



Transport
**Roads & Maritime
Services**

Warrell Creek to Nambucca Heads

Interim Underpass Monitoring Report – spring /
summer - year one operational phase

Roads and Maritime Services | February 2019



Document Review

Date	Version	Status	Sent to	Represent	Delivered Format	Dispatched By
28/2/19	A	Draft	B. Taylor	Sandpiper	MSW	D. Rohweder
1/3/19	1	Draft	S. Hardiman	RMS	MSW	D. Rohweder

Document Distribution

Date	Version	Status	Sent to	Represent	Delivered Format	Dispatched By
4/3/2019	2	Final	S. Hardiman	RMS	MSW & PDF	D. Rohweder

Project team:

David Rohweder (Project management, field survey, reporting)
Nick Priest (Field survey, reporting)
Luke Andrews (Field survey)
Nirvarna Makings (Field survey)
Oska Taylor (Field survey)
Brendan Taylor (Review)

Report prepared for:

Roads and Maritime Services NSW

© Sandpiper Ecological Surveys 2019
ABN: 82 084 096 828

PO Box 401
ALSTONVILLE NSW 2477
P 02 6628 3559 | E david@sandpipereco.com.au

Cover Photo: NA.

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 Pacific Complete. The report relies upon data, surveys and measurement obtained at the times and locations specified herein. The report has been prepared solely for Pacific Complete 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

1. Introduction	1
1.1 Background	1
1.2 Study area	2
2. Methods	2
2.1 Timing and weather conditions	2
2.2 Underpasses	4
2.2.1 Sand pads.....	4
2.2.2 Scat and track search	5
2.2.3 Cameras	5
2.3 Adjacent habitat	6
2.3.1 Survey design	6
2.3.2 Trapping.....	6
2.3.3 Diurnal active search.....	7
2.3.4 Nocturnal active search.....	7
2.3.5 Opportunistic records	7
3. Results	8
3.1 Underpasses	8
3.1.1 Sand pads.....	8
3.1.2 Scat and track	8
3.1.3 Cameras	9
3.2 Adjacent habitat	13
3.3 Species recorded in underpasses and adjacent habitat	15
4. Key findings	17
5. Recommendations	18
6. References	18
Appendix A – Species list	20
Appendix B – Field Data	22

List of tables

Table 1: Underpasses sampled during operational phase monitoring of the WC2NH upgrade. SQ = spotted-tailed quoll; K = koala; GBF = giant barred frog; * sites consists of dual cell 3x3m box culverts with one cell providing wet passage for aquatic fauna; P/A = presence/absence 1

Table 2: Summary of weather conditions recorded at the northern compound between 20 October and 20 December 2018. 2

Table 3: Survey effort for sampling adjacent habitat at 10 underpass sites on the WC2NH upgrade. 7

Table 4: Species and groups of fauna recorded during sand pad monitoring at 12 underpasses on the WC2NH upgrade. * possible record only..... 8

Table 5: Species and fauna groups recorded during track and scat surveys of 12 underpasses on the WC2NH upgrade. 9

Table 6: Species and groups of fauna recorded by infra-red cameras at 12 underpasses on the WC2NH upgrade. C = complete crossing; IC = incomplete crossing; ^l = introduced species. 10

Table 7: Number of species and groups of fauna recorded and complete and incomplete crossings recorded at each of 12 underpasses monitored on the WC2NH upgrade..... 11

Table 8: Number of complete crossings made by each species/group at each of 12 underpasses monitored on the WC2NH upgrade. NB – Sites 1 and 5 did not contain fauna furniture. ^l = introduced species 12

Table 9: Species of vertebrate recorded during surveys of habitat adjoining each side of all underpasses. ^v = vulnerable species; ^E = Endangered species; ^l = Introduced species.. 14

Table 10: Species and fauna groups recorded using underpasses by all methods and those recorded in adjacent habitat. Shading denotes a species or group not confirmed in both areas that is likely to be represented in another species/group that was recorded in both areas, for example northern brown bandicoot is likely represented by Peramelidae spp. 16

List of figures

Figure 1: Location of underpass sample sites in relation to the WC2NH alignment. 3

Figure 2: Comparison of the number of complete crossings by native and introduced species recorded at each underpass..... 11

Figure 3: Complete crossings by all species on underpass floor and fauna furniture..... 13

List of plates

Plate 1: Sand pad being installed in a fauna underpass on the WC2NH upgrade.	4
Plate 2: Example of a pitfall trap line installed during adjacent habitat surveys.....	6
Plate 3: Koala recorded at Site 12, moving east on 22 October (left) and west of 23 October (right).	12
Plate 4: <i>Melomys</i> spp. (left) and brown antechinus (right) captured in adjacent habitat during spring 2018 monitoring.....	15

1. Introduction

In 2015, Roads and Maritime Services (RMS) NSW, in conjunction with Acciona Ferrovia Joint Venture (AFJV), commenced the upgrade of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH). The WC2NH project was opened to traffic in two stages:

- stage 2a - 13.5km section from Lower Warrell Creek Bridge to Nambucca Heads opened on 18 December 2017; and
- stage 2b - 6.25km section from the southern end of the project to the Lower Warrell Creek bridge opened on 29 June 2018.

Approvals for the WC2NH upgrade required monitoring of several species and mitigation measures during the operational phase. Species and mitigation measures targeted include koala, spotted tailed quoll, grey-headed flying-foxes, yellow-bellied glider, giant barred frog, green-thighed frog ponds, fauna underpasses, vegetated median, roadkill, exclusion fencing, and threatened flora. Sandpiper Ecological Surveys (SES) was contracted by RMS to deliver the WC2NH operational ecological and water quality monitoring program.

The objective of fauna underpass monitoring is “to assess use of underpasses by threatened and common fauna and to assess the effect of exclusion fencing on movement of small mammals, reptiles and frogs” (RMS 2018). Exclusion fence monitoring occurs annually in winter and is not reported on here.

The following interim report presents and methods and results of the spring / summer 2018 underpass and adjacent habitat surveys. The second round of monitoring in year one is scheduled for winter 2019. Due to its interim status this report does not include detailed analysis of data and results are presented as counts rather than crossings/unit of time. A detailed annual report will be prepared following the winter monitoring event. The discussion is also limited to a summary of key findings and recommendations that will be implemented in the second year one sample. A list of species names for fauna referred to in text and Tables is provided in Appendix A.

1.1 Background

The WC2NH upgrade features 23 fauna underpasses, including 13 sites with box culverts, three sites with pipe culverts and seven sites with bridges. Underpasses targeted for monitoring were specified in the WC2NH Ecological Monitoring Program (EMP; Table 1) and include eleven box culverts and one bridge. Site five includes a dual cell box culvert with one cell designated as a wet passage (for aquatic fauna) and the other as a dry cell. The dry cell includes a concrete ledge that provides dry passage for terrestrial fauna. Fauna underpasses were designed to target spotted-tailed quoll (*Dasyurus maculatus*), koala (*Phascolarctos cinereus*) and giant barred frog (*Mixophyes iteratus*). Sites 9/10, and 11/12 consist of corresponding culverts on either side of the vegetated median.

Table 1: Underpasses sampled during operational phase monitoring of the WC2NH upgrade. SQ = spotted-tailed quoll; K = koala; GBF = giant barred frog; * sites consists of dual cell 3x3m box culverts with one cell providing wet passage for aquatic fauna; P/A = presence/absence

Site	Chainage	Type	Structure	Dimensions	Fauna Furniture (P/A)	Substrate	SQ	K	GBF
1	42500	Combined	Bridge over Upper Warrell Ck		A	Soil			x
2	55120	Dedicated	Box Culvert	1 x 3000 x 3000	P	Concrete	x	x	
3	56410	Combined	Box Culvert	1 x 2400 x 2400	P	Concrete	x	x	
4	57770	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
5	58510	Combined	Box Culvert	2 x 3000 x 3000*	A	Concrete	x	x	

Site	Chainage	Type	Structure	Dimensions	Fauna Furniture (P/A)	Substrate	SQ	K	GBF
6	58560	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
7	59090	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
8	59550	Dedicated	Box Culvert	1 x 3000 x 3000	P	Mulch	x	x	
9	59750 NB Lanes	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
10	59760 SB Lanes	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
11	60600 NB Lanes	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	
12	60610 SB Lanes	Dedicated	Box Culvert	1 x 2400 x 2400	P	Mulch	x	x	

1.2 Study area

The WC2NH project covers a total length of 19.75km and extends from Warrell Creek in the south to Nambucca Heads in the north (Figure 1). The alignment bypasses the town of Macksville and the northern section traverses Nambucca State Forest. Eleven underpasses are situated north of the Nambucca River and one (Site 1) is situated at Upper Warrell Creek near the southern extent of the project. Sites four to 12 adjoin Nambucca State Forest and sites two and three adjoin remnant vegetation on private land.

2. Methods

2.1 Timing and weather conditions

Spring / summer year one operational phase underpass monitoring was conducted between 15 October and 17 December 2018. Weather conditions over the sample period were characterised by warm humid conditions with small amounts of rain (10-30mm) occurring at regular intervals (Table 2). Rain events of 20-30mm created moist conditions in underpasses conducive to movements by amphibians. Daily weather conditions recorded at the northern compound are presented in Table B1, Appendix B.

Table 2: Summary of weather conditions recorded at the northern compound of the project site between 20 October and 20 December 2018.

Total rainfall	No. rain days	Max wind gusts	Relative Humidity	Max temp range (°C)	Min temp range (°C)
223mm	19	13-50kph	>70% on 90% of days	22.2-33.9	9.4-22.9

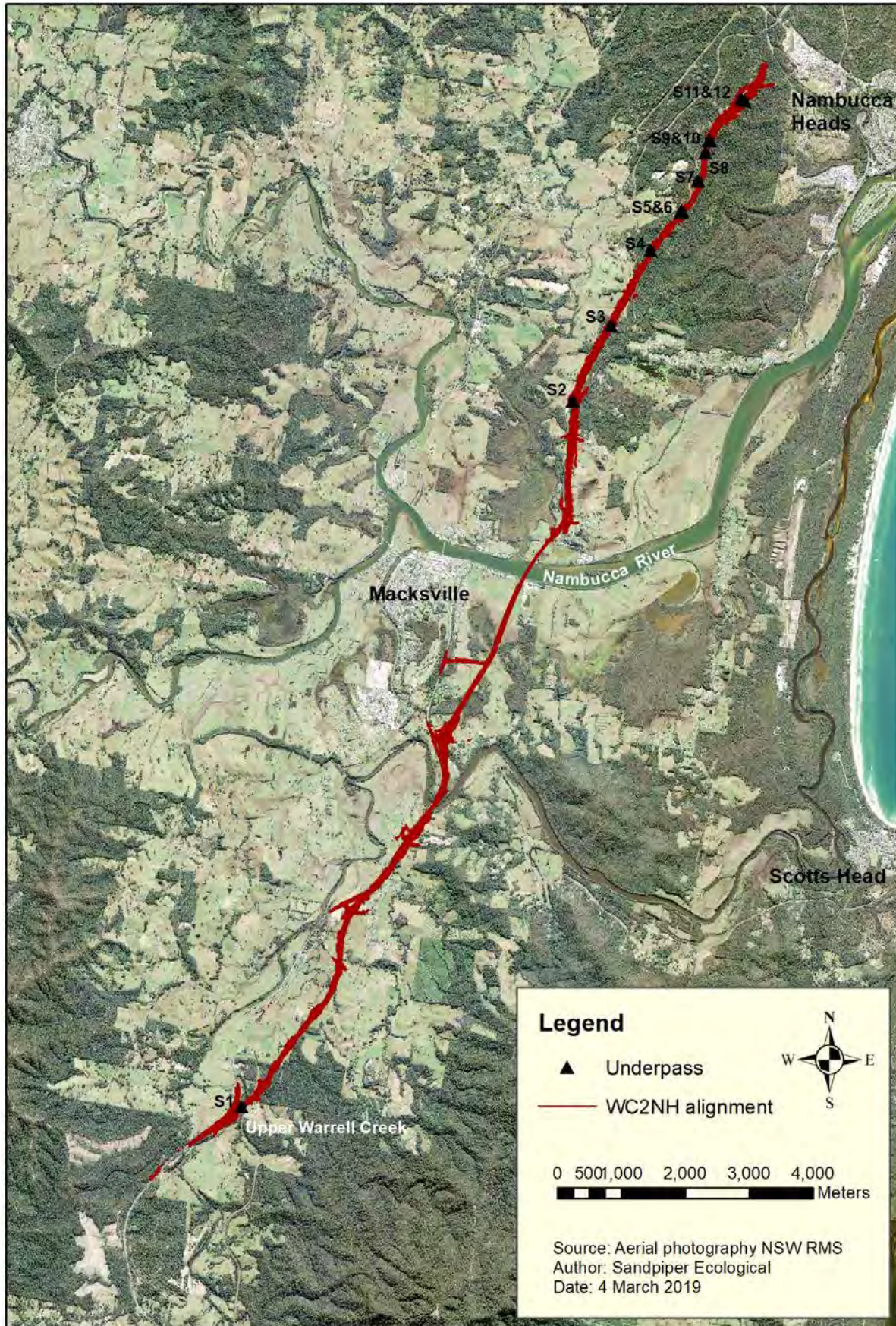


Figure 1: Location of underpass sample sites in relation to the WC2NH alignment.

2.2 Underpasses

2.2.1 Sand pads

Sand pads were installed on 30 October 2018 (sites 2-12) and 14 November 2018 (site 1). A 50:50 mix of brickies sand and washed beach sand was used. Two sand pads were installed at each site. In culverts, pads were installed 3-5m from each end, whilst at the bridge (Site 1) one pad was installed on each side of Warrell creek. Each pad was approximately 50mm deep by 1m wide and extended for the entire culvert width, or for 3m at Site 1. At sites with a concrete ledge the pad covered both the floor and ledge (Plate 1). The exception was site 5 where the pad only covered the ledge due to standing water over the culvert floor.

Sand pads were inspected on eight consecutive days, 31 October to 7 November at Sites 2-12 and 15-22 November at Site 1. Inspections were conducted by an ecologist and included a systematic scan of each pad searching for fauna tracks. A Small torch was used to illuminate the pad, if required. Information recorded included species or fauna group, number of traverses, direction of traverse and pad condition (Good, moderate, poor). Pad condition focussed on suitability of the pad for capturing good quality animal tracks. Tracks were identified with reference to Triggs (2004) and advice from senior ecologists. Tracks that could not be identified insitu were photographed and referred to a senior ecologist for identification.



Plate 1: Sand pad being installed in a fauna underpass on the WC2NH upgrade.

2.2.2 Scat and track search

Each underpass was searched by a senior ecologist for scats and tracks on two occasions during the sample period. Sites 2-12 were sampled on 17 and 31 October and Site 1 was sampled on 26 October and 8 November. The search involved a slow systematic traverse of each culvert using a hand-held spotlight (Led Lenser P14). Fauna furniture, the culvert floor, and joints were targeted. Areas of accumulated fine sediment were targeted for tracks. Tracks and scats were identified in-situ, with reference to Triggs (2004) and the ecologists' experience, or photographed and sent to colleagues for identification.

2.2.3 Cameras

Two motion activated infra-red cameras were installed centrally in each underpass except at Site one where a single camera, fixed to a star picket, was installed on each side of Warrell Creek, and Site 5 where one camera was installed centrally in each cell. In total, 24 cameras were installed. Swift Enduro cameras were used at sites 2-12 and Reconyx HC500 cameras were used at Site 1. In underpasses, both cameras were installed centrally, one on the fauna furniture, and one 300mm above the culvert floor. All cameras were oriented to the east. Swift cameras were set to take 10 seconds of video with no delay between activation. Cameras at site 1 were positioned at approximately 1m above ground level and oriented towards ground vegetation near the creek bank. Reconyx cameras were set on time-lapse mode to take a picture at 1-minute intervals between 8pm and 6am each day throughout the monitoring period. Time-lapse mode is better suited to targeting frogs and was used successfully to monitor frog pipes at Sapphire to Woolgoolga Upgrade (Sandpiper Ecological 2017a, 2018a).

