



Northern Beaches Hospital Connectivity and
Network Enhancements Project:
Ecological Monitoring Program Implementation 2016/17

FINAL REPORT

Prepared for Ferrovial York Joint Venture

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Biosis offices

NEW SOUTH WALES

Albury

Phone: (02) 6069 9200
Email: albury@biosis.com.au

Newcastle

Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

VICTORIA

Ballarat

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne

Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta

Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

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Prepared by: Luke Stone
Callan Wharfe

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Glossary

DEE	Department of the Environment and Energy
DPI	Department of Primary Industry
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
NSW	New South Wales
NV Act	<i>Native Vegetation Act 2003</i>
NW Act	<i>Noxious Weed Act 1993</i>
OEH	NSW Office of Environment and Heritage
BC Act	<i>Biodiversity Conservation Act 2016</i>

1 Introduction

Biosis Pty Ltd was commissioned by Ferrovial York Joint Venture (FYJV) to undertake the implementation of components of the Northern Beaches Hospital and Connectivity Network Enhancement Ecological Monitoring Program (NBHCNE EMP) for the Northern Beaches Hospital Connectivity and Network Enhancement Project (the Project). This EMP (Biosis 2016a) was developed to outline specific measures to be undertaken to monitor the effectiveness of prescribed mitigation measures outlined in the Flora and Fauna Management Plan (FFMP) (FYJV 2015).

The Project has been assessed under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and classified as State Significant Infrastructure (SSI). Infrastructure approval for Stage 1 has been issued (SSI-6434) 29 June 2015, and Stage 2 Infrastructure approval (SSI-6622) 25 February 2016 has also been issued, both of which are subject to provision of formal Conditions of Approval (CoA). The NBHCNE EMP has been prepared in accordance with these conditions.

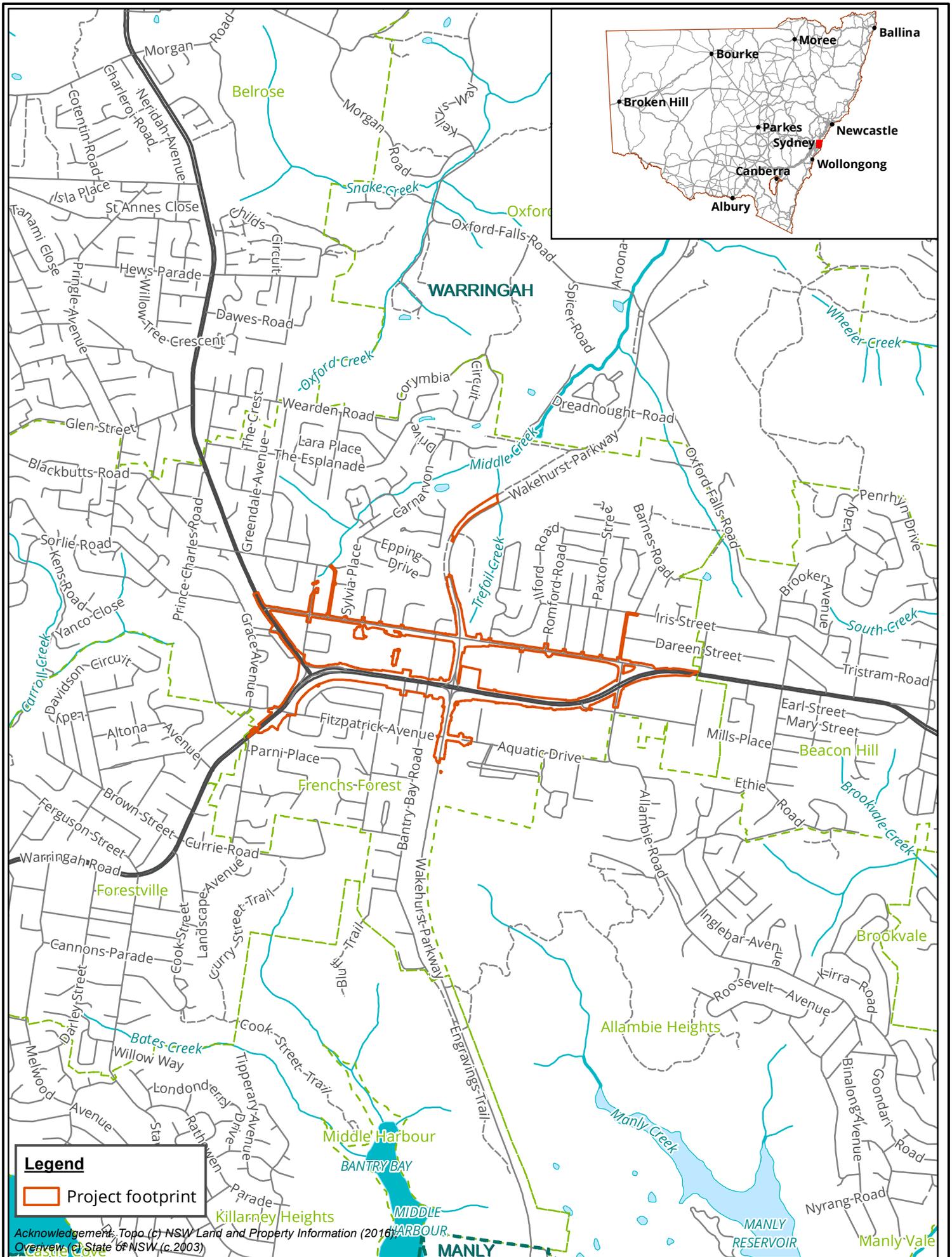
1.1 Project background

This report addresses the first 12 months of the NBHCNE EMP implementation for stage one works. The monitoring tasks included in the first 12 months of the NBHCNE EMP implementation for stage one works and the reporting responsibilities for each task are provided in Table 1. Biosis has been commissioned by FYJV to undertake four components of the NBHCNE EMP, these components include Red-crowned Toadlet monitoring surveys, microbat monitoring, weed and pathogen monitoring. This annual report summarises the data collected during the implementation of these four tasks required to implement the NBHCNE EMP. This report will also make assessments based on the listed performance parameters / assessment criteria in line with *Table 3.3 Monitoring Actions* of the NBHCNE EMP (Biosis 2016a), provided in Appendix 1.

Table 1 NBHCNE EMP implementation tasks and responsibilities

Action	Monitoring event over 12 Months from July 2016				Survey effort	Reporting responsibilities
Red-crowned Toadlet Monitoring	October – November (spring) during suitable weather conditions		March – April (autumn) during suitable weather conditions		2 surveys of each transect (6 total) per night	Biosis
Monitoring and of nest boxes	Initial inspection "prior to completion of construction (August – November 2016)"		Follow-up inspection following completion of construction (March – April 2017)		Up to 171 boxes for inspection	Biosis
Pathogen and Weed Monitoring	Q1 – July 2016	Q2 – November 2016	Q3 – March 2017	Q4 – June 2017	Survey location as per mapping in Weed and Pathogen Management Plan	Biosis
Microbat habitat monitoring	Winter monitoring of culverts August 2016	Pre-disturbance surveys (1 week prior to disturbance) August 2016	Supervision of culvert disturbance August 2016		Inspection of 2 culverts along Curl Curl Creek	Biosis

Action	Monitoring event over 12 Months from July 2016	Survey effort	Reporting responsibilities
Annual reporting to Secretary, OEH and relevant Council, or as otherwise agreed	Annual – data collation following each monitoring event to work towards and progressively build annual report.		FYJV
Revegetation Monitoring	<i>Revegetation to be completed.</i>		FYJV
Road Kill Monitoring	Undertaken by FYJV		FYJV
Supervision of fauna habitat clearance	As required		FYJV
Removal of HBTs	As required		FYJV
Monitoring of vegetation clearance	As required		FYJV



Legend
 Project footprint

Acknowledgements: Topo (c) NSW Land and Property Information (2016)
 Overview (c) State of NSW (c.2003)

Figure 1: Location of the project footprint

2 Methods

The following section outlines the methods applied for all NBHCNE EMP monitoring surveys conducted between July 2016 and July 2017.

2.1 Red-crowned Toadlet monitoring

2.1.1 Targeted survey

Prior to the Red-crowned Toadlet monitoring undertaken for the NBHCNE EMP, baseline surveys were conducted to ground-truth the presence of suitable habitat and to establish transects that form the control and impact sites used in the NBHCNE EMP monitoring surveys (Biosis 2015a). Suitable habitat for the species was identified at the monitoring sites listed in Table 2. The NBHCNE EMP monitoring for Red-crowned Toadlets was comprised of two monitoring surveys, conducted during spring 2016 and autumn 2017.

Table 2 Monitoring sites

Site	Type	Location	Latitude	Longitude
1	Impact	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	-33.7432	151.2372
2	Impact	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	-33.7451	151.2372
3	Impact	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	-33.7474	151.2365
4	Impact	Curl Curl Creek (ESU 8) in the Stage 2 Project footprint	-33.7542	151.2349
5	Control	Parkway track access, Wakehurst Parkway	-33.7241	151.2512
6	Control	Cascades Trail, St Ives	-33.7267	151.1844

The following methods were employed during the baseline and ongoing annual monitoring surveys:

- Surveys were undertaken during optimal conditions, which is during or soon after heavy rain.
- A 200 metre transect was established within each of these sites, and all surveys were conducted along these transects.
- Two staff walked along each 200 metre transect twice, once during the day and a second survey at night, recording all Red-crowned Toadlets heard calling. Call playback was used at several points along each transect (if required) to elicit a calling response from Red-crowned Toadlets.
- At the end of each 200 metre transect survey, a tally of all Red-crowned Toadlets calling were recorded, designed to provide a measure of relative abundance at each site.
- Where no Red-crowned Toadlets are heard calling during the survey at each site, staff undertook a search of all suitable habitat within the 200 metre transect in an effort to located sheltering adult Red-crowned Toadlets.

