT BACKGROUND

The Albury-Wodonga National Highway, which is approximately 14.7 kms long, was opened to the public on the 6th March 2007, linking the Hume Highway in Wodonga (Victoria) with the Hume Highway at Ettamogah, just north of Albury (New South Wales). The main objective for constructing this new dual carriageway was to strengthen the major transport link that connects the two major cities of Sydney and Melbourne, along with improving safety to road users along this section of the freeway.

An Operational Environmental Management Plan (OEMP) for the Albury-Wodonga National Highway Project (AWNHP) was prepared by Abigroup Pty Ltd to provide Abigroup and Bilfinger Berger Services (BBS) a system that establishes and maintains best practice controls to manage potential environmental impacts during the operational phase of the Albury-Wodonga Hume Freeway project. In August 2010 BBS changed its trading name to Conneq Infrastructure Services.

A total of 27 Ministerial Conditions were associated with the operational phase of this project with the monitoring of threatened terrestrial fauna species required under Condition of Approval (COA) Number 51. This COA requires the preparation of a "*threatened species management procedure addressing requirements for minimising habitat disturbance, remediation of degraded habitat, monitoring procedures and training. All reasonable measures shall be taken to ensure minimal harm and/or risk to threatened species during operation"*.

nghenvironmental have been engaged by Conneq (formerly BBS) to undertake the threatened species monitoring to ensure that the above COA is met.

1.2 IDENTIFICATION OF TARGET THREATENED SPECIES

The original EIS (GHD 1995) identified a total of 12 threatened species (listed on the schedules of the *Threatened Species Conservation Act 1995* (NSW) (TSC Act) that could potentially occur in the route corridor. Since then a number of additional studies have been conducted for the RTA and other developments in the locality which identified a range of additional threatened species which could potentially occur (RTA 2003, Taylor 2002).

During surveys for the Albury Wodonga Development Corporation (AWDC) threatened species conservation strategy undertaken in 2003 the Black-chinned Honeyeater (*Melithreptus gularis gularis)* was found utilising creek line areas and planted revegetation areas near Thurgoona, while the Brown Treecreeper (*Climacteris picumnus victoriae)* and Barking Owl (*Ninox connivens)* were also recorded. The Black-chinned Honeyeater, Brown Treecreeper and Barking Owl are all listed as Vulnerable on the NSW TSC Act. A pair of breeding Barking Owls was observed roosting in a large River Red Gum (*Eucalyptus camaldulensis*) approximately 100 m north of the Murray River near the main channel (Taylor 2002). This location is approximately 300-400 metres south of the site at Oddies Creek. Research on this breeding pair suggests that they have bred at the site for three successive years from 2000 (Taylor 2002).

It was noted in the original EIS / EES that the Squirrel Glider (*Petaurus norfolcensis*) may potentially occur within the Highway alignment however this species was not expected to be present as it was last recorded in the area in 1954. More recent studies indicated that the study area contains a viable Squirrel Glider population, particularly between Billy Hughes Bridge and Thurgoona Drive. Similarly, surveys undertaken for the AWDC by Davidson and Datson in 2003 revealed the presence of the Squirrel Glider

within the Thurgoona region. Squirrel Gliders are believed to inhabit the creek line areas near Eight Mile Creek, approximately 4 kms north of Thurgoona Drive and near the Thurgoona area. Squirrel Gliders are listed as vulnerable on the NSW TSC Act.

The Charles Sturt University (CSU) Johnston Centre was engaged in 2003 to undertake additional 7 Part tests for the Squirrel Glider with the assessment concluding that the project would act as a barrier to movement of the Squirrel Gliders along the Murray River and across the Thurgoona region, reducing the home range of some individuals and passages for dispersal. The project was also likely to result in the isolation of suitable Squirrel Glider habitat.

Based on the above studies, the list of target species for this monitoring program includes:

- Turquoise Parrot (*Neophema pulchella*)
- Superb Parrot (*Polytelis swainsonii*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Painted Honeyeater (*Grantiella picta*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Bush Stone-curlew (*Burhinus grallarius*)
- Hooded Robin (*Melanodryas cucullata cucullata*)
- Diamond Firetail (*Stagonopleura guttata*)
- Speckled Warbler (*Pyrrholaemus saggitatus*)
- Barking Owl (*Ninox connivens*)
- Swift Parrot (*Lathamus discolor*)
- Squirrel Glider (*Petaurus norfolcensis*)

1.3 TIMING

This is a five year monitoring program with surveys being conducted bi-annually in spring and autumn commencing in spring 2008 and concluding in autumn 2013. An annual report is prepared after completion of the autumn survey period each year.

The annual report is sent to the Conneq maintenance contractor (Maintenance Project Manager) for internal review, and then provided onto the NSW Roads and Traffic Authority (RTA). The RTA will then liaise with the NSW Department of Environment and Climate Change and Water (DECCW) and the Department of Primary Industries (DPI) and formulate a response on the monitoring project.

This third annual report documents the results of the third year of monitoring encompassing spring 2010 and autumn 2011 monitoring events, and includes discussion of results over the total period of monitoring.

2 METHODOLOGY

2.1 MONITORING PROGRAM RATIONALE

The primary objective of the monitoring program is to evaluate the effects of the operation of the new Albury-Wodonga National Highway Project on target species. The terrestrial fauna monitoring program is detailed in the OEMP Version A2 (**ngh**environmental 2008) and involves targeted monitoring of key threatened species including the Squirrel Glider (*Petaurus norfolcensis*), Barking Owl (*Ninox connivens*) and threatened woodland birds. The aim of this program is to gauge the on-going effect from the operation of the dual carriageway on these threatened species.

The monitoring program has been designed in consultation with Rodney van der Ree of the Australian Research Centre for Urban Ecology to ensure that the data being collected can be utilised in the analysis of broader Squirrel Glider monitoring programs along the Hume Highway. It has been specifically designed to determine:

- The presence, seasonal use of habitat and possible movement behaviour of the Squirrel Glider;
- The distribution, abundance, reproductive output and long term survival of Squirrel Gliders in relation to the highway;
- Whether any cross-highway movements are being undertaken by Squirrel Gliders;
- The presence, abundance and stability of bird populations, particularly threatened woodland birds including the Brown Treecreeper, Diamond Firetail, Speckled Warbler and Hooded Robin, and their response to disturbance and revegetation of the road corridors; and
- The presence of Barking Owls in the general locality and/or near the location of the previously located breeding pair on the Murray River near the Oddies Creek site (Taylor 2002).

2.2 SITE DESCRIPTION AND SITE SELECTION PROCESS

The terrestrial monitoring program has incorporated three study sites across the Albury region to undertake surveys for the duration of the monitoring program. These study sites were selected on the basis of their ecological characteristics, the potential provision of habitat for target species, and the results of previous surveys where target species have been recorded.

Squirrel Gliders inhabit vegetated areas using linear strips of woodland along creek line areas and roadsides (van der Ree, 2002). Vegetated roadside strips can also provide movement corridors and can be important for gene flow and recolonisation in small populations. An assessment of significance undertaken by CSU in 2003 for the Squirrel Glider assumed that in addition to the known Thurgoona population, a viable population of Squirrel Gliders also occurred along the Murray River and that all hollow bearing trees along the highway alignment were potentially used by the species. The AWDC also stated that the species may inhabit areas of Eight Mile Creek as large hollow bearing trees are present and the creek line runs east to west.