Cameras were installed between 16 and 24 October and checked on 21 and 22 November. Images were downloaded and batteries replaced, if capacity was below 50%. Cameras were retrieved on 17 December 2018. Three cameras were damaged and one stolen on 14 December 2018. All damaged and stolen cameras were at Sites 9 and 10. SD cards in the three damaged cameras were readable and data were lost from the fauna furniture camera at Site 9 only.

Each underpass cameras was deployed for a minimum of 60 days. A total of 1339 recording days was recorded across all sites (Table B2, Appendix B). Nine of the 24 cameras were active for less than the 60 day minimum sample period, although two of these cameras, both at Site 5, were active for 58 days each. Of the remaining cameras four were positioned on fauna furniture, and three were on the floor. One of the furniture cameras was stolen during the second half of the spring monitoring period.

Image review

Images were uploaded to a computer and viewed using Windows Photo Viewer©. A senior ecologist or ecologist reviewed all images, with reference to standard field guides (i.e. Menkhorst & Knight 2004; Pizzey & Knight 2007; Van Dyck *et al.* undated). Input from multiple ecologists was sought to identify some images.

Animals were scored making a complete or incomplete crossing. A complete crossing was scored when an animal showed directional movement when detected by the centrally mounted underpass camera. An incomplete crossing was scored when an animal showed no directional movement (i.e. remained stationary in front of camera) or when an animal passed the camera but returned within 10 minutes. Crossing definitions are consistent with those used at other Pacific Highway monitoring sites (e.g. Sandpiper Ecological 2017b, 2018b, 2019) and crossing structure research programs (e.g. Soanes *et al.* 2015). Further, it represents a conservative approach to identification of complete crossings.

Data recorded for each active image included: site, date, time, species, accuracy (definite 90%+ certainty, probable 75-90% certainty, and possible 60-75% certainty), movement direction (east, west, no directional

movement (animal stationary, returned), number of images and image numbers. A hierarchical approach was adopted to species identification that included: species, genus or group. If a species could not be identified or assigned to a group, it was labelled as “unidentified species”.

2.3 Adjacent habitat

2.3.1 Survey design

A total of 18 sites were sampled at the 12 underpasses as part of the adjacent habitat surveys, with one site established on each side of an underpass. Vegetated median underpasses (i.e. Sites 9-10, & 11-12) were considered single sites where sampling occurred on the east and west sides of the highway and not in the median. Survey effort was reduced at Site 3 due to concern about disturbing neighbours. No Spotlighting or arboreal Elliott trapping occurred on the west side at Site 3 and the diurnal active search was restricted to a small (100m x 30m) remnant of vegetation in the road reserve.

2.3.2 Trapping

Trapping methods applied during the survey included: cage traps, ground Elliott traps (Type A), arboreal Elliott traps (Type B), pipe traps, pitfall traps, and hair funnels. Trapping occurred within a 1ha area immediately adjacent to each culvert entrance and was conducted over three nights at each site. A maximum of 10 sites were sampled concurrently and trapping was conducted between 12 and 21 November 2018.

Traps were set in a “X” formation with five ground and five arboreal traps (4 type B Elliott traps and 1 pipe trap) set at 20m intervals on one axis and two cage traps and two hair funnels set at 50m spacing on the other axis. A line of three pitfall traps with drift fence was set at the intersection of both lines (Plate 2). Pitfall traps typically followed the contour and were set near fallen logs and dense ground cover. Trap effort is summarised in Table 2.



Plate 2: Example of a pitfall trap line installed during adjacent habitat surveys.

Arboreal traps and ground Elliott traps were baited with a peanut butter, honey and oats mixture. Arboreal traps were installed 1.8m above ground and attached to a bracket. Honey water was sprayed on the trunk above each arboreal trap, and bait was replaced as required. A plastic bag was placed over the end of each trap to provide cover, and a small amount of leaf litter was placed inside the trap. Elliott and pipe traps were set on the western side of trees to provide shelter from the morning sun. Cage traps were set in a sheltered location and baited with either peanut butter, honey and oats, or sardines. All traps were checked within four hours of sunrise. Cage traps were closed following the morning inspection and re-opened in the late afternoon. Pitfall traps were checked in the morning and again in the late afternoon.

Captured fauna were identified to species or genus, and, where possible, sexed and aged. Fauna were identified with reference to standard field guides (Van Dyck *et al.* 2013; Menkhorst & Knight 2004; Wilson & Swan 2010). Fauna were not marked as the aim of sampling was to determine the range of species present in adjacent habitat.

2.3.3 Diurnal active search

Diurnal active searches were conducted by one to two ecologists and involved a meandering traverse of habitat within 100m of the culvert entrance at each sample site. Surveys involved searching leaf litter, rolling logs, observing reptile habitat (i.e. log piles, rocks, dense leaf litter) and looking for fauna signs such as scats and tracks. Each site was sampled twice during the spring sample period for a minimum of 30 person minutes each sample. Diurnal active searches were conducted between 26 October and 22 November 2018. A total of 1118 person minutes were spent conducting diurnal active searches (Table 2).

2.3.4 Nocturnal active search

Nocturnal surveys were conducted on each side of each underpass on two occasions during the sample period. Surveys were conducted by one or two ecologists for between 30 and 60 person minutes per culvert side (Table 2). Surveys were conducted using hand-held Led Lenser P14 spotlights and involved a meandering traverse of habitat within 200m of the culvert entrance. Fauna were detected by sight and call and identified to species or genus. Surveys were conducted between 8 and 22 November 2018. A total of 1148 person minutes were spent conducting nocturnal active searches (Table 2).

2.3.5 Opportunistic records

Opportunistic observations of fauna near culvert entrances made whilst doing other monitoring activities such as koala and giant barred frog monitoring were recorded. All fauna observed whilst setting up equipment were also recorded.

Table 3: Survey effort for sampling adjacent habitat at 10 underpass sites on the WC2NH upgrade.

Component	Method / culvert side	No Samples	Total effort
Arboreal Elliott traps	5 x traps @ 20m spacing (4 Type B Elliott traps and 1 pipe trap)	3 nights/site	255 trap nights
Ground Elliott traps	5 x Type A Elliott traps @ 20m spacing	3 nights/site	270 trap nights
Cage traps	2 @ 50m spacing	3 nights/site	108 trap nights
Pitfall traps	1 x line of 3 pits with drift fence	3 nights/site	162 trap nights
Hair funnels	2 @ 50m spacing	14 nights/site	504 trap nights
Active diurnal search	30 person minute meandering traverse within 100m of culvert entrance	2 sample/site	1118 person minutes
Active nocturnal search	30 person minute meandering traverse within 200m of culvert entrance	2 samples/site	1148 person minutes

3. Results

3.1 Underpasses

3.1.1 Sand pads

Seven species and 13 fauna groups were recorded during sand pad monitoring (Table 3). Two introduced species, cat and red fox, were confirmed and it is likely that at least some of the *Rattus* spp. tracks are attributable to the introduced black rat (*R. rattus*). Koala was recorded on four occasions at Site 4 (Plate 3) and a possible long-nosed potoroo (*Potorous tridactylus*) was recorded from two track sequences at Site 8. Long-nosed potoroo is listed as vulnerable by the NSW *Biodiversity Conservation Act 2016* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The highest diversity of species/groups was recorded at Site 8 (nine species/groups). Cat was the most frequently recorded species with 42 track sequences, followed by red fox 29, and lace monitor with 26 (Table 3). *Rattus* spp. and *Dasyuridae* spp. were each recorded on 15 occasions and *Bandicoot* spp. on 13 occasions.

Table 4: Species and groups of fauna recorded during sand pad monitoring at 12 underpasses on the WC2NH upgrade. * possible record only.

Species/group	Site and number of track sequences												Total sequences	
	1	2	3	4	5	6	7	8	9	10	11	12		
Small Bird	2													2
Medium Bird	1													1
Waterbird	2													2
Lace monitor				10			2	10			2	2		26
Small reptile	2				2							6		10
Medium reptile	1			2				2			2	3		10
Frog								2						2
Short-beaked echidna		10												10
Long-nosed potoroo*								2						2
Swamp wallaby							5							5
Macropodidae spp.	1													1
<i>Dasyuridae</i> spp		5			1	2		6	1					15
<i>Peramelidae</i> spp.		4	2		2			5						13
Koala				4										4
<i>Trichosurus</i> spp.			2											2
Cat			16	4	4	1		6	1	2	4	4		42
Red fox		2	21	2		2		2						29
<i>Rattus</i> spp.		2			11					2				15
<i>Canidae</i> spp.			1											1
Small mammal						1		2		1				4
Total species/group	6	5	5	5	5	4	2	9	3	2	3	4		

3.1.2 Scat and track

Scats, tracks and live specimens of three species, two genera, and six fauna groups were recorded during the scat and track surveys of 12 underpasses (Table 4). Species recorded inside underpasses during the scat and track survey included: two bentwing bats (*Miniopterus* spp) roosting in culvert joints at Site 3 and an eastern water dragon at Site 5. The *Miniopterus* spp. was most likely little bentwing bat (*M. australis*) which is listed as vulnerable by the *Biodiversity Conservation Act 2016*. The eastern water dragon was observed making a complete crossing of Site 5.



Plate 3: Koala tracks recorded on sand pads at Site 4.

Table 5: Species and fauna groups recorded during track and scat surveys of 12 underpasses on the WC2NH upgrade. ¹ = introduced species.

Species/Group	Site											
	1	2	3	4	5	6	7	8	9	10	11	12
Macropodidae spp.	X						X					
Peramelidae spp.	X											
<i>Trichosurus</i> spp.							X					
<i>Miniopterus</i> spp.			X									
Microbat spp.					X							
Rodentia spp.	X		X		X				X			
Cat ¹										X		
Fox ¹	X								X	X		
Eastern water dragon	X				X							
Amphibian (large)	X		X									
Bird spp.			X									

3.1.3 Cameras

Species richness

Eighteen species and six fauna groups were recorded during underpass Camera monitoring (Table 5). Koala was the only threatened species recorded, with individuals detected at Sites 4, 7, 9, 11 and 12 (Table 5). Five introduced species were recorded. Cat (*Felis catis*) was recorded at 10 sites, red fox at seven sites, and black rat at five sites (Table 5). The highest fauna diversity was recorded at Sites 2 and 3 with 10 species/groups each, followed by Site 6 (nine species/groups) and Sites 7 and 8 (eight species each). The lowest diversity was recorded at Site 5 (three species), and Site 10 (four species).

Table 6: Species and groups of fauna recorded by infra-red cameras at 12 underpasses on the WC2NH upgrade. C = complete crossing; IC = incomplete crossing; ¹ = introduced species.

Species/ Groups	Site and Crossing type																							
	1	2	3	4	5	6	7	8	9	10	11	12	C	IC	C	IC	C	IC	C	IC	C	IC	C	IC
Short-beaked echidna	1		13											1										
Peramelidae spp.										1														
Koala						10						2			1					2		2		
Short-eared brushtail possum					1							8		16	4									1
Common brushtail possum					1																			
<i>Trichosurus</i> spp.	1				2									5							1			
Swamp wallaby	2	1	6	1	2	1				1		2		5	1	1								
Red-necked wallaby			1				1					2												
Eastern grey kangaroo					2							3												
Macropodidae spp.	1		2							3		1												
House mouse ¹							1			1														
Black rat ¹			5	5					3	2						1		2	1					
Rodentia spp.										1														
Cat ¹			2		68	1	8			10		4		8		6		3		11	1	12		
Red fox ¹			3		13		7			5				7		2		2						
European Hare ¹					1																			
Small mammal spp.										1							1							
Lace monitor			1				21			3		1		26		5		3		4		4		
Eastern water dragon					3	1			1	1										7		3		
Pacific black duck									2															
Pheasant coucal					1																			
Intermediate egret																						1		
Medium frog spp.	5	1		1																				

Complete and incomplete crossings

A total of 405 fauna detections were recorded in spring 2018 and included 381 complete crossings and 24 incomplete crossings. Total crossings were evenly split between native (52%) and introduced species (48%), and complete crossings were evenly split between the two groups (51% native and 49% introduced; Table 6).

Comparison of complete crossings by native and introduced species at each site highlights substantial differences in occurrence of the two groups. Native species were recorded more frequently at Sites 2, 4, 7 and 8 and introduced species at Sites 3, 6, and 10 (Figure 2). Fragmented habitat and the presence of roads may explain the higher occurrence of introduced species at Sites 3 and 6.

Fauna crossings at the split median underpasses were consistent at Sites 11 and 12 but varied between Sites 9 and 10 (Table 6). Variation at Sites 9 and 10 is most likely due to theft of the Site 9 floor camera in the second half of the spring monitoring period.

Table 7: Number of species and groups of fauna recorded and complete and incomplete crossings recorded at each of 12 underpasses monitored on the WC2NH upgrade.

Site	Diversity			No crossings			
	No. Species/Groups	Native Sp/Gr	Introduced Sp/Gr	Complete		Incomplete	
				Native	Intro	Native	Intro
1	5	5	0	10	0	2	0
2	10	7	3	23	10	2	5
3	10	7	3	12	82	2	1
4	6	3	3	32	16	0	0
5	3	2	1	3	3	1	0
6	9	5	4	9	18	0	0
7	8	7	1	19	4	0	0
8	8	6	2	53	15	6	0
9	7	4	3	7	9	1	0
10	4	1	3	3	7	0	1
11	6	5	1	14	11	1	1
12	5	4	1	9	12	1	0
Total				194	187	16	8

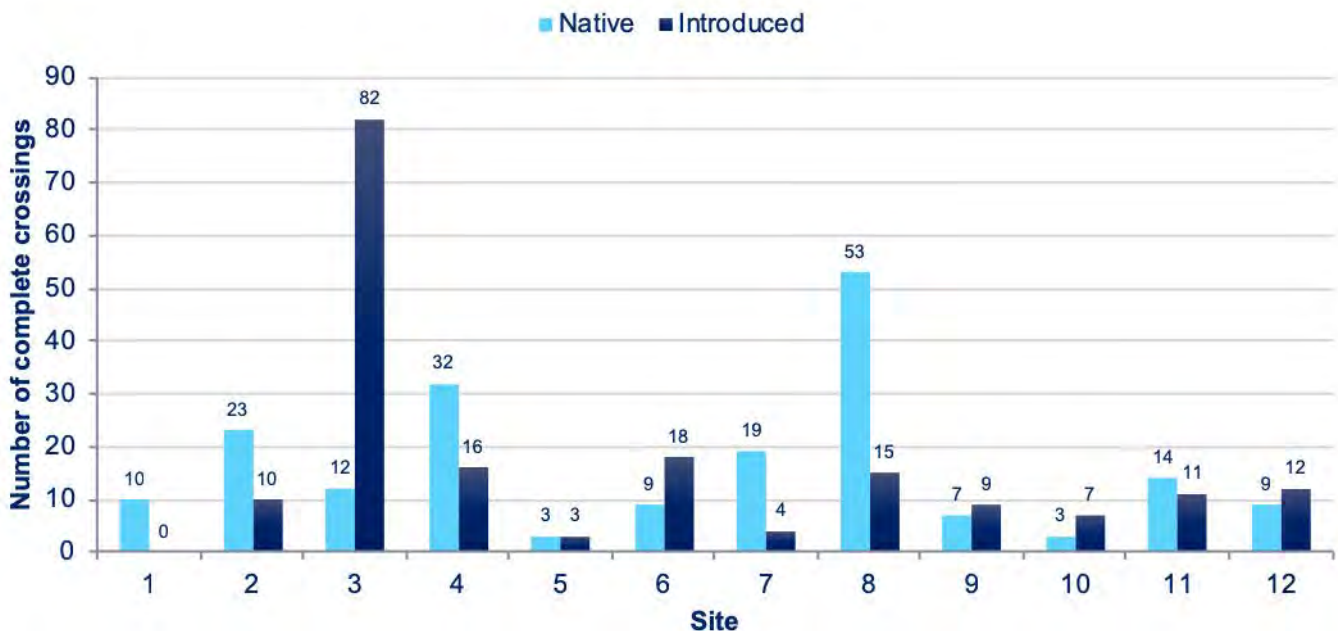


Figure 2: Comparison of the number of complete crossings by native and introduced species recorded at each underpass.

