Pacific Highway Upgrade: Sapphire to Woolgoolga.

Progress Report: Nest Box Monitoring – Operational Phase, Year 2 (2016).

Sandpiper Ecological
1/94 Main Street, Alstonville, 2477
www.sandpipereco.com.au

Version 2 - Final Report
14 December 2016

Document Distribution

Date	Version	Status	Sent to	Represent	Delivery Format	Dispatched By
16/9/2016	A	Draft	B. Taylor, D. Rohweder	SES	MS Word	G. McDonald
13/10/2016	1	Draft	N. Ray	RMS	MS Word	B. Taylor
14/12/2016	2	Final	N. Ray	RMS	Pdf	B. Taylor

Project Team: Dr B. Taylor (reporting, field work)
G. McDonald (reporting, field work)
N. Priest (field work)
Dr D. Rohweder (project management, review)

Report prepared for: Roads and Maritime Services (RMS)

© Sandpiper Ecological Surveys 2016
ABN: 82 084 096 828

PO Box 401
ALSTONVILLE NSW 2477
M 0401 195 480 | E **sandpipereco@optusnet.com.au**

Cover Photo: Brown antechinus (*Antechinus stuartii*) in a pygmy possum box.

Disclaimer:
This report has been prepared in accordance with the scope of services described in the contract or agreement between Sandpiper Ecological Surveys (ABN 82 084 096 828) and NSW Roads & Maritime Services. The report relies upon data, surveys and measurement obtained at the times and locations specified herein. The report has been prepared solely for use by Roads and Maritime Services and Sandpiper Ecological Surveys accepts no responsibility for its use by other parties. Sandpiper Ecological Surveys accepts no responsibility or liability for changes in context, meaning, conclusions or omissions caused by cutting, pasting or editing the report.

Table of Contents

List of Tables

List of Figures

List of Plates

1. Introduction

The upgrade of the Pacific Highway from Sapphire to Woolgoolga (S2W) involved construction of 25 km of dual carriageway from Campbell Close, Sapphire, to Arrawarra Beach Road, Arrawarra. The upgrade became operational in July 2014.

The Ministerial Conditions of Approval (MCoA) for the S2W upgrade included a requirement to implement appropriate actions to mitigate the impact of removing hollow bearing trees (HBT) on hollow-dependent fauna (HDF). Such actions included preparation of a Nest Box Management Plan (NBMP) in accordance with MCoA 2.9, which states that:

> *"The proponent shall prepare and implement a nest box plan prior to commencement of clearing of vegetation for construction to provide replacement hollows for displaced fauna in conjunction with SoC F7. The plan shall detail the number and type of nest boxes to be installed, which must be justified based on the number and type of hollows removed, the density of hollows in the area to be cleared and adjacent forest; and the availability of adjacent food resources."*

A NBMP was prepared by Benchmark Environmental Management (BEM) in 2009 and approved in 2010. The NBMP guides the installation and monitoring of nest boxes to replace tree hollows removed during the construction phase of the upgrade (BEM 2010). In total, 132 nest boxes were installed within five nest box installation areas (NIA) adjacent to the project during 2010/11. Details of the installation process and results of construction phase inspections conducted in spring 2011 and spring/autumn 2012/2013 have been reported on previously (BEM 2011, 2013a). A further 10 boxes were installed in May 2013 to account for the final number of HBT removed during clearing and construction. The final number and type of nest boxes assigned to each area is described in Table 1 and location of nest box areas across the alignment shown in Figure 1.

Sandpiper Ecological Surveys (Sandpiper) was contracted by Roads and Maritime Services NSW (RMS) in January 2015 to conduct monitoring of fauna crossings along the S2W alignment and inspect nest boxes. According to the S2W Ecological Monitoring Program (EcMP (Benchmark 2014)), nest box inspections were to occur during summer and late winter of year one (2014/15), year two (2015/16) and year 5 (2018/19) of the operational phase monitoring period. Due to delays in awarding of contracts, commencement of year one monitoring was postponed until early 2015. Subsequently year two monitoring began in early 2016. The following report presents results of year two nest box inspections conducted during late summer and late winter 2016. The report discusses the implications of the results and proposes a number of management recommendations.

Table 1. Number and type of nest boxes installed within five nest box installation areas (NIA) adjacent the S2W upgrade. * includes Zone 35 boxes.

Box Type	Area 2	Area 7	Area 9*	Area 10	Area 11/12	Total
Brush-tailed phascogale	-	**2**	**4**	**1**	**2**	9
Pygmy possum	-	**3**	**5**	**1**	**1**	10
Sugar/squirrel glider	**2**	**5**	**9**	**4**	**6**	26
Yellow-bellied glider	**1**	**3**	**7**	**3**	**3**	17
Greater glider	-	-	**2**	**1**	**2**	5
Brushtail/ringtail possum	**1**	**2**	**10**	**4**	**2**	19
Microbat	**2**	**2**	**10**	**2**	**4**	20
Cockatoo	**1**	**2**	**3**	**2**	**2**	10
Corella	-	-	**1**	**1**	-	2
Rosella	**1**	**2**	**1**	-	-	4
Lorikeet	**2**	**1**	**2**	-	-	5
Kookaburra	-	**1**	**3**	**1**	-	5
Owlet nightjar	-	**2**	**5**	**1**	**2**	10
Total	10	25	62	21	24	142

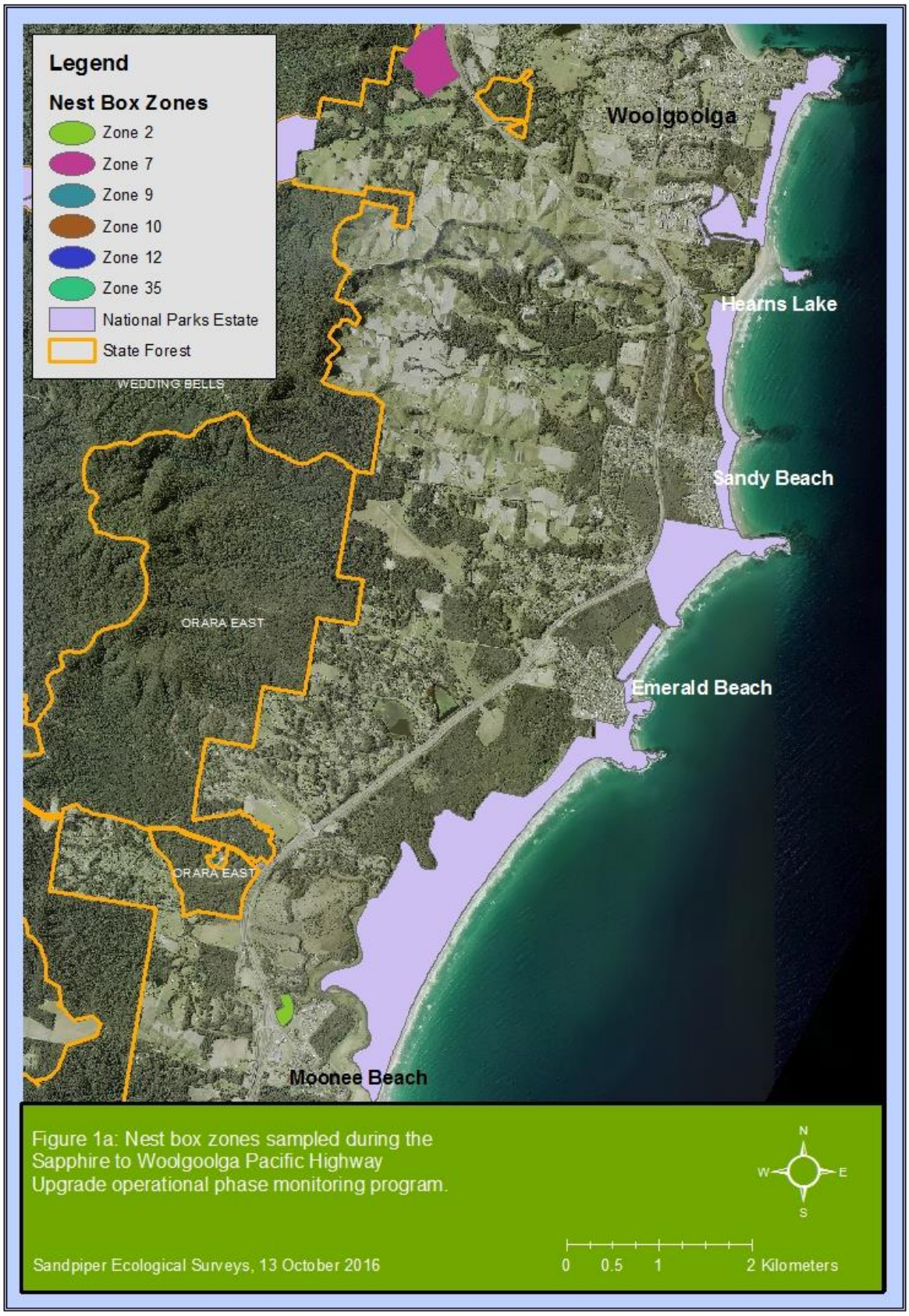

Figure 1a: Nest box zones sampled during the Sapphire to Woolgoolga Pacific Highway Upgrade operational phase monitoring program.