Based on the above information, the OEMP vA2 (**ngh**environmental 2008) identified three sites that demonstrate the appropriate attributes. These were Oddies Creek in the South, and Thurgoona Drive and Eight Mile Creek in the North (Figure 2-1). The number of traps placed at each site differed depending on the shape and extent of suitable habitat, access issues and safety. Surveys focus on

threatened species habitat along the highway at each of the three sites. Table 2-1 provides details on each survey site.

Figure 2-1. Site Locations

Table 2-1. Site Descriptions

Location	Description	Aerial View	Landscape View
Thurgoona Drive	Located just north-east of Lavington, Thurgoona Drive traverses over the Albury-Wodonga Highway		
Eight Mile Creek	Located approximately 5 kms north of Thurgoona Drive, near Norske Skog		
Oddies Creek	Located south of Albury township, approximately 270 m north-east of the Murray River		

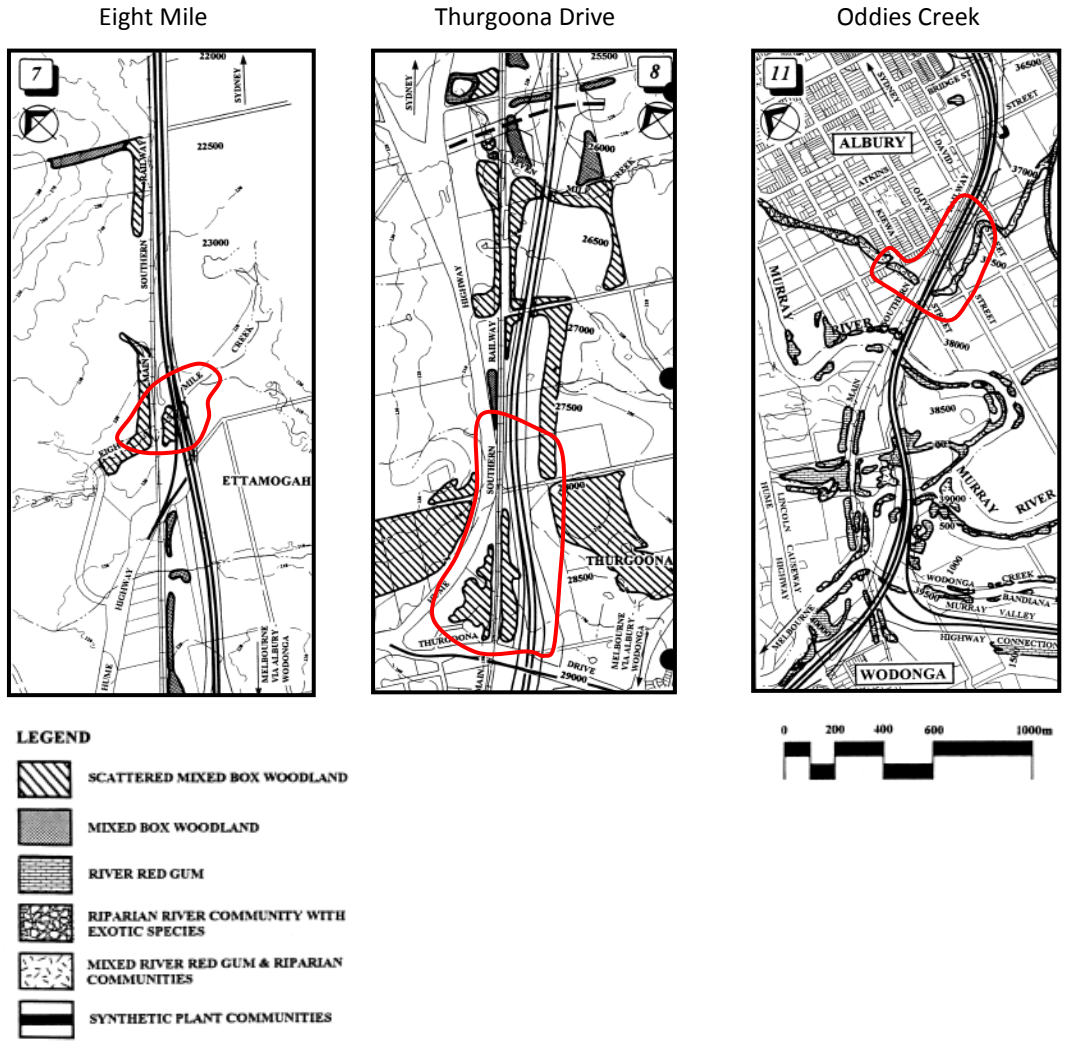

Figure 2-2. Vegetation Communities identified in original EIS (Source: Gunninah Consultants, 1995).

2.3 AVIFAUNA

Call-playback was undertaken for the Barking Owl at Oddies Creek. Methodology used followed the DECC (2004) survey guidelines with an initial listening period of 10 minutes, followed by a spotlight search for 10 minutes to detect any animal in the immediate vicinity. The Barking Owl call was played for 5 minutes, followed by a 10 minute listening period and further spotlighting for an additional 15 to 20 minutes to check for birds that were attracted by the calls but were not vocalising. Call playback surveys were undertaken by two field staff for two nights at Oddies Creek during both the spring 2010 and autumn 2011 survey periods.

The three survey sites contain suitable habitat for threatened woodland birds. Twenty minute diurnal bird surveys were undertaken at all three sites in spring 2010 and autumn 2011. During spring 2010 three morning surveys were carried out at Thurgoona, two afternoon surveys at Eight Mile Creek, and one morning and one afternoon survey at Oddies Creek. In autumn 2011 three surveys were undertaken at Thurgoona, and two at each of Eight Mile Creek and Oddies Creek. All species observed or heard were recorded.

2.4 SQUIRREL GLIDERS

Surveys for Squirrel Gliders were undertaken as part of a monitoring program to assess a population during the operation of the highway. Trap locations for the long term monitoring of this threatened species were selected within the three survey locations based on the following criteria:

- Sites that contained woodland of medium habitat quality (i.e. areas supporting trees including large diameter trees, trees with hollows and potentially some shrubby understorey).
- Sites that were large enough to position traps at least 100 m apart, to increase potential capture rates.

The monitoring program is designed so that all trapping methods implemented are consistent across sites; however during the first and second years of survey works, due to access issues at Eight Mile Creek and stolen traps at Oddies Creek a number of traps could not be set. Consequently the number of trap nights has differed at each site in spring and autumn during the first and second years of the monitoring program. In year 3 trap numbers were reduced at Oddies Creek due to the large numbers of Brush tailed Possums being captured and the exposure of traps to theft. Five traps were set at Oddies Creek in spring 2010 and autumn 2011. The number of traps at all sites was the same for both sessions of year 3 (spring 2010 and autumn 2011). Table 2-2 shows the number of cage traps placed at each of the three sites during the year 1, year 2, and year 3 survey periods.