Use of floor and furniture

Fauna were recorded using both the culvert floor and fauna furniture to traverse underpasses (Table 7). Exceptions occurred at Sites 4, 9, and 10 where no fauna were recorded using the furniture. Use of the culvert floor was substantially greater than use of furniture across all sites (Figure 3). Excluding Sites 1 and 5, which did not contain fauna furniture, a total of 345 complete crossings were recorded on the culvert floor and 20 were recorded on the furniture.

No species was detected using the furniture only. As expected, several terrestrial species were recorded using the floor only. Short-eared brushtail possum was recorded using the furniture only at Site 7 and floor and furniture at Site 8 (Table 7). Short-eared brushtail possum, *Trichosurus* spp., water dragon, cat, and black rat were recorded using both the floor and furniture. Medium frog was recorded crossing the camera monitoring zone at Site 1 on five occasions. Due to the proportion of the crossing monitored at Site 1 this is

not considered as evidence of complete crossings. Koalas were recorded on 19 occasions using the floor only (Plate 3).



Plate 4: Koala recorded at Site 12, moving east on 22 October (left) and west of 23 October (right).

Table 8: Number of complete crossings made by each species/group at each of 12 underpasses monitored on the WC2NH upgrade. NB – Sites 1 and 5 did not contain fauna furniture. ¹ = introduced species, FI = Floor, Fu = furniture.

Species/group	Site and number of complete crossings																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu	FI	Fu
Short-beaked echidna	1	13																						
Peramelidae spp.														1										
Koala					10						2				1					2			2	
Short-eared brushtail possum				1								8	14	4										
Common brushtail possum				1																				
<i>Trichosurus</i> spp.	1			2										3	2							1		
Swamp wallaby	2	6							1		2		5		1									
Red-necked wallaby		1		2		1					2													
Eastern grey kangaroo				1							3													
Macropodidae spp.	1	2								2		1												
House mouse ¹						1					1													
Black rat ¹		2	3						3	1	1				1		2							
Rodentia spp.										1														
Cat ¹		2		68	8					10	4		8		6	3				11			11	1
Red fox ¹		3		13	7					5			7		2		2							
European Hare ¹				1																				
Lace monitor		1				21				3	1		26		5		3			4			4	
Eastern water dragon				3																6	1		3	
Pacific black duck								2																
Pheasant coucal				2																				
Intermediate egret																								
Medium frog spp.	5																							

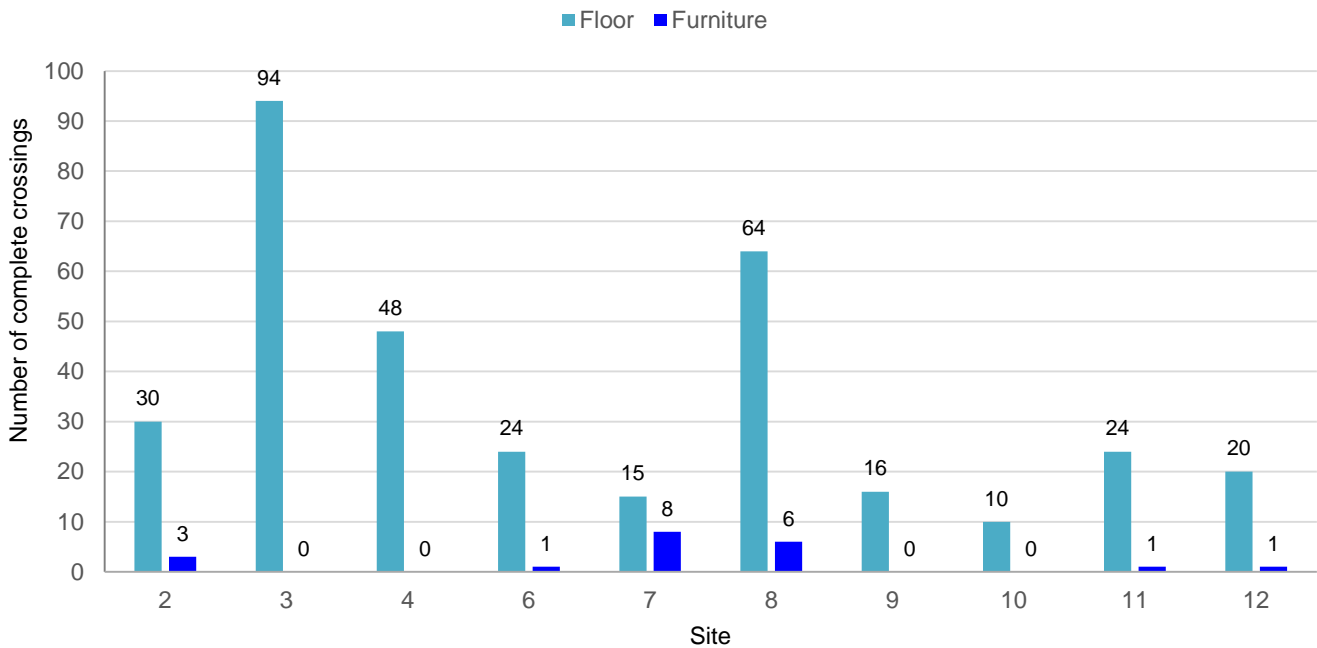


Figure 3: Complete crossings by all species on underpass floor and fauna furniture.

3.2 Adjacent habitat

Forty species were recorded in habitat adjoining underpasses (Table 8). A further six species were identified to the level of Genera only. Most of these are likely to belong to one of the identified species. For example *Petaurus* spp. was most likely a sugar glider. Some records during active search and spotlighting were assigned to three families, Macropodidae (wallaby/kangaroo), Peramelidae (bandicoots), and Chelidae (freshwater turtles). Three threatened species were recorded in adjacent habitat. Yellow-bellied glider (*Petaurus australis*) was recorded on the west side of the alignment at Site 8, giant barred frog (*Mixophyes iteratus*) was recorded on the west side of the alignment at Site 1, and little eagle (*Hieraaetus morphnoides*) was recorded soaring above the alignment at Sites 11 and 12.

The majority of species/groups (38 in total) were detected by diurnal and nocturnal active searches (Table 8). No fauna were captured in pipe traps and only one species (short-eared brushtail possum) was captured in an arboreal Elliott trap. Six species, four reptiles and two frogs, were captured in pitfall traps and four species were captured in ground Elliott traps. A total of 54 individuals were captured in all trap types, 12 individuals in cage traps, 15 in ground Elliott traps, 26 in pitfall traps and one in an arboreal Elliott trap (Appendix B). The introduced black rat was the most commonly captured species (14 individuals), followed by garden skink (*Lampropholis delicata*; 9 individuals); *Calypotis ruficauda* (7 individuals), fawn-footed Melomys (*Melomys cervinipes*; 5 individuals; Plate 4), grass skink (*L. guichenoti*; 4 individuals), and brown antechinus (*Antechinus stuartii*; 3 individuals; Plate 4).

Table 9: Species of vertebrate recorded during surveys of habitat adjoining each side of all underpasses. ^V = vulnerable species; ^E = Endangered species; ^I = Introduced species.

Species	Active Search	Spotlight	Ground Elliott trap	Arboreal Elliott trap	Pitfall trap	Pipe trap	Cage trap	Hair funnel
Mammals								
Swamp wallaby		*						
Macropodidae spp.	*	*						
Northern brown bandicoot							*	*
Peramelidae spp.	*							
Short-beaked echidna	*							
Fawn-footed melomys			*					
<i>Melomys</i> spp.			*					
Short-eared brushtail possum		*		*			*	
<i>Trichosurus</i> spp.								*
Common ringtail possum								*
Bush rat			*				*	*
<i>Rattus</i> spp.								*
Brown antechinus			*					
Sugar glider		*						
Yellow-bellied glider ^V		*						
<i>Petaurus</i> spp.		*						
Black rat ^I			*				*	*
Red fox ^I	*							
Reptiles								
<i>Egernia mcpheii</i>	*							
Lampropholis delicata	*				*			
Lampropholis guttichinoti					*			
<i>Lampropholis</i> spp.	*							
<i>Calyptotis ruficauda</i>	*				*			
Eastern water-skink	*							
Red-bellied black snake	*							
Yellow-faced whipsnake	*							
Black-bellied swamp snake	*							
Blackish blind snake					*			
Coastal carpet python	*							
Burton's legless lizard	*							
Eastern water dragon	*	*						
Lace monitor	*							
<i>Chelidae</i> spp. (Freshwater turtle)	*							
Birds								
Tawny frogmouth		*						
Owlet-nightjar		*						
Little eagle ^V	*							
Frogs								
<i>Litoria fallax</i>	*	*						
<i>Litoria tyleri</i>		*						
<i>Litoria chloris</i>		*						
<i>Litoria tyleri</i> (tadpoles)	*							
<i>Litoria peronii</i> (tadpoles)	*							
<i>Uperolia fusca</i>		*						
<i>Adelotus brevis</i>	*	*						
<i>Crinia signifera</i>		*						
<i>Mixophyes fasciolatus</i>		*						
<i>Mixophyes iteratus</i> ^E		*						
<i>Limnodynastes peronii</i>		*			*			
<i>Pseudophryne coriacea</i>		*			*			
<i>Uperolia</i> spp.		*						
Total N ^o . Species/groups	22	20	5	1	6	0	4	6



Plate 5: *Melomys* spp. (left) and brown antechinus (right) captured in adjacent habitat during spring 2018 monitoring.

3.3 Species recorded in underpasses and adjacent habitat

A total of 46 species, including five introduced species, five Genera, four Families and nine fauna groups were identified by the various survey methods during spring 2018 monitoring of underpasses and adjacent habitat were identified by the various survey methods. Several of the Genera, Families and Groups would be include species that were also recorded. For example, *Trichosurus* spp. would be either short-eared or common brushtail possum, *Rattus* spp. would most likely be bush rat or black rat, small and medium reptiles could be one of the several species of skink and lizard recorded, and small mammal and Dasyuridae spp. would most likely be one of the *Rattus* species or brown antechinus.

The use of various sample methods each with different degrees of accuracy in identifying fauna to species level has contributed to the large number of Families and groups recorded. Methods such as sand pads only allow identification to the group level for some fauna and contribute substantially to the inclusion of broad groups such as small or medium reptile. The inclusion of broad groups makes it difficult to be definitive in determining how many species from adjacent habitat have used underpasses. In addition, infra-red cameras often miss small reptiles and frogs meaning these groups are under represented in underpass monitoring results. It is highly likely that several of the fauna groups recorded in underpasses (particularly during sand pad surveys) include species that were recorded in adjacent habitats.

Eight species, one genera (*Trichosurus* spp.), and three Families (Macropodidae spp., Peramelidae spp., & Rodentia spp) were recorded in both adjacent habitat and underpasses. Excluding gliders, 23% of species/groups recorded in adjacent habitat were recorded in underpasses. For the reasons noted above this represents a substantial underestimate of the actual proportion of species present that are likely to be using underpasses. Notwithstanding, some species were recorded using the underpasses but not detected in adjacent habitat. These species include red-necked wallaby (*Macropus rufogriseus*), eastern grey kangaroo (*M. giganteus*), common brushtail possum (*T. vulpecula*), and possibly, long-nosed potoroo.

Table 10: Species and fauna groups recorded using underpasses by all methods and those recorded in adjacent habitat. Shading denotes a species or group not confirmed in both areas that is likely to be represented in another species/group that was recorded in both areas, for example northern brown bandicoot is likely represented by Peramelidae spp.

Species	Recorded in underpass	Recorded in adjacent habitat
Mammals		
Short-beaked echidna	*	*
Brown antechinus		*
Northern brown bandicoot		*
Peramelidae spp.	*	*
Koala ^v	*	*†
Short-eared brushtail possum	*	*
Common brushtail possum	*	
<i>Trichosurus</i> spp.	*	*
Common ringtail possum		*
Sugar glider		*
Yellow-bellied glider		*
<i>Petaurus</i> spp.		*
Swamp wallaby	*	*
Red-necked wallaby	*	
Eastern grey kangaroo	*	
Macropodidae spp.	*	*
<i>Miniopterus</i> spp.	*	
Fawn-footed melomys		*
<i>Melomys</i> spp.		*
Bush rat		*
Rodentia spp.	*	*
Long-nosed potoroo ^v	*	
Small mammal spp.	*	
Dasyuridae spp.	*	
Reptiles		
Chelidae spp.		*
<i>Calyptotis ruficauda</i>		*
<i>Egernia mcphieii</i>		*
Eastern water skink		*
<i>Lampropholis delicata</i>		*
<i>Lampropholis guichenoti</i>		*
<i>Lampropholis</i> spp.		*
Scincidae spp.		*
Burton's legless lizard		*
Lace monitor	*	*
Eastern water dragon	*	*
Red-bellied black snake		*
Yellow-faced whipsnake		*
Black-bellied swamp snake		*
Blackish blind snake		*
Coastal carpet python		*
Medium reptile spp.	*	
Small reptile spp.	*	
Birds		
Pacific black duck	*	
Pheasant coucal	*	
Intermediate egret	*	
Water bird spp.	*	
Medium bird spp.	*	
Small bird spp.	*	

Species	Recorded in underpass	Recorded in adjacent habitat
Frogs		
<i>Litoria fallax</i>		*
<i>Litoria tyleri</i>		*
<i>Litoria chloris</i>		*
<i>Uperolia fusca</i>		*
<i>Adelotus brevis</i>		*
<i>Crinia signifera</i>		*
<i>Mixophyes fasciolatus</i>		*
<i>Mixophyes iteratus</i> ^V		*
<i>Limnodynastes peronii</i>		*
<i>Pseudophryne coriacea</i>		*
<i>Uperolia spp.</i>		*
Medium frog spp.	*	
Frog spp.	*	
Introduced		
Cat	*	
Red fox	*	*
Black rat	*	*
European Hare	*	
House mouse	*	

4. Key findings

1. Survey methods used to monitor fauna use of underpasses were suitable for obtaining an indication of the frequency of fauna movement and the range of species using underpasses and the range of species occurring in adjacent habitat.
2. Inclusion of motion-activated cameras in adjacent habitat monitoring would compliment existing methods.
3. Motion activated cameras, sand pads, and scat and track searches, used in underpasses, are deficient in detecting use by small reptiles and frogs. Whilst sand pads and scat and track surveys confirmed the presence of both groups it is exceedingly difficult to determine which species were using the underpasses.
4. The duration of camera monitoring was compromised by a high incidence of false triggers at some sites, and the theft of one camera. False triggers are attributed to ongoing construction work at some sites, regular movement through underpasses by ecologists completing other activities, and detection of traffic on the adjacent carriageway. Detection of traffic was an issue for furniture cameras at the vegetated median underpasses.
5. In total, 18 species (including 5 introduced species), one genera, four families and eight fauna groups were identified using underpasses. There is likely overlap in species between fauna groups, families and species and the totals presented should not be interpreted as individual species. Mammals, reptiles, frogs and birds were all recorded using underpasses.
6. Fauna were recorded using both the culvert floor and fauna furniture. Use of the floor was substantially higher than furniture, although data need to be analysed using crossings/unit of time as opposed to raw counts to determine the scale of difference between the two surfaces.
7. A total of 405 fauna detections were recorded by underpass cameras, of which 94% were classed as complete crossings.