2.1.2 Surface water monitoring review

The Red-crowned Toadlet Management Plan (Biosis 2015a) included a review of surface water monitoring data collected by Ferrovial York Joint Venture as part of the Surface Water Quality Monitoring Program (SMEC 2015) from sites SW 2, SW 5 and SW 7. The results of this review were to be used to determine whether there is any variation in the parameters recorded which would be assessed against the management measures to determine the implications for the species in the vicinity of Trefoil Creek.

Two flow monitoring sites were to be established within Trefoil Creek, measuring the volume of surface water flow. An additional two control sites measuring discharge were to be established on Middle Creek (upstream of confluence with Trefoil Creek) and on the unnamed tributary of Trefoil Creek (upstream of their confluence). Comparisons between the potential impact sites and control sites then allow for changes in surface water flows as a result of the Project to be identified. Variations in surface water flows at the potential impact sites to be assessed against flow data collected at the control sites. If a gross variation in surface water flows is identified at potential impact sites and not recorded at the control sites, the source of the variation would be investigated.

The surface water and flow data collection commenced in November 2017 and will be discussed in reference to the Red Crowned Toadlet.

2.2 Nest box monitoring

Nest box monitoring was conducted by two ecologists utilising a monitoring camera (wherever possible) twice over a 12 month period between July 2016 and July 2017.

The first monitoring event was undertaken prior to the completion of construction works (August - November 2016), with a second follow-up monitoring event undertaken following completion of construction (March - April 2017).

The spring 2016 nest box monitoring surveys were undertaken between 8 and 14 September 2016. The autumn 2017 nest box monitoring surveys were undertaken between 2 and 20 June 2017. All nest boxes were initially inspected from the ground to determine whether boxes had been installed correctly and to determine whether any boxes required maintenance. Following the initial inspection the box interior was then examined (where possible) from the ground using a pole-mounted inspection camera. Internal inspection was undertaken to identify signs of current (fauna present) or previous (e.g. nesting material, scats, feathers) occupancy.

Where nest boxes were mounted too high to be reached with an inspection camera, extended ground-based observations were undertaken to detect signs of current or previous occupancy such as:

- Fauna visible at entrance to nest box.
- Fauna observed entering or exiting the nest box.
- Nesting material visible at entrance to nest box.
- Chewed entrance to nest box.
- White wash or guano at nest box entrance or beneath nest box.
- Scats, egg shells, regurgitated pellets, feathers or discarded food items on the ground beneath nest box.

Nest box monitoring was undertaken in accordance with recommendations of the Project NBS and NBHCNE EMP, and is consistent with the recommended methodology outlined in the NSW Roads and Maritime Services (Roads and Maritime) *Biodiversity Guidelines – Guide 8: Nest boxes*.

2.3 Pathogen and weed monitoring

Biosis has undertaken quarterly inspections of the project footprint to monitor for the presence of noxious species, progress of weed control works, and evidence of pathogens. Visual inspections for weed species

were made across the study and the locations of noxious weed species and priority weed species were recorded using a using hand-held (uncorrected) GPS units and Tablet Personal Computer units (GDA94).

The inspections were undertaken in September 2016, December 2016, March 2017 and June 2017 by Callan Wharfe (Consultant Botanist), Nicola Trulock (Botanist) and Carl Corden (Zoologist).

The quarterly weed surveys and reports of the results of the first three quarterly surveys were made in reference to the *Noxious Weeds Act 1993*. The Biosecurity Act 2015 (Biosecurity Act) came into effect as of 1 July 2017 and repeals the Noxious Weeds Act 1993. This annual report provides advice following the fourth quarterly survey in reference to the Biosecurity Act 2015.

2.4 Microbat habitat monitoring

A winter inspection for microbats was undertaken at two culverts along Curl Curl Creek. The objective of the inspection was to confirm that any over-wintering microbats were not adversely impacted by the Project works. This inspection was conducted by Carl Corden (Zoologist) over one day on the 10/08/2016.

A preclearance inspection of both culverts was undertaken one week prior to their decommissioning as part of the Project works. If suitable microbat habitat was confirmed during the preclearance survey, the decommissioning works would be supervised by an experienced ecologist to ensure any microbats present were rescued and relocated safely. The preclearance inspection was conducted by Carl Corden (Zoologist) over one day on the 30 August 2016.

2.5 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a site during survey, such as species dormancy, seasonal conditions, migration and breeding behaviours of some fauna. In many cases these factors do not present a significant limitation to assessing the overall ecological values of a site.

2.6 Mapping

Aerial photography and site plans (supplied by Ferrovia York Joint Venture/Near Maps (2014).

Mapping was conducted using hand-held (uncorrected) GPS units and Tablet Personal Computer units (GDA94) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Mapping has been produced using a Geographic Information System (GIS). Electronic GIS files containing the relevant flora and fauna spatial data are available to incorporate into design concept plans. However this mapping may not be sufficiently precise for detailed design purposes.

3 Results

The results provided below have been provided in line with the details required in *Table 3.3 Monitoring Actions* of the NBHCNE EMP (Biosis 2016a), provided in Appendix 1.

3.1 Red-crowned Toadlet monitoring

The Pathogen and Weed Management Strategy (Biosis 2015b) identified the prevalence of Frog Chytrid in 80% of all individual frogs sampled in the vicinity of Trefoil Creek. The presence of this pathogen is highly likely to confound the results of the surveys, and as such it is difficult for any deleterious change in the population to be attributed to the Project.

The initial baseline Red-crowned Toadlet surveys conducted recorded no Red-crowned Toadlets at the sites monitored, although habitat assessment confirmed the presence of suitable habitat for Red-crowned Toadlets at all sites (Biosis 2015b). Despite the absence of records, during baseline surveys it was assumed that Red-crowned Toadlets were still present within Trefoil Creek.

Red-crowned Toadlet surveys for the spring 2016 and autumn 2017 monitoring periods were undertaken at a total of six monitoring sites, including four impact sites and two control sites. The locations of all survey sites are shown in Figure 2.

Red-crowned Toadlet surveys for the spring 2016 and autumn 2017 monitoring periods were undertaken by two Biosis zoologists (Carl Corden and Luke Stone) over two separate days/nights for each seasonal event. Dates and weather conditions prior to and during each of these surveys are outlined in Table 3 below.

Table 3 Survey dates and weather conditions*

Survey date	Temperatures (min/max) during survey (degrees Celcius)	Rainfall during survey (millimetres)	Total rainfall over six days prior to survey (millimetres)
Spring - 28 October 2016	12.5/18.4	3.8	10.8
Autumn - 7 March 2017	15.4/20.7	0.8	39.8

* Source: Bureau of Meteorology daily weather observations data for Terrey Hills AWS (station 066059).

Significant rainfall was experienced prior to or during each of the two monitoring surveys. Further, Red-crowned Toadlet calling adults and tadpoles were detected at one control site during the autumn 2017 monitoring survey. It is therefore considered that conditions were suitable for detecting Red-crowned Toadlets during each of the two monitoring periods.

No Red-crowned Toadlet individuals were identified at any of the impact sites monitored during the spring 2016 and autumn 2017 monitoring events conducted as part of the NBHCNE EMP. No Red-crowned Toadlet individuals were identified at the control sites during the spring 2016 monitoring event. Control site 5 was substituted for control site 6 during the autumn 2017 monitoring event, which provides superior habitat for Red-crowned Toadlets. Three calling male Red-crowned Toadlets were heard and six tadpoles of the species were observed at Site 6 during the autumn 2017 monitoring event. No Red-crowned Toadlets were recorded at the other control sites during the autumn 2017 monitoring event. While no Red-crowned Toadlets were recorded during monitoring, these results are considered consistent with survey results of targeted surveys undertaken during the EIS, with the species detected 3 times out of 18 surveys.

Table 4 Red-crowned Toadlet targeted survey results

Site	Location	Type	Red-crowned Toadlets recorded	
			Spring 2016	Autumn 2017
1	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	Impact	0	0
2	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	Impact	0	0
3	Trefoil Creek (ESU 5) in the Stage 1 Project footprint	Impact	0	0
4	Curl Curl Creek (ESU 8) in the Stage 2 Project footprint	Impact	0	0
5	Parkway track access, Wakehurst Parkway	Control	0	-
6	Cascades Trail, St Ives	Control	-	3 adults, 6 tadpoles



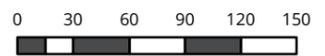
Figure 2a: Red-crowned Toadlet Monitoring Sites (Impact)



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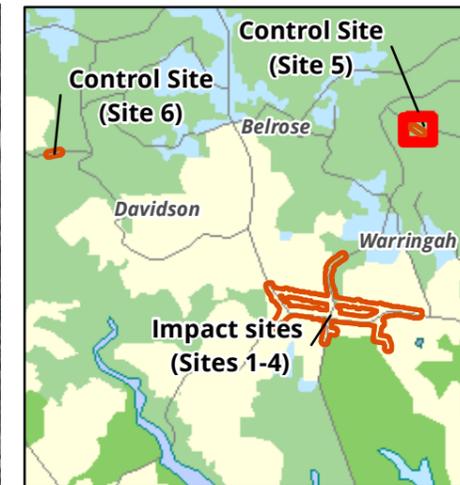
Acknowledgements: Imagery (c) Nearmap 2014
Topo (c) NSW Land and Planning Information (2015)

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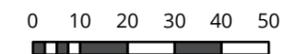




Legend

- Study area
- Monitoring transect

Figure 2b: Red-crowned Toadlet Monitoring Sites (Control - Site 5)