During the first round of surveys undertaken in spring 2008, Bell's TSR (travelling stock route) was established as a control site. This site was known to have Squirrel Gliders present from Rodney van der Ree's ongoing work for the RTA and was utilised to ensure our trapping methods were succeeding if the species was not being recorded at the other three identified survey sites. Since Squirrel Gliders have been recorded at the survey sites in all years, the Bells TSR site is no longer used as a control site.

Live trapping was used for monitoring Squirrel Gliders using specially designed cage traps at each of the three sites. This method was considered more appropriate than spotlighting or hair-tube analysis as information regarding sex, reproduction, distribution and abundance was required for the monitoring program. In addition, differentiation of hairs from Squirrel Gliders and Sugar Gliders is problematic (Lobert *et al*. 2001), and spotlighting can repeatedly fail to detect the presence of Squirrel Gliders due to their small stature, poor reflective eye shine and quiet behaviour (van der Ree 2003). Unlike Sugar Gliders, Squirrel Gliders rarely vocalise: calling rates may only be one per night, and not all nights (Goldingay *pers. comm.*2009).

Each cage trap was baited with a mixture of honey, rolled oats and peanut butter to attract Squirrel Gliders, while a trail of diluted honey water was sprayed above the trap to a height of 5-10 m. The location of each tree trap was marked with a GPS unit to identify locations during each survey period, locations of recaptured Squirrel Gliders, and gliding distances post-capture.

Table 2-2. Number of traps at each site.

Survey Period	Thurgoona Drive West	Thurgoona Drive East	Eight Mile Creek	Oddies Creek	Bell's TSR (control)	Total
Spring 2008	7 traps	6 traps	4 traps	7 to 4 traps*	7 traps	28
Autumn 2009	7 traps	7 traps	3 traps	6 traps	N/A	23
Spring 2009	7 traps	8 traps	3 traps	6 to 5 traps*	N/A	24

Autumn 2010	9 traps	9 traps	3 traps	7 to 6 traps*	N/A	28
Spring 2010	9 traps	9 traps	3 traps	5 traps	N/A	26
Autumn 2011	9 traps	9 traps	3 traps	5 traps	N/A	26

(* denotes where traps were stolen)

Twenty-six traps were positioned across the three sites. An aluminium extension ladder was used to place the traps at a height of 3-5 m off the ground. Each trap was nailed to the selected tree trunk. Traps were placed approximately 100 m apart to maximise the area covered and to accommodate for home ranges and territories of Squirrel Gliders. Trap locations at each of the three survey sites during the spring 2010 and autumn 2011 survey periods are shown in Figure 2-3, Figure 2-4 and Figure 2-5. One trap location (THW9) was moved at Thurgoona West from spring 2010 to autumn 2011 due to a dense thicket of Blackberry (*Rubus fruticosus agg.*) that impeded access to the base of the original tree (Figure 2-3).

A total of six trap nights were undertaken during each survey period. Traps were checked at dawn each morning. Captured Squirrel Gliders were processed at the point of capture and released. Non-threatened species, namely Common Brushtail Possums, were immediately released upon capture.

Each captured Squirrel Glider was fitted with a microchip with a unique numerical code and given an ear tattoo comprising of a letter and a number (e.g. A9) to easily identify each individual in the field as a back-up for individuals who may have lost their microchip. It was deemed unnecessary to microchip Common Brushtail Possums considering their non-threatened status and abundance in the area, as well as the time implications of processing additional animals and the cost of micro chips. Males were tattooed in the left ear, while females were tattooed in the right ear. A tissue sample from the ear was also taken using a toe punch device and then preserved in ethanol to assist in subsequent genetic analysis determining population structures in the future. Tissue samples will be sent to Rod van der Ree to be analysed with other samples taken by his team to aid in research of this threatened species within the Albury region.

Processing involved recording the following information for each individual:

- Species identification
- Weight
- Sex
- Tattoo Identification
- Upper Incisor wear
- Microchip Implant number
- Tissue sampling details
- Reproductive condition

The unique combination of the three identification methods assists in future identification of any recaptured animals.