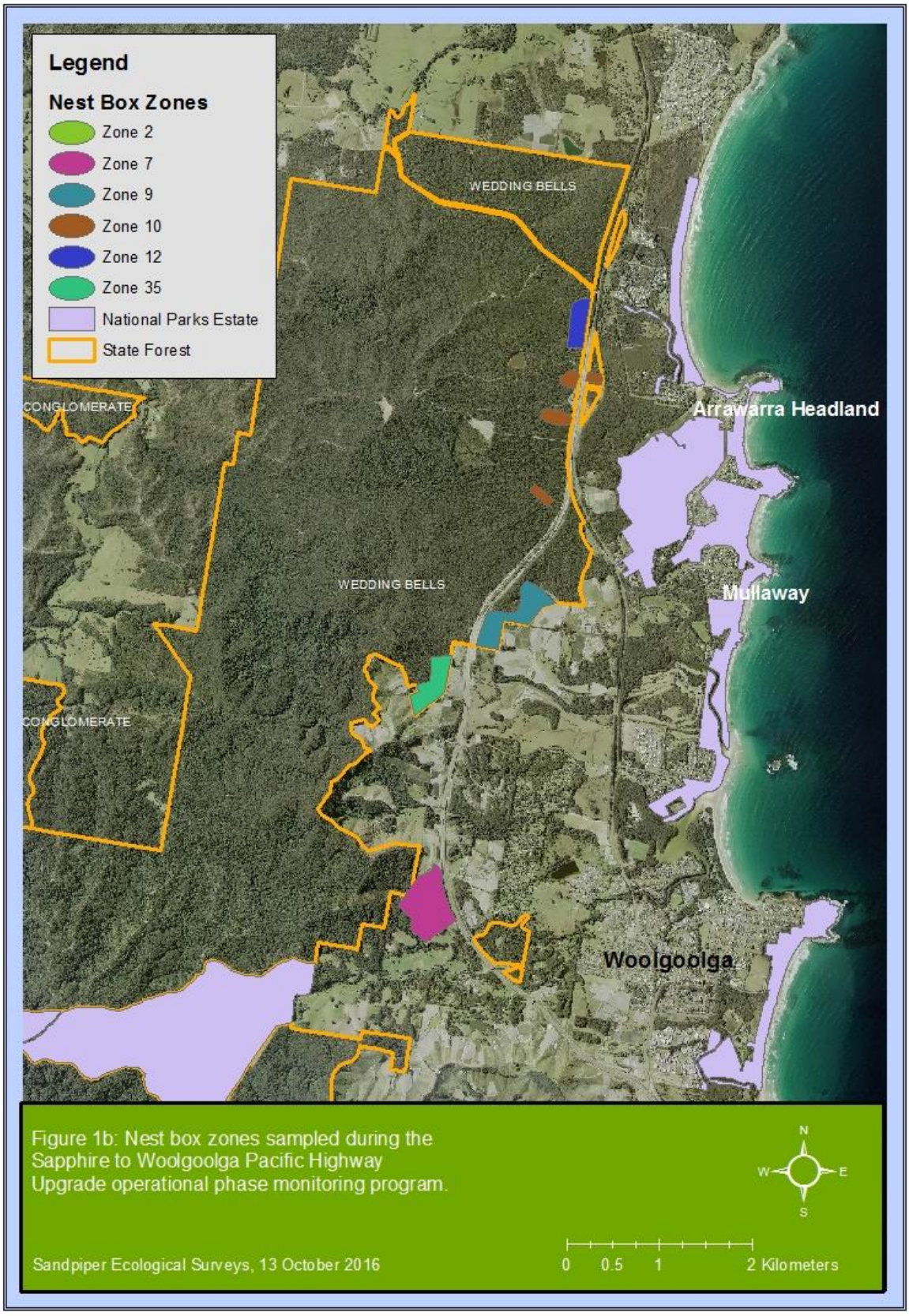

Figure 1b: Nest box zones sampled during the Sapphire to Woolgoolga Pacific Highway Upgrade operational phase monitoring program.

2. Methods

2.1 Nest Box Inspections

Year two operational phase nest box inspections were carried out between 18 January to 21 January 2016 (late summer) and 31 August to 2 September 2016 (late winter). One hundred and forty-two boxes were inspected during each period. Inspections were conducted by a team of two ecologists. Each box was initially inspected visually from the ground with binoculars to determine its condition followed by inspection of the box contents using a GoPro Hero3 camera mounted to a telescopic extension pole. Images from the GoPro camera were wirelessly streamed to an iPad and a photo(s) of the contents was recorded. Some nest boxes featuring concealed contents (e.g. thick leaf nests) were also inspected by means of a ladder to enable closer inspection. The data recorded for each nest box included: species present, number of individuals, age (juvenile or adult), signs e.g. nesting/denning material, scats, hair and condition of box and supporting wire. Minor repairs and maintenance were undertaken where possible.

Identification of fauna was based on the ecologist's experience with reference to standard field guides (e.g. Menkhorst & Knight 2004; Churchill 2008; Tyler & Knight 2009) as required. With the exception of some insectivorous bats, most fauna can be confidently identified from viewing photographs/video footage. The identification of fauna signs was based on previous experience of nest characteristics of hollow dependent fauna (HDF) and published information. Where there was sufficient evidence, such as distinct nests/denning material, a probability rating of possible (60-75% certainty), probable (75-90% certainty) or definite (>90% certainty) was assigned to the likely fauna species.

3. Results

3.1 Use of Nest Boxes

Five vertebrate species were observed occupying nest boxes during the 2016 inspection periods (Table 2; Table A1, Appendix A). Three vertebrate species were observed during summer and four during winter. Common brushtail possum (*Trichosurus vulpecula*) was the most common occupant followed by brown antechinus (*Antechinus stuartii*). They were the only species occupying boxes during both inspection periods (Plate 1 & 2).

Common brushtail possums were observed on six occasions in summer and twice in winter with dependent young (Plate 1). A Short-eared brushtail possum (*T. caninus*) was confirmed in one box during winter (Plate 1). Squirrel gliders (*Petaurus norfolcensis*) (Plate 2) were confirmed occupying at least two boxes during summer and recorded as probable occupants during winter (Table 2). Squirrel gliders are listed as vulnerable on the NSW *Threatened Species Conservation Act* (*TSC* Act) 1995. Sugar gliders were observed occupying two pygmy possum boxes during winter (Table 2). Overall, 6% of boxes were occupied by vertebrates in summer and 7% in winter.


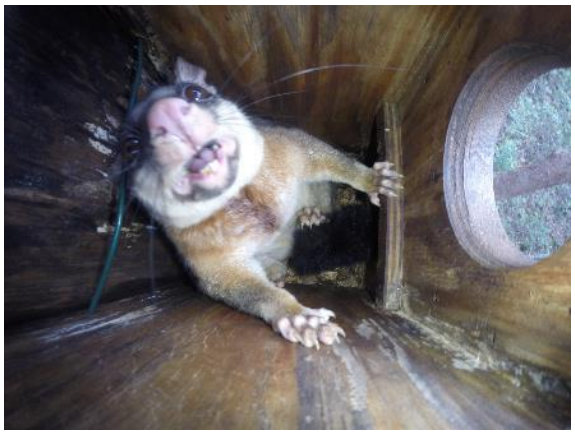

Plate 1: Common brushtail possum (left, adult & juvenile) was the most common vertebrate occupying nest boxes during the two inspections. Short-eared brushtail possum (right) was observed during the winter inspection.