8. Identification of species is difficult from tracks in sand pads and there is some doubt regarding small the Dasyuridae spp. as no dasyurids were recorded on cameras.
9. Koalas were recorded using five underpasses on 17 occasions, with the highest use recorded at Site 4. Evidence suggests that koalas have been using underpasses to move east and west across the alignment.
10. Two tracks in sand pads at Site 7 were identified as possible long-nosed potoroo. Further evidence of potoroos is required before their presence is confirmed.
11. Monitoring the large bridge underpass at Site 1 (Upper Warrell Creek) for giant barred frog is difficult due to the large area available for movement. In spring 2018 camera sampling was focused on the small areas of landscape planting around the creek bank.
12. Five introduced species were recorded using underpasses. Cats were the most frequently recorded species (10 sites, 134 crossings) followed by foxes (7 sites, 39 crossings). The higher incidence of cats than foxes may be associated with the contiguous nature of forest adjoining most sites. The occurrence of both species peaked at Site 3, which is situated in a more fragmented agricultural landscape with nearby residents. Black rats were recorded at five sites on 19 occasions.
13. Forty species and six genera were identified in habitat adjoining underpasses, of which, 18% were confirmed using underpasses. This figure does not include the fauna groups identified during sand pad monitoring (i.e. small and medium reptiles, small frog etc) and the actual proportion is likely to be higher.

5. Recommendations

1. Fauna furniture cameras at the vegetated median underpasses should be oriented outwards i.e. towards the forest as opposed to the standard east orientation.
2. Video duration should be reduced from 10s to 5s with no delay between activation. Based on the spring monitoring a 5s video sequence will be sufficient to identify fauna and confirm movement direction.
3. The adjacent habitat trapping and underpass sand pad survey should be completed immediately prior to commencement of underpass camera monitoring.
4. Inclusion of infrared cameras as part of adjacent habitat monitoring should be considered.
5. Management to control feral predator use of underpasses should be evaluated following the winter 2019 sample period.
6. Using time-lapse photography in underpasses should be considered to confirm use by small reptiles, frogs and small mammals.

6. References

Menkhorst, P. & Knight, F. (2004). *A field guide to the mammals of Australia*. Oxford University press, Melbourne.

Pizzey, G. & Knight, F. (2007). *The field guide to the birds of Australia*. Harper Collins, Sydney.

RMS (2018). *Warrell Creek to Nambucca Heads Operational Ecological and Water Quality Monitoring Brief*. NSW Government.

Sandpiper Ecological (2017a). Pacific Highway Upgrade – Sapphire to Woolgoolga: operational phase fauna monitoring year 2 – Greys Dam Frog Pipes. Report prepared for Roads and Maritime Services.

Sandpiper Ecological (2017b). Pacific Highway Upgrade – Glenugie: operational phase fauna crossing monitoring program (years 1-3). Report prepared for NSW Roads and Maritime Services.

Sandpiper Ecological (2018a). Pacific Highway Upgrade – Sapphire to Woolgoolga: operational phase fauna monitoring year 3 – Greys Dam Frog Pipes. Report prepared for Roads and Maritime Services.

Sandpiper Ecological (2018b). Sapphire to Woolgoolga Pacific Highway Upgrade: operational phase fauna crossing monitoring program years 1-3. Report prepared for NSW Roads and Maritime Services.

Sandpiper Ecological (2019). Nambucca Heads to Urunga Pacific Highway Upgrade: operational phase monitoring year one. Report prepared for NSW Roads and Maritime Services.

Soanes, K., Vesk, P. A. and van der Ree, R. (2015). Monitoring the use of road-crossing structures by arboreal marsupials: insights gained from motion-triggered cameras and passive integrated transponder (PIT) tags. *Wildlife Research*: 10.107.

Wilson, S. & Swan, G. (2010). *A complete guide to reptiles of Australia*. New Holland, Sydney.

Van Dyck, S., Gynther, I. & Baker, A. (2013). *Field companion to the mammals of Australia*. New Holland, Sydney.

Appendix A – Species list

Table A1: Common and scientific names for all species recorded during spring 2018 monitoring event at WC2NH. ^ = Threatened species.

Common Name	Scientific Name
Koala [^]	<i>Phascolarctos cinereus</i>
Swamp wallaby	<i>Wallabia bicolor</i>
Red-necked wallaby	<i>Macropus rufogriseus</i>
Wallaby spp.	
Eastern grey kangaroo	<i>Macropus giganteus</i>
	<i>Macropod spp.</i>
Short-beaked echidna	<i>Tachyglossus aculeatus</i>
Short-eared brushtail possum	<i>Trichosurus caninus</i>
Common brushtail possum	<i>Trichosurus vulpecula</i>
Brushtail possum spp.	<i>Trichosurus spp.</i>
Common ringtail possum	<i>Pseudocheirus peregrinus</i>
Northern brown bandicoot	<i>Isodon macrourus</i>
Bandicoot spp.	
Fawn-footed melomys	<i>Melomys cervinipes</i>
	<i>Melomys spp.</i>
Bush rat	<i>Rattus fuscipes</i>
Rodent spp.	<i>Muridae spp.</i>
Brown antechinus	<i>Antechinus stuartii</i>
Long-nosed potoroo [^]	<i>Potorous tridactylus</i>
Small mammal spp.	
	<i>Dasyuridae spp.</i>
McPhee's skink	<i>Egernia mcpheii</i>
Rainbow skink	<i>Lampropholis delicata</i>
Common garden skink	<i>Lampropholis guichenoti</i>
Red-tailed calyptotis	<i>Calyptotis ruficauda</i>
Eastern water-skink	<i>Eulamprus quoyii</i>
Red-bellied black snake	<i>Pseudechis porphyriacus</i>
Yellow-faced whipsnake	<i>Demansia psammophis</i>
Black-bellied swamp snake	<i>Hemiaspis signata</i>
Blackish blind snake	<i>Anilius nigrescens</i>
Coastal carpet python	<i>Morelia spilota</i>
Burton's legless lizard	<i>Lialis burtonis</i>
Lace monitor	<i>Varanus varius</i>
Eastern water dragon	<i>Intellagama lesueurii</i>
Medium reptile spp.	
Small reptile spp.	
Pacific black duck	<i>Anas superciliosa</i>
Pheasant coucal	<i>Centropus phasianinus</i>
Intermediate egret	<i>Ardea intermedia</i>

Common Name	Scientific Name
Tawny frogmouth	<i>Podargus strigoides</i>
Owlet-nightjar	<i>Aegotheles</i>
Little eagle^	<i>Hieraetus morphnoides</i>
Water bird spp.	
Medium bird spp.	
Small bird spp.	
Eastern dwarf tree frog	<i>Litoria fallax</i>
Tyler's tree frog	<i>Litoria tyleri</i>
Red-eyed tree frog	<i>Litoria chloris</i>
Dusky toadlet	<i>Uperolia fusca</i>
Tusked frog	<i>Adelotus brevis</i>
Common eastern froglet	<i>Crinia signifera</i>
Great barred frog	<i>Mixophyes fasciolatus</i>
Giant barred frog^	<i>Mixophyes iteratus</i>
Striped marsh frog	<i>Limnodynastes peronii</i>
Red-backed toadlet	<i>Pseudophryne coriacea</i>
Cat	<i>Felis catus</i>
Red fox	<i>Vulpes vulpes</i>
Black rat	<i>Rattus rattus</i>
European hare	<i>Lepus europaeus</i>
House mouse	<i>Mus musculus</i>

Appendix B – Field Data

Table B1: Weather during and immediately prior to the spring / summer 2018 giant barred frog survey.

Date	MAXIMUM Wind Speed km/h	AVERAGE Wind Direction DESCRIPTION	AVERAGE Relative Humidity %	MAXIMUM Air Temperature DegC	MINIMUM Air Temperature DegC	TOTAL Rain Gauge mm
20/10/18	32.4	ESE	82.9	25.4	14.5	0.2
21/10/18	36	ESE	85.6	25.9	17.6	8.4
22/10/18	13.4	SW	90.1	24.9	17	0.2
23/10/18	18.5	SSW	87.9	25.8	14.9	0.2
24/10/18	25.3	S	85.7	26.1	16.1	0
25/10/18	16.9	SSW	80.7	27.5	17.4	0
26/10/18	13.6	S	82.2	24.2	15.1	0
27/10/18	20.5	SSW	80.5	28.2	16.6	0
28/10/18	19.9	SSE	81.6	25.4	14.4	0
29/10/18	16.4	SW	79.9	22.2	15.6	0
30/10/18	12.8	SSW	77.7	22.2	15.3	0
31/10/18	28.5	SSE	83.2	24.7	13.7	0
1/11/18	18.5	S	80.5	30.5	14.1	0
2/11/18	23	SSE	80.1	27.5	12.4	0
3/11/18	33.4	ESE	72.5	29.7	18.8	0
4/11/18	22.8	SSE	73.4	33.6	19.6	0
5/11/18	14.4	S	82.6	30	17.3	0
6/11/18	16.6	SSE	88.2	28.6	19.1	0
7/11/18	20.9	ESE	84.9	30.4	22.9	0.2
8/11/18	24	SSE	89.8	30.2	14.9	21
9/11/18	20.4	SW	76.8	23	10.7	0
10/11/18	17.4	S	74.2	22.9	13.5	0
11/11/18	32.1	S	79.3	25.4	12.8	0
12/11/18	20.5	SW	81	25.7	12.8	0
13/11/18	18.5	SSW	79.8	25	12.5	0
14/11/18	25	SE	81.5	25.1	13.3	0
15/11/18	25.9	SSE	82.8	27.1	18.5	0
16/11/18	21.2	SSE	83	28.4	19.1	0
17/11/18	15.4	SSW	83.6	26.1	18.1	0
18/11/18	24	SSW	87.8	26.3	16.6	14.2
19/11/18	16	SW	93	23	15.7	15
20/11/18	17.4	SSW	78.3	23.7	14.6	0.2
21/11/18	30.2	ESE	77.9	27	17.6	0
22/11/18	16	SSE	89.9	30.3	19.5	6
23/11/18	33.1	SW	58.9	31.7	9.4	0
24/11/18	31.1	WSW	44.6	28.1	10.3	0
25/11/18	20.5	SW	68	28.8	10.9	0
26/11/18	21.9	SSW	66.2	30.4	13.9	0
27/11/18	18.7	SSW	73	26.2	14.3	0
28/11/18	28.5	SE	83.3	27.1	17.8	0
29/11/18	33.5	SSW	69.2	28.7	18.3	9.6
30/11/18	17	SW	69.4	28.6	13.4	0
1/12/18	20.2	S	80.6	27.1	14.1	0

WC2NH operational phase underpass monitoring – spring / summer year one

2/12/18	20.2	SSW	77.8	31.8	12.5	0
3/12/18	24.1	SSE	70.8	33.9	17.8	0
4/12/18	19.9	SSE	78.1	27.9	14.4	0
5/12/18	19.5	S	76.3	28.8	18.3	9.6
6/12/18	17.7	SSW	82	25.9	17	1.2
7/12/18	22.4	S	74.9	25.8	15.4	0.2
8/12/18	24	SSE	75.6	25.8	14.9	0
9/12/18	33.7	ESE	78.1	26.9	13.5	0
10/12/18	30.1	SE	80.9	27.4	14.7	0
11/12/18	26.2	SE	84.4	29.3	17.7	0
12/12/18	13.7	SSW	92.1	28.2	19.2	6.8
13/12/18	13	SE	89.9	26.2	18.1	0.8
14/12/18	29.3	ENE	88.4	28.5	19.8	14.8
15/12/18	38.2	NE	86.3	29	22.2	0
16/12/18	50	NE	88	28.8	22.2	0
17/12/18	27.1	ESE	97.2	25	17.5	101.6
18/12/18	40.5	ESE	89.8	27.7	18.1	0
19/12/18	28.2	ESE	72.8	28.7	21	0
20/12/18	23.1	SE	79.2	29.6	20.1	12.8

Table B2: Underpass camera survey effort.

Location	Cam Location	Easting	Northing	Date installed	Date checked	Pics	Last pic date	Days Active	Date removed	Pics	Days Active	Total Days Active	Comment
12	Furniture	497115	6610068	17/10/18	22/11/18	383	1/11/18	16	17/12/18	38	29	45	
	Ground	497115	6610068	16/10/18	22/11/18	326	22/11/18	38	17/12/18	73	29	67	
11	Furniture	497168	6610040	17/10/18	22/11/18	286	22/11/18	37	17/12/18	300	27	64	All false triggers, need to reconfigure/change settings.
	Ground	497168	6610040	17/10/18	22/11/18	397	22/11/18	37	17/12/18	47	29	66	
10	Furniture	496622	6609409	17/10/18	22/11/18	317	22/11/18	37	17/12/18	Stolen		37	Stolen
	Ground	496622	6609409	17/10/18	22/11/18	543	5/11/18	20	17/12/18	75	23	43	Destroyed 14/12/18 - cam retrieved
9	Furniture	496622	6609409	17/10/18	22/11/18	169	22/11/18	37	17/12/18	37	23	60	Destroyed 14/12/18 cam retrieved
	Ground	496622	6609409	17/10/18	22/11/18	412	22/11/18	37	17/12/18	47	23	60	Destroyed 14/12/18 cam retrieved
8	Furniture	496506	6609219	17/10/18	22/11/18	110	22/11/18	37	17/12/18	19	26	63	
	Ground	496506	6609219	17/10/18	22/11/18	202	22/11/18	37	17/12/18	85	26	63	
7	Furniture	496438	6608780	17/10/18	22/11/18	154	30/10/18	14	17/12/18	14	26	40	
	Ground	496438	6608780	17/10/18	22/11/18	158	22/11/18	37	17/12/18	30	26	63	
6	Furniture	496188	6608319	17/10/18	21/11/18	10	21/11/18	36	17/12/18	13	27	63	
	Ground	496188	6608319	17/10/18	21/11/18	138	21/11/18	36	17/12/18	50	27	63	
5	North	496171	6608286	22/10/18	21/11/18	184	21/11/18	31	17/12/18	64	27	58	
	South	496168	6608282	22/10/18	21/11/18	128	21/11/18	31	17/12/18	75	27	58	
4	Furniture	495702	6607693	17/10/18	22/11/18	60	22/11/18	37	17/12/18	18	26	63	
	Ground	495702	6607693	17/10/18	22/11/18	175	22/11/18	37	17/12/18	106	26	63	
3	Furniture	495082	6606515	17/10/18	21/11/18	186	2/11/18	17	17/12/18	317	12	29	Mostly W. swallows and false triggers
	Ground	495082	6606515	17/10/18	21/11/18	258	21/11/18	36	17/12/18	60	12	48	
2	Furniture	494477	6605329	18/10/18	21/11/18	718	21/11/18	35	17/12/18	676	31	66	All false triggers, need to reconfigure
	Ground	494477	6605329	18/10/18	21/11/18	185	5/11/18	19	17/12/18	66	6	25	
1	North	489300	6594286	30/10/18	22/11/18	13799	22/11/18	24	17/12/18	15000	39	63	
	South	489262	6594252	24/10/18	22/11/18	17400	22/11/18	30	17/12/18	15000	39	69	

Table B3: All species detected in fauna underpasses by infrared camera. ^ = Threatened species, D = Definite, Pr = Probable, Po = Possible.