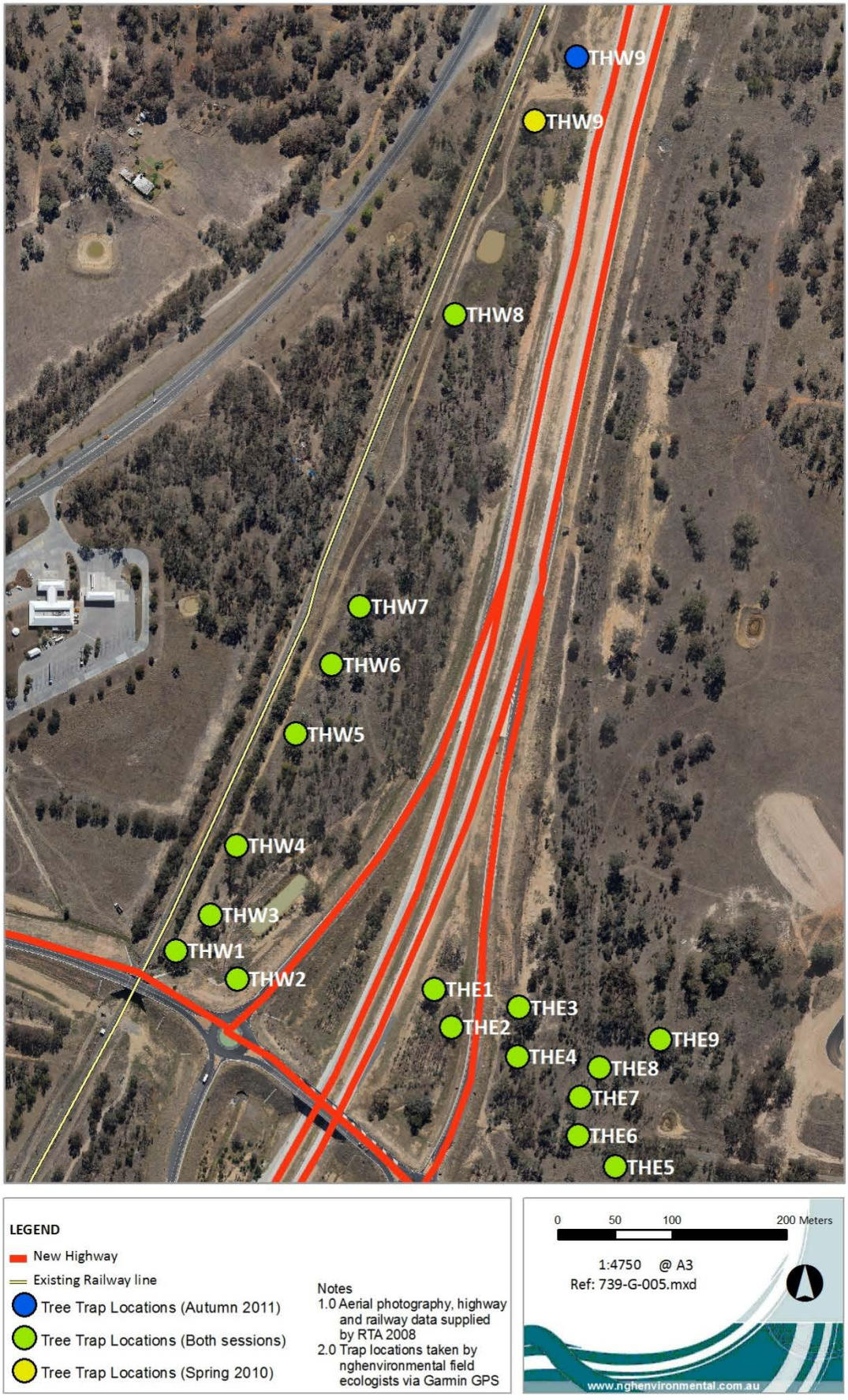

Figure 2-3. Year 3 Trap Locations at Thurgoona

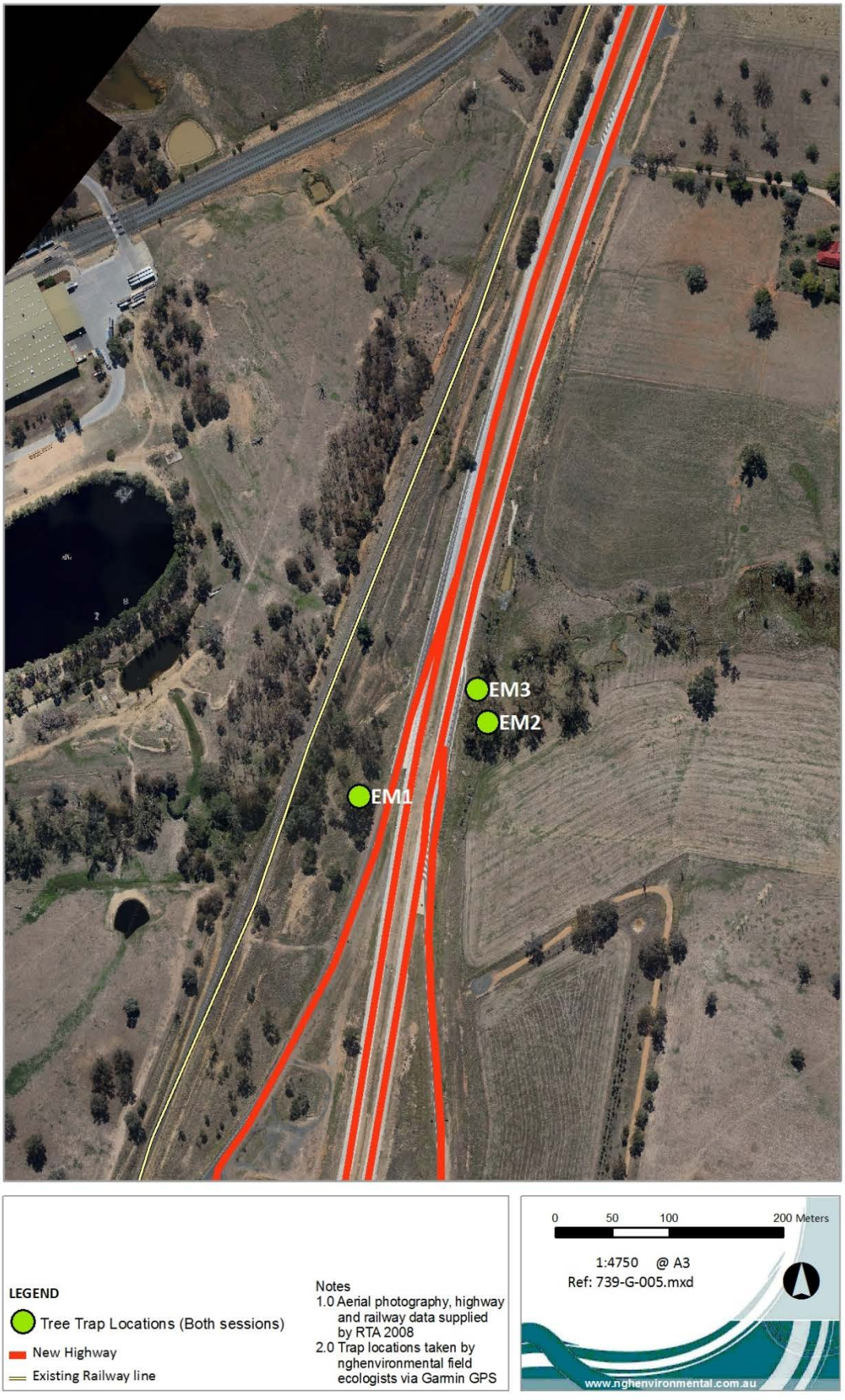

Figure 2-4. Year 3 Trap Locations at Eight Mile Creek

Figure 2-5. Year 3 Trap Locations at Oddies Creek

A combination of traits was used to estimate the age of Squirrel Gliders. Body weight and incisor wear are the most ideal characteristics to use when estimating the age class (Quin 1995). Age estimates for juvenile individuals less than 18 months old could be reliably made using these parameters, however after the 18 month age; estimates were less reliable due to the overlap between differing characteristics. The following Table 2-3 shows characteristics used to estimate age classes of the Squirrel Glider.

Table 2-3. Parameters to estimate age class of Squirrel Glider (Derived from van der Ree 2002)

Trait	< 1 year	1 – 2 years	2 – 3 years	> 3 years
Weight of male (g)	< 200g	> 220 g	> 220 g	> 220 g
Weight of female (g)	< 180 g	> 200 g	> 200 g	> 200 g
Wear of upper incisors	None to slight (1 – 1.5)	Slight to moderate (2 – 2.5)	Moderate to heavy (3 – 3.5)	Moderate to very heavy, both are brown/rotting colour. Worn to gum line. (3.5 – 4)
Wear of lower incisors	White, no cracks	Slight, discoloured, lateral cracks slight	Orange discolouration, lateral cracks obvious, often chipped teeth in older animals	
Pouch condition	Small and shallow with fine white hairs, teats < 1 mm long	Carrying pouch young or pouch larger and deeper than in females that had not bred. Yellow/rusty coloured hairs, black scale often present. Teats > 1 mm long		
Frontal gland condition	Not developed	Partially to well developed		
Patagium colour	White	Cream / yellow / lemon		

To estimate the female reproductive condition, each female caught was allocated a 1 to 6 reproductive category (Quin 1995 described in Table 2-4.)

Table 2-4. Female Squirrel Glider Reproductive Categories

Category	Description
1 – Juvenile Virgin	Pouch is small, tight and undeveloped. Hairs white and teats < 1 mm
2 – Pregnant Females	Pouch lining thicker with the pouch wall glandular, muscular and richly vascularised, may or may not have previously bred.
3 – Female carrying pouch young	Female carrying pouch young should be able to see pouch young.
4 – Lactating females	Females with a loose pouch and one or two lactating teats present.
5 – Females recently bred	Pouch and teats are large but are not lactating.
6 – Adult female non breeding	Pouch is larger and deeper than virgin females, but reproductive activity not apparent. Hairs are brown to yellow with teats > 1 mm.