Plate 2: Brown Antechinus (left) were observed in boxes during both inspection periods. Squirrel gliders (right) were observed on two occasions during the summer inspection.

No bird or reptile species were recorded occupying nest boxes in either period. However, based on evidence of use, owlet nightjar (*Aegotheles cristatus*) probably used both yellow-bellied glider and phascogale boxes, including a box previously occupied by a nesting white-throated treecreeper (*Cormobates leucophaea*) (Table 2; Plate 3).

Plate 3: Loose leaves, probably those of an owlet night jar (left), scattered over an old shredded bark nest of a white-throated treecreeper recorded in 2015 (right) within a yellow-bellied glider box.

In addition to occupied boxes, 59% of boxes contained evidence of use by vertebrates in summer and 66% of boxes in winter (Table 3). The probable nest of the threatened brush-tailed phascogale (*Phascogale tapoatafa*) observed in a kookaburra box in 2015 showed possible signs of continued use during 2016 (Plate 4). Brush-tailed phascogales' are listed as vulnerable on the NSW *TSC* Act 1999. Nests of *Antechinus* spp. (probably brown antechinus*, A. stuartii*), another Dasyurid, typically feature leaves and a scat latrine in the corner and were evident in eight and nine boxes during summer and winter 2016 respectively (Plate 4).

Other identifiable evidence included bowl-shaped eucalypt leaf nests of sugar or squirrel glider (Plate 5) and ball-shaped eucalypt leaf nests of feathertail glider (*Acrobates pygmaeus*). Nests of brustail possums (either common or short-eared) typically feature scattered/flattened leaf material often with a bare patch in the centre of the nest box floor and were the most commonly recorded nest (Plate 5). Overall, the proportion of nest boxes that featured fauna activity (i.e. sum of boxes occupied and boxes with evidence of use) increased from 65% in summer to 73% in winter.

Plate 4: Dasyurid's typically create 'latrines' by depositing scats in the corner of a nest box. The combination of scats in the corner and shredded bark in this kookaburra box is indicative of a brush-tailed phascogale den (left) whereas antechinus sp. generally build nests made of leaf material (right).

Plate 5: Sugar and/or squirrel gliders generally create bowl-shaped eucalypt leaf nests (left). Brushtail possums generally den on a thin layer of leaf material which is often cleared in the middle (right).

No active European beehives (*Apis* sp.) were detected during summer or winter, however nine boxes contained abandoned/eaten-out hives in summer with no further colonies evident during the winter inspection (Plate 6). Hives only occurred in medium sized boxes (i.e. yellow-bellied glider, sugar/squirrel glider, owlet nightjar). Ants (probable *Polyrachis* spp.) were prevalent in 23% of boxes during summer and 29% of boxes during winter. No vertebrates were observed in boxes containing ants and ants were evident across a range of box sizes/types.

Table 2. The number and type of nest boxes occupied and/or showing evidence of use during inspections conducted in summer and winter 2016. SS=SqG/SuG glider; ON=Owlet Nightjar; PP=Pygmy Possum; Pg=Phascogale; Kb=Kookaburra; Ct=Cockatoo; Po=Brushtail/Ringtail Possum; GG=Greater Glider; Mb=Microbat; Yb=Yellow-bellied Glider; Ro=Rosella; Co=Corella; Lo=Lorikeet; ^=juveniles present. Likelihood of use based on evidence were all scored as 'probable'.

Species/Group	No. occupied		No. with evidence of use		Box type used
	Sum	Win	Sum	Win	
Antechinus sp.		1	8	9	SS=11; ON=2; PP=3; Yb=2
Brown Antechinus	1	1			PP=1; SS=1
Brush-tailed phascogale			1	1	Kb=2
Common brushtail possum	6	2			Ct=4; Po=3; Kb=1
Short-eared brushtail possum		1			Po=1
Brushtail possum sp.		2	23	29	Po=30; Kb=6; Ct=10; Ro=2; Co=2; GG=4
Squirrel/Sugar/Yellow-belllied glider			3	3	Yb=6
Squirrel/Sugar glider		1	19	28	SS=20; Lo=3; Ro=2; ON=8; Pg=5; Yb=10
Feathertail glider			1	1	Mb=2
Sugar glider		2	2	1	PP=4; Pg=1
Squirrel glider	2				SS=1; Pg=1
Owlet nightjar			3	3	Yb=4; Pg=2
European beehive			9	9	Yb=8; SS=4; Po=2; GG=2; Pg=2
Ants	33	41		1	SS=19; PP=12; Yb=9; ON=9; Po=3; Pg=6; Lo=3; Co=2; Mb=8; Kb=2; Ct=1; GG=1

Plate 6: Boxes that featured European beehives were abandoned and most showed evidence of re-occupation by native vertebrates, such as sugar or squirrel gliders (left). *Polyrachis sp*. ants were evident in 23% and 29% of boxes in summer and winter respectively (right).

Fauna activity (i.e. boxes occupied + evidence of use) across the Nest Box Installation Areas (NIA's) showed a general rising trend between the two inspection periods with the exception of area 11/12, which remained equal at 71% (Table 3). Area 2 was the most active rising from 80 - 100%. Areas 7 and 9 showed the least activity during summer with 60 and 61% respectively. Area 7 had a slightly greater increase compared to area 9 during the winter inspection, with 72 and 69% evidence respectively. Comparing data from the late winter/early spring 2016 inspection with data from inspections conducted in spring 2011, spring 2012/autumn 2013 and late winter/early spring 2015 (Figure 2), the proportion of nest box fauna activity in area 2 indicates a general rising trend. NIA's 7, 10 and 11/12 have all seen a decreasing trend for the last three inspection periods. The rising trend previously seen in area 9 has plateaued for 2016.

Table 3. The number and proportion of vertebrates occupying or showing evidence of nest box use during 2016 inspections according to Nest Box Installation Area (NIA).

NIA	No. installed	No. occupied		No. with evidence of use		Proportion with fauna activity (%)	
		Sum	Win	Sum	Win	Sum	Win
2	10	1	2	7	8	80	100
7	25	1	1	14	17	60	72
9	62	6	5	32	38	61	69
10	21	1	1	14	15	71	79
11/12	24	0	1	17	16	71	71
Total (%)	142	9(6%)	10(7%)	84(59%)	94(66%)		

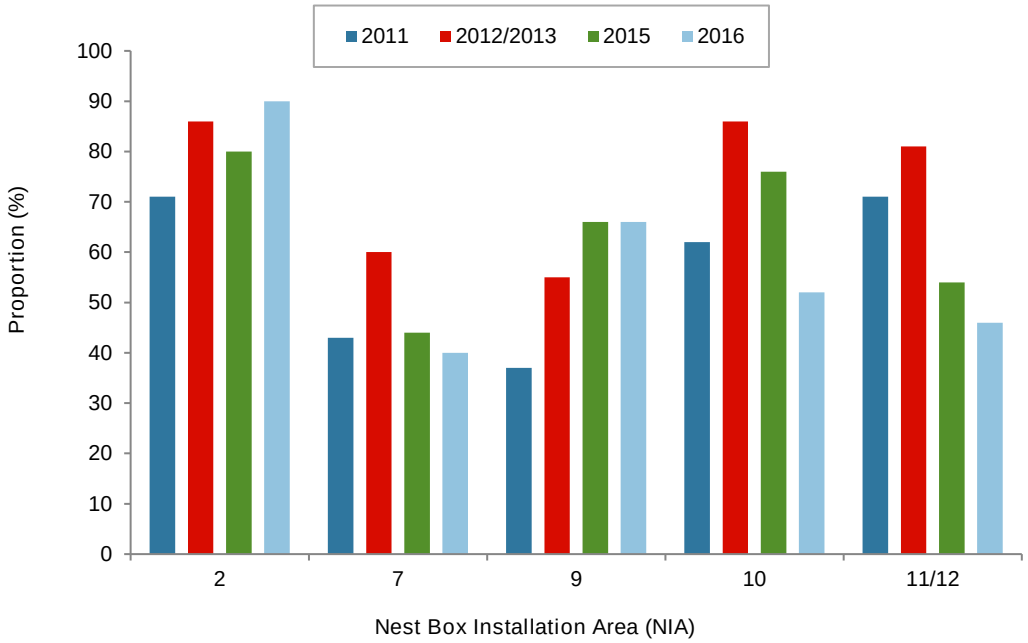

Figure 2: Proportion of nest boxes with fauna activity (i.e. no. boxes occupied + no. showing evidence of use) by Nest Box Installation Area (NIA) across four inspection periods. Spring 2011 and spring 2012/autumn 2013 inspections were conducted during construction phase. Data for 2015 and 2016 are from the late winter/early spring inspection.