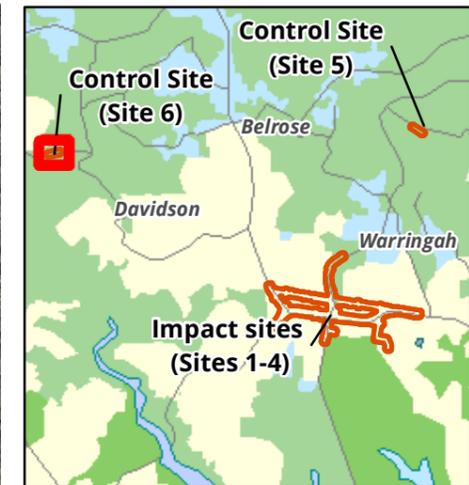
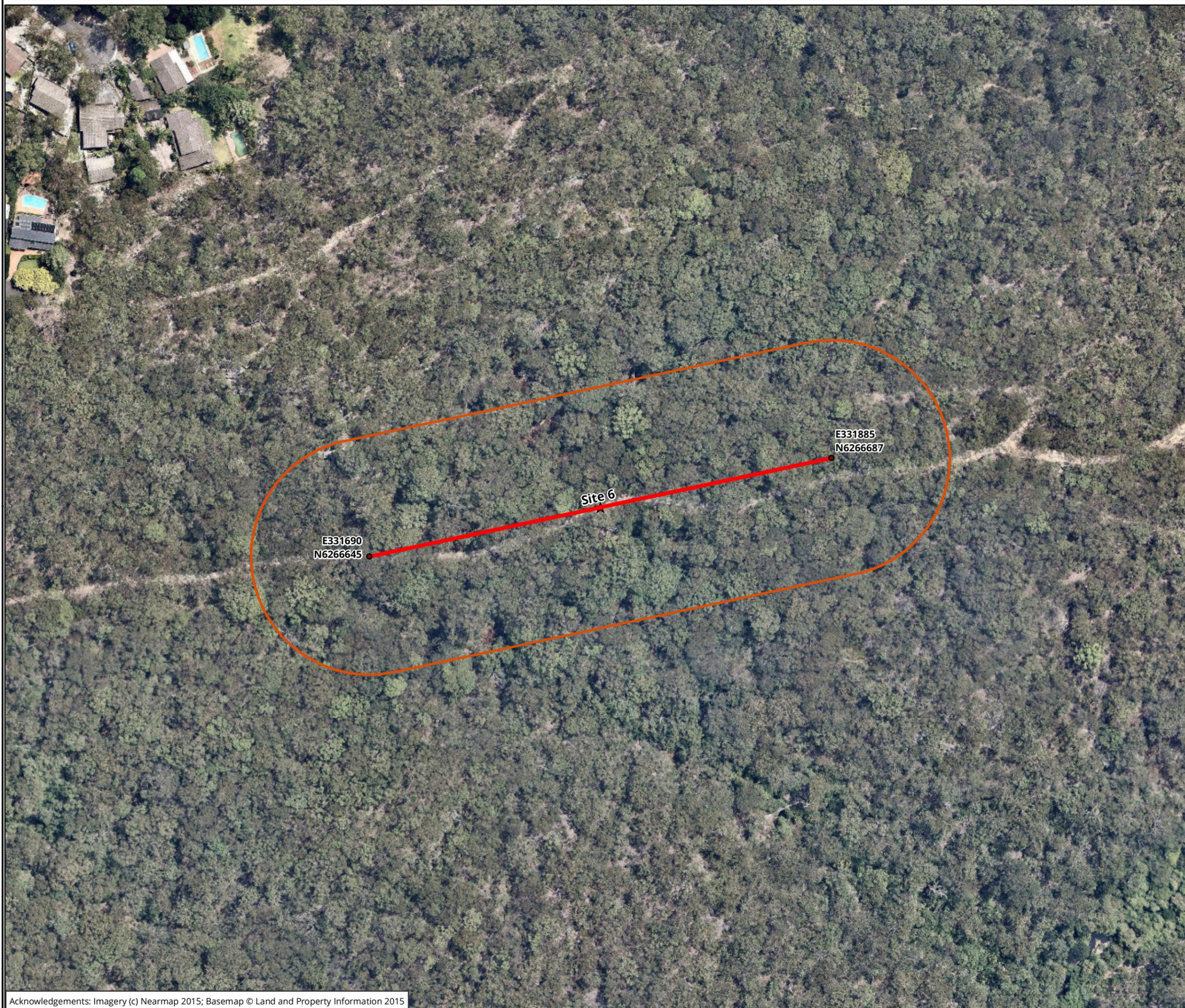


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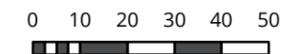
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Legend

-  Study area
-  Monitoring transect

Figure 2c: Red-crowned Toadlet Monitoring Sites (Control - Site 6)



Metres
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 Coordinate System: GDA 1994 MGA Zone 56



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3.2 Nest box monitoring

Monitoring data from the 144 total boxes monitored has been collated following inspections and is provided in Table 5. The location of the trees utilised for the nest boxes is provided in Figure 3.

3.2.1 Spring 2016

A total of 138 nest boxes were installed for the Project when the spring 2016 monitoring survey was conducted. The results of the nest box monitoring surveys are briefly summarised below:

- A total of 2 nest boxes were currently occupied by Ringtail Possums *Pseudocheirus peregrinus*.
- A total of 4 nest boxes show signs of previous occupation by native fauna.
- A total of 3 nest boxes were currently occupied by pest species (European Honey Bee).
- A total of 9 nest boxes were installed poorly.
- A total of 3 nest boxes were not installed in appropriate locations.

During nest box monitoring surveys a total of 4 nest boxes were identified that had not been installed. These boxes were found on the ground at the base of trees. An inspection of these boxes confirmed that none had previously been installed in trees, as evidenced by the condition of the boxes and the straight mounting wire (i.e. no bends or twists suggesting previous installation).

The results of the spring 2016 nest box monitoring surveys were used to identify actions required prior to the autumn 2017 nest box monitoring surveys. Maintenance actions required were provided in an interim nest-box monitoring advice report and were completed following the spring 2016 monitoring event.

3.2.2 Autumn 2017

A total of 144 nest boxes were installed for the Project when the autumn 2017 monitoring survey was conducted. The results of the nest box monitoring surveys are briefly summarised below:

- A total of 7 nest boxes were currently occupied by native fauna species (Ringtail Possum, Brushtail Possum *Trichosurus vulpecula*, and Rainbow Lorikeet *Trichoglossus moluccanus*).
- A total of 10 nest boxes show signs of previous occupation by native fauna.
- A total of 2 nest boxes were currently occupied by pest species (European Honey Bee and Ants).

The nest boxes that had not been correctly installed or that had been installed in inappropriate locations at the time of the spring 2016 monitoring survey had been rectified by the autumn 2017 monitoring survey.

Table 5 Nest box occupation during monitoring surveys

Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
1	336550	6264074	1	Ringtail			1	Ringtail		Bees no longer present
2	336559	6264106	1	Pygmy-possum			1	Pygmy-possum		
3	336558	6264107	1	Owlet-nightjar		Chewed entrance and fresh leaves present	1	Owlet-nightjar		Chewed entrance, old nesting material present
4	336566	6264104	1	Crimson Rosella		Chewed entrance	1	Crimson Rosella		Chewed entrance
5	336555	6264094	1	Kookaburra			1	Kookaburra		
6	336550	6264096	1	Dollarbird	Ringtail-Possum		1	Dollarbird		Old nesting material present
7	336559	6264082	1	Galah			1	Galah		
8	336575	6264077	1	Treecreeper			1	Treecreeper		Material present
9	336579	6264067	1	Eastern Rosella, Microbat			1	Microbat		
10	336575	6264065	1	Lorikeet			1	Possum	Brushtail-Possum	
11	336585	6264055	2	King Parrot, Microbat			1	Microbat		
13	336561	6264055	1	Pygmy-possum			1	Pygmy-possum		
14	336552	6264059	1	Feathertail Glider			1	Feathertail glider		
15	336547	6264059	1	Kingfisher			1	Kingfisher		
16	336540	6264051	1	Treecreeper			1	Treecreeper		
17	336547	6264041	1	Brushtail-possum	Ringtail-Possum	Material present	1	Brushtail-possum	Ringtail-Possum	

Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
18	336531	6264072	1	Pardalote			1	Pardalote		
20	336381	6263586	1	Feathertail glider			1	Feathertail glider		
21	336481	6263662	1	Possum			1	Possum		Chewed
22	336476	6263667	1	Possum			1	Possum		Chewed
23	336478	6263684	1	Possum			1	Possum		Chewed
24	336489	6263661	1	Dollarbird			1	Dollarbird		
25	336490	6263658	1	Pygmy-possum			1	Pygmy-possum		
26	336494	6263664	1	Feathertail glider			1	Feathertail glider		
27	336492	6263671	1	Possum			1	Possum		
28	336493	6263676	1	King Parrot			1	King Parrot		
29	336501	6263671	1	Pygmy-possum			1	Pygmy-possum		
30	336502	6263669	1	Possum			1	Possum		
32	336502	6263678	1	Possum			1	Possum		Material present
33	336506	6263680	3	Kookaburra, Microbat, Cockatoo			3	Kookaburra, Microbat, Cockatoo		
34	336518	6263668	1	Dollarbird			2	Dollarbird, King Parrot		
35	336521	6263672	2	Possum, Feathertail Glider			2	Possum, Feathertail Glider		
36	336521	6263678	2	Possum, Feathertail Glider			2	Possum, Feathertail Glider		