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
12	Furniture	13/12/18	2213	Cat	D	E	36	Complete	
	Ground	17/10/2018	0105	Cat	D	W	38-40	Complete	
		17/10/2018	2332	Cat	D	W	50	Complete	
		22/10/2018	0147	Koala^	D	E	54	Complete	
		23/10/2018	0337	Koala^	D	W	77	Complete	
		28/10/2018	0020	Cat	D	W	145	Complete	
		31/10/2018	2237	Cat	D	E	199	Complete	
		5/11/2018	0840	Lace monitor	D	East	14	Complete	
		5/11/2018	1124	Water dragon	D	West	15	Complete	
		5/11/2018	2305	Cat	D	East	16	Complete	
		8/11/2018	1359	Water dragon	D	East	46	Complete	
		9/11/2018	2305	Cat	D	East	53	Complete	
		13/11/2018	1138	Water dragon	D	East	82	Complete	
		17/11/2018	1431	Lace monitor	D	East	102	Complete	
		19/11/2018	2307	Cat	D	West	103	Complete	
		20/11/2018	1855	Cat	D	West	104	Complete	
		1/12/2018	2005	SEBtP	D	NDM	33-42	Incomplete	Back and forth then climbs railing (prob)
		2/12/2018	1944	Cat	D	E	43	Complete	
		3/12/2018	1110	Lace Monitor	D	E	44	Complete	
		7/12/2018	1954	Cat	D	E	51	Complete	
11/12/2018	1056	Lace Monitor	D	W	52, 53	Complete			
13/12/2018	1955	Cat	D	W	54	Complete			
11	Furniture	3/11/2018	1400	Water dragon	D	East	172	Complete	
	Ground	22/10/2018	146	Koala^	D	East	26-34,36-42	Complete	
		23/10/2018	332	Koala^	D	West	49	Complete	
		28/10/2018	0015	Cat	D	W	214	Complete	
		31/10/2018	2243	Cat	D	E	259	Complete	
		3/11/2018	1042	Water dragon	Pr	East	215	Complete	
		5/11/2018	0121	Cat	D	West	219	Complete	
		5/11/2018	0832	Lace Monitor	D	East	225	Complete	
		5/11/2018	1459	Water dragon	D	West	226	Complete	
		5/11/2018	1518	Water dragon	D	East	227	Complete	
		8/11/2018	0804	Intermediate Egret	D	EXM	248-259	Incomplete	
		9/11/2018	2305	Cat	D	East	264	Complete	
		17/11/2018	1421	Lace Monitor	D	East	302	Complete	
		17/11/2018	2153	Cat	D	West	303	Complete	
		18/11/2018	2051	Cat	D	West	304	Complete	
		19/11/2018	2312	Cat	D	W-E	305-306	Incomplete	
		20/11/2018	1904	Cat	D	West	307	Complete	
		21/11/2018	0851	Water dragon	D	West	308	Complete	
27/11/2018	2337	BtPoss spp.	D	E	227	Complete			

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		2/12/2018	0232	Cat	D	W	229	Complete	
		2/12/2018	1949	Cat	D	E	230	Complete	
		3/12/2018	1109	Lace Monitor	D	E	231	Complete	
		7/12/2018	1951	Cat	D	E	236	Complete	
		10/12/2018	1417	EW Dragon	D	W	237	Complete	
		11/12/2018	1103	Lace Monitor	D	W	238, 239	Complete	
		13/12/2018	1008	EW Dragon	D	E	240	Complete	
		17/12/2018	0054	Cat	D	W	243	Complete	
10	Furniture				D				Roosting in FF joins. Not recorded hereafter.
		27/11/2018	1945	Microbat spp.		NDM	8	Incomplete	
	Ground	19/10/2018	0259	Cat	D	E	11	Complete	
			0150	Fox	D	W	12	Complete	
		28/11/2018	0858	Lace Monitor	D	E	9	Complete	
		28/11/2018	2132	Black Rat	D	E	10	Complete	
		2/12/2018	2004	Black Rat	D	W	11, 12, 13	Complete	
		2/12/2018	2119	Cat	D	W	14	Complete	
		3/12/2018	1153	Lace Monitor	D	W	15	Complete	
		3/12/2018	1926	Black Rat	D	EthenW	16, 17	Incomplete	
		4/12/2018	0241	Cat	D	W	18	Complete	
		7/12/2018	0006	Fox	D	E	30	Complete	
		13/12/2018	1311	Lace Monitor	D	E	34	Complete	
				Human x 2 tagging					
9	Furniture	5/11/2018	0034	Small mammal	Pr	NDM	111	Incomplete	Only eyeshine visible
				Cam stolen					
	Ground	19/10/2018	0303	Cat	D	east	39	Complete	
		21/10/2018	0030	Cat	D	east	40	Complete	
		21/10/2018	0152	Fox	D	W	41-42	Complete	
		7/11/2018	0247	Cat	D	W	309	Complete	
		20/11/2018	1248	Lace monitor	D	W	403	Complete	
		21/11/2018	0259	Koala^	D	W	404	Complete	
		22/11/2018	0258	Cat	D	W	409	Complete	
		26/11/2018	0356	Swamp Wallaby	D	W	236, 237	Complete	
		28/11/2018	2142	Black Rat	D	E	238	Complete	
		2/12/2018	0923	Lace Monitor	D	E	239	Complete	
		2/12/2018	2118	Cat	D	W	241	Complete	
		3/12/2018	1152	Lace Monitor	D	W	243	Complete	
		4/12/2018	0242	Cat	D	W	244	Complete	
		7/12/2018	0009	Fox	D	E	250	Complete	
		13/12/2018	1318	Lace Monitor	D	E	252	Complete	
		14/12/2018	1404	Lace Monitor	D	E	253	Complete	
						Human x 2			

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
				tagging					
8	Furniture	31/10/2018	2250	SEBtP	D	E	34	Complete	
		7/10/2018	0233	SEBtP	D	E	65	Complete	
		10/11/2018	2339	SEBtP	D	E	72	Complete	
		12/11/2018	2138	SEBtP	D	E	88	Complete	
		29/11/2018	0026	BtPoss spp.	D	E	7	Complete	
		2/12/2018	0222	BtPoss spp.	D	E	9	Complete	
		9/12/2018	2109	Microbat spp.	D	NDM	13	Incomplete	Roosting in FF joins?
	Ground	17/10/2018	2303	Fox	D	E	12	Complete	
		19/10/2018	2135	SEBtP	D	E	13	Complete	
		21/10/2018	0140	Fox	D	E	14	Complete	
		22/10/2018	1418	Lace monitor	D	W	17	Complete	
		26/10/2018	1058	Lace monitor	D	W	22	Complete	
		27/10/2018	1119	Lace monitor	D	E	23	Complete	
		29/10/2018	2137	Cat	D	E	27	Complete	
		30/10/2018	2328	Bandicoot spp	Pr	E	50	Complete	
		31/10/2018	2004	Echidna	D	E	63-65	Incomplete	
		1/11/2018	1922	Cat	D	E	83	Complete	
		2/11/2018	1826	Cat	D	E	94	Complete	
		6/11/2018	2343	Cat	D	W	131	Complete	
		7/11/2018	0238	Cat	D	E	132	Complete	
		10/11/2018	0012	Swamp wallaby	Pr	E	149	Complete	
		10/11/2018	0944	Lace Monitor	D	W	150	Complete	
		11/11/2018	0847	Swamp wallaby	D	W	151-152	Complete	
		11/11/2018	1645	Swamp wallaby	Pr	E	153	Complete	
		12/11/2018	0921	Lace Monitor	D	W	155	Complete	
		17/11/2018	0007	Fox	D	E	187-189	Complete	
		18/11/2018	2328	Fox	D	E	190	Complete	
		20/11/2018	0824	Lace Monitor	D	W	192	Complete	
		20/11/2018	2036	SEBtP x 2	D	W	193	Complete	Mother with back young
		20/11/2018	2107	SEBtP x 2	D	E-W	194-195	Incomplete	
		20/11/2018	2137	SEBtP x 2	D	E	196	Complete	
		23/11/2018	2202	SEBtPx2	Pr	W	14	Complete	
		23/11/2018	2339	SEBtPx2	D	E	15	Complete	
24/11/2018	2112	BtPoss spp.	Pr	W	20	Complete			
26/11/2018	1216	Lace Monitor	D	W	21	Complete			
26/11/2018	1602	Lace Monitor	D	E	22	Complete			
28/11/2018	2142	SEBtPx2	D	E	24	Complete			
29/11/2018	0751	Lace Monitor	D	W	26	Complete			
30/11/2018	0829	Lace Monitor	D	W	27	Complete			
30/11/2018	2136	Cat	D	W	28	Complete			

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		1/12/2018	0226	Fox	D	E	29	Complete	
		2/12/2018	1031	Lace Monitor	D	E	31	Complete	
		2/12/2018	1455	Lace Monitor	D	E	32	Complete	
		2/12/2018	2129	BtPoss spp.x2	D	W	33	Complete	
		2/12/2018	2314	Cat	D	E	34	Complete	
		2/12/2018	2339	SEBtPx2	D	E	35	Complete	
		4/12/2018	1326	Lace Monitor	D	W	36	Complete	
		6/12/2018	0021	Fox	D	W	37	Complete	
		7/12/2018	1131	Lace Monitor	D	W	39	Complete	
		7/12/2018	1345	Lace Monitor	D	E	40	Complete	
		8/12/2018	2352	Cat	D	W	41	Complete	
		9/12/2018	1129	Lace Monitor	D	W	42	Complete	
		9/12/2018	1438	Lace Monitor	D	W	43	Complete	
		9/12/2018	1949	Swamp Wallaby	Pr	E	44	Complete	
		9/12/2018	1954	Swamp Wallaby	D	NDM	46/47	Incomplete	
		9/12/2018	1958	SEBtP	D	W	49	Complete	
		9/12/2018	2023	Swamp Wallaby	Pr	E	50	Complete	
		10/12/2018	1017	Lace Monitor	D	W	52	Complete	
		10/12/2018	1411	Lace Monitor	D	E	53	Complete	
		13/12/2018	0853	Lace Monitor	D	W	54	Complete	
		13/12/2018	1359	Lace Monitor	D	E	55	Complete	
		14/12/2018	1347	Lace Monitor	D	W	56	Complete	
		15/12/2018	0033	Fox	D	E	57	Complete	
		15/12/2018	1046	Lace Monitor	D	W	58	Complete	
		15/12/2018	1128	Lace Monitor	D	W	59	Complete	
		15/12/2018	1312	Lace Monitor	D	W	60	Complete	
		15/12/2018	1616	Lace Monitor	D	E	61	Complete	
7	Furniture	20/10/2018	0142	SEBtP	D	E	14	Complete	
		25/10/2018	2114	SEBtP x 2	D	W	15	Complete	
		5/12/2018	1955	SEBtP x 2	D	E	10	Complete	
		5/12/2018	2116	SEBtP x 2	D	W	11	Complete	
		6/12/2018	1937	SEBtP	Pr	E	12	Complete	Urinates on FF
	Ground	26/10/2018	1723	EG Kangaroo x 3	Pr	E	30-32	Complete	
		26/10/2018	2242	Red-necked wallaby	Pr	W	34-35	Complete	
		3/11/2018	0103	Swamp Wallaby	D	W	77	Complete	
		3/11/2018	1821	Cat	D	W	81	Complete	
		7/11/2018	0539	Macropod spp	D	E	95	Complete	
		8/11/2018	0011	Red-necked wallaby	Pr	W	98-99	Complete	
		11/11/2018	0351	Cat	D	E	107	Complete	
		11/11/2018	1846	Cat	D	W	109	Complete	

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		20/11/2018	0013	Koala^	D	E	152	Complete	
		23/11/2018	1440	Lace Monitor	D	E	14	Complete	
		1/12/2018	1848	Swamp Wallaby	Pr	E	15	Complete	
		5/12/2018	2127	Cat	D	W	16	Complete	
		8/12/2018	2255	Koala^	D	W	19	Complete	
6	Furniture	3/12/2018	0013	Black Rat	Pr	W	6	Complete	
	Ground	18/10/2018	2321	Cat	D	W	16	Complete	
		20/10/2018	1935	Cat	D	W	17	Complete	
		21/10/2018	0144	Fox	D	W	18	Complete	
		21/10/2018	0312	Cat	D	W	19	Complete	
		1/11/2018	0257	Cat	D	E	51	Complete	
		2/11/2018	0130	Fox	D	W	58	Complete	
		2/11/2018	1919	Cat	D	W	61	Complete	
		3/11/2018	0434	Cat	D	E	62	Complete	
		7/11/2018	1311	Lace Monitor	D	E	86	Complete	
		8/11/2018	0057	Rodent spp	Pr	E	87	Complete	
		11/11/2018	0029	Fox	D	W	91	Complete	
		20/11/2018	0215	House mouse	Pr	E	136	Complete	
		24/11/2018	2033	Cat	D	E	15	Complete	
		25/11/2018	2341	Wallaby spp.	D	W	16	Complete	
		26/11/2018	0902	Lace Monitor	D	W	19	Complete	
		27/11/2018	2055	Small mammal spp.	D	W	20	Complete	
		30/11/2018	0434	Wallaby spp.	D	E	28	Complete	
		3/12/2018	0237	Fox	D	W	31	Complete	
		5/12/2018	1925	Cat	D	W	32	Complete	
5/12/2018	2017	Cat	D	E	33	Complete			
8/12/2018	2020	Fox	D	E	34	Complete			
9/12/2018	0032	Cat	D	E	35	Complete			
9/12/2018	2008	Swamp Wallaby	Pr	W	36	Complete			
10/12/2018	2311	Wallaby spp.	D	E	37	Complete			
14/12/2018	1142	Lace Monitor	D	E	38	Complete			
5	North	30/10/2018	1527	Microbat spp.	D	EXM	46-49	Incomplete	
		1/11/2018	0331	Microbat spp	D	NDM	62	Incomplete	
		7/11/2018	0109	Black rat	Pr	West	134	Complete	
		8/11/2018	0358	Microbat spp	D	EXM	142	Incomplete	
		10/11/2018	0005	Black rat	D	West	150-153	Complete	
		14/12/2018	2320	Black Rat	Pr	E	49	Complete	
	South	26/10/2018	0140	Microbat spp	D	EXM	42,51-53	Incomplete	
		27/10/2018	2251	Microbat spp	D	EXM	58-60	Incomplete	
		1/11/2018	0409	Microbat spp	D	EXM	76	Incomplete	
		3/11/2018	0407	Microbat spp	D	EXM	80,82-83	Incomplete	
		6/11/2018	1843	Microbat spp	D	EXM	88	Incomplete	
		9/11/2018	0355	Microbat spp	D	East	104	Complete	
		11/11/2018	0354	Microbat spp	D	EXM	105	Incomplete	

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		14/11/2018	0401	Microbat spp	D	EXM	112	Incomplete	
		19/11/2018	1904	Microbat spp	D	EXM	117,120	Incomplete	
		2/12/2018	0413	Microbat spp.	D	W	29	Complete	
		7/12/2018	1656	PB Duck x 2	D	E	34, 35	Complete	
4	Furniture			Nil					
	Ground	17/10/2018	2006	Cat	D	W	55	Complete	
		20/10/2018	0108	Koala^	D	E	56	Complete	
		22/10/2018	1250	Cat	D	E	57-58	Complete	
		26/10/2018	1042	Lace monitor	D	E	68	Complete	
		30/10/2018	1020	Lace monitor	D	W	71	Complete	
		30/10/2018	1140	Lace monitor	D	E	72	Complete	
		30/10/2018	2030	Koala^	D	E	93	Complete	
		31/10/2018	1044	Lace monitor	D	E	98	Complete	
		31/10/2018	2131	House mouse	D	E	99	Complete	
		2/11/2018	0054	Fox	D	E	108	Complete	
		2/11/2018	0220	Cat	D	E	109	Complete	
		2/11/2018	0411	Cat	D	W	110	Complete	
		2/11/2018	0837	Lace monitor	D	W	51	Complete	
		2/11/2018	1201	Lace monitor	D	W	52	Complete	
		3/11/2018	1341	Lace monitor	D	E	55	Complete	
		4/11/2018	0132	Koala^	D	W	56	Complete	
		6/11/2018	1036	Lace monitor	D	W	70	Complete	
		7/11/2018	2015	Koala^	D	E	80	Complete	
		10/11/2018	1302	Lace monitor	D	W	81	Complete	
		10/11/2018	1840	Cat	D	W	82	Complete	
		10/11/2018	2254	Koala^	D	W	83	Complete	
		10/11/2018	2358	Fox	D	E	84	Complete	
		11/11/2018	1348	Lace monitor	D	E	85	Complete	
		12/11/2018	2305	Koala^	D	E	86	Complete	
		13/11/2018	0059	Koala^	D	W	87	Complete	
		15/11/2018	0937	Lace monitor	D	E	102	Complete	
		16/11/2018	2257	Fox	D	E	121	Complete	
		17/11/2018	0155	Cat	D	W	122	Complete	
		19/11/2018	2252	Koala^	D	E	136	Complete	
		20/11/2018	1228	Lace monitor	D	W	139	Complete	
		20/11/2018	2038	Cat	D	W	144	Complete	
		23/11/2018	1126	Lace monitor	D	E	69, 70	Complete	
		24/11/2018	1222	Lace Monitor	D	E	72	Complete	
		29/11/2018	0858	Lace monitor	D	E	77	Complete	
		29/11/2018	1734	RN Wallaby	Pr	W	80	Complete	
		1/12/2018	0432	Koala^	D	W	81	Complete	
		2/12/2018	0858	Lace Monitor	D	E	82	Complete	
		3/12/2018	0155	Fox	D	E	83	Complete	
		5/12/2018	1314	Lace Monitor	D	W	84	Complete	
5/12/2018	2314	Fox	D	E	85	Complete			
7/12/2018	0310	Cat	D	W	86	Complete			
8/12/2018	0944	Lace monitor	D	E	87	Complete			