3.2 Fauna Displaced During Clearing and Nest Box Use

Twenty-six vertebrate species were recovered from hollows displaced during the clearing phase and a further three species were identified from evidence of distinct nests within hollows (BEM 2013b). Of the 29 species confirmed to be displaced during clearing, 14 (48%) were recorded using nest boxes across the four inspection periods (Table 4). In total, no frog species, 18% (n = 2) of reptile species, 40% (n = 2) of bird species and 80% (n = 8) of mammal species were recorded in nest boxes.

Table 4. Species of vertebrate retrieved from hollows during the clearing phase of the S2W upgrade (BEM 2013b) and species detected in nest boxes across four inspection periods. O = species occupying nest box; E = species identified from evidence in nest box; Likelihood Rating: D = Definite; Pr = Probable; Po = Possible. * = species detected during nest box inspection only.

Scientific Name	Common Name	No. Ind's	Detected in Nest Boxes			
			2011	2012/13	2015	2016
Litoria caerulea	Green tree frog	2				
Litoria peronii	Peron's tree frog	25				
Litoria tyleri	Tyler's tree frog	8				
Eulamprus tenuis	Greater bar-sided skink	12				
Egernia mcpheei	Eastern crevice skink	7			O	
Cyclodomorphus gerrardii	Pink-tongued skink	13				
Oedura robusta	Robust velvet gecko	9				
Saltuarius swaini	Southern leaf-tailed gecko	1				
Physignathus lesueurii	Eastern water dragon	1				
Varanus varius	Lace monitor	4		O	O	
Ramphotyphlops nigrescens	Blackish blind snake	8				
Dendrelaphis punctulata	Green tree snake	18				
Boiga irregularis	Brown tree snake	6				
Morelia spilota	Carpet python	5				
Chenonetta jubata	Australian wood duck	E (Pr)				
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet	2		E (D)		
Trichoglossus haematodus	Rainbow lorikeet	9				
Cacatua roseicapilla	Galah	E (Pr)				
Cormobates leucophaeus	White-thr tree-creeper*				O	
Aegotheles cristatus	Australian owlet-nightjar	2		E (Pr)	O	E (Pr)
Antechinus sp.						O
Antechinus stuartii	Brown antechinus	10	E (Pr)	O	E (Pr)	O
Phascogale tapoatafa	Brush-tailed phascogale*				E (D)	E(D)
Acrobates pygmaeus	Feathertail glider	32	O	E (Pr)	E (D)	E(Pr)
Squirrel/Sugar/Yellow-bellied Glider						E(D)
Petaurus breviceps	Sugar glider	25	O	O	O	O
Petaurus norfolcensis	Squirrel glider	10	O	E (Pr)	E (Po)	O
Trichosurus vulpecula	Common brushtail possum	30	O	O	O	O
Trichosurus caninus	Short-eared b'tail possum	1			O	O
Pseudocheirus peregrinus	Common ringtail possum	E (Pr)	E (Pr)	E (D)	O	
Chalinolobus gouldii	Gould's wattled bat	4			O	
Myotis adversus	Large-footed myotis	50				
Nyctophilus gouldi	Gould’s long-eared bat	1				

3.3 Nest Box Condition

Most boxes remained in good condition although continued deterioration is evident across the survey periods (Figure 3). The number of boxes in good condition dropped from 115 (81%) to 102 (72%) between summer and winter 2016 and evidence of minor and major deterioration decreased from 15% to 4% and increased from 10% to 18% respectively. Minor deterioration was largely attributed to lid detachment and preliminary termite damage whereas major deterioration featured advanced termite damage (Plate 7). The incidence of deterioration was spread across the sites and box designs. In total, 29 boxes require replacement - 25 boxes suffering major deterioration and a further four boxes were missing/stolen.

Figure 3: Relative condition of 142 nest boxes inspected during late summer and late winter 2016. Box condition was scored as either good, minor deterioration or major deterioration.

Plate 7: Box damage/deterioration was largely attributed to detached lids and termite attack as evident in a Possum box (left) and a Yellow-bellied Glider box (right).

4. Discussion

4.1 Use of Nest Boxes

Based on occupation and evidence of use, eight vertebrate species were confirmed using nest boxes along the S2W upgrade during 2016 inspections – owlet nightjar, brown antechinus, brush-tailed phascogale, feathertail glider, common brushtail possum, short-eared brushtail possum, squirrel glider and sugar glider. The brush-tailed phascogale nest appears to be still in use and the species is known to occur from local records (Bionet 2015). Phascogales are also known to readily use nest boxes (Beyer and Goldingay 2006).

Whereas the level of vertebrate species diversity occupying boxes (3 spp. & 4 spp.) was comparable to previous reporting periods (i.e. 2011 = 4 spp.; 2012/13 = 4 spp.; 2015 = 5 spp. & 7 spp.) the rate of occupation (6% & 7%) was lower than previous reporting periods (2011 = 12.9%; 2012/13 = 8.5%; 2015 = 11% & 15%) (BEM 2011, 2013a; Sandpiper 2016). The occupation rate figures are somewhat less than those reported on other highway upgrades at Coopernook (15%), Nabiac (23%) and Branxton (22% & 29%) (Sandpiper 2009, 2013, 2015). However, such differences may be an artefact of the inspection season rather than an indication of lower usage. Coopernook, Nabiac and Branxton inspections all occurred during spring which may be a time of the year when occupation is at its highest. This is supported by the data for overall activity (occupancy + evidence of use) which was greater for the current reporting period (65% & 73%) compared to 2015 (51% & 58%), 2012/13 (64%) and 2011 (51%) and comparable to that reported at Coopernook (50%), Nabiac (72-75%) and Branxton (47-67%) (Sandpiper 2009, 2013, 2015).

4.2 Displaced Fauna Use of Nest Boxes

The stated purpose of the S2W NBMP "… is to maximize the effectiveness of nest boxes in compensating for tree hollows to be removed during the construction phase …" and to "… provide replacement hollows for displaced fauna …" (MCoA 2.9). As such, the success of the nest box program is largely determined by the degree of uptake by displaced species. Of the 29 species confirmed displaced during clearing, 14 (48%) were recorded using nest boxes across the four inspection periods. The highest uptake by a taxa group was mammals, with 80% of displaced species recorded using nest boxes. This figure is somewhat higher if we include the threatened brush-tailed phascogale, a species not detected during clearing, but evident in a kookaburra box in winter 2015 and 2016. The two mammal species recovered during clearing but not recorded across the four inspection periods were Gould's long-eared bat and large-footed myotis. Both species are known to use timber nest boxes though there are few records of large-footed myotis (Goldingay & Stevens 2009; Sandpiper unpub. data). Further, microbats are infrequently recorded in nest boxes associated with highway upgrades (e.g. Sandpiper 2009, 2013, 2015). Indeed, only two microbats were detected across the monitoring periods, both individuals were Gould's wattled bat, which was recorded during the summer 2015 survey. Current knowledge suggests that use of bat boxes is affected by a range of factors including canopy cover, abundance of natural hollows, season, box aspect and box design though it is unclear how these factors interact (Goldingay and Stevens 2009).