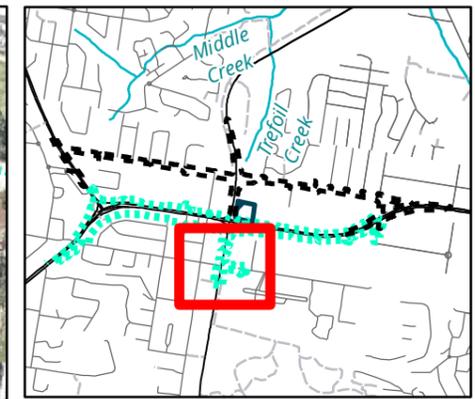
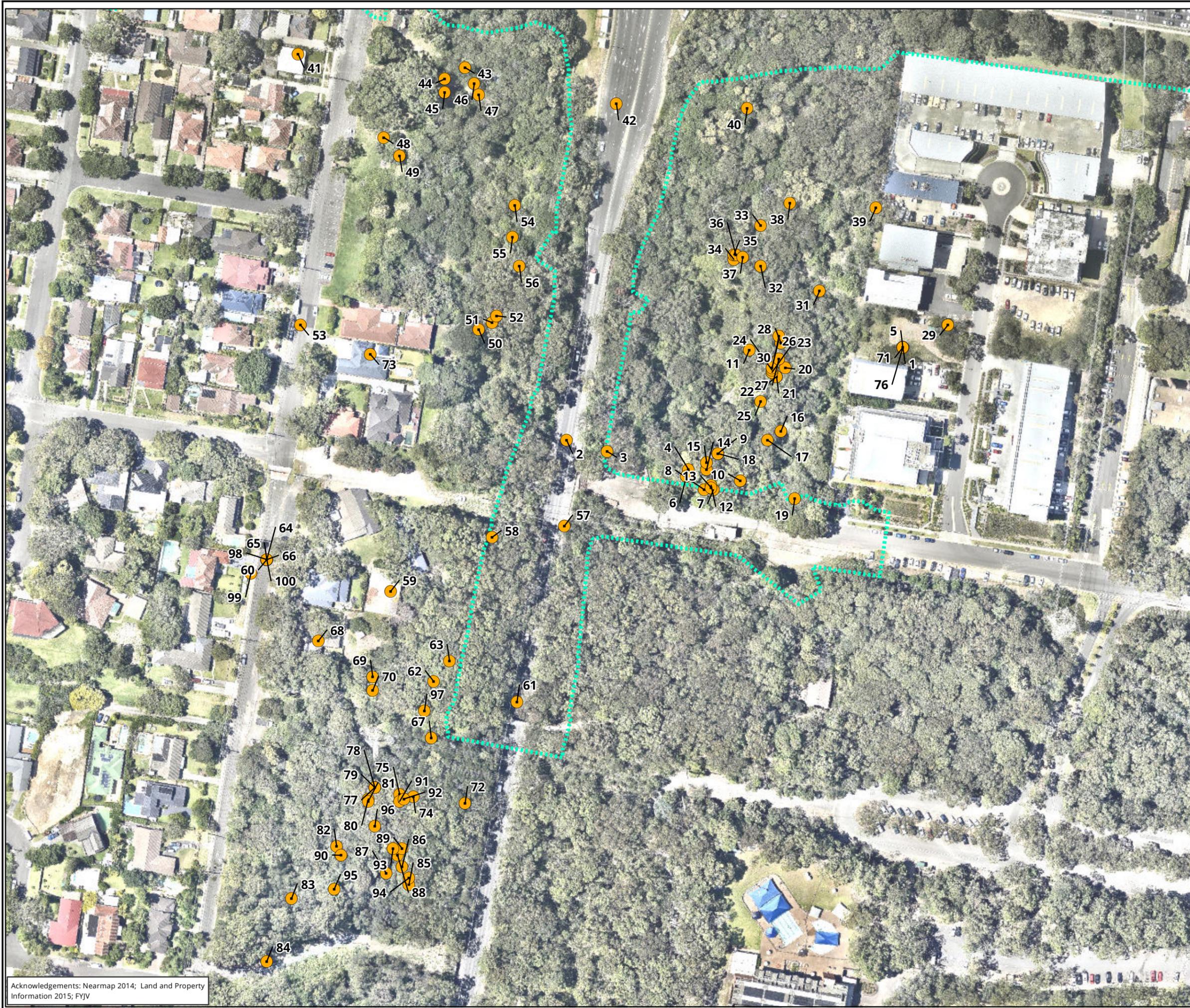
Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
37	336523	6263688	3	Cockatoo, Possum, Possum			3	Cockatoo, Possum, Possum		
38	336525	6263701	2	Pygmy- possum, Sugar Glider			2	Pygmy- possum, Sugar Glider		
39	336520	6263706	1	Microbat			1	Microbat		
40	336524	6263700	1	Possum			1	Possum		
41	336511	6263705	3	Pygmy- possum, Possum, Cockatoo			3	Pygmy- possum, Possum, Cockatoo		
42	336516	6263712	1	Microbat			1	Microbat		
43	336527	6263713	1	Possum			1	Possum		
44	336530	6263731	3	Pygmy- Possum, Possum, Glider			3	Pygmy- Possum, Possum, Glider		
45	336524	6263726	2	Pygmy, Cockatoo			2	Pygmy, Cockatoo		
46	336520	6263734	1	Microbat			1	Microbat		
47	336521	6263735	1	Pardalote			1	Pardalote		
48	336525	6263739	3	Possum, Cockatoo, Cockatoo			2	Possum, Cockatoo		
49	336541	6263738	2	Glider, Microbat		Bees present in Glider box	2	Glider, Microbat		No bee activity in Glider box
50	336522	6263751	1	Kookaburra			1	Kookaburra		

Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
51	336520	6263752	1	Feathertail Glider			1	Feathertail Glider		
52	336507	6263758	1	Kookaburra			2	Kookaburra, Cockatoo		Cockatoo box installed July 2017
53	336521	6263775	1	Possum			2	Possum, Cockatoo		Cockatoo box installed July 2017
54	336528	6263756	3	Possum, Feathertail Glider, Cockatoo			3	Possum, Feathertail Glider, Cockatoo		
55	336531	6263802	2	Cockatoo, Cockatoo			2	Cockatoo, Feathertail Glider		
56	336539	6263812	3	Pygmy-possum, Cockatoo, Cockatoo			2	Pygmy-possum, Cockatoo		
57	336544	6263801	1	Feathertail Glider			2	Feathertail Glider, Cockatoo		Cockatoo box installed July 2017
58	336512	6263801	1	King-Parrot			1	King-Parrot	Brushtail-Possum	
59	336364	6263835	1	Glider		Bees present in Glider box	1	Glider		No bee activity in Glider box
60	336369	6263835	1	Possum			1	Lorikeet		
61	336365	6263830	1	King-Parrot			1	King-Parrot		
63	336383	6263822	1	Microbat			1	Microbat		
64	336394	6263806	1	Glider			1	Glider	Brushtail-Possum	
65	336408	6263845	1	Feathertail			1	Feathertail		

Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
				Glider				Glider		
66	336350	6263805	1	Possum			1	Possum	Ringtail-Possum	
67	336352	6263802	1	Dollarbird			1	Dollarbird	Brushtail-Possum	
68	336409	6263684	1	Glider			1	Glider		
69	336406	6263727	1	Possum			1	Possum		
70	336404	6263742	1	Feathertail Glider			1	Feathertail Glider		
71	336397	6263748	1	Feathertail Glider			1	Treecreeper		
72	336395	6263748	1	Possum			1	Treecreeper		
75	336396	6263635	2	Possum, Microbat			2	Possum, Microbat		
76	336381	6263598	1	Pardalote			1	Pardalote		
77	336382	6263586	1	Possum			1	Possum		
78	336378	6263580	1	Possum			1	Possum	Two Lorikeets	
79	336374	6263579	1	Pardalote			1	Pardalote		
80	336354	6263564	1	Glider			1	Glider		
81	336356	6263566	1	Dollarbird			1	Dollarbird		
82	336358	6263571	0				1	Lorikeet		
83	336349	6263569	1	Dollarbird			1	Dollarbird		
85	336339	6263559	1	Coackatoo			1	Coackatoo		
86	336334	6263552	1	Possum			1	Possum		Material present
87	336339	6263576	1	Feathertail Glider			1	Feathertail Glider		Bees present

Tree ID	Easting	Northing	Spring 2016				Autumn 2017				
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes	
88	336378	6263561	1	Cockatoo				1	Cockatoo		
89	336366	6263519	1	Kingfisher				1	Kingfisher		Ant nest present
90	336367	6263517	1	Cockatoo				1	Cockatoo		
91	336358	6263518	2	Possum, Kingfisher				2	Possum, Kingfisher		
92	336357	6263518	1	Possum				1	Possum		
93	336342	6263520	1	Cockatoo				1	Cockatoo		
95	336340	6263510	2	King-Parrot, Possum				2	King-Parrot, Possum		
96	336344	6263505	1	Possum				1	Possum		
97	336343	6263497	2	King-Parrot, Microbat		Fresh leaves present		3	King-Parrot, Microbat		Material present in King Parrot box
98	336349	6263491	1	Microbat				1	Microbat		
99	336338	6263485	2	Microbat, Cockatoo				2	Microbat, Cockatoo		
100	336323	6263471	2	Possum, Microbat				2	Possum, Microbat		
101	336301	6263467	0					1	Possum		
104	336355	6263485	1	Cockatoo				2	Possum, Cockatoo		
105	336370	6263514	1	Pygmy- Possum				1	Pygmy- Possum		
106	336369	6263514	1	Cockatoo				1	Cockatoo		
107	336368	6263508	1	Possum				1	Possum		
108	336366	6263512	1	Lorikeet				1	Lorikeet		
109	336357	6263511	2	King-Parrot, Small Bird				2	King-Parrot, Small Bird		
110	336364	6263488	1	Possum				1	Possum		