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		8/12/2018	1045	Lace monitor	D	E	88	Complete	
		8/12/2018	2051	Fox	D	E	91-92	Complete	
		9/12/2018	1201	Lace Monitor	D	W	93	Complete	
		14/12/2018	2313	Koala^	D	E	96	Complete	
		15/12/2018	0249	Fox	D	W	97	Complete	
		15/12/2018	1245	Lace monitor	D	W	98	Complete	
3	Furniture	18/10/2018	0830	Welcome swallow x 2	D	NDM	7-81	Incomplete	Not recorded hereafter.
		30/10/2019	1009	Water dragon	D	E-W	82-97	Incomplete	
		23/11/2018	0101	Microbat spp.	D	W	38, 39, 40	Complete	Not recorded hereafter.
	Ground	18/10/2018	0002	Cat	D	East	5	Complete	
		19/10/2018	0841	Fox	D	East	7	Complete	
		20/10/2018	0831	Welcome swallow x 2	D	NDM	8	Incomplete	Not recorded hereafter
		20/10/2018	1522	Water dragon	D	East	12	Complete	
		20/10/2018	1606	Water dragon	D	West	13	Complete	
		22/10/2018	0109	Cat	D	West	15	Complete	
		22/10/2018	0549	Fox	D	East	16	Complete	
		23/10/2018	0945	Cat	D	West	17	Complete	
		24/10/2018	0319	Cat	D	West	18-19	Complete	
		24/10/2018	0452	Cat	D	East	20	Complete	
		24/10/2018	0517	Cat	D	East	22-31	Complete	
		24/10/2018	2339	Cat	D	West	32	Complete	
		25/10/2018	0104	Cat	D	East	33-34	Complete	
		25/10/2018	0342	Brushtail Possum spp	D	East	35	Complete	
		26/10/2018	0255	Cat	D	West	36-37	Complete	
		26/10/2018	0518	Cat	D	East	38	Complete	
		27/10/2018	0908	Water dragon	D	East	39	Complete	
		27/10/2018	1942	Cat	D	West	42	Complete	
		27/10/2018	2207	Fox	D	West	43	Complete	
		27/10/2018	2209	Cat	D	West	44	Complete	
		27/10/2018	2331	Cat	D	East	45-69	Complete	
		28/10/2018	2004	Cat	D	West	71	Complete	
		29/10/2018	0307	Cat	D	East	72-73	Complete	
		29/10/2018	1854	Cat	D	West	74	Complete	
		29/10/2018	2009	Cat w prey	D	East	75	Complete	
		30/10/2018	1345	Pheasant coucal	D	West	76	Complete	
		30/10/2018	2006	Cat	D	West	105	Complete	
		30/10/2018	2031	Cat	D	East	106	Complete	
	30/10/2018	2200	Cat	D	West	107	Complete		
	31/10/2018	0220	Cat	D	East	108	Complete		
31/10/2018	0450	Cat	D	East	109	Complete			

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		31/10/2018	1817	Cat	D	West	117	Complete	
		31/10/2018	2013	Cat	D	East	118	Complete	
		1/11/2018	0107	Cat	D	West	119	Complete	
		1/11/2018	0249	Cat	D	East	120	Complete	
		1/11/2018	2330	Cat	D	West	131	Complete	
		2/11/2018	0232	Cat	D	East	132	Complete	
		2/11/2018	2017	Cat	D	West	142	Complete	
		2/11/2018	2346	Cat	D	East	143	Complete	
		3/11/2018	0037	Cat	D	West	144	Complete	
		3/11/2018	0401	Cat	D	East	145	Complete	
		3/11/2018	2124	Cat	D	West	152	Complete	
		4/11/2018	0607	Fox	D	East	154	Complete	
		4/11/2018	1859	Cat	D	W-E	157-158	Incomplete	
		5/11/2018	0319	Cat	D	East	159	Complete	
		6/11/2018	0106	Cat	D	West	167	Complete	
		6/11/2018	0334	Cat	D	East	168	Complete	
		7/11/2018	0312	Cat	D	East	178	Complete	
		7/11/2018	1938	Cat	D	West	182	Complete	
		7/11/2018	2218	Cat	D	East	183	Complete	
		7/11/2018	2227	Fox	D	West	184	Complete	
		8/11/2018	2207	Cat	D	West	185	Complete	
		9/11/2018	0224	Brush-tail Possum spp	D	East	186	Complete	
		9/11/2018	0253	Cat	D	East	187	Complete	
		9/11/2018	0352	Swamp Wallaby	D	East	188	Complete	
		9/11/2018	1951	Cat	D	West	191	Complete	
		9/11/2018	2114	Fox	D	West	192	Complete	
		10/11/2018	0030	Cat	D	East	193-194	Complete	
		11/11/2018	0117	Cat	D	West	196	Complete	
		11/11/2018	0304	Cat	D	East	197	Complete	
		11/11/2018	0346	Swamp Wallaby	D	East	198-199	Complete	
		11/11/2018	2132	Swamp Wallaby	D	W-E	200	Incomplete	
		11/11/2018	2209	Cat	D	East	201	Complete	
		12/11/2018	0050	Cat	D	West	203	Complete	
		12/11/2018	0207	Fox w prey	D	East	204	Complete	
		12/11/2018	0350	Cat	D	East	205	Complete	
		13/11/2018	0154	Cat	D	East	206	Complete	
		15/11/2018	0319	Cat	D	West	215	Complete	
		15/11/2018	0538	Cat	D	East	216	Complete	
		17/11/2018	0109	Fox	D	West	236	Complete	
		18/11/2018	0239	Cat	D	East	239	Complete	
		19/11/2018	0312	Common Brush-tail possum	D	East	249	Complete	

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		19/11/2018	2124	Cat	D	East	250	Complete	
		20/11/2018	0424	Cat	D	West	251	Complete	
		20/11/2018	0526	Cat	D	East	252	Complete	
		21/11/2018	0059	Cat	D	West	255	Complete	
		21/11/2018	0358	Cat	D	East	256	Complete	
		21/11/2018	2100	Fox	D	W	25	Complete	
		21/11/2018	2107	Cat	D	E	26	Complete	
		21/11/2018	0221	Fox	D	E	27	Complete	
		21/11/2018	0236	Fox	D	W	28	Complete	
		23/11/2018	0225	Cat	D	W	32	Complete	
		23/11/2018	0406	Cat	D	E	33	Complete	
		24/11/2018	0311	Cat	D	E	35	Complete	
		24/11/2018	0440	EG Kangaroo	Pr	E	36	Complete	
		25/11/2018	0229	Fox	D	E	38	Complete	
		25/11/2018	2048	Cat	D	W	39	Complete	
		25/11/2018	2306	Cat	D	E	40	Complete	
		26/11/2018	0242	Hare	Po	E	41	Complete	
		26/11/2018	0314	Cat	D	E	42	Complete	
		27/11/2018	0110	Fox	Pr	W	43	Complete	
		27/11/2018	0323	Cat	D	E	44	Complete	
		27/11/2018	2316	SEBtP	D	W	45	Complete	
		28/11/2018	2129	Cat	D	W	46	Complete	
		28/11/2018	2319	Cat	D	E	47	Complete	
29/11/2018	0501	EG Kangaroo	Pr	E	48	Complete			
29/11/2018	2009	Cat	D	W	51	Complete			
2	Furniture	27/10/2018	2057	Black rat	D	W-E	41-46	Incomplete	
		28/10/2018	2049	Black rat	D	W-E	49-52	Incomplete	
		31/10/2018	2003	Black rat	D	W-E	91-94	Incomplete	
		2/11/2018	2124	Black rat	D	W	203	Complete	
		2/11/2018	2144	Black rat	D	E	205-208	Complete	
		7/11/2018	0045	Black rat	D	W-E	341-348	Incomplete	
		8/11/2018	0040	Black rat	Pr	W	381	Complete	
		17/11/2018	0213	Black rat	D	W-E	637-644	Incomplete	
	Ground	19/11/2018	0321	Echidna	D	East	11	Complete	
		20/11/2018	0502	Cat	D	East	12	Complete	
		20/11/2018	1925	Echidna	D	West	13	Complete	
		20/11/2018	2144	Echidna	D	West	14	Complete	
		21/11/2018	2340	Fox	D	East	15	Complete	
		23/10/2018	0122	Echidna	D	East	16-17	Complete	
		23/10/2018	2022	Echidna	D	East	18	Complete	
		24/10/2018	0329	Echidna	D	East	19	Complete	
		26/10/2018	1923	Swamp Wallaby	Pr	West	24	Complete	
		27/10/2018	0209	Swamp Wallaby	D	East	25	Complete	
		27/10/2018	2014	Swamp Wallaby	D	EXM	26-36	Incomplete	

Site	Side	Date	Time	Species	Accuracy	Movement	Pic/vid No.	Complete or incomplete	Comments
		28/10/2018	2338	Swamp Wallaby	D	East	38	Complete	
		29/10/2018	0045	Fox	D	East	39	Complete	
		29/10/2018	0243	Swamp Wallaby	D	East	40	Complete	
		29/10/2018	0410	Swamp Wallaby	D	East	41	Complete	
		30/10/2018	1834	Swamp Wallaby	D	West	42	Complete	
		31/10/2018	2353	Echidna	D	East	72	Complete	
		1/11/2018	0102	Echidna	D	East	73	Complete	
		2/11/2018	0218	Echidna	D	West	113	Complete	
		3/11/2018	2249	Echidna	D	East	153	Complete	
		23/11/2018	1223	Lace monitor	D	E	29	Complete	
		23/11/2018	1854	RN Wallaby	Pr	E	35	Complete	
		23/11/2018	2146	Black rat	Pr	E	36	Complete	
		24/11/2018	1934	Black rat	Pr	E	48	Complete	
		24/11/2018	2313	Fox	D	E	49	Complete	
		24/11/2018	2346	Cat	D	W	50	Complete	
		26/11/2018	0049	Echidna	D	E	59, 60	Complete	
		26/11/2018	0121	Wallaby spp.	D	E	61	Complete	
		26/11/2018	0237	Echidna	D	E	62	Complete	
		13/12/2018	2311	Med frog	D	NDM	2853	Incomplete	
		25/11/2018	2045	Echidna	D	W	1906	Complete	
10/12/2018	0017	Macropod spp.	D	W	519	Complete			
1	North	31/10/2018	1205	BtPoss spp	D	W	306	Complete	
		2/11/2018	2127	Swamp Wallaby	Pr	NDM	1948	Incomplete	
		3/11/2018	0222	Swamp Wallaby	D	W	2243,2246	Complete	
		3/11/2018	2329	Swamp Wallaby	Pr	E	2670	Complete	
		6/11/2018	0147	Medium frog spp	D	E	4008-4017	Complete	
		6/11/2018	1112	Medium frog spp	D	E	4453-4461	Complete	
		7/11/2018	1920	Medium frog spp	D	W	4821-4825	Complete	
		21/11/2018	2246	Medium frog spp	D	NDM	91-96	Complete	
		22/11/2018	0112	Medium frog spp	D	E	237-240	Complete	
		13/12/2018	2311	Medium frog spp	D	NDM	2853	Incomplete	
		25/11/2018	2045	Echidna	D	W	1906	Complete	
	South	10/12/2018	0017	Macropod spp.	D	W	519	Complete	

Table B4: Results from diurnal active searches. OBS = Observed, prob = probable.

Site	Date	Side	Day/Night (survey no.)	Obs	Start Time	Finish Time	Wind	Rain	Visibility	Air Temp	RH	Species (no. of individuals / behaviour)	Signs (scats/tracks)
11 & 12	26/10/2018	W	D1	NP	938	1010	RL	Nil	Good	22.5	76	Lampropholis spp.	OBS
												Wallaby spp.	Scats
	26/10/2018	E	D1	NP	1015	1045	RL	Nil	Good	22.5	76	Lace Monitor	OBS
												Yellow-faced whip snake	OBS
												Bandicoot spp.	Diggings
												Macropod spp.	Scat
												Lampropholis spp.	OBS
												Adelotis brevis	HC
												Little Eagle soaring above	
	14/11/2018	W	D2	DR	940	1010	Nil	Nil	Good	25	77	Lampropholis delicata x2	OBS
	14/11/2018	E	D2	DR	1015	1050	Nil	Nil	Good	25	77	Egernia mcphreei	OBS
												Lampropholis delicata	OBS
											Lampropholis spp.	OBS	
22/11/2018											Swamp Snake	Incidental obs	
9 & 10	26/10/2018	W	D1	NP	1110	1140	MsB	Nil	Good	23	73	Nil	
	26/10/2018	E	D1	NP	1145	1215	MsB	Nil	Good	23	73	Wallaby spp.	Tracks
												Bandicoot spp.	Diggings
												Echidna	Diggings
	14/11/2018	E	D2	DR	1100	1135	Nil	Nil	Good	25	75	Lampropholis spp.	OBS
	14/11/2018	W	D2	DR	1137	1210	Nil	Nil	Good	25	75	Lampropholis spp.	OBS
											Litoria fallax	Heard	
8	1/11/2018	E	D1	NM/OT	1217	1232	MsB	Nil	Good	23.9	75	Lampropholis spp.	OBS
												Wallaby spp.	Scat
	1/11/2018	W	D1	NM/OT	1233	1248	MsB	Nil	Good	23.9	75	Bandicoot spp.	Diggings
												Wallaby spp.	Scat
	14/11/2018	W	D2	DR	1300	1330	Nil	Nil	Good	28	75	Lampropholis delicata	OBS
												Lampropholis spp.	OBS
14/11/2018	E	D2	DR	1335	1410	Nil	Nil	Good	30	72	Nil		
7	1/11/2018	W	D1	NM/OT	1259	1314	MsB	Nil	Good	25.4	73	Wallaby spp.	Scat