Forty percent of displaced species of bird were detected using nest boxes across the four monitoring periods. While the overall rate of uptake by displaced birds is relatively low, infrequent use of nest boxes

by birds has been reported in other nest box programs associated with highway upgrades (e.g. Sandpiper 2013, 2015) and in forest landscapes (e.g. Menkhorst 1984). No bird observations were reported during the 2011 inspection and only two evidence-based observations were made during the 2012/13 inspection. They were attributed to scaly-breasted lorikeets and owlet nightjars (BEM 2011, 2013a). The 2015 reporting period confirmed use by owlet nightjar and white-throated tree-creeper, a species often targeted in nest box programs but rarely detected. Moreover, this species was not retrieved from hollows during the clearing phase. Another two boxes inspected during the 2016 inspections showed evidence of owlet nightjar use. No other boxes displayed evidence of bird use, including the treecreeper nest detected during 2015, which is now covered in a sugar/squirrel glider eucalypt leaf nest. Infrequent use of nest boxes by birds may indicate that adequate hollow resources for these species exist in the local landscape. Indeed, some species may prefer natural hollows to nest boxes and only use nest boxes as temporary roosting sites (Lindenmayer et al. 2009). Temporary use of nest boxes by roosting birds is difficult to detect as signs may not be readily apparent (e.g. guano/faeces) or may be covered by mammal leaf nests. Low use may also be indicative of competitive interactions from other species, which may negatively affect bird usage (see Goldingay and Stevens 2009). For example, individuals or family groups of possums and gliders may utilise several nearby boxes and exclude other species (Menkhorst 1984).

No displaced frog species and 18% of reptile species were recorded in nest boxes across the four monitoring periods. An additional reptile species (Eastern crevice skink) was recorded in a nest box during 2015 but not recovered during clearing. No nest box designs specifically target either hollow-using frogs or reptiles although they have been recorded in a range of nest box designs (e.g. Sandpiper 2013). With the exception of lace monitors, hollow-using frogs and reptiles appear to be infrequent users of nest boxes (e.g. Sandpiper 2009, 2013, 2015). Further, frogs and reptiles do not readily leave signs of use, such as nesting material and are therefore difficult to detect unless present.

Ants were prevalent in 23-29% of boxes across the two inspection periods. Little is known about the potential competitive interactions between ants and native vertebrates although Dobson (2002 cited in Beyer and Goldingay 2006) reported that squirrel gliders were not deterred by the presence of ants and feathertail gliders have been observed in bat boxes containing ants. At S2W, vertebrate fauna were not observed in boxes containing ants but 38% of nest boxes featuring ants in summer showed evidence of recent use by native vertebrates in winter, including sugar/squirrel gliders, feathertail gliders and probably owlet nightjars.

European bees regularly establish hives in nest boxes (Beyer and Goldingay 2006; Lindenmayer *et al.* 2009). Nine abandoned hives were present during both inspections with varying degrees of hive material remaining. A similar pattern of hive establishment and abandonment was evident at Nabiac and along the Hunter Expressway at Branxton (Sandpiper 2009, 2013). Whilst the reasons for hive failure are unclear, it appears that nest box volume is a limiting factor with abandonment more likely for smaller sized boxes (Goldingay et al. 2007; A. Franks, pers. comm.).

4.3 Condition of Nest Boxes

Despite most nest boxes appearing in good condition, continued deterioration is apparent. At the time of the winter inspection, 72% of boxes were in good condition, 10% showed minor deterioration and 18% featured major deterioration or collapse. Minor deterioration was largely attributed to lid detachment and preliminary termite damage whereas major deterioration featured advanced termite damage. No

spatial pattern was evident in the incidence of box deterioration as it was spread across the sites and box designs. In total, 29 boxes require replacement - 25 boxes suffering major deterioration and a further four boxes lost/stolen.

Few studies report on nest box maintenance and attrition. Lindenmayer *et al.* (2009) reported 51% nest box attrition, mostly caused by tree fall or self-detachment, over the course of a 10 year nest box study in Victoria; albeit their screw-attachment method likely made boxes more prone to detachment. Beyer and Goldingay (2006) suggest that most boxes will persist for ~5 years but concede few data exist on how habitat type, designs or materials may affect this.

At S2W, 93% of nest boxes were installed during 2010/11 with the remainder in early 2013. As such, most boxes are 5-6 years old and would be expected to show varying signs of deterioration. A recent inspection of eight year old nest boxes along the highway upgrade at Coopernook recorded 69% of boxes requiring either full replacement or lid replacement (Sandpiper unpub. data). Moist coastal forests of northern NSW present challenging conditions for the persistence of timber ply boxes. The recent development of a Cyplas (recycled plastic) nest box reputed to last up to 30 years is a promising development and worthy of trials (see www.hollowloghomes.com).

5. Conclusion and Recommendations

The S2W nest box program has been utilized by at least 48% of hollow-using vertebrate fauna species displaced during clearing and construction. A further two species, brush-tailed phascogale and white-throated treecreeper, that were not recorded as displaced fauna, were detected using nest boxes in 2015 and 2015/16 respectively.

In addition to confirmed users, it is likely that more species have utilized the nest boxes but do not leave detectable evidence of use. This is particularly the case for frogs, reptiles, and microbats. While rates of occupation are less than at other Pacific Highway upgrade sites, the overall level of fauna activity or use of boxes is comparable. The level of pest activity is very low and self-managing with only a few instances of temporary feral bee incursion. Ant occupation has risen but previous studies suggest this should not interfere with use by vertebrate fauna (e.g. Dobson 2002 cited in Beyer and Goldingay 2006). However, accumulation of ant nesting debris may affect the rate of box decay in some instances.

Box maintenance and repair/replacement was noted in the 2015 monitoring report and requires a management response. The monitoring program is required to extend until year 5 of the operational phase (2019). With the current rate of box deterioration already recorded (i.e. year 2), many boxes will feature major deterioration by 2019. The S2W NBMP (BEM 2010) states that maintenance of damaged nest boxes should be undertaken on site at the time of inspection. We interpret maintenance to include replacement of screws, replacement of hinges and replacement of wire, which we have undertaken during 2015 and 2016 inspections. The plan also states that in the event a nest box requires replacement (presumably beyond maintenance repair), then an alternative nest box should be installed. As such, we recommend:

- Replace all boxes suffering major deterioration (n= 25) and those that are missing/stolen (n = 4); a total of 29 boxes.

- Nest box replacement should occur in summer 2017.
- Replacement boxes should be positioned in either the same tree as the damaged/lost box or an appropriate nearby tree.

6. References

Benchmark Environmental Management (2011). S2W Pacific Highway Upgrade: Nest Box Monitoring Report 2011. Report prepared for LFHJV.

Benchmark Environmental Management (2013a). S2W Pacific Highway Upgrade: Nest Box Monitoring Report 2012/13. Report prepared for LFHJV.

Benchmark Environmental Management (2013b). S2W Pacific Highway Upgrade: Clearing Report. Report prepared for LFHJV.

Benchmark Environmental Management (2014). S2W Pacific Highway Upgrade: Ecological Monitoring Program. Report prepared for NSW Roads and Maritime Services.

Beyer, G. L. & Goldingay, R. L. (2006). The value of nest boxes in the research and management of Australian hollow-using arboreal marsupials. *Wildlife Research:* 33, 161-174.

Goldingay, R., Grimson, M. and Smith, G. (2007). Do feathertail gliders show a preference for nest box design? *Wildlife Research:* 34, 484-90.

Goldingay, R. L. and Stevens, J. (2009). Use of artificial tree hollows by Australian birds and bats. *Wildlife Research:* 36, 81-97.

Lindenmayer, D., Welsh, A., Donnelly, C., Crane, M., Michael, D., Macgregor, C., McBurney, L., Montague-Drake, R. and Gibbons, P. (2009). Are nest boxes a viable alternative source of cavities for hollow-dependent animals? Long-term monitoring of nest box occupancy, pest use and attrition. *Biological Conservation:* 142, 33-42.

Menkhorst, P. A. (1984). The application of nest boxes in research and management of possums and gliders. Pages 517-525 in *Possums and Gliders*, Eds A. Smith and I. Hume, Surrey Beatty and Sons, Chipping Norton.

Sandpiper Ecological Surveys (2009). *Bundacree Creek to Possum Brush Pacific Highway Upgrade: Nest Box Monitoring Report no. 3*. Unpublished report prepared for Bilfinger Berger Services Australia.