Tree ID	Easting	Northing	Spring 2016				Autumn 2017			
			Number of boxes	Box type	Fauna recorded	Notes	Number of boxes	Box type	Fauna recorded	Notes
111	336362	6263484	2	Pygmy-Possum, Kookaburra			2	Pygmy-Possum, Kookaburra		
112	336340	6263492	1	Dollarbird			1	Dollarbird		
113	336336	6263508	1	Possum			1	Possum		
115	336376	6263561	1	Dollarbird			1	Dollarbird		
116	336341	6263570	1	Microbat			1	Microbat		
117	336358	6263578	1	Lorikeet			1	Lorikeet		
118	336338	6263570	1	Dollarbird			1	Dollarbird		
119	336534	6263714	0				2	Possum, Possum		
120	336532	6263737	0				1	Cockatoo		
121	336515	6263745	0				1	Cockatoo		
122	336559	6263802	0				1	Cockatoo		



Legend

- Nestbox locations
- Project footprint**
- Lease boundary
- Stage 1
- Stage 2

Figure 1: Nestbox locations

0 10 20 30 40 50

Metres

Scale: 1:1,565 @ A3

Coordinate System: GDA 1994 MGA Zone 56



Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Acknowledgements: Nearmap 2014; Land and Property Information 2015; FJVJ

Matter: 20987
 Date: 10 June 2016,
 Checked by: APS, Drawn by: JMS, Last edited by: Iharley
 Location: P:\20300s\20367\Mapping\20367 NP F1 NestboxLocations

3.3 Pathogen and weed monitoring

3.3.1 Weed monitoring

The majority of the project alignment has moderate to high levels of weed invasion due to disturbance from stormwater, the highly urbanised nature of the site, vegetation clearance and edge effects. A total of 26 priority weed species have been recorded within the project footprint over the course of the four quarterly monitoring surveys. The priority weed species, abundance and control requirements, previously under the Noxious Weeds Act now repealed and replaced by the Biosecurity Duty, is provided in Table 6. The locations of the weed species recorded during all monitoring surveys are provided in Figure 4. Biosis has provided summaries of the weed species recorded, the number of weeds, and requirements under the Noxious Weeds Act following each quarterly survey, including interim advice based upon the findings, to FYJV. Advice following the quarter four monitoring survey is provided in Section 4.3.1.

No new areas of weed infestations were recorded during the quarterly monitoring surveys and a reduction in the area of weed infestations within the project footprint was observed. In areas of vegetation clearance new weed recruits were suppressed. The number of noxious weed species did increase in quarter three however this increase was attributed to the NSW DPI updating the list of noxious weed species for the Northern Beaches Council Area, and as such additional species were listed as noxious for the project footprint.

Table 6 Noxious and Priority weed species recorded in the quarterly weed monitoring surveys

Scientific name	Common name	Q1	Q2	Q3	Q4	Legal Requirements - Noxious weeds	Biosecurity Duty
<i>Acetosa sagittata</i>	Rambling Dock	X		X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.
<i>Ailanthus altissima</i>	Tree of Heaven			X		The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.
<i>Anredera cordifolia</i>	Madeira Vine	X	X	X		The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread	Must not be imported into the State or sold
<i>Araujia sericifera</i>	Moth Vine	X	X				Must not be imported into the State or sold
<i>Arundo donax</i>	Giant Reed	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.
<i>Asparagus aethiopicus</i>	Asparagus Fern	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.
<i>Cardiospermum grandiflorum</i>	Balloon Vine	X		X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment.
<i>Cinnamomum camphora</i>	Camphor Laurel	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	The Bitou Bush Biosecurity Zone is established for all land within the State except land within 10 kilometres of the mean high water mark of the Pacific Ocean between Cape Byron in the north and Point Perpendicular in the south. Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed

Scientific name	Common name	Q1	Q2	Q3	Q4	Legal Requirements - Noxious weeds	Biosecurity Duty
							suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone
<i>Cortaderia spp.</i>	Pampas Grass			X		The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed	A person who deals with prohibited matter or a carrier of prohibited matter is guilty of an offence. A person who becomes aware of or suspects the presence of prohibited matter must immediately notify the Department of Primary Industries
<i>Cytisus scoparius</i> subsp. <i>scoparius</i>	Scotch Broom	X				The plant must not be sold, propagated or knowingly distributed, only in the area formerly known as Manly Council	Land managers should mitigate the risk of new weeds being introduced to their land.
<i>Erythrina crista-galli</i>	Cockspur Coral Tree	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Whole region except Northern Beaches local government area: The plant should be eradicated from the land and the land kept free of the plant. Notify local control authority if found. Plant should not be bought, sold, grown, carried or released into the environment. Northern Beaches local government area: Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. Plant should not be bought, sold, grown, carried or released into the environment. Notify Local Control Authority if found.
<i>Genista monspessulana</i>	Montpellier Broom		X			The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Exclusion zone: whole region except the core infestation area of Sutherland Shire. Whole region: Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Notify local control authority if found. Core area: Land managers should mitigate the risk of new weeds being introduced to their land.
<i>Ipomoea cairica</i>	Coastal Morning Glory		X	X			Land managers should mitigate the risk of new weeds being introduced to their land. The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.
<i>Ipomoea indica</i>	Morning Glory		X	X		The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.

Scientific name	Common name	Q1	Q2	Q3	Q4	Legal Requirements - Noxious weeds	Biosecurity Duty
<i>Jasminum polyanthum</i>	Jasmine			X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Land managers should mitigate the risk of new weeds being introduced to their land. The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.
<i>Lantana camara</i>	Lantana	X	X	X	X		Must not be imported into the State or sold
<i>Ligustrum lucidum</i>	Broad-leaf Privet	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread	Must not be imported into the State or sold
<i>Ligustrum sinense</i>	Small-leaved Privet	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread	Must not be imported into the State or sold
<i>Lonicera japonica</i>	Japanese Honeysuckle	X	X	X	X		The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.
<i>Ochna serrulata</i>	Ochna	X	X	X	X		Whole region: Land managers should mitigate the risk of new weeds being introduced to their land. The plant or parts of the plant should not be traded, carried, grown or released into the environment. Notify the Local Control Authority if found. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core infestation: Land managers should mitigate spread from their land.
<i>Olea europaea subsp. cuspidata</i>	African Olive	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Whole region: Land managers should mitigate the risk of new weeds being introduced to their land. The plant or parts of the plant should not be traded, carried, grown or released into the environment. Notify the Local Control Authority if found. Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core infestation: Land managers should mitigate spread from their land.
<i>Paspalum quadrifarium</i>	Tussock Paspalum	X	X	X	X		The following equipment must not be imported into NSW from Queensland: grain harvesters (including the comb or front), comb trailers (including the comb or front), bins used for holding grain during harvest operations, augers or similar for moving grain, vehicles used to transport grain harvesters, support vehicles driven in paddocks during

Scientific name	Common name	Q1	Q2	Q3	Q4	Legal Requirements - Noxious weeds	Biosecurity Duty
							harvest operations, mineral exploration drilling rigs and vehicles used to transport those rigs, unless set out as an exception in Division 5, Part 2 of the Biosecurity Order (Permitted Activities) 2017
<i>Ricinus communis</i>	Castor Oil Plant		X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread	The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.
<i>Rubus fruticosus</i> species aggregate	Blackberry complex	X	X	X	X		The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment. Notify local control authority if found.
<i>Senecio madagascariensis</i>	Fireweed			X	X		Exclusion zone: whole region except for the core infestation area of the Georges and Hawkesbury-Nepean Rivers and their tributaries. Whole region: Land managers mitigate the risk of the plant being introduced to their land. Exclusion zone: The plant is eradicated and the land kept free of the plant. The Local Control Authority should be notified if the plant is found. Core infestation area: Land managers should prevent spread from their land where feasible.
<i>Senna pendula</i> var. <i>glabrata</i>	Senna Pendula	X	X	X	X	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed	Must not be imported into the State or sold

Figure 4 Weed species locations recorded in quarter four

3.3.2 Pathogen monitoring

The following pathogens have been identified by the EIS (SMEC 2014) as having the potential to occur within the project footprint.

- Phytophthora *Phytophthora cinnamomi*
- Myrtle Rust *Uredo rangelii*
- (Frog) Chytrid *Batrochytridium dendrobatidis*

The results of baseline monitoring in 2015 are provided in Table 7. None of the subsequent quarterly monitoring surveys identified any change in the risk rating of the existing areas identified, nor did they identify any new areas of potential pathogen risk.

Table 7 Baseline pathogen monitoring results 2015

Pathogen	Mapped risk areas	Comments
Myrtle Rust	N/a	No areas or Myrtle rust have been mapped within the project footprint.
Phytophthora	High risk area mapped near northern-most extent of the project adjacent to Wakehurst Parkway, outside of the project area.	Area of tree death identified as <i>Phytophthora cinnamomi</i> infection adjacent to the power line easement adjacent to Wakehurst Parkway.
Chytrid	<p>High risk area mapped near northern-most extent of the project adjacent to Wakehurst Parkway.</p> <p>Medium risk area mapped within Curl Curl Creek from Warringah Rd and travelling under Wakehurst Pky</p>	Areas of frog habitat are considered to have risk of Chytrid infection.