Site	Date	Side	Day/Night (survey no.)	Obs	Start Time	Finish Time	Wind	Rain	Visibility	Air Temp	RH	Species (no. of individuals / behaviour)	Signs (scats/tracks)
	1/11/2018	E	D1	NM/OT	1315	1330	Msb	Nil	Good	24.7	69	Wallaby spp.	Scat
												Bandicoot spp.	Diggings
	16/11/2018	W	D2	LA	1400	1430	Nil	Light shower	Good	26	70	Wallaby spp.	Scat
												Small Scincidae spp.	OBS
	16/11/2018	E	D2	NP	1400	1430	Nil	Light shower	Good	26	70	Nil	
5 & 6	6/11/2018	W	D1	NP	1047	1120	Nil	Nil	Good	26.9	75	Lampropholis delicata	OBS
	6/11/2018	E	D1	NP	1120	1150	Nil	Nil	Good	26.9	75	Carpet Python	OBS
												Lampropholis delicata	OBS
												Swamp Wallaby	Scat
												Tadpoles (prob Lit. tyleri, Lit peronii)	OBS
												Freshwater Turtle spp.	OBS
	16/11/18	W	D2	NP/LA	1145	1200	Nil	Nil	Good	22.6	74	Swamp snake	OBS
												Wallaby spp.	Tracks
												Lampropholis spp.	OBS
												Bandicoot spp.	Diggings
	16/11/18	E	D2	NP/LA	1200	1215	Nil	Nil	Good	22.6	74	Wallaby spp.	Scat, tracks
												Large snake spp.	Skin
												Lampropholis spp.	Obs
												Lampropholis delicata	OBS
											Fox	Tracks	
											Tadpoles (prob Lit. tyleri, Lit. peronii)	OBS	
4	11/06/2018	W	D1	NP	1200	1230	Nil	Nil	Good	26	76	Lampropholis delicata	OBS
												Swamp Wallaby	OBS
	11/06/2018	E	D1	NP	1230	1300	Nil	Nil	Good	26	76	Lampropholis spp.	OBS
												Swamp Wallaby	Scat
	16/11/2018	W	D2	LA	1320	1350	Nil	Nil	Good	23.7	75	Swamp Wallaby (prob)	Heard

Site	Date	Side	Day/Night (survey no.)	Obs	Start Time	Finish Time	Wind	Rain	Visibility	Air Temp	RH	Species (no. of individuals / behaviour)	Signs (scats/tracks)
												Lampropholis spp.	OBS
	6/11/2018	E	D2	NP	1320	1350	Nil	Nil	Good	23.7	75	Lampropholis spp.	OBS
												Burton's Legless Lizard (prob)	OBS
												Bandicoot spp.	Diggings
3	9/11/2018	E	D1	NP	1130	1200	Nil	Nil	Good	22	55	Lampropholis spp.	OBS
												Wallaby spp.	Scat
												Bandicoot spp.	Diggings
	14/11/2018	W	D1	NP	920	950	Nil	Nil	Good	24	53	Bandicoot spp.	Diggings
												Lampropholis spp.	OBS
												EW Dragon	Scat
	16/11/2018	W	D2	NP/LA	1200	1245	Nil	Nil	Good	24.3	74	Calyptotis ruficauda (prob)	OBS
											EW Dragon	Scat	
16/11/2018	E	D2	NP/LA	1245	1300	Nil	Nil	Good	24.3	74	Bandicoot spp.	Diggings	
2	9/11/2018	E	D1	NP	1020	1050	Nil	Nil	Good	21.3	53	Lampropholis spp.	OBS
												Wallaby spp.	Scats
												Echidna	Diggings
												Bandicoot spp.	Diggings
	11/09/2018	W	D1	NP	1050	1120	Nil	Nil	Good	21.3	53	Wallaby spp.	Scats
												Lampropholis spp.	OBS
	14/11/2018	W	D2	NP	1330	1400	MLB	Nil	Good	26	62	Bandicoot spp.	Diggings
												Wallaby spp.	Scat
												Lampropholis spp.	Obs
	14/11/2018	E	D2	NP	1400	1430	MLB	Nil	Good	26	62	Echidna	Tracks and diggings
											Bandicoot	Diggings	
											Lampropholis spp.	OBS	
1	8/11/2018	E	D1	NP	1230	1300	Msb	Nil	Good	20.2	60	Wallaby spp.	Scat
	8/11/2018	W	D1	NP	1300	1330	Msb	Nil	Good	20.2	60	Eastern Water Dragon	OBS
												Wallaby spp.	Scat
	14/11/2018	E	D2	NP	1100	1130	RL	Nil	Good	25.6	54	EW Dragon	OBS

Site	Date	Side	Day/Night (survey no.)	Obs	Start Time	Finish Time	Wind	Rain	Visibility	Air Temp	RH	Species (no. of individuals / behaviour)	Signs (scats/tracks)
												Wallaby spp.	Scats
												Water Skink	OBS
	14/11/2018	W	D2	NP	1130	1200	RL	Nil	Good	25.6	54	Red-bellied Black Snake	OBS
												EW Dragon	OBS
												Wallaby spp.	Scat
												Total 18 species and 6 groups detected.	

Table B5: Results from nocturnal active searches. Upe = Uperolia spp., P. coriacea = Pseudophryne coriacea, ONj = Owlet-nightjar, A. = Adeltus, M. = Mixophyes, Lim. = Limnodynastes, Lit = Litoria, YBG = Yellow-bellied glider.

Location	Side	Date	Obs. No.	Observers	Start	Finish	Species	Wind	Rain	Visibility	Air Temp	RH	Comment
11&12	E	08/11/2018	1	DR	2215	2245	P. coriacea, A. brevis, Upe. spp., Wallaby spp.	Nil	Nil	Good	15.6	65	
	W	08/11/2018	1	NP	2215	2245	Nil	Nil	Nil	Good	15.6	65	
	E	21/11/18	2	NP/NM	2230	2255	P. coriacea, A. brevis	Nil	Nil	Moderate	23	90	
	W	21/11/2018	2	DR, LA	2255	2315	Nil	Nil	Nil	Moderate	23	90	
9&10	E	08/11/2018	1	DR	2140	2210	ONj, P. coriacea	Nil	Nil	Good	16	64	
	W	08/11/2018	1	NP	2140	2210	A. brevis, P. coriacea	Nil	Nil	Good	16	64	
	E	21/11/2018	2	DR, LA	2235	2250	M. fasciolatus, A. brevis	Nil	Nil	Moderate	23	90	
	W	21/11/2018	2	DR, LA	2215	2230	P. coriacea	Nil	Nil	Moderate	23	90	
8	E	08/11/2018	1	DR	2107	2137	P. coriacea, A. brevis	RL	Nil	Good	16.1	65	
	W	08/11/2018	1	NP	2107	2137	A. brevis, Lit. fallax	RL	Nil	Good	16.1	65	
	E	21/11/2018	2	DR, LA	2145	2205	Sugar glider, Lim. peroni, A. brevis	Nil	light	Moderate	23	88	
	W	21/11/2018	2	DR, LA	2120	2140	Sugar glider, Lit. fallax, A. brevis; YBG (496489; 6609135)	Nil	light	Moderate	23	88	YBG heard calling from east side of H'way, clear call heard by both obs.
7	E	08/11/2018	1	DR	2030	2100	P. coriacea	Nil	Nil	Good	16.1	67	
	W	08/11/2018	1	NP	2030	2100	P. coriacea, A. brevis	Nil	Nil	Good	16.1	67	
	E	21/11/2018	2	DR, LA	2050	2110	A. brevis	Nil	light	Moderate	23	88	
	W	21/11/2018	2	DR, LA	2025	2040	Petaurus spp. (prob breviceps), A. brevis, P. coriacea	Nil	light	Moderate	23	88	
5&6	E	08/11/2018	1	DR	1950	2025	TF, Lit. peronii, Lit. fallax	Msb	Nil	Good	18.4	63	
	W	08/11/2018	1	NP	1950	2025	P. coriacea, Lit. tyleri, Long-finned eel	Msb	Nil	Good	18.4	63	Eel heading west in fish passage
	E	19/11/18	2	DR, LA	2320	2335	L. fallax, L. peroni, L. tyleri	Nil	Nil	Good	17.5	81	
	W	19/11/18	2	DR, LA	2300	2315	Ps. coriacea	Nil	Nil	Good	17.5	81	

4	E	16/11/2018	1	NP	1945	2015	Nil	Nil	Showers	Poor	20.6	83		
	W	16/11/18	1	NP	2015	2045	Nil	Msb	Rain	Poor	20	88		
	E	19/11/18	2	DR, LA	2125	2145	Ps. coriacea, Lim. peroni	Nil	Nil	Good	16.5	81		
	W	19/11/18	2	DR, LA	2105	2120	Ps. coriacea	Nil	Nil	Good	16.5	81		
3 (E only)	E	21/11/18	1	NP/NM	1955	2022	Ps. coriacea, Upe. fusca, C. signifera	Nil	Moderate	Moderate	22.4	90		
	E	22/11/18	2	NP/NM	1955	2015	SEBtP, Wallaby spp., Ps. coriacea	RL	Nil	Moderate	25.6	27	Dust storm	
2	E	19/11/18	1	DR, LA	2230	2245	Ps. coriacea	Nil	Nil	Good	16.8	64		
	W	19/11/18	1	DR, LA	2205	2220	Nil	Nil	Nil	Good	16.8	64		
	E	21/11/18	2	NP/NM	2047	2104	A. brevis, C. signifera	Nil	Light	Moderate	21	97		
	W	21/11/18	2	NP/NM	2030	2045	Wallaby spp.	Nil	Light	Moderate	21	97		
1	E	19/11/18	1	DR, LA	2000	2015	Microbat spp.	Nil	Nil	Good	18	69.7		
	W	19/11/18	1	DR, LA	2020	2040	L. fallax, L. chloris, A. Brewis, M. iteratus (M, at trib), SEBtP x 2, swamp wallaby	Nil	Nil	Good	18	69.7		
	E	21/11/18	2	NP/NM	2200	2220	EW Dragon	Nil	Nil	Good	20	90		
	W	21/11/18	2	NP/NM	2130	2200	M. iteratus x 2 (F1: 489368, 6594460, M: 5m SW of previous location), A. brevis, L. fallax, EW Dragon	Nil	Nil	Good	20	90		
								Totals: 15 species and 4 groups detected						

Table B6: Adjacent habitat trapping data.

Site	Date	Trap type	Species	Sex	Weight	Comments
1 east	19/11/2018	Small cage	Black rat	F	NR	
1 east	19/11/2018	Large cage	Black rat	F	NR	
1 east	21/11/2018	Small elliott	Black rat	M	130	
1 west	19/11/2018	Small cage	Black rat	F	130g	Euthanised
1 west	21/11/2018	Small elliott	Black rat	F	130	Euthanised
1 west	21/11/2018	Large elliott	SEBtP	M	NR	
2 east	19/11/2018	Small elliott	Melomys spp.	M	87g	
2 east	19/11/2018	Small elliott	Melomys spp.	F	82g	Lactating
2 east	20/11/2018	Small elliott	Fawn-footed melomys	M	92g	
2 east	20/11/2018	Pitfall	Lampropholis delicata	Uk	NA	
2 east	21/11/2018	Small elliott	Black rat	F	150	
2 east	21/11/2018	Small elliott	Bush rat	M	120	
2 west	20/11/2018	Large cage	Black rat	M	NR	
2 west	20/11/2018	Pitfall	Lampropholis guichenoti	Uk	NA	
2 west	21/11/2018	Small elliott	Black rat	UK	NA	
3 east	15/11/2018	Pitfall	Lampropholis delicata x 2	UK	NA	
3 east	18/11/2018	Pitfall	Calyptotis ruficauda	Uk	NA	
3 east	18/11/2018	Pitfall	Lampropholis delicata	F		
3 west	16/11/2018	Pitfall	Calyptotis ruficauda	UK	NA	
3 west	16/11/2018	Pitfall	Calyptotis ruficauda	UK	NA	
3 west	17/11/2018	Pitfall	Lampropholis delicata	UK	NA	RN Wallaby in veg patch .
3 west	18/11/2018	Pitfall	Calyptotis ruficauda	UK	NA	
3 west	18/11/2018	Pitfall	Lampropholis guichenoti	UK	NA	
3 west	20/11/2018	Pit fall	Lampropholis guichenoti	UK	NA	
4 east	17/11/2018	Pitfall	Pseudophryne coriacea	UK	NA	
4 west	15/11/2018	Pitfall	Blackish blind snake	UK	NA	
4 west	18/11/2018	Small elliott	Black rat	M	183g	Euthanised
5&6 east	14/11/2018	Pitfall	Lampropholis delicata x 2	UK	NA	All animals in same trap.
5&6 west	14/11/2018	Pitfall	Lampropholis delicata	UK	NA	
5&6 west	15/11/2018	Small cage	Bush rat	M	120g	
5&6 west	15/11/2018	Small elliott	Bush rat	M	155g	
5&6 west	16/11/2018	Large cage	Northern brown bandicoot	UK	NA	
5&6east	15/11/2018	Pitfall	Calyptotis ruficauda	UK	NA	
7 east	16/11/2018	Pitfall	Lampropholis gitchinoti	UK	NA	
7 west	14/11/2018	Pitfall	Lampropholis delicata	UK	NA	
7 west	14/11/2018	Small cage	SEBtP	UK	NA	Released immediately
7 west	15/11/2018	Pitfall	Calyptotis ruficauda	UK	NA	
8 west	13/11/2018	Small elliott	Fawn-footed melomys	F	80g	Lactating teats
8 west	13/11/2018	Small elliott	Brown antechinus	F	30g	Evidence of recent pouch young
8 west	15/11/2018	Small elliott	Brown antechinus	F	37g	Evidence of recent pouch young
8west	14/11/2018	Small elliott	Fawn-footed melomys	Male	87g	
8west	14/11/2018	Pitfall	Red-backed toadlet	UK	NA	
9&10 east	14/11/2018	Pitfall	Lampropholis delicata	UK	NA	
9&10 east	15/11/2018	Large cage	SEBtP	UK	NA	
9&10 west	13/11/2018	Large cage	Black rat	F	NA	Euthanised
9&10 west	14/11/2018	Small cage	Black rat	M	NA	Euthanised

Site	Date	Trap type	Species	Sex	Weight	Comments
9&10 west	15/11/2018	Small cage	Black rat	UK	NA	Escaped
9&10 west	15/11/2018	Small elliot	Brown antechinus	UK	24g	
11&12 east	13/11/18	Pitfall	<i>Calyptotis ruficauda</i>	UK	NA	
11&12 west	14/11/2018	Pitfall	Striped marsh frog	Uk	NA	
11&12 west	14/11/2018	Small cage	Black rat	Male	100g	Euthanised
11&12 west	14/11/2018	Pitfall	<i>Lampropholis delicata</i>	UK	NA	

Table B7: Results from hair funnel sampling in adjacent habitat. BtPoss = Brushtail possum species, CRtP = Common ringtail possum.

Site	Side	Spring 2018		
		Install Date	Collect date	Fauna
1	E-1	12-16/11/18	30/11/2018	BtPoss spp.
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	BtPoss spp.
	W-2	12-16/11/18	30/11/2018	Rattus spp.
2	E-1	12-16/11/18	30/11/2018	
	E-2	12-16/11/18	30/11/2018	Bush rat
	W-1	12-16/11/18	30/11/2018	Black rat
	W-2	12-16/11/18	30/11/2018	
3	E-1	12-16/11/18	30/11/2018	
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	Northern brown bandicoot
	W-2	12-16/11/18	30/11/2018	
4	E-1	12-16/11/18	30/11/2018	
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	
	W-2	12-16/11/18	30/11/2018	
5 & 6	E-1	12-16/11/18	30/11/2018	
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	Rattus spp.
	W-2	12-16/11/18	30/11/2018	
7	E-1	12-16/11/18	30/11/2018	BtPoss spp.
	E-2	12-16/11/18	30/11/2018	Bush rat
	W-1	12-16/11/18	30/11/2018	

Site	Side	Spring 2018		
		Install Date	Collect date	Fauna
	W-2	12-16/11/18	30/11/2018	
8	E-1	12-16/11/18	30/11/2018	CRtP
	E-2	12-16/11/18	30/11/2018	BtPoss spp.
	W-1	12-16/11/18	30/11/2018	BtPoss spp.
	W-2	12-16/11/18	30/11/2018	
9 & 10	E-1	12-16/11/18	30/11/2018	BtPoss spp.
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	
	W-2	12-16/11/18	30/11/2018	
11 & 12	E-1	12-16/11/18	30/11/2018	Carnivora spp.
	E-2	12-16/11/18	30/11/2018	
	W-1	12-16/11/18	30/11/2018	
	W-2	12-16/11/18	30/11/2018	

Table B8: Sandpad data.