Sandpiper Ecological Surveys (2013). *Hunter Expressway Upgrade – Kurri Kurri to Branxton: Nest Box Inspection #4.* Unpublished report prepared for Lend Lease Engineering.

Sandpiper Ecological Surveys (2015). *Pacific Highway Upgrade - Coopernook to Herons Creek: Nest Box Monitoring Year 3.* Unpublished report prepared for Roads and Maritime Services NSW.

Sandpiper Ecological Surveys (2016). *Pacific Highway Upgrade – Sapphire to Woolgoolga: Operational Phase Nest Box Monitoring, Year 1.* Unpublished report prepared for Roads and Maritime Services NSW.

Appendix A – Nest Box Inspection Data

Table A1: Data for summer (18/01/2016 - 21/1/2016) and late winter (31/08/2016 - 2/09/2016) nest box inspections along the S2W Pacific Hwy Upgrade. CBP = common brushtail possum; SeBP = short-eared brushtail possum; BP = brushtail possum sp.; CRP = common ringtail possum; SuG = sugar glider; Sug/SqG = sugar or squirrel glider; FtG = feathertail glider; ONj = owlet nightjar. Pr = probable; Po = Possible

Nest Box Area & No.	Tree sp.	Box Type	2016 Summer			2016 Winter			
			Condition	Fauna	Evidence of use	Condition	Fauna	Evidence of use	Comments/Photo ID
02GBC01		Cockatoo	Good	CBP(m)		Good	CBP x 2		
02SG03		SuG/SqG glider	Good	Nil	Old euc leaf nest (SqG/SuG (Pr))	Good	Nil	Old flattened leaf nest (BP (Po); SqG/SuG(Pr)	
02MB02	*E. pilularis*	Microbat	Good	Nil	Nil	Good	Nil	Leaf nest up to top (FtG(Pr))	
02MB01	*E. pilularis*	Microbat	Good	Nil	Nil	Good	Nil	Nil, spiderweb	
02RO01	*A. costata*	Rosella	Good	Nil	Very old leaf nest	Good	Nil	Very old leaf nest, chewing at entrance	
02SG01	*C. intermedia*	SuG/SqG glider	Good	Nil	Old leaf nest, latrine in corner (A'chinus(Pr)).	Major; lid loose	Br A'chinus x 5 at least	Extensive leaf nest and latrine cnr, up to entrance.	Needs Replacing
02YG01	*E. pilularis*	Possum	Good	Nil	Depressed material (BP(Pr))	Good	Nil	Depressed material (BP(Pr))	
02YG02+		Yellow-bellied glider	Good	Nil	Fresh euc leaves (SqG/SuG/YbG(Pr))	Good	Nil	Fresh euc leaves (SqG/SuG/YbG(Pr))	
02L01	*E. pilularis*	Lorikeet	Minor; lid missing; reattached	Nil	Old leaf material	Good	Nil	Old leaf material	
02L02+		Lorikeet	Minor; hinge loose	Nil	Old euc leaves (SuG/SqG(Pr))	Minor; Lid off - reattached	Nil	Old euc leaves (SuG/SqG(Pr))	
07PP03	*E. siderophloia*	Pygmy-possum	Good	Nil	Old leaf material; ants	Good	Nil	Old leaf material; ants	
07GBC01	*E. acmenoides*	Cockatoo	Good	Nil	Depressed material (BP(Pr))	Good	Nil	Depressed material (BP(Pr))	
07SG02	*E. siderophloia*	SuG/SqG glider	Good	Nil	Old decayed lvs; ants	Good	Nil	Old decayed lvs; ants	
07YG02	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Nil; old mulch; old Euro bee hive	Good	Nil	Nil, old euro beehive, ants	
07ON01	*C.variegata*	Owlet nightjar	Good	Nil	Few old lvs; composting mulch	Good	Nil	Few old leaf; ants	
07 GBC02	*E. microcorys*	Cockatoo	Good	Nil	Few lvs; depressed material (BP(Pr))	Good	Nil	Few lvs; depressed material (BP(Pr))	
07SG04	*E. siderophloia*	SuG/SqG glider	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
07Br 01	*E. microcorys*	Possum	Minor; lid missing; reattached	Nil	Scattered/depressed lvs/bark (BP(Pr))	Major; Rotten	Nil	Scattered/depressed lvs/bark (BP(Pr))	Needs Replacing
07L01	*E. microcorys*	Lorikeet	Minor: termite damage	Nil	Ver old leaf material	Minor: termite damage	Nil	Old euc leaves (SuG/SqG(Pr))	

07PP02		Pygmy-possum	Good	Br A'chinus amongst old euc leaves		Major; Rotten	Nil	Old euc leaves; Br A'chinus obsv. in summer	Needs Replacing
07SG03	*E. microcorys*	SuG/SqG glider	Good	Nil	Ants	Major; Rotten, on ground	Nil	Old nesting material	Needs Replacing
07K01	*E. propinqua*	Kookaburra	Good	Nil	Nil;	Good	Nil	Depressed material (BP(Pr))	
07R01	*E. propinqua*	Rosella	Good	Nil	Entry chewed; nil	Good	Nil	Entry chewed; nil	
07MB01	*E. propinqua*	Microbat	Minor; lid missing; reattached	Nil	Nil	Good	Nil	Extensive chewing, galahs (Pr)	
07MB02	*E. propinqua*	Microbat	Good	Nil	Euc leaves (FtG(Pr))	Good	Nil	Old euc leaves (FtG(Pr))	
07PP01		Pygmy-possum	Good	Nil	Nil; ants	Good	Nil	Nil	
07RP01	*C. intermedia*	Possum	Good	Nil	Few lvs; depressed material (BP(Pr))	Good	SeBP x 1	Few lvs; depressed material (BP(Pr))	
07YG01	*E. microcorys*	Yellow-bellied glider	MinLD, loose	Nil	Old leaf material; old Euro bee hive	Major; Lid off - reattached. Lid was rotting	Nil	Old leaf material; old Euro bee hive	Needs Replacing
07R02	*E. siderophloia*	Rosella	Good	Nil	Entry chewed; very old euc leaf nest (SqG/Sug(Pr))	Good	Nil	Entry chewed; very old euc leaf nest (SqG/Sug(Pr))	
07SG01	*C.variegata*	SuG/SqG glider	Good	Nil	Ants; Decaying leaves	Good	Nil	Ants; Decaying leaves	
07YG03	*E. microcorys*	Yellow-bellied glider	Good	Nil	Old scattered leaves (ONj (Pr))	Good	Nil	Old scattered leaves (ONj (Pr)); Old euc leaves (SuG/SqG(Po))	
07SG05	*S. glomulifera*	SuG/SqG glider	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
07BP01	*E. acmenoides*	Phascogale	Good	Nil	Nil; ants	Minor; Lid off - reattached	Nil	Nil; ants	
07BP02	*E. acmenoides*	Phascogale	Minor; lid missing; reattached	Nil	Nil	Good	Nil	Nil	
07ON02	*E. grandis*	Owlet nightjar	Good	Nil	Ants. Decaying leaf material	Good	Nil	Ants. Decaying leaf material	
09L01	*E. propinqua*	Lorikeet	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09MB06	*E. microcorys*	Microbat	Good	Nil	Nil;	Good	Nil	Nil	
09MB07	*E. microcorys*	Microbat	Good	Nil	Nil;	Good	Nil	Nil	
09MB09	*L. confertus*	Microbat	Good	Nil	Nil	Good	Nil	Nil	
09YG05	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Entry chewed; old euc leaf nest (SqG/SuG/YbG(Pr))	Good	Nil	Entry chewed; old euc leaf nest (SqG/SuG/YbG(Pr))	