3.4 Microbat habitat monitoring

The winter inspection of two culverts along Curl Curl Creek did not identify any microbat individuals as being present. The two culverts do not support potential roosting or breeding habitat for any species of microbat for the following reasons:

- Both culverts were small (less than 100 cm diameter) and are highly likely to be completely inundated during heavy rainfall periods.
- Neither culvert supported internal expansion joints with significant depth to be used by roosting microbats.
- All entrances to both culverts were obstructed by weedy vegetation providing a significant obstacle to microbats entering or exiting the culverts, particularly fast-flying, long-winged species (e.g. Large Bentwing-bat *Miniopterus orianae oceanensis*).
- No microbats were detected during the preclearance assessment, and none were detected during culvert decommissioning.

Microbats are therefore not considered likely to occupy these culverts, and ongoing monitoring of culverts for microbats is not required.

4 Discussion and recommendations

4.1 Red-crowned Toadlet monitoring

The initial baseline Red-crowned Toadlet surveys conducted recorded no Red-crowned Toadlets at the monitoring sites, despite the presence of suitable habitat for this species at all sites (Biosis 2015b). No Red-crowned Toadlet individuals were recorded at impact sites during the spring 2016 and autumn 2017 monitoring surveys. Since Red-crowned Toadlet individuals were recorded at one of the control sites during the autumn 2017 monitoring survey, the monitoring survey methodology is considered to be satisfactory to detect Red-crowned Toadlet individuals.

The Red-crowned Toadlet monitoring plan (Biosis 2015b) outlines the following contingency measures, should the non-detection of Red-crowned Toadlet continue to occur:

- Review surface water monitoring results and consult with design team, to determine if there is a variation between modelled and actual flows.
- Determine whether there is any correlation between parameters of the surface water monitoring results and any decrease in Red-crowned Toadlet detection during the relevant time period.
- Provide advice regarding surface water management in relation to Red-crowned Toadlet.

Surface water quality data for November 2017 indicates that the creeks monitored displayed a reasonable dry-weather flow rate at three of the four monitoring sites, and no appreciable flow at the fourth creek. Given this monitoring was undertaken following a week of dry weather, further monitoring data is required to determine flow response after rain. Further analysis will be provided in future monitoring reports.

4.1.1 Performance parameters/criteria assessment

The performance parameters/ criteria assessment required by the NBHCNE EMP (Biosis 2016a) are provided in Appendix 1. The criteria specific to Red-crowned Toadlet monitoring are addressed below.

All impact and control sites are successfully established.

All impact and control sites have been successfully established.

Red-crowned Toadlets are recorded within impact sites where previously recorded (EIS) and at control sites during the same period.

No Red-crowned Toadlets have been recorded at impact sites where they have previously been recorded. This is not considered inconsistent with the surveys undertaken during the EIS with individuals detected on three occasions out of 18 surveys undertaken during EIS investigations.

4.1.2 Recommendations

Due to the presence of suitable habitat for Red-crowned Toadlets to occur at the impact sites within the project footprint, it is recommended that the survey methodology be continued to determine if Red-crowned Toadlets are present within the project footprint. Ongoing flows monitoring data will be provided in future reports, to supplement flow data from November 2017.

4.2 Nest box monitoring

Biosis provided FYJV with an interim advice letter report (Biosis 2016b) following the spring 2016 nest box monitoring survey. The results of the spring 2016 nest box monitoring surveys indicated that the uptake of nest boxes by native fauna was low. However most nest boxes were installed only a few months prior to monitoring, and a higher rate of occupancy was anticipated to occur as time progressed.

Biosis identified a number of issues with the location and installation of nest boxes during the spring 2016 survey. Biosis provided advice and recommendations following the spring 2016 survey and the recommendations were implemented by the time of the autumn 2017 survey.

The three nest boxes that were occupied by European Honey Bees in spring 2016 were not occupied by bees in autumn 2017. However a new nest box occupied by bees and another by ants was recorded. It is likely that the bees and ants will vacate these boxes within 1-2 years so no action is currently recommended to remove the pest species from the boxes.

The results of the autumn 2017 nest box monitoring surveys indicate that the current uptake of nest boxes by native fauna remains low. However the results of the autumn 2017 monitoring demonstrate a higher rate of occupancy than during spring 2016. It is anticipated that the rate of occupancy will increase over time.

4.2.1 Performance parameters/criteria assessment

The performance parameters/ criteria assessment required by the NBHCNE EMP (Biosis 2016a) are provided the Appendix 1. The criteria specific to nest box monitoring are addressed below.

Indicators of success of nest boxes include:

- *Use of nest boxes by a wide range of native fauna species.*
- *Use of nest boxes designed for specific species by those same species*

After one year of monitoring, the nest boxes have been utilised by three species. Occupation of the nest boxes that have been utilised is dominated by possums, in particular Brush-tailed Possums. This is not considered unusual given the highly urbanised nature of the project footprint.

Assessment criteria:

- *Inspection to be undertaken to record nest box utilisation (by which species, native and pest) and success yearly for five years.*
- *Reporting to outline nest box utilisation and success yearly for five years.*
- *Uptake of nest boxes is >60% of pre-clearing tree hollow occupation*
- *<20% uptake of nest boxes by pest species.*

The uptake of nest boxes by native species during spring 2016 monitoring was only 1%. The uptake of nest boxes by native species during autumn 2017 monitoring increased to 5%. Although currently below the assessment criteria percentage, this rate of uptake is broadly consistent with the results of clearing supervision where occupation of suitable tree hollows removed for the project was also lower than anticipated.

The uptake of nest boxes by pest species is in line with the assessment criteria, being 2% in spring 2016 and 1% in autumn 2017.

4.2.2 Recommendations

The spring 2016/autumn 2017 nest box monitoring and maintenance has now been completed in accordance with the project Nest Box Strategy (NBS) (Biosis 2016). As specified in the NBS, ongoing nest box monitoring and maintenance is required throughout the construction phase of the project, and for a period of three years post-construction. It is recommended that ongoing nest box monitoring and maintenance should continue annually during the period specified in the NSB.

4.3 Pathogen and weed monitoring

4.3.1 Weed monitoring

Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) came into effect as of 1 July 2017 and repeals the *Noxious Weeds Act 1993*. The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to:
 - Out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.
 - Harm or reduce biodiversity.

The Biosecurity Act introduces the concept of Priority Weeds. A priority weed is any weed identified in a local strategic plan, for a region that includes that land or area, as a weed that is or should be prevented, managed, controlled or eradicated in the region. Where a local strategic plan means a local strategic plan approved by the Minister under Division 2 of Part 4 of the *Local Land Services Act 2013*.

The Biosecurity Act also introduces the General Biosecurity Duty, which states:

All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

June 2017 monitoring survey

Of the 18 priority weed species recorded in the June 2017 monitoring survey (Table 6), the following species should be targeted as a priority. These species should be prioritised due to their shorter lifecycles, higher fecundity, and therefore higher likelihood of dispersal across the project footprint and into adjacent natural areas.

- Balloon Vine
- Castor Oil Plant
- Fireweed
- Rambling Dock
- Senna Pendula
- Tussock Paspalum

The remaining priority weed species have longer reproductive cycles and therefore remediation of disturbed areas, and/or completion of localised construction activities, are likely to prevent propagule development.

4.3.2 Pathogen monitoring

No changes in the risk rating of the existing pathogen risk areas, and no new areas of potential pathogen risk were identified by any of the quarterly monitoring surveys. The pathogen management measures recommended in the interim advice to FYJV should continue to be implemented, Table 8.

Table 8 Pathogen management measures

Activity	Management: Myrtle Rust	Management: Phytophthora	Management: Chytrid	Responsibility	Quality control mechanism
Construction scheduling and works programs	Plan works to commence in low risk areas and move to medium risk areas, and last in high risk areas.			Environmental Manager	Staging documentation Inductions/start up meetings
Inductions	Construction personnel should be made aware of this plan or its core components, and include an identification/fact sheet on Myrtle Rust.	Construction personnel should be made aware of this plan and its core components.	Construction personnel should be made aware of this plan or its core components, with particular focus for personnel undertaking dust suppression and works in riparian areas.	Environmental Manager	Inductions: Figure 2 and Figure 3
Vehicles and machinery hygiene	Vehicles and machinery should arrive on site free of sources of potential contaminants including vegetative material and mud.	Vehicles and machinery should arrive on site free of sources of potential contaminants including mud. Plant is to be washed down Appropriate wash down facilities should be provided for plant in medium to high risk areas.	Vehicles and machinery should arrive on site free of sources of potential contaminants including mud. Dust suppression operations to consider the sourcing of suitable water resources where introduction of Chytrid is unlikely.	Foreman Environmental coordinator	Inductions/audits
Access restrictions	Access to medium and high risk zones where Pathogens listed above are identified should be restricted with the specific control measures implemented for the disposal of material or hygiene in these zones. Medium and high risk pathogen zones, are to be marked on relevant plans, with wash down facilities provided to prevent potential pathogens spreading beyond the area.			Environmental Manager	Inductions/audits

Activity	Management: Myrtle Rust	Management: Phytophthora	Management: Chytrid	Responsibility	Quality control mechanism
Transport of new material	Use a certified supply of plants that is disease-free (the Australian Nursery Industry Myrtle Rust Management Plan (McDonald 2011) provides best practice Myrtle rust management that is to be expected from suppliers).	Soil and fill is to be sourced from suppliers that can provide certification that the material is free of disease.	Where works are undertaken in the vicinity (within 100 m) of Trefoil Creek the use of water externally sourced should be minimised or be potable water.	Environmental Manager	Inductions/start up meetings/audits
Identification and Testing	Instances of Myrtle Rust on host plants identified during construction are to be verified by an ecologist or the environment manager.	If medium or high risk areas are identified in the pathogen risk zones AND cannot be avoided during construction, testing of soils or plant material is to be undertaken to confirm the presence or absence of Phytophthora. The Plant Disease Diagnostic Service provides a range of services to assist in the identification and management of Phytophthora.	If a medium to high risk zone is identified for Chytrid AND the management measures identified herein cannot be practically achieved, then samples of water and/or testing of common frog is to be undertaken by ecologists with samples sent to a NATA accredited laboratory. The CSIRO Livestock Industries Australian Animal Health Laboratories can undertake appropriate laboratory testing.	Environmental Representative / Ecologist	Inductions/start up meetings/audits

4.3.3 Performance parameters/criteria assessment

The performance parameters/ criteria assessment required by the NBHCNE EMP (Biosis 2016a) are provided in Appendix 1. The criteria specific to weed and pathogen monitoring are addressed below.