3 RESULTS

3.1 THREATENED OWLS AND WOODLAND BIRDS

No Barking Owls were recorded or observed during call playback and spotlighting surveys at Oddies Creek in either spring 2010 or autumn 2011. In addition, there were no opportunistic sightings of the Barking Owl at Thurgoona Drive or Eight Mile Creek during dawn surveys. Given the snapshot nature of the survey and traffic noise from the highway and surrounding neighbours it is possible that this species could still occupy areas of the sites and possibly other areas within the locality, including the Murray River. The Barking Owl has a large home range and can traverse extensive distances between foraging, roosting and breeding sites (NPWS 2003), all of which are ample along the Murray River, approximately 150 m from the Oddies Creek site.

A total of 21 bird species were recorded during the spring 2008 survey, 35 during autumn 2009, 49 species during spring 2009, 32 species during the autumn 2010 survey, 36 during spring 2010, and 30 during autumn 2011 (Appendix A). Conditions during spring 2010 were fine and mostly clear with cool morning temperatures. Bird survey conditions were not ideal during autumn 2011 owing to high rainfall and low temperatures. It is likely that these factors impacted on the abundance and diversity of bird species observed at this time. No threatened species listed under the TSC Act or EPBC Act were identified during diurnal bird surveys. Thurgoona Drive provided the most suitable potential habitat for threatened woodland bird species with a higher density of vegetation present, revegetation of shrubs and ground cover species, presence of hollow bearing trees and nest boxes.

The majority of species recorded across Oddies Creek, Thurgoona Drive and Eight Mile Creek are commonly found in woodland areas and roadside vegetation. Two introduced bird species were recorded during surveys in all years of monitoring (spring 2008 to autumn 2011); the Common Blackbird (*Turdus merula*) and the Common Starling (*Sturnus vulgaris*). Two other introduced species were observed during year 2 monitoring session (spring 2009 and autumn 2010); Rock Dove (*Columba livia*) and the Spotted Turtle-dove (*Streptopelia chinensis*).

Given the timing and snapshot nature of the surveys it is expected that a range of other species, including threatened species, could occur across all three survey sites at other times of the year.

3.2 SQUIRREL GLIDERS

A total of 26 cage traps were set up across the three survey sites in both spring 2010 and autumn 2011 to continue monitoring of Squirrel Gliders in the study locality.

3.2.1 Spring 2010 Captures

Four Squirrel Gliders were captured during the spring 2010 survey - one at Thurgoona East and three at Thurgoona West. All of the Squirrel Gliders from Thurgoona West, SQA74, SQB3M and SQA5M, were recaptures from previous years (Table 3-1). One new individual was captured on the eastern side (male SQC7). No Squirrel Gliders were captured at Oddies Creek or at Eight Mile Creek.

Table 3-1. Capture Rates Spring 2010

Individual	Current capture date	Sex	Location	Recapture	Date of past captures	Past capture location	Distance
SQA7F	07.10.10	F	THW6	Yes	20.04.10 22.04.10	THW5 THW1	m
SQB3M	09.10.10	M	THW8	Yes	24.04.10 21.04.10 04.10.09 11.10.09	THW6 THW6 THW5 THW5	m
SQA5M	09.10.10	M	THW6	Yes	23.04.10 22.04.10 20.04.09	THW5 THW8 THW4	m
SQC7M	10.10.10	M	THE7	No	N/A	N/A	m

Seven Common Brushtail Possums were captured at Thurgoona Drive during the spring 2010 trapping period (four on the western side and three on the eastern side). One Common Ringtail was trapped at Oddies Creek, and there were no captures at Eight Mile Creek. Detailed data is provided in Appendix B.

3.2.2 Autumn 2011 Captures

A total of eight individual Squirrel Gliders were trapped in autumn 2011 with four recaptures and four new captures (Table 3-2). One individual, SQB3M, was caught twice during the autumn 2011 trapping session at Thurgoona West, with a distance of 175m between trapped locations.

Table 3-2.Capture Rates Autumn 2011

Individual	Current capture date	Sex	Location	Recapture	Date of past captures	Past capture location
SQB3M	10.04.11 11.04.11	M	THW7 THW5	Yes	01.10.09 04.10.09 21.04.10 24.04.10 09.10.10	THW7 THW7 THW6 THW6 THW8
SQD0F	11.04.11	F	THW1	No	N/A	N/A
SQ2BF	11.04.11	F	**THE2**	Yes	03.10.09 21.04.10 23.04.10	THE8 THE7 THE4
SQA7F	12.04.11	F	THW1	Yes	17.04.09 30.09.09 01.10.09 20.04.10 22.04.10 07.10.10	THW3 THW1 THW3 THW5 THW1 THW6
SQC1F	12.04.11	F	THW9	No	N/A	N/A
SQC2F	12.04.11	F	THE2	No	N/A	N/A
SQA9M	12.04.11	M	THE4	Yes	15.04.09 17.04.09 20.04.09 02.10.09 20.04.10 21.04.10 22.04.10 23.04.10 24.04.10	THE9 THE5 **THE1** THE7 THE7 THE8 THE6 **THE1** THE3
SQ9CM	12.04.11	M	THE7	No	N/A	N/A

One Common Brushtail Possum was caught at each of Thurgoona East and West sites and at Oddies Creek. If a Common Brushtail Possum was caught in a trap on more than three occasions the trap was removed for ethical reasons. This occurred at both Oddies Creek and Thurgoona West. Common Brushtail Possums were not microchipped as they are not a threatened species and are not being monitored as part of this project.

No animals were caught at Eight Mile Creek.

To summarise, eight Squirrel Gliders were caught at the Thurgoona Drive site; two recaptures and two new captures on the western side of the highway, and two recaptures and two new captures on the eastern side. No Squirrel Gliders were captured at Oddies Creek or at Eight Mile Creek. Two Common Brushtail Possums were captured at Thurgoona Drive; one on the western side and one on the eastern side.

3.2.3 Squirrel Glider Population Parameters

Capture and survival rates

In total 16 Squirrel Gliders have been captured and microchipped since commencement of monitoring in spring 2008. Ten of these have subsequently been re-captured. Three individuals caught in either year 1 or year 2 have never been recaptured (Table 3-4); they were recorded as having an upper incisor wear of 3, therefore it is likely that these individuals have died of old age or possibly by predation. Three individual Squirrel Gliders have been caught in all years of this monitoring program; SQA9M, SQA5M, SQA7F (Table 3-3). SQA9M has been caught the most number of times with three captures in autumn 2009, one capture in spring 2009, five captures in autumn 2010, and one capture in autumn 2011 (Table 3-2). These sustained captures give a good indication of age in these individuals, and the ongoing health of the population.

In year 1 there were 8 new captures, and 3 new captures in year 2. There was one new capture in spring 2010 and 4 in autumn 2011, making a total of 5 new individuals in year 3.

Table 3-3. Squirrel Glider captures over time

Individual	Thurgoona West			Thurgoona East			Eight Mile Creek			Oddies Creek		
	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3	Yr1	Yr2	Yr3
SQH2M	✓											
SQH0F	✓											
SQF3F				✓	✓							
SQA5M	✓	✓	✓									
SQA6M	✓											
SQA7F	✓	✓	✓									
SQA8F				✓	✓							
SQA9M				✓	✓	✓						
SQB1F		✓										
SQ2BF					✓	✓						
SQB3M		✓	✓									
SQD0F			✓									
SQC1F			✓									
SQC2F						✓						
SQ9CM						✓						

SQC7M	✓		

Recruitment and age class structure

Table 3-4 gives an indication of approximate age classes of trapped individuals in both spring 2010 and autumn 2011. The five new individuals caught in year 3 were all estimated to be in the juvenile to sub-adult age bracket, which is an indication that recruitment into the Thurgoona East and West sub-populations is still occurring. However it should be noted that there is inbuilt error in estimating age based on weight and tooth wear and without genetic analysis it is not possible to discern the source of new individuals into the population.