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
12 median west	497115	6610068	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	nil	Good
			West	31/11/2018		Nil	Good
			East	1/11/2018	Insp2	Cat (definite, 1e)	Fair
			West	1/11/2018		Cat (definite, 1e)	Fair
			East	2/11/2018	Insp3	Nil	Fair
			West	2/11/2018		Nil	Fair
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Fair
			East	4/11/2018	Insp5	Small reptile (definite, 1e,1w), medium reptile (definite, 3 e, 1w)	Fair
			West	4/11/2018		Medium reptile (definite, 2e, 1w meandering)	Fair
			East	5/11/2018	Insp6	Small reptile (definite, 2w, 1e, 1 meandering) cat (definite 1w meandering)	Fair
			West	5/11/2018		Small reptile (definite, 1w, 1e) cat (definite 1w)	Fair
		East	6/11/2018	Insp7	Lace monitor (definite 1e), medium size reptile (definite 1e, 1w) small reptile (definite, 1e 1w)	Fair	

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
			West	6/11/2018		Lace monitor (definite 1e), medium size reptile (definite 1e, 1w) small reptile (definite, 1e 1w)	Fair
			East	7/11/2018	Insp8	Small reptile (definite 2e2w)	Poor
			West	7/11/2018		Small reptile (definite 2e2w)	Poor
11 median east	497168	6610040	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Nil	Good
			West	31/10/2018		Nil	Good
			East	1/11/2018	Insp2	Cat (definite, 1e)	Good
			West	1/11/2018		Cat (definite, 1e)	Fair
			East	2/11/2018	Insp3	Nil	Fair
			West	2/11/2018		Nil	Fair
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Fair
			East	4/11/2018	Insp5	Nil	Good
			West	4/11/2018		Nil	Fair
			East	5/11/2018	Insp6	Nil	Fair
			West	5/11/2018		Nil	Fair
			East	6/11/2018	Insp7	Lace monitor (definite 1e), medium reptile (definite 1e) cat (probable 1e)	Fair
			West	6/11/2018		Lace monitor (definite 1e), medium reptile (definite 1e) cat (probable 1e)	Fair
		East	7/11/2018	Insp8	Nil	Poor	
		West	7/11/2018		Nil	Poor	
10 median west	496622	6609409	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Small mammal (possible:1 track e/w)	Good
			West	31/10/2018		Nil	Good
			East	1/11/2018	Insp2	Nil	Fair
			West	1/11/2018		Nil	Fair
			East	2/11/2018	Insp3	Nil	Fair
			West	2/11/2018		Nil	Fair
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Fair
			East	4/11/2018	Insp5	Nil	Fair
			West	4/11/2018		Nil	Fair
			East	5/11/2018	Insp6	Nil	Fair
			West	5/11/2018		Nil	Fair
			East	6/11/2018	Insp7	Nil	Fair
			West	6/11/2018		Nil	Good
		East	7/11/2018	Insp8	Cat (definite 1w)	Poor	
		West	7/11/2018		Cat (definite 1w)	Poor	
9 median east	496622	6609409	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10-18	Insp1	Nil	Fair
			West	31/10/2018		Nil	Good

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
			East	1/11/2018	Insp2	Nil	Fair
			West	1/11/2018		Nil	Fair
			East	2/11/2018	Insp3	Nil	Fair
			West	2/11/2018		Nil	Fair
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Good
			East	4/11/2018	Insp5	Nil	Fair
			West	4/11/2018		Nil	Fair
			East	5/11/2018	Insp6	Nil	Fair
			West	5/11/2018		Nil	Fair
			East	6/11/2018	Insp7	Rat sp. (probable, 1e)	Fair
			West	6/11/2018		Rat sp. (probable, 1e)	Fair
			East	7/11/2018	Insp8	Cat (definite 1w)	Poor
			West	7/11/2018		Cat (definite 1w) small Dasyurid (probable 1e)	Poor
8 full length	496506	6609219	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Lace monitor (definite:1track e/w), Bandicoot sp. (definite 1track e/w), LN Potoroo (possible, 1track w/e)	Good
			West	31/10/2018		Lace monitor (definite:1track e/w), Bandicoot sp. (definite 1 track e/w), Bandicoot sp. (definite 1 track w/e).	Good
			East	1/11/2018	Insp2	Lace monitor (definite, 1 w), echidna (probable, 1 w)	Good
			West	1/11/2018		Lace monitor (definite, 1w), echidna (probable, 1 w)	Fair
			East	2/11/2018	Insp3	Cat (definite 1e)	Fair
			West	2/11/2018		Cat (definite, 1e)	Fair
			East	3/11/2018	Insp4	Definite lace monitor (1e) fox (probable, 1 e), definite medium sized reptile (1 e)	Fair
			West	3/11/2018		Definite lace monitor (1e) fox (probable, 1 e), definite medium sized reptile (1 e), Dasyurid(possible, 1e)	Fair
			East	4/11/2018	Insp5	Lace monitor (definite, 1w), Frog(definite, 1e)	Fair
			West	4/11/2018		Lace monitor (definite, 1w), Frog(definite, 1e)	Fair
			East	5/11/2018	Insp6	Dasyurid (possible 1w) small rodent (probable 1e)	Fair
			West	5/11/2018		Dasyurid (possible 2w 1e), probable small rodent (1e)	Fair
			East	6/11/2018	Insp7	Lace monitor (definite 1e)	Fair
			West	6/11/2018		Lace monitor (definite 1e) dasyurid (probable 1w)	Fair
			East	7/11/2018	Insp8	Cat (definite 1e1w), brushtail possum (definite 1e)	Fair
		West	7/11/2018		Cat (definite 1e1w), brush tail possum (definite 1e)	Fair	
7 full length	496438	6608780	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Nil	Good
			West	31/10/2018		Nil	Good
			East	1/11/2018	Insp2	Nil	Good
			West	1/11/2018		Nil	Good
			East	2/11/2018	Insp3	Nil	Good
			West	2/11/2018		Nil	Good
			East	3/11/2018	Insp4	Definite swamp wallaby (1e)	Good

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
			West	3/11/2018		Definite swamp wallaby(1e,1w)	Good
			East	4/11/2018	Insp5	Cat (definite 1w)	Good
			West	4/11/2018		Cat (definite 1w)	Good
			East	5/11/2018	Insp6	Nil	Good
			West	5/11/2018		Definite swamp wallaby(1e,1w)	Good
			East	6/11/2018	Insp7	Nil	Good
			West	6/11/2018		Nil	Good
			East	7/11/2018	Insp8	Lace monitor (definite, 1w)	Good
			West	7/11/2018		Lace monitor (definite, 1w)	Good
6 full length	496188	6608319	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Nil	Good
			West	31/10/2018		Nil	Good
			East	1/11/2018	Insp2	Cat (definite, 1 e)	Good
			West	1/11/2018		Cat (definite, 1e)	Good
			East	2/11/2018	Insp3	Fox (probable 1 w)	Good
			West	2/11/2018		Fox (probable 1w)	Fair
			East	3/11/2018	Insp4	Probable cat (1e)	Fair
			West	3/11/2018		Probable cat (1e,1w)	Fair
			East	4/11/2018	Insp5	Possible small mammal(1e)	Fair
			West	4/11/2018		Nil	Fair
			East	5/11/2018	Insp6	Nil	Fair
			West	5/11/2018		Nil	Fair
			East	6/11/2018	Insp7	Dasyurid (possible 1e)	Fair
			West	6/11/2018		Nil	Fair
		East	7/11/2018	Insp8	Nil	Fair	
		West	7/11/2018		Dasyurid (possible 1e)	Fair	
5			West	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			West	31/10/2018	Insp1	Nil	Good
			West	31/10/2018		Nil	Good
			West	1/11/2018	Insp2	Nil	Fair
			West (water)	1/11/2018		Cat (definite, 2e,2w)	Fair
			East	2/11/2018	Insp3	Nil	Fair
			West	2/11/2018		Nil	Fair
			West (water)	2/11/2018		Nil	Fair
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Fair
			West	3/11/2018		Nil	Fair
			East	4/11/2018	Insp5	Small reptile (probable, 1e)	Fair
			West	4/11/2018		Rat sp, (definite, 1e,1w, 1ew)	Fair
		West	4/11/2018		Small reptile (probable, 1e)	Fair	

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
			East	5/11/2018	Insp6	Nil	Fair
			West	5/11/2018		Rat sp, (definite, 1e,1w)	Fair
			West	5/11/2018		Definite bandicoot (1e1w)	Fair
			East	6/11/2018	Insp7	Dasyurid (possible 1w)	Fair
			West	6/11/2018		Nil	Fair
			West	6/11/2018		Nil	Fair
			East	7/11/2018	Insp8	Rat sp (definite 1e1w)	Fair
			West	7/11/2018		Rat sp (definite 1e1w)	Fair
			West	7/11/2018		Rat sp (definite 1e1w)	Fair
4	495702	6607693	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Koala (definite: 1 e)	Good
			West	31/10/2018		Koala (definite: 1 e)	Good
			East	1/11/2018	Insp2	Lace monitor(definite: 1e)	Good
			West	1/11/2018		Lace monitor (definite , 1e)	Good
			East	2/11/2018	Insp3	Cat (definite, 1e 1w) Fox(definite 1e)	Good
			West	2/11/2018		Cat (definite 1 e 1w) Fox (definite 1 e)	Good
			East	3/11/2018	Insp4	Lace monitor (2w)	Good
			West	3/11/2018		Lace monitor (2w)	Good
			East	4/11/2018	Insp5	Koala (definite 1w) medium reptile (definite 1e) lace monitor (definite 1e)	Good
			West	4/11/2018		Koala (definite 1w) medium reptile (definite 1e) lace monitor (definite 1e)	Good
			East	5/11/2018	Insp6	Nil	Good
			West	5/11/2018		Nil	Good
			East	6/11/2018	Insp7	Nil	Good
			West	6/11/2018		Nil	Good
		East	7/11/2018	Insp8	Lace monitor (definite, 1w)	Good	
		West	7/11/2018		Lace monitor (definite, 1w)	Good	
3	495082	6606515	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Cat (definite, 3e, 2w)	Good
			West	31/10/2018		Cat (definite, 1e,1 canid (probable 1 e)	Good
			East	1/11/2018	Insp2	Cat (definite, 1e, 1 w)	Fair
			West	1/11/2018		Cat (definite, 2e, 1 w)	Fair
			East	2/11/2018	Insp3	Cat (probable 1w), Fox (definite 1e)	Fair
			West	2/11/2018		Cat probable (1 w), Fox (probable e)	Fair
			East	3/11/2018	Insp4	Cat (definite, 1 e 1w) fox(probable 1w)	Fair
			West	3/11/2018		Cat (definite, 1 e) fox (probable 1e1w)	Fair
			East	4/11/2018	Insp5	Fox(definite, 1e,1w) Brushtail possum (definite, 1w)	Poor
			West	4/11/2018		Fox(definite, 1e,1w) Brushtail possum (definite, 1w)	Poor
			East	5/11/2018	Insp6	Fox(definite 2e,1w)	Poor
			West	5/11/2018		Fox(definite 2e,1w)	Poor
			East	6/11/2018	Insp7	Fox(definite 1e,1w)	Poor
			West	6/11/2018		Fox(definite 1e, 1w)	Poor
		East	7/11/2018	Insp8	Fox (probable 1e) bandicoot (definite 1w)	Poor	

Location	Easting	Northing	Sand pad	Date	Action	Species (direction & no passes)	Pad condition
			West	7/11/2018		Fox (probable 1e) bandicoot (definite 1w)	Poor
2	494477	6605329	East	30/10/2018	Install	NA	
			West	30/10/2018		NA	
			East	31/10/2018	Insp1	Nil	Good
			West	31/10/2018		Nil	Good
			East	1/11/2018	Insp2	Echidna(definite, 1 w/meander)	Good
			West	1/11/2018		Echidna(definite, 1e, 1w/meander)	Good
			East	2/11/2018	Insp3	echidna (definite, 1 w) dasyurid (possible 1w)	Good
			West	2/11/2018		echidna (definite, 1 w) dasyurid (possible 1w)	Good
			East	3/11/2018	Insp4	Nil	Fair
			West	3/11/2018		Nil	Good
			East	4/11/2018	Insp5	Echidna (definite 1w)	Good
			West	4/11/2018		Echidna (definite 1w)	Good
			East	5/11/2018	Insp6	Definite bandicoot (1e1w)	Fair
			West	5/11/2018		Definite bandicoot (1e1w)	Fair
			East	6/11/2018	Insp7	Fox (definite, 1w) echidna (probable 1e) dasyurid (possible 1e)	Fair
			West	6/11/2018		Fox (definite, 1w) echidna (probable 1e)	Fair
East	7/11/2018	Insp8	Echidna (definite 1w), dasyurid (possible 2e 1w) rat sp(definite 1e)	Fair			
West	7/11/2018		Echidna (definite 1w), dasyurid (possible 1e 1w) rat sp(definite 1e)	Fair			
1	489375	6594290	North	14/11/2018	Install		
			South	14/11/2018			
			North	15/11/2018	Insp 1	Nil	Dry
			South	15/11/2018		Medium bird (prob 1e)	Dry
			North	16/11/2018	Insp 2	Nil	Dry, water added
			South	16/11/2018		Nil	Dry, water added
			North	17/11/2018	Insp 3	Wallaby sp. (1/e)	Dry, water added
			South	17/11/2018		Nil	Dry, water added
			North	18/11/2018	Insp 4	Small bird (1/e)	
			South	18/11/2018		Small bird (1/w); small lizard (1/w)	
			North	19/11/2018	Insp 5	Nil	
			South	19/11/2018		Nil	
			North	20/11/2018	Insp 6	Nil	
			South	20/11/2018		Nil	
			North	21/11/2018	Insp 7	Nil	
			South	21/11/2018		Med reptile (def 1/?), small reptile (prob 1/?)	
North	22/11/2018	Insp 8	Water bird (def 1/w)				
South	22/11/2018		Waterbird (def 1/meander)				

Table B9: Scat and Track search data.

Site	Cell	Date	Check no.	Scats/tracks	Comments
1	Bridge	26/10/2018	1	Wallaby sp. tracks, fox scats, large amphibian scat.	Scat in front of cam on south side
		8/11/2018	2	Wallaby sp. tracks, Bandicoot scats, rodent scats, Wallaby sp. scats. Dead EW Dragon stuck in fauna fence.	
2	1	17/10/2018	1	Nil	
		31/10/2018	2	Nil	
3	1	17/10/2018	1	Rat scat ground (pic), Bird scat on rail and ground	
		31/10/2018	2	Miniopterus sp. x2, Large frog scat.	
4	1	17/10/2018	1	Nil	
		31/10/2018	2	Nil	
5	2	17/10/2018	1	Nil	
		31/10/2018	2	E. Water Dragon (full crossing), microbat scat, rodent tracks.	
6	1	17/10/2018	1	Nil	
		31/10/2018	2	Nil	
7	1	17/10/2018	1	Brushtail possum scat	On FF
		31/10/2018	2	Wallaby sp. scat, Brushtail possum scat.	CBtP prob on FF (location of scat)
8	1	17/10/2018	1	Nil	
		31/10/2018	2	Nil	
9 & 10	East	17/10/2018	1	Nil	
	West	17/10/2018	1	Nil	
	East	31/10/2018	2	Cat tracks, fox tracks	
	West	17/10/2018	2	Cat tracks, Rattus sp.	
11 & 12	West	16/10/2018	1	Nil	
	East	16/10/2018	1	Nil	
	West	31/10/2018	2	Nil	
	East	31/10/2018	2	Nil	



rms.nsw.gov.au



13 22 13



Customer feedback
Roads and Maritime
Locked Bag 928,
North Sydney NSW 2059