Indicators of success of the Weed Management Procedure include:

- *No new noxious weed and pathogen infestations within the Project footprint and in adjacent bushland as a result of the Project.*

No new areas of weed infestations were recorded. In areas of vegetation clearance new weed recruits were suppressed. No new pathogen infestations have been recorded during the quarterly monitoring.

Assessment criteria:

- *No new noxious weed species (in addition to the species list within this plan) to establish in the Project footprint.*

The number of noxious weed species did increase in quarter three however this increase was attributed to the NSW DPI updating the list of noxious weed species for the Northern Beaches Council Area, and as such additional species were listed as noxious for the project footprint.

Indicators of success of the Weed Management Procedure include:

- *A reduction in the area of noxious weed and pathogen infestations within the project footprint.*

A reduction in the area of weed infestations within the project footprint has occurred. In areas of vegetation clearance new weed recruits were suppressed. No new pathogen infestations have been recorded during the quarterly monitoring.

Assessment criteria:

- *A 50% reduction in identified weed infestations to be achieved in year 1 within the project footprint, with gradual improvement for the following two years.*

A reduction in the area of weed infestations within the project footprint has occurred and no new areas of weed infestations were recorded within the project footprint.

4.3.4 Recommendations

It is recommended that control measures be continued and duties be checked for currency under the Biosecurity Act 2015, outlined in Table 6.

4.4 Microbat habitat monitoring

Preclearance inspections of culverts, identified as potential microbat habitat, were undertaken. No microbats were recorded and no suitable habitat was identified.

The performance of microbat habitat monitoring will be assessed against:

- *Successful removal of artificial structures without disturbance to threatened microbats.*
- *Data collation and reporting of these measures.*

Assessment criteria:

- *Zero impact to threatened microbat species.*

No microbats were recorded and no suitable habitat for microbats was identified, therefore no disturbance occurred.

References

Ferrovia York Joint Venture 2015a. Northern Beaches Hospital Connectivity and Network Enhancements Project - Flora and Fauna Management Plan. Draft report.

Biosis 2016a. Northern Beaches Hospital Connectivity and Network Enhancements Ecological Monitoring Plan. Authors: Steelcable, A., Biosis Pty Ltd, Sydney. Project no. 20367.

Biosis 2016b. Interim advice – Northern Beaches Hospital Connectivity and Network Enhancement Project – spring 2016 nest box monitoring. Authors: Corden, C. Biosis Pty Ltd, Sydney. Project no. 21833.

Biosis 2015a. Northern Beaches Hospital Connectivity and Network Enhancements Red-crowned Toadlet Management Plan. Authors: T. Steelcable & C. Corden. Biosis Pty Ltd, Sydney. Project no. 20367.

Biosis 2015b. Northern Beaches Hospital Connections and Network Enhancement Project – Pathogen and Weed Management Strategy. Draft report for Ferrovia York Joint Venture. Authors: Steelcable, A. and Benbow, C. Biosis Pty Ltd, Sydney. Project no. 20367.

SMEC 2015. Northern Beaches Hospital Road Connectivity and Network Enhancements Project: Surface Water Quality Monitoring Program. Prepared for NSW Roads and Maritime Services.

Appendix 1 Monitoring Actions of the NBHaCNE EMP

Table 3.3 Monitoring Actions of the NBHCNE EMP (Biosis 2016a) is provided below and identifies actions, timing, responsibility and performance criteria designed in order to monitor the effectiveness of the ecological mitigation measures to be implemented as part of the Project. This addresses the requirements of Condition B20 of the CoA.

Table 9 Monitoring Actions of the NBHCNE EMP (Biosis 2016a)

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Clearing procedure Monitoring						
FFMP section 7, Appendix C, Appendix D, Appendix E and Appendix G.	Removal of hollow-bearing trees	<p>Hollow-bearing trees are to be removed under the supervision of a suitably qualified ecologist by felling and not with the use of an excavator. Each hollow-bearing tree will be carefully lowered to the ground and immediately inspected by an ecologist for fauna.</p> <p>The Environment Manager (or appointed ecologist) is to supervise the removal of key fauna habitats and relocate any healthy resident native fauna to adjacent habitat and to transfer any injured fauna to a wildlife carer.</p>	During clearing operations, specifically at least 24 hours after the removal of non-habitat trees and understorey vegetation.	<p>Pre-clearing survey techniques, timing and responsibilities for surveying in accordance with the FFMP and form a component of the annual reporting to the Secretary, OEH and relevant Council, or as otherwise agreed by those agencies. The reports will include:</p> <ul style="list-style-type: none"> • Survey date. • Time. • Surveyors. • Weather conditions. • Details of methods used during pre-clearing surveys and clearing operations. • Fauna species displaced by clearing, species captured, species released and any wildlife. • Mortalities resulting either directly or indirectly from the clearing operations. • Location of fauna within clearing footprint (recorded with GPS) and release locations. • Hollow-bearing tree register, and comparison of this data to nest box plan (assess the adequacy of nest boxes installed and how they are mitigating the loss of tree hollows). • Discussion of the effectiveness of those methods employed. <p>Recommendations for future pre-clearing and/or clearing procedures.</p>	Environment Manager	<p>The performance of removal of hollow-bearing trees procedures will be assessed against:</p> <ul style="list-style-type: none"> • Low rates of fauna injury and mortality resulting from clearing operations, particularly of threatened species. • Successful capture and release of fauna displaced by clearing operations. • Rapid processing, treatment and release of injured fauna. • Accurate quantification of fauna habitat features and hollow-bearing trees being removed. • Data collation and reporting of these measures. <p>Assessment criteria:</p> <ul style="list-style-type: none"> • Zero direct harm to wildlife. • Incidental harm to be managed/reported on by Ecologist/Environment Manager. <p>Incidents to be raised through toolbox meetings with all construction workers.</p>