Squirrel Glider condition over time

The Squirrel Gliders caught at Thurgoona Drive on both the eastern and western sides of the dual carriageways appear to be in a stable condition over the 3-year monitoring period. Overall condition of the Squirrel Gliders based on body weight appears to have improved. The average weight in grams of individuals was 232g in year 1, 255g in year 2, and 271g in year 3. Relative weight has fluctuated over the three years of monitoring but this is to be expected with varying times of the year and the presence and absence of pouch young (Table 3-4). The three individuals that have been caught in all years of monitoring and their condition over time have been highlighted in Table 3-4.

Table 3-4. Condition of Squirrel Gliders over time from Spring 2008 to Autumn 2011

Individual	Location at Thurgoona	Condition of Squirrel Glider over time at each Monitoring Session						
		Spring 2008	Autumn 2009	Spring 2009	Autumn 2010	Spring 2010	Autumn 2011	Estimated Age
SQH2M	W	265g/UIW 3	-	-	-			
SQH0F	W	240g/UIW 3/with 1 unfurred young/blind in left eye	200g/UIW 3/adult not breeding/blind in left eye	-	-			
SQF3F	E	-	225g/UIW 3	250g/UIW 3.5	215g/UIW 3/pregnant			
SQA5M	W	-	240g/UIW 3.5	265g/UIW 3	270g/UIW 2	280g/UIW 2		2-3 yrs
SQA6M	W	-	185g/UIW 3	-	-			
SQA7F	W	-	260g/UIW/ 3.5/virgin	260g/UIW 3.5/ carrying pouch young	245g/UIW 3.5/adult not breeding	270g/UIW 3.5/ adult not breeding	260g/UIW 3.5/adult not breeding	2-3 yrs
SQA8F	E	-	205g/UIW 3.5-4/virgin	285g/UIW 3-3.5/ carrying pouch young	230g/UIW 2/carrying pouch young			
SQA9M	E	-	265g/UIW 3.5	240g/UIW 3.5	250g/UIW 2.5		250/UIW 2.5	2-3 yrs
SQB1F	W	-	-	305g/UIW 3.5 carrying pouch young	-			
SQ2BF	E	-	-	290g/UIW 2.5/recently bred	305g/UIW 2.5/carrying pouch young		320/UIW 3/Recently bred	2-3 yrs
SQB3M	W	-	-	255g/UIW 3	260g/UIW 2.5	280/UIW 2.5-3	320/UIW3-3.5	2-3 yrs
SQC7M	E					UIW 1		1-2 yrs
SQD0F	W						245/UIW	1-2

							2/virgin	yrs
Individual	**Location at Thurgoona**	**Condition of Squirrel Glider over time at each Monitoring Session**						
		Spring 2008	**Autumn 2009**	**Spring 2009**	**Autumn 2010**	**Spring 2010**	**Autumn 2011**	
SQC1F	W						250/UIW 1.5/adult not breeding	1-2 yrs
SQC2F	E						230/UIW 1/virgin	1-2
SQ9CM	E						280/UIW 2	1-2 yrs
Mean weight (g)		252.5	230	268.8	253.6	276.7	269.4	

Note: location at Thurgoona has been represented as "E" for Gliders found East of the dual carriages of the Hume Highway and "W" for Gliders found West of these dual carriages. UIW – Upper Incisor Wear. Individuals captured in all three years are highlighted.

Sex ratio and reproductive output

During year 3 monitoring there was an overall total of five male and six female Squirrel Gliders captured. Three males and one female were caught in spring 2010, and three males and five females were caught in autumn 2011 (Table 3-5). There were members of both sexes caught at each of Thurgoona East and West, an important factor considering their apparent inability to cross the dual carriageway. Research at Euroa in northern Victoria found a Squirrel Glider population to exhibit a female-biased sex ratio, but not significantly so (van der Ree 2002). In contrast, the study of a Squirrel Glider population at Limeburners Creek in northern NSW was found to be male-biased (Quin 1995). Pending outcomes of other variables such as demographic, genetic and environmental uncertainties, both sub-populations may continue to successfully breed. Collected tissue samples will be submitted to the Australian Research Centre for Urban Ecology as part of a larger study of Squirrel Gliders and their genetics. These results may give an indication of the genetic diversity and ultimately the health of the populations at Thurgoona.

No pouch young were observed in year 3 and there was no evidence that females were breeding. The breeding season tends to peak from April to July but can occur at any time depending on the availability of resources (Sharpe & Goldingay, 2010; NPWS, 1999). In previous surveys pouch young have been recorded in spring 2008, spring 2009 and autumn 2010. Pouch young were present in 7 different individuals on eight occasions during these survey periods.

Table 3-5. Sex ratio of captures of Squirrel Gliders over time

	Spring 2008		**Autumn 2009**		**Spring 2009**		**Autumn 2010**		**Spring 2010**		**Autumn 2011**	
Location at Thurgoona	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
EAST	-	-	1	2	1	3*	1	3*	1	-	2	2
WEST	1	1*	2	2	2	2*	2	1	2	1	1	3

*denotes the presence of breeding female Squirrel Gliders

Cross road movements

Three individual Squirrel Gliders have been caught on both sides of the southbound exit ramp at Thurgoona East; SQA9M, SQA8F and SQ2BF. SQA9M has been caught on either side of the exit ramp, firstly in autumn 2009 then again in autumn 2010. SQA8F has also crossed this exit ramp, but was not captured in year 3. This individual was captured on each side of the exit ramp in autumn 2009, then again in spring 2009 and autumn 2010. SQ2BF was first recorded in the remnant triangle of vegetation between the southbound exit ramp and the dual carriageway in autumn 2011, having previously been caught on the other side of this exit ramp. The canopy gap between this triangle of vegetation and the vegetation on the other side of the exit ramp requires a gliding distance of approximately 40m.

3.2.4 Summary of results

No Squirrel Gliders were captured at Eight Mile Creek or Oddies Creek during year 1, year 2, or year 3 survey periods. At Thurgoona Drive a total of seven individual Squirrel Gliders were captured during the second year of monitoring (spring 2009 and autumn 2010), and nine during the third year of monitoring (spring 2010 and autumn 2011). Three individuals caught during year 2 were not caught again during year 3 monitoring.

There were five new captures in year 3 classified as juveniles or sub-adults which indicates that successful breeding and/or recruitment is occurring at both Thurgoona East and West. However, no pouch young were recorded in year 3.

There are no indications that the populations are either female or male-biased, and both sexes have been recorded on both sides of the exit ramp at Thurgoona East. There is evidence that three individuals have crossed the southbound exit ramp at Thurgoona East, however there have been no captures of an individual at both Thurgoona East and West.