09Br04	*E. siderophloia*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Depressed & spread material (BP(Pr))	
09ON04	*E. globoidea*	Owlet nightjar	Good	Nil	Old euc lvs (SuG/SqG (Pr))	Good	Nil	Old euc lvs (SuG/SqG (Pr)); ants	
09PP04	*E. microcorys*	Pygmy-possum	Good	Nil	Entry chewed; mod old euc leaf nest (SuG (Pr))	Good	SuG x 3 at least		
09K03	*E. siderophloia*	Kookaburra	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Depressed & spread material (BP(Pr))	
09MB08	*E. acmenoides*	Microbat	Good	Nil	Nil; ants	Good	Nil	Nil	
09Br05	*E. acmenoides*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Depressed & spread material (BP(Pr))	
09SG06	*E. acmenoides*	SuG/SqG glider	Good	Nil	Nil; ants	Good	Nil	Extensive euc leaf nest (SqG/Sug (Pr))	
09SG08	*E. siderophloia*	SuG/SqG glider	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09BR06	*E. microcorys*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Major; Lid off and rotten	Nil	Old depressed & spread material (BP(Pr))	Needs Replacing
09ON03	*C.variegata*	Owlet nightjar	Good	Nil	Old euc leaf nest (SqG/Sug (Pr))	Good	Nil	Old euc leaf nest (SqG/Sug (Pr)); ants	
09YG06	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09SG07	*E. microcorys*	SuG/SqG glider	Good	Nil	Fresh euc leaf nest (SqG/Sug (Pr))	Good	Nil	Old euc leaf nest (SqG/Sug (Pr))Antechinus nest - latrine cnr	
09MB01	*C.variegata*	Microbat	Major: termite damage/collapse	Nil	Nil	Major; Completely rotten	Nil	Nil	Needs Replacing
09MB02	*C. intermedia*	Microbat	Good	Nil	Nil; ants	Major; Extensive termite damage	Nil	Nil	Needs Replacing
09GBC01		Cockatoo	Good	Nil	Depressed & spread material (BP(Pr))	Good	CBP x 1	Depressed & spread material (BP(Pr))	Animal looks injured
09MB03	*E. microcorys*	Microbat	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09RP01	*E. microcorys*	Possum	Major: termite damage, lid loose; replace box	Nil	Depressed & spread lvs (BP (Pr)); old bee hive	Major; Completely rotten	Nil	Depressed & spread lvs (BP (Pr)); old bee hive	Needs Replacing
09MB04	*E. microcorys*	Microbat	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09ON01		Owlet nightjar	Good	Nil	Old euc leaf nest (SqG/Sug (Pr))	Good	Nil	Old euc leaf nest (SqG/Sug (Pr))	

09SG01		SuG/SqG glider	Good	Nil	Old euc leaf nest (SqG/Sug (Pr))	Good	A'chinus sp x 3	Old euc leaf nest (SqG/Sug (Pr)); Extensive A'chinus nest	
09ON02	*C.variegata*	Owlet nightjar	Good	Nil	Old t'creeper nest material	Good	Nil	Old tree creeper nest and scattered fresh leaf on top; ants	
09BP01	*E. siderophloia*	Phascogale	Good	Nil	V old euc leaf nest (SqG/Sug (Pr))	Good	Nil	V old euc leaf nest (SqG/Sug (Pr)); ants	
09GG01	*E. acmenoides*	Greater Glider	Good	Nil	Nil	Good	BP sp.x 1		
09R01	*C.variegata*	Rosella	Minor termite damage	Nil	Depressed & spread material (BP(Pr))	Major; Termite damage	Nil	Chew marks; Depressed & spread material (BP(Pr))	Needs Replacing
09PP03		Pygmy-possum	Good	Nil	Old leaf nest (FtG (pr))	Good	Nil	Old leaf nest (FtG (pr))	Top of tree (canopy) has snapped off trunk.
09K02	*E. propinqua*	Kookaburra	Good	CBP(m)		Good	Nil	Very smooth, wear (BP(Pr)	
09YG04	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Ants; Decaying lvs/material	Good	Nil	Very old leaf, chewing at entrance; ants	
09SG04	*C. intermedia*	SuG/SqG glider	Good	Nil	V old euc leaf nest (SqG/Sug (Pr)); ants	Good	Nil	V old euc leaf nest (SqG/Sug (Pr)); ants	
09YG02	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Decaying box mulch	Good	Nil	Relatively fresh nest (SqG/SuG(Pr))	
09BP03	*E. siderophloia*	Phascogale	Good	SqG x2; (absent on 20/1/16)		Good	Nil	Old euc leaf nest (SqG/Sug (Pr))	
09Br03	*E. siderophloia*	Possum	Good	CBP		Good	Nil	Wear, flattened old nest (BP(Pr)	
09GBC02	*E. siderophloia*	Cockatoo	Good	CBP		Major; Lid missing, rotten	Nil	Nil	Needs Replacing
09BP02	*E. microcorys*	Phascogale	Minor lid deterioration	Nil	Old euc lvs; SuG/SqG (Pr)	Minor lid deterioration	Nil	Fresh euc lvs; SuG/SqG (Pr)	
09YG01	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Nil; ants	Good	Nil	Fresh euc lvs; SuG/SqG (Pr)	
09SG02		SuG/SqG glider	Good	Nil	Old euc lvs; SuG/SqG (Pr)	Minor; Lid loose	Nil	Old euc lvs; SuG/SqG (Pr); ants	
09CO01	*E. siderophloia*	Corella	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09MB05	*E. microcorys*	Microbat	Good	Nil	Nil;	Major; Severe termite damage	Nil	Nil	Needs Replacing

09SG03	*E. siderophloia*	SuG/SqG glider	Good	Nil	Old leaf nest; latrine in corner (A'chinus(Pr)).	Good	Nil	Fresh euc lvs; SuG/SqG (Pr); Previous - latrine in corner (A'chinus(Pr)).	
09Br01	*E. microcorys*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Major; Lid rotten and off	Nil	Old depressed & spread material (BP(Pr))	Needs Replacing
09K01	*E. propinqua*	Kookaburra	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Old depressed & spread material (BP(Pr)); ants	
09SG05	*E. microcorys*	SuG/SqG glider	Good	SqG x3		Good	SqG/SuG x 1		
09PP02		Pygmy-possum	Major: termite damage; replace box	Nil	Nil; ants	Major; Severe termite damage	Nil	Nil; ants	Needs replacing
09Br02	*E. siderophloia*	Possum	Good	CBP		Good	Nil	Old flattened BP nest (Pr)	
09GG02	*E. siderophloia*	Greater Glider	Minor: termite damage	Nil	Nil	Minor: termite damage	Nil	Nil; old ant material	
09PP01	*E. microcorys*	Pygmy-possum	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
09YG03	*C. intermedia*	Yellow-bellied glider	Good	Nil	Few lvs (ONj -po); ants	Good	Nil	Few lvs (ONj (Po)); Old euc lvs; SuG/SqG (Po); ants	
10K01	*E. pilularis*	Kookaburra	Good	Nil	Old Shredded bark, scats at edge (Phascogale (Pr)); ants	Major; Rotten, lid loose	Nil	Old Shredded bark, scats at edge (Phascogale (Pr))	Needs Replacing
10YG03	*E. pilularis*	Yellow-bellied glider	Good	Nil	Old euc leaves (SqG/SuG/YbG(Pr))	Major; Complete termite damage	Nil	Old euc leaves (SqG/SuG/YbG(Pr))	Needs Replacing
10ON01	*E. pilularis*	Owlet nightjar	Good	Nil	Old leaf material. Ants	Good	Nil	Old leaf material. Ants	
10GG01	*E. microcorys*	Greater Glider	Good	Nil	Old decaying leaf material. Old Europ bee hive	Good	Nil	Old depressed & spread material (BP(Pr)); Old Europ bee hive	Very tight on tree - loosen wire.
10SG03	*E. resinifera*	SuG/SqG glider	**Missing**	Nil	**NA**	**Missing**		**NA**	**Needs Replacing**
10RP02	*E. resinifera*	Possum	**Missing**	Nil	**NA**	**Missing**		**NA**	**Needs Replacing**
10GBC02	*E. resinifera*	Cockatoo	Major rotting box/lid-replace box	Nil	Nil	Major; Rotten completely	Nil	Nil	Needs Replacing
10MB01	*C. intermedia*	Microbat	Good	Nil	Nil	Good	Nil	Nil; ants	