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
	Monitoring of vegetation clearance in areas adjacent to ecologically sensitive areas or vegetation to be retained.	Pre-clearance survey was undertaken to document the actual extent of native vegetation. Following the installation of protective fencing and signage, on-going monitoring is to be undertaken to ensure no accidental clearing is undertaken in native and derived plant communities and associated habitat for threatened and non-threatened terrestrial biodiversity (demonstrates avoidance). A register of sensitive site maps will be maintained.	Monitoring of vegetation clearance to be undertaken: 1. On a weekly basis during construction by the on site environmental officer. 2. Immediately after construction by the on site environmental officer.	Pre-clearing survey techniques, timing and responsibilities for surveying are detailed in the FFMP. The following documentation is to be kept on record following each monitoring event and form a component of the annual reporting to the Secretary, OEH and relevant Council, or as otherwise agreed by those agencies: <ul style="list-style-type: none"> • Survey date. • Time. • Surveyors. • Location and extent of vegetation clearance, including photo-point monitoring. • Location and photographs of protective fencing and signage. • Discussion of the effectiveness of those methods employed. • If there is any deterioration or damage to protective fencing and signage and if maintenance is required. 	Environment Manager	The performance of pre-clearing and clearing procedures will be assessed against: <ul style="list-style-type: none"> • Successful removal of intended vegetation without accidental damage to vegetation proposed for retention. • Data collation and reporting of these measures. Assessment criteria: <ul style="list-style-type: none"> • Zero impact to vegetation marked for protection • Reporting regarding vegetation clearance and water quality to be prepared and provided to relevant stakeholders as per Project Approval parameters and/or requirements.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Nest Box Monitoring						
FFMP Section 7 and Appendix G.	Monitoring of nest boxes	A visual inspection of each nest box will be undertaken by an appropriately trained zoologist using a ground-based nest-box surveillance camera or in conjunction with a qualified arborist if tree climbing is required.	Monitoring of nest boxes to be undertaken: <ol style="list-style-type: none"> 1. During construction 2. Immediately after construction 3. At least 6 months to a year after construction, preferably in summer and twice a year for up to five years. 	<p>Brief monitoring reports are to be produced following each nest box monitoring session, as outlined in Biosis (2015), and these form a component of the annual reporting to the Secretary, OEH and relevant Council, or as otherwise agreed by those agencies. The following information will be collected for each nest box:</p> <ul style="list-style-type: none"> • Nest box Identification number. • Time each nest box was inspected. • Inspection date, weather conditions (precipitation, cloud cover, temperature) • If the nest box is occupied by native fauna, and if so, the species. If the nest box is not occupied by a native species, record any signs of use by native species such as feathers, droppings, scats, hair or nesting material. • If the nest box is occupied by a pest species such as European bees, or Common Myna. • Is there any deterioration of the nest box and is any maintenance required. • Any changes to the surrounding habitats, such as clearing. 	Environment Manager	<p>Indicators of success of nest boxes include:</p> <ul style="list-style-type: none"> • Use of nest boxes by a wide range of native fauna species. • Use of nest boxes designed for specific species by those same species <p>Assessment criteria:</p> <ul style="list-style-type: none"> • Inspection to be undertaken to record nest box utilisation (by which species, native and pest) and success yearly for five years. • Reporting to outline nest box utilisation and success yearly for five years. • >60% uptake of nest boxes by native species. • <20% uptake of nest boxes by pest species.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
	Nest box maintenance regime	<p>The maintenance regime will involve:</p> <ul style="list-style-type: none"> • The removal of pest species such as common myna, common starlings and European bees. • The replacement of fallen, damaged or deteriorated nest boxes. • The repositioning or relocation of nest boxes that show no sign of use after several successive monitoring periods • The removal or excess nesting material that may block access to the nest box over time. 	Annual until completion of the project (operation phase), with maintenance assessments undertaken during nest box monitoring.	<p>The following information will be collected for each nest box and is to be submitted in annual reporting to the Secretary and relevant Council, form a component of the annual reporting to the Secretary, OEH and relevant Council, or as otherwise agreed by those agencies:</p> <ul style="list-style-type: none"> • Nest box Identification number. • Time each nest box was inspected. • Inspection date, weather conditions (precipitation, cloud cover, temperature). • If the nest box is occupied by a pest species such as European bees, or Common Myna. • Maintenance completed. 	Environment Manager or Operator	<p>Indicators of success of nest boxes include:</p> <ul style="list-style-type: none"> • Use of nest boxes designed for specific species by those same species. • Low rate of use of nest boxes by pest species • Low level of maintenance of nest boxes. <p>Assessment criteria:</p> <ul style="list-style-type: none"> • <5% of nest boxes requiring maintenance over a five year span.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Pathogen and Weed Monitoring						
FFMP Section 7 and Appendix B.	Noxious weed mapping will occur prior to clearing works.	Noxious weed mapping will occur progressively throughout construction prior to clearing works in each location. Weed management will occur throughout the extent and duration of the project in accordance with Pathogen and Weed Management Strategy.	Noxious weed mapping to be undertaken: 1. Prior construction.	Any additional instances of weeds or pathogens that are identified are to be provided, with co-ordinates and species identification to ensure weed and pathogen mapping remains current.	Environment Manager	Indicators of success of the Weed Management Procedure include: <ul style="list-style-type: none"> No new noxious weed and pathogen infestations within the Project footprint and in adjacent bushland as a result of the Project. Assessment criteria: <ul style="list-style-type: none"> No new noxious weed species (in addition species list within this plan) to establish in the Project footprint.
	Weed and pathogen management measures will occur throughout the extent and duration of the project in accordance with this plan.	Pathogen mapping will occur progressively throughout construction when signs of infection are evident. Pathogen management will occur throughout the extent and duration of the project, with testing to be undertaken to confirm presence or absence of pathogens in medium to high risk areas.	Noxious weed management to be undertaken: 1. Prior construction 2. During construction	The project footprint would be continually monitored for weed invasion during weekly site inspections, and any other inspections or audits undertaken as part of CEMP requirements. The presence of weed infestations would be reported as part of the inspection process, and include actions to be undertaken to manage these infestations	Environment Manager	Indicators of success of the Weed Management Procedure include: <ul style="list-style-type: none"> A reduction in the area of noxious weed and pathogen infestations within the project footprint. Assessment criteria: <ul style="list-style-type: none"> A 50% reduction in identified weed infestations to be achieved in year 1 within the project footprint, with gradual improvement for the following two years.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
	Weed and pathogen management during rehabilitation	Rehabilitated sites.	Stabilisation of catchments.	Rehabilitated sites would be monitored during inspections, with pathogen and weed management to be undertaken if required to manage any new infestations.	Environment Manager	<p>Indicators of success of the Weed Management Procedure include:</p> <ul style="list-style-type: none"> Control of weed infestation during rehabilitation of sites. <p>Assessment criteria:</p> <ul style="list-style-type: none"> No uncontrolled weed infestations.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Red-crowned Toadlet Monitoring						
FFMP section 7, Appendix 2 (in this document) Appendix B, Appendix D and Appendix E	Establish monitoring sites and collect baseline data	<p>Monitoring sites will be selected from within the Project (5 impact sites) and in the wider locality (1 control site).</p> <p>Monitoring will be conducted at night during optimal conditions along a 200m transect within each site. Surveys will be undertaken at each site over two nights. Surveys will involve listening for calling frogs, and using call-playback to elicit a call response from frogs. Active searching of suitable habitat will be undertaken if no frogs are calling during the survey period.</p>	To be completed prior to the commencement of works. Ideally in late winter/early spring during or soon after rainfall periods.	<p>The baseline survey results will be incorporated in the Red-crowned Toadlet Monitoring Plan (Appendix 2) in the Ecological Monitoring Program, to be completed prior to the commencement of construction works.</p> <p>The baseline survey results will include:</p> <ul style="list-style-type: none"> • Survey date. • Time. • Impact and control site locations. • Surveyors. • Weather conditions. • Details of methods used during monitoring surveys • Results of the surveys (i.e. number of calling Red-crowned Toadlets recorded at each site). • Discussion of the results, including impacts of ongoing construction and operation of the Project and effectiveness of mitigation measures. <p>Recommendations for future monitoring procedures.</p>	Environment Manager	<p>All impact and control sites are successfully established.</p> <p>Red-crowned Toadlets are recorded within impact sites where previously recorded (EIS) and at control sites during the same period.</p>

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
FFMP Section 7 and Appendix G.	Monitoring of all impact and control sites	Monitoring will be conducted at night during optimal conditions along a 200m transect within each site. Surveys will be undertaken at each site over two nights. Surveys will involve listening for calling frogs, and using call-playback to elicit a call response from frogs. Active searching of suitable habitat will be undertaken if no frogs are calling during the survey period.	To be completed annually. Ideally in late winter/early spring during or soon after rainfall periods.	<p>Annual monitoring survey results report to be submitted at the completion of each monitoring period. Reports will be completed in accordance with the FFMP and are to be submitted in annual reporting to the Secretary and relevant Council, or as otherwise agreed by those agencies. The reports will include:</p> <ul style="list-style-type: none"> • Survey date. • Time. • Impact and control site locations. • Surveyors. • Weather conditions. • Details of methods used during monitoring surveys • Results of the surveys (i.e. number of calling Red-crowned Toadlets recorded at each site). • Discussion of the results, including impacts of ongoing construction and operation of the Project and effectiveness of mitigation measures. <p>Recommendations for future monitoring procedures.</p>	Environment Manager	<p>Red-crowned Toadlets are recorded within all impact sites in similar or greater abundance to baseline levels.</p> <p>Red-crowned Toadlets are successfully recorded at control sites during monitoring periods.</p> <p>Red-crowned Toadlet abundance will not be less than baseline levels over two consecutive monitoring periods.</p>

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Roadkill Monitoring						
FFMP Appendix B and section 7	Roadkill monitoring.	Roadkill monitoring transects have been established within the Project footprint at key locations at which fauna habitat abuts the road corridor (Figure 1). Transects will be assessed by walking along the marked transects, with observed roadkill to be recorded. Photos of roadkill will be taken for verification by the Project Ecologist to confirm the identification of animals encountered.	Roadkill monitoring to be undertaken monthly undertaken at dawn/early morning : 1. Prior construction 2. During construction 3. Operational phase for up to 12 months	Brief roadkill monitoring reports are to be produced following each roadkill monitoring session, with the findings to be submitted in annual reporting to the Secretary and relevant Council, or as otherwise agreed by those agencies shortly after the clearing operations have been completed. The following information will be collected for each nest box: <ul style="list-style-type: none"> • Date. • Transect number. • Individual roadkill (to species if possible). • Time of day. • GPS waypoint of each individual. • Any changes to the surrounding habitats, such as clearing. 	Environment Manager with operational phase monitoring requirements to be determined post-construction.	Indicators of the success of roadkill control measures and assessment criteria include: <ul style="list-style-type: none"> • No increase in the frequency of roadkill encounters during assessments. • No new species encountered during construction phase when compared to baseline data.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Microbat Habitat Monitoring						
FFMP Section 7 and Appendix C, D, E, F and G.	Microbat Habitat Monitoring	Prior to any disturbances of potential microbat habitat a Project Ecologist is to inspect culverts and other potential non-hollow roost sites one week before works are undertaken. Inspections will be conducted during the day with the use of a powerful hand held torch to determine whether microbats are occupying the culverts. Any signs of historical use by microbats (e.g. dead specimens, bat droppings etc.) will also be recorded.	Microbat habitat monitoring to be undertaken: 1. Prior construction 2. During construction	Following pre-clearance assessments, the findings of the microbat habitat monitoring is to be included within the Pre-clearing report which would be undertaken in accordance with the FFMP and form a component of the annual reporting to the Secretary, OEH and relevant Council, or as otherwise agreed by those agencies. The reports will include: <ul style="list-style-type: none"> • Survey date. • Time (to verify works undertaken outside of winter torpor periods). • Surveyors. • Weather conditions. • Details of microbats identified during pre-clearing surveys and clearing operations. • Microbat species displaced by clearing, captured or released. • Mortalities resulting either directly or indirectly from the clearing operations. • Discussion of the effectiveness of those methods employed. Recommendations for future pre-clearing and/or clearing procedures.	Environment Manager	The performance of microbat habitat monitoring will be assessed against: <ul style="list-style-type: none"> • Successful removal of artificial structures without disturbance to threatened microbats. • Data collation and reporting of these measures. Assessment criteria: <ul style="list-style-type: none"> • Zero impact to threatened microbat species. • Reporting regarding microbat/fauna habitat and provided to relevant stakeholders as per Project Approval parameters and/or requirements.

Reference	Action	Description	Timing of action	Reporting	Responsibility	Performance Parameters / Assessment Criteria
Revegetation Monitoring						
Urban Design and Landscape Plan	Revegetation and rehabilitation measures.	Specific rehabilitation measures for each watercourse will be documented in Urban Design and Corridor Landscape Plan.	Refer to <i>Urban Design and Landscape Plan</i> .			