4 DISCUSSION

Woodland birds

No threatened woodland birds have been detected on site and the diversity of birds appears to be stable. The three sites provide sub-optimal habitat and resources for native birds due to their proximity to a large urban centre and the highly fragmented local landscape and lack of significant habitat features present at the sites. The three woodlands are generally open linear strips of vegetation with varying degrees of disturbed and weedy understoreys. There is limited structural complexity at most of the sites; however, Thurgoona east has some regenerating Acacia understorey. Given the disturbed and modified nature of the sites and their proximity to a large urban centre, it is not expected any threatened woodland birds would be reliant on the sites, if present in the general locality. The birds detected thus far have been generally common and abundant and consequently tolerant of human modified environments and the limited habitat types present would somewhat restrict the range of bird species that could potentially utilise the sites.

Barking Owls

No Barking Owls have been detected during call playback surveys over 3 years of survey. However there are records from local naturalists of resident Barking Owls in the area. Individuals have been sighted at Thurgoona, Eastern Hill, Albury Botanic Gardens, Heathwood Park, Monument Hill, and Padman Park (Paul Scannell *pers. comm.* 2010).

It is possible that the original pair recorded by Taylor (2002) on the Murray River is still present in the original location as Barking Owls show high nest site fidelity. Owl call playback probably has limited use in such close proximity to the noisy highway, which means without additional targeted owl survey it would be very difficult to ascertain where an individual has come from. Given the known presence of breeding Barking Owls in the Albury Thurgoona area and given that owls can travel very long distances to respond to calls, it would be difficult to interpret the origin of a bird if it did respond to call playback. Furthermore, owl call playback could place birds at risk if they were called across the highway when responding to a broadcast call. When owl call playback is conducted during the breeding season it can disturb nesting adults and disrupt the breeding cycle. In addition, owls may not respond vocally to playback within 500 metres of core nesting and roosting areas (DEC, 2004). So it would be almost impossible to make any link between a response to call playback and any impact of the freeway. For these reasons **ngh**environmental recommend that owl call playback be discontinued as part of the monitoring program. We also recommend that an attempt be made to access the original site during the Spring 2011 monitoring session to locate the original pair.

Squirrel Glider Movements

Squirrel Gliders caught between year 1 and 3 monitoring periods appear to be stable residents of these locations. Two thirds of the individuals caught between year 1 and spring 2010 have been re-captured over more than one trapping session. The remaining one third of trapped individuals has only been captured once. No pouch young were recorded in year 3, however new individuals indicate successful breeding and/or recruitment.

A recent study on Squirrel Gliders near the Hume Highway in north-east Victoria has found that those populations adjacent to the freeway have a survival rate 60% lower than those Squirrel Gliders living near local roads (McCall *et al*. 2010). Research into the movements of Squirrel Gliders found that only 6% of individuals crossed at least once at freeway sites without trees in the median (van der Ree *et al.* 2010).

Glider poles may improve connectivity but may also increase mortality rates by placing gliding individuals in the way of traffic. Given this, the height of the poles is an important consideration (McCall *et al.* 2010). The maximum glide distance for a Squirrel Glider is approximately 70m (van der Ree *et al.* 2010; van der Ree *et al*. 2003), with typical glide lengths between 20 m (Goldingay & Taylor 2009) and 35 m (van der Ree *et al*. 2010; van der Ree & Bennett 2003; van der Ree *et al*. 2003). There is an estimated canopy gap of over 150 m between Thurgoona East and Thurgoona West. Thus without assistance it is highly unlikely that Squirrel Gliders will cross the highway.

During similar trapping assessments near Euroa in South-eastern Australia (van der Ree 2002), predation was responsible for the loss of 11 Squirrel Gliders with nine individuals exhibiting injuries consistent with owl predation. Owls have not as yet been detected at the three sites despite call playback efforts for threatened owls but are known to occur in the locality.

Oddies Creek

Trapping at Oddies Creek has resulted in a number of Brushtail Possums being captured. This location appears to be dominated by its urban characteristics with highly modified vegetation dominated by invasive species. While it may have connectivity along the creekline, it consists of a single linear strip of trees and shrubs only with a very weedy understory. In spring 2010 five Brushtail Possums were spotlighted in a single tree containing a trap, and another 5 individuals within 200m. Such an abundance of Brushtail Possums reduces the likelihood of their being Squirrel Gliders in the area.

The trapping of individuals on consecutive days can have an effect on their ability to forage which thereby affects their overall condition. In year 3 Common Brushtail Possums in particular were susceptible to being continually trapped, therefore a trap was closed if an individual was recaptured on three successive days, as recommended in the year 2 report. Based on the complete absence of Squirrel Gliders at this site over three years, and the potential impact on the Brush tailed possums through continual re-trapping **ngh**environmental recommends that trapping at Oddies creek be discontinued.

Nest Boxes

The nest boxes at Thurgoona Drive are in a state of disrepair. Observation of a Squirrel Glider using a nest box at Thurgoona West in April 2011 indicates that these nest boxes provide and important supplementary resource which requires ongoing maintenance. We recommend that all nest boxes be located and assessed for maintenance requirements and that they be monitored as part of the ongoing program.

5 CONCLUSION AND RECOMMENDATIONS

After three years of monitoring there is suggestive evidence that Squirrel Gliders in the population at Thurgoona are not crossing the full width of the Hume Highway. Thus the highway is likely to be acting as a barrier to dispersal of young and to the maintenance of genetic diversity, which is essential for the long term persistence of the population. If movement continues to be restricted within the Thurgoona population, the result will likely be the formation of two smaller sub-populations that may suffer loss of genetic diversity through inbreeding. A recent study on the Hume Freeway between Avenel and Benalla has found that recruitment is essential to maintaining populations near the freeway, and that natality rates (number of offspring born per adult female) are not high enough to compensate for mortality from the freeway (McCall *et al*. 2010). The Thurgoona west population is bound on the west by the railway line and the Hume Highway. It is unknown whether members of this population are capable of crossing the railway line and the Hume Highway. Residential development is encroaching on the Thurgoona east sub-population which is bound on the west by the freeway, however aerial imagery suggests that there are opportunities for immigration and emigration to the north of this site. As such, the long-term viability of the Thurgoona East population may be less at risk than the Thurgoona West (sub) population.

Monitoring so far strongly suggests that the freeway is acting as a barrier to movement which is likely to result in the reduced viability of the population and possible extinction of the population. We therefore recommend that options for reconnecting the population be investigated urgently. Research into the installation of structures such as glider poles or rope bridges to reconnect this divided population is necessary to understand the most appropriate way to ensure that the population remains viable.

The lack of Barking Owl activity during call playback surveys indicates that this monitoring is not assisting us with measuring the impact of the Hume Freeway on nesting pairs. In addition, owls may not respond vocally to playback within 500 metres of core nesting and roosting areas (DEC, 2004). This information will not assist us with locating a nest site, and has the potential to lure owls in from the other side of the freeway placing them at risk of a collision with oncoming traffic.