10RP01	*C. intermedia*	Possum	Good	CBP		Good	Nil	Depressed & spread material (BP(Pr))	
10YG01	*C. intermedia*	Yellow-bellied glider	Good	Nil	Old euc lvs (SuG/SqG (Pr))	Good	Nil	Very old euc lvs (SuG/SqG (Pr))	
10SG01	*E. pilularis*	SuG/SqG glider	Good	Nil	Old leaf nest & latrine in corner (A'chinus(Pr))	Good	Nil	Old leaf nest (Petaurid sp.(Po)); latrine in corner (A'chinus(Pr))	
10SG02	*E. resinifera*	SuG/SqG glider	Minor: termite damage	Nil	Very old leaf material	Major; Severe termite damage	Nil	Very old leaf material	Needs Replacing
10Br02	*E. siderophloia*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Good	BP sp.x 2	Depressed & spread material (BP(Pr))	
10PP01	*E. siderophloia*	Pygmy-possum	Good	Nil	Old leaf material, ants. Entry chew; Sug(Pr)	Minor; Lid off - reattached	Nil	Old leaf material, Entry chew; Sug(Pr); ants	
10BP01	*E. resinifera*	Phascogale	Minor: lid off; reattached	Nil	Old flat leaves (ONj (Pr))	Good	Nil	Very Old flat leaves (ONj (Pr))	
10GBC01	*E. resinifera*	Cockatoo	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Depressed & spread material (BP(Pr))	
10SG04	*E. resinifera*	SuG/SqG glider	Minor termite damage	Nil	Old euc lvs (SuG/SqG (Pr))	Major; Termite damage	Nil	Old euc lvs; SuG/SqG pr	Needs Replacing
10CO01	*E. tereticornis*	Corella	Good	Nil	Old depressed & spread material (BP(Pr))	Good	Nil	Old depressed & spread material (BP(Pr))	
10Br01	*C. intermedia*	Possum	Minor: lid off; reattached.	Nil	Depressed & spread material (BP(Pr))	Minor; Lid loose but functional	Nil	Old depressed & spread material (BP(Pr))	
10YG02	*C. intermedia*	Yellow-bellied glider	Good	Nil	Entry chewed; old Euro bee hive	Good	Nil	Entry chewed; old Euro bee hive	
10MB02	*L. suaveolens*	Microbat	Good	Nil	Nil	Good	Nil	Nil	
12PP01	*C. intermedia*	Pygmy-possum	Good	Nil	Few old lvs A'chinus (Pr); ants	Good	Nil	Very old leaf nest A'chinus (Pr); ants	
12BR01	*Cas. glauca*	Possum	Minor: lid deterioration	Nil	V Old decayed lvs, ants	Minor: lid deterioration	Nil	V Old decayed lvs	
12BP01	*E. resinifera*	Phascogale	Good	Nil	V Old leaf material, ants	Major; Severe termite damage	Nil	V Old leaf material	Needs Replacing
12YG01	*C. intermedia*	Yellow-bellied glider	Good	Nil	Old euc lvs (SuG/SqG (Pr))	**Missing**		**NA**	**Needs replacing**

12ON01	*C. intermedia*	Owlet nightjar	Good	Nil	old euc lvs; latrine in cnr (A'chinus (Pr))	Good	Nil	old euc lvs; latrine in cnr (A'chinus (Pr))	
12MB01	*C. intermedia*	Microbat	Major termite damage; Replace box	Nil	Nil	Major; Completely disintegrated	Nil	Nil	Needs Replacing
12SG01	*M. quinquenervia*	SuG/SqG glider	Good	Nil	old euc leaves (SqG/Sug (Pr)); Ants	Good	Nil	Vewry old euc leaves (SqG/Sug (Pr)); Ants	
12GBC01		Cockatoo	Major termite damage; Replace box	Nil	Nil	Major; Severe termite damage	Nil	Nil	Needs Replacing
12SG04	*C. intermedia*	SuG/SqG glider	Good	Nil	Very Old decayed lvs/debris; ants	Good	Nil	Very Old decayed lvs/debris	
12SG05	*E. resinifera*	SuG/SqG glider	Minor: termite damage	Nil	Very old leaf nest	Major; Severe termite damage	Nil	Very old leaf nest	Needs Replacing
12YG02	*E. resinifera*	Yellow-bellied glider	Minor lid deterioration	Nil	Very Old decayed material; ants	Minor lid deterioration	Nil	Very Old decayed material; ants	
12RP01	*E. robusta*	Possum	Good	Nil	Nil	Good	Nil	Nil	
12SG06	*C. intermedia*	SuG/SqG glider	Good	Nil	Old euc lvs (A chinus(Pr)); old Euro bee hive	Good	Nil	Old euc lvs (A chinus(Pr)); old Euro bee hive	
12YG03a	*C. intermedia*	Yellow-bellied glider	Good (upper box)	Nil	Old euc leaves & old Europ bee hive	Good	Nil	Old euc leaves & old Europ bee hive	
12MB04	*C. intermedia*	Microbat	Good	Nil	Nil	Good	Nil	Nil	
12MB03	*L. suaveolens*	Microbat	Good	Nil	Nil	Good	Nil	Nil; ants	
12BP02	*C. intermedia*	Phascogale	Good	Nil	Very old leaf nest; Euro bee hive	Good	SuG x 3	Very old leaf nest; Euro bee hive	
12ON02	*E. resinifera*	Owlet nightjar	Good	Nil	Old decayed lvs; ants	Good	Nil	Old decayed lvs; ants	
12MB02	*L. suaveolens*	Microbat	Good	Nil	Nil	Good	Nil	Nil; ants	
12SG02	*M. quinquenervia*	SuG/SqG glider	Minor box deterioration	Nil	Few old lvs	Minor box deterioration	Nil	Very old leaf nest	
12SG03	*M. quinquenervia*	SuG/SqG glider	Good	Nil	Brown A'chinus nest (Pr); old Euro bee hive	Good	**Nil**	Fresh euc lvs; SuG/SqG (Pr); Brown A'chinus nest (Pr); old Euro bee hive	
12MB01b (GGbox not Mb)	*C. intermedia*	Greater Glider	Minor; Lid loose; reattached	Nil	Old decayed lvs	Good	Nil	Old decayed lvs	
12GG01	*E. resinifera*	Greater Glider	Good	Nil	Depressed & spread material (BP(Pr))	Major; Severe rot in lid	Nil	Depressed & spread material (BP(Pr))	Needs Replacing

12GBC01b	*C. intermedia*	Cockatoo	Minor: termite damage	Nil	Nil	Major; Severe termite damage	Nil	Nil	Needs Replacing
35GBC01	*C. intermedia*	Cockatoo	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Depressed & spread material (BP(Pr)); ants	
35ON01	*E. acmenoides*	Owlet nightjar	Minor; termite damage; spout ungluing	Nil	Euc leaf nest (SqG/Sug (Pr))	Minor; termite damage; spout ungluing	Nil	Old euc leaf nest (SqG/Sug (Pr))	
35YG01	*E. siderophloia*	Yellow-bellied glider	Good	Nil	Old leaf nest & latrine in corner (A'chinus (Pr))	Good	Nil	Old euc leaf nest (SqG/Sug (Po)); (A'chinus (Pr))	
35BP01	*E. siderophloia*	Phascogale	Good	Nil	Nil; ants	Good	Nil	Nil; ants	
35MB01	*C.variegata*	Microbat	Good	Nil	Nil	Good	Nil	Nil	
35L01	*E. propinqua*	Lorikeet	Good	Nil	Nil; ants	Major; Deterioated, rotting	Nil	Nil	Needs Replacing
35BR03	*C. intermedia*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Minor; Good, evidence of water inundation	Nil	Depressed & spread material (BP(Pr))	
35SG01	*E. microcorys*	SuG/SqG glider	Good	Nil	Old euc lvs; (SuG/SqG-pr); ants	Good	Nil	Old euc lvs; (SuG/SqG-pr); ants	
35BR02	*E. microcorys*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Good	Nil	Chewing around entrance; Depressed & spread material (BP(Pr)); ants	
35BR01	*E. microcorys*	Possum	Good	Nil	Depressed & spread material (BP(Pr))	Minor; Good, evidence of water inundation.	Nil	Old depressed & spread material (BP(Pr)); ants	
35PP01	*E. globoidea*	Pygmy-possum	Good	Nil	Nil; ants	Good	Nil	Nil; ants	