The following recommendations are made in relation the monitoring program, to be implemented as of Spring 2011:

- Discontinue owl call playback at Oddies Creek
- Investigate the original nest location of Barking Owls on the Murray River
- Discontinue trapping at Oddies creek
- Investigate access issues at Norse Skog to enable expansion of the 8 Mile creek site.
- Commence discussion with RTA and other relevant individuals with regard to installation of glider poles/rope bridges or other such structures to link the Thurgoona east and west Squirrel Glider populations.
- Undertake nest box maintenance and incorporate monitoring of their condition into the ongoing monitoring program.

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APPENDIX A BIRD CENSUS RESULTS

	Thurgoona West		Thurgoona East		Eight Mile Creek		Oddies Creek	
Common Name	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**
Australian Magpie	✓	✓	✓	✓	✓	✓		
Australian Pelican							✓	
Australian Raven		✓	✓	✓	✓	✓	✓	✓
Black Duck					✓			
Blackbird*							✓	
Black-faced Cuckoo-shrike			✓	✓	✓	✓		✓
Black-shouldered Kite	✓							
Blue-faced Honeyeater			✓					
Brown Thornbill							✓	✓
Common Starling*	✓		✓		✓	✓	✓	✓
Crested Shrike-tit	✓							
Eastern Rosella		✓	✓		✓			
Fairy Martin	✓	✓						
Fantail Cuckoo			✓					
Galah	✓	✓	✓	✓	✓	✓	✓	✓
Golden Whistler				✓				
Grey Fantail		✓						✓
Grey Shrike-thrush			✓	✓	✓			
Laughing Kookaburra		✓	✓					
Little Egret								✓
Little Friarbird	✓		✓					
Magpie-lark	✓	✓	✓			✓	✓	
Masked Lapwing		✓						
Masked Woodswallow					✓			
Noisy Friarbird			✓					
Noisy Miner	✓	✓		✓	✓			
Pied Butcherbird				✓				
Pied Currawong		✓	✓					
Red Wattlebird	✓							

	Thurgoona West		Thurgoona East		Eight Mile Creek		Oddies Creek	
Common Name	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**	**Spring 2010**	**Autumn 2011**
Red-rumped Parrot		✓					✓	
Rufous Songlark			✓					
Rufous Whistler						✓		
Sacred Kingfisher			✓		✓			
Silvereye								✓
Spotted Pardalote				✓				
Striated Pardalote	✓		✓				✓	
Superb Fairy Wren					✓	✓	✓	✓
Wedge-tailed Eagle		✓						
Welcome Swallow					✓			
White-browed Scrubwren							✓	
White-faced Heron					✓			
White-plumed Honeyeater		✓	✓	✓	✓	✓		
White-winged Chough	✓	✓						
Willie Wagtail		✓	✓	✓	✓			
Wood Duck								✓
Yellow Rosella							✓	
Yellow Thornbill								✓

* Denotes exotic species

APPENDIX B DATABASE INFORMATION – YEAR 3 CAPTURES

Species Type	Date	Trap Day	Animal Unique I.D			New or Recap	GPS I.D	Capture Location	Weight (g) (Animal Only)	Upper Incisor Wear	Sex	Female Reproductive Condition	Notes
			Micro-chip I.D	Tattoo Number	I.D on data sheet								
Squirrel Glider	7/10/2010		0006D15CA4	A7	SQA7F	Recap	742	THW	270	3.5	Female	6	Did not view returning to hollow. Went to top of tree. Not in top of tree at 3pm when re-visited.
Squirrel Glider	9/10/2010		0006D15B89	B3	SQB3M	Recap	744	THW	280	2.5-3	Male		Cracking visible on lower incisor. Patagium orange yellow. Returned to top of tree; presumably to a hollow. Male glands active - frontal.
Squirrel Glider	9/10/2010		0006D144A0	A5	SQA5M	Recap	742	THW	280	1.5-2	Male		Patagium orangey yellow. Brown spot on nose. Returned to hollow. Frontal gland looks dry.
Squirrel Glider	10/10/2010		0006D148D6	C7	SQC7M	New	751	THE		1	Male		Body condition 2.5. Incisor- no cracking. Frontal male gland visible, not weepy. Patagium creamy white, no orange.Returned to hollow 750.
Squirrel Glider	10/04/2011	1	0006D15B89	B3	SQB3M	Recap	THW7	THW	320	3-3.5	Male		Couple of notches in right ear. Gland visible. Returned to top of tree.
Brushtail Possum	10/04/2011	1					THE6	THE					
Squirrel Glider	11/04/2011	2	0006D1655D	D0	SQD0F	New	THW1	THW	245	2	Female	1	White spot on right hand, creamy yellow/orange fur. Tissue sample taken. Released in tree, glided from THW1 to THW2 (near hwy). Young.
Brushtail Possum	11/04/2011	2					THW2	THW					
Squirrel Glider	11/04/2011	2	0006D15B89	B3	SQB3M	Recap	THW5	THW			Male		
Squirrel Glider	11/04/2011	2	0006D15840	2B	SQ2BF	Recap	THE2	THE	320	3	Female	5?	Orange fluff present in pouch, 1 central prominent vein. White spots right hand. Creamy yellow fur. Notches x 3 on left ear.

Species Type	Date	Trap Day	Animal Unique I.D			New or Recap	GPS I.D	Capture Location	Weight (g) (Animal Only)	Upper Incisor Wear	Sex	Female Reproductive Condition	Notes
			Micro-chip I.D	Tattoo Number	I.D on data sheet								
Brushtail Possum	11/04/2011	1					Oddies4	Oddies Creek					
Squirrel Glider	12/04/2011	3	0006D15CA4	A7	SQA7F	Recap	THW1	THW	260	3.5	Female	6	Yellowed incisors, lateral cracks. 4mm piece of right lower incisor broken off. Black scale visible in pouch, 4 teats. Released into capture tree, moved to outer branches and remained there approx 0.5hr. Still there when left, no bird mobbing.
Brushtail Possum	12/04/2011	3					THW2	THW					Adult and juvenile in trap
Squirrel Glider	12/04/2011	3	0006D15A74	C1	SQC1F	New	THW9	THW	250	1.5	Female	6	Teeth white, no apparent wear. Orange fuzz in pouch. On release, crossed over to adjacent tree, glided 50m to stag (SQC1Fglide 1), then downward glide to large tree (SQC1Fglide 2).
Squirrel Glider	12/04/2011	3	0006D1439A	C2	SQC2F	New	THE2	THE	230	1	Female	1	White teeth, no wear. Juvenile. Creamy fur, light grey on top. On release, returned to same hollow as female yesterday in capture tree. 2 teats barely visible.
Squirrel Glider	12/04/2011	3	0006E4ED5C	A9	SQA9M	Recap	THE4	THE	250	2.5	Male		No glands evident. Slightly worn teeth, lots of lateral cracking on upper half of lower incisors. Scrotal - soft. Release ok, not mobbed. Fell off tree, went up adjacent tree, stayed at top licking branches.
Brushtail Possum	12/04/2011	3					THE3	THE					
Squirrel Glider	12/04/2011	3	0006D1429A	9C	SQ9CM	New	THE7	THE	280	2	Male		Some curve to upper incisors. Frontal gland evident. Firm scrotum. On release, returned to hollow spout in tree no. 6 after gliding 2x and being mobbed by ravens, butcherbirds, willie wagtail.