

Kempsey Bypass

Fauna Mitigation Monitoring Results

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Cover photograph, left to right: Sugar/ Squirrel Glider observed using the Old Station Road glider poles, Brush-tailed Phascogale captured during the monitoring program, Common Brushtail Possum recorded by remote camera using the underpass furniture at Bingis Lane.

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Executive Summary

Niche Environment and Heritage were engaged by the NSW Roads and Maritime Services to undertake ecological monitoring of the Kempsey Bypass. This report summarises the results of the monitoring, for the period from Spring 2014 until Winter 2015. This report also refers to previous ecological monitoring completed on the Kempsey bypass, prior to Autumn 2014, by ERM and Lewis Ecological.

This report summarises the results of the monitoring of the aerial crossings and fauna underpasses, nest box monitoring, Brush-tailed Phascogale monitoring and Green-thighed Frog pond monitoring.

Aerial crossings

Arboreal trapping occurred on both sides of the six mitigation structures (i.e. two sets of glider poles at Old Station Road and the rope ladder at Bingis Lane) in Spring 2014 and Autumn 2015. The Brush-tailed Phascogale was recorded on the western side of Bingis Lane, with two individuals being trapped in Autumn 2015. One Common Brushtail Possum was captured at Bingis Lane east and west and northern poles east. A number of Brown Antechinus were also captured at most sites. No gliders were captured during this monitoring period, although the Sugar Glider has been caught during past monitoring campaigns.

The monitoring of the crossing structures via remote cameras provided variable results. The Feathertail Glider and Sugar or Squirrel Glider was recorded using both sets of glider poles. However, no mammalian fauna was recorded using the Bingis Lane rope ladder.

Performance criteria were met, except for those relating to the use of the Bingis Lane rope ladder where, to date, use by this structure by any mammalian species is yet to be recorded and individuals have not been recorded crossing from one side of the road to the other.

Underpass monitoring

Three underpasses were monitored, being a dedicated box culvert underpass at Bingis Lane and two combined underpasses at Pola Creek and Boat Harbour Creek. Remote cameras were deployed in January-February 2015 and in April 2015 for 30 days at a time. These were supported by ten hair tubes, in place for 14 consecutive nights during each deployment. This monitoring resulted in the detection of a range of common fauna species, such as the Swamp Wallaby and rats. No breaches in the fauna fence were observed during inspections. A comparison with the baseline data indicated the performance measures have been met.

Nest box monitoring

The 90 installed nest boxes were inspected from the ground, with a pole and endoscope in February 2015. Fourteen of the 90 boxes contained fauna, of which 11 contained the Common Brushtail Possum, with the remaining boxes containing a Green Tree Snake and parrots. No gliders were recorded within the nest boxes in the 2015 survey, although they had been recorded previously. No bats were recorded during this monitoring event (however a bat was recorded in a previous monitoring event). The diversity of fauna using the nest boxes has declined to just one species, so the performance measure for a diversity of species using the boxes has not been met for this monitoring event. The performance measure of target species using their target boxes has not been met this monitoring event as no phascogales, gliders or bats were found to be using their specifically installed nest boxes. However, this performance measure has been met in previous monitoring events. In the case of bats, they have never been recorded in the "bat" boxes Despite

the results for this survey event, all performance measures are considered to have been met when the monitoring program results as a whole (from 2012 to 2015) are considered.

Brush-tailed Phascogale monitoring

Arboreal trapping occurred at three paired locations over four consecutive nights in April to June 2015. These locations were Bingis Lane, Boat Harbour Creek and Pola Creek. No Brush-tailed Phascogale were captured during this field campaign, although two individuals were captured at Bingis Lane West two weeks prior as part of the aerial crossing monitoring. Common Brushtail Possums and Brown Antechinus were captured as part of this field campaign. One performance measure for this program was achieved with the continued presence of Brush-tailed Phascogale at Bingis Lane. The situation in regards to the two other measures is uncertain as both rely on observations of Phascogales at two other sites and the presence of lactating females or juveniles. Phascogales have never been recorded from the other locations and no lactating or juvenile Phascogales have ever been observed in any location.

Green-thighed Frog

Green-thighed frog monitoring was undertaken at the three designated monitoring sites on both the 20th January and 4th March 2015. Green-thighed Frogs were recorded calling at one site (Site 1) and there they were using the natural floodway and not the constructed ponds. Tadpole surveys did not detect any Green-thighed Frogs.

These findings mirror those of monitoring Episodes 1 and 2, where a calling male was recorded at Site 1 in Episode 2. The other sites showed no frogs at any time and tadpoles and/or metamorphs were not recorded on any occasion.

The overall monitoring results indicates that Sites 2 and 3 are not being used by the Green-thighed Frog and that Site 1 has Green-thighed Frog adults present, although these individuals may not be using the constructed ponds and no breeding activity was evident. Therefore, the following performance measure have not been met during the last round of monitoring: that Green-thighed Frogs be found calling from the ponds and that there should be the indications of successful reproduction at follow up surveys through the recorded presence of tadpoles, juveniles or metamorphs. The performance measure of ponds holding water for long enough to allow metamorphosis and for the ponds to be non-permanent have been met.

Conclusion

Overall the monitoring program has shown that the majority of performance measures for the different monitoring components have clearly been met. The exceptions are:

- Aerial Crossings: the Bingis Lane rope ladder has not been used by a mammalian species.
- Green-thighed Frogs: Adult males have not been recorded at two of the three sites and tadpoles and/or juveniles have not been recorded at any of the three sites.
- Nest boxes: were not utilised by a wide range of native fauna in the latest monitoring period and target species did not use the boxes set in place for them. However, a wider range of fauna have occupied the nest boxes in the past, and all performance measures are considered to have been met when the monitoring program results as a whole (from 2012 to 2015) are considered.

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1. Aerial Crossings Monitoring Program

1.1 Introduction

In accordance with the Minister's Condition of Approval 2.10 (d) and the approved Kempsey Bypass Ecological Monitoring Program (Lewis 2012), Niche Environment and Heritage Pty Ltd (Niche) has been engaged by the NSW Roads and Maritime Services to undertake monitoring of arboreal crossing structures on the Kempsey Bypass, a 14.5 km upgrade of the Pacific Highway, located to the east of Kempsey, NSW.

This report summarises monitoring activities that involved the monitoring of fauna crossings using remote cameras and supplementary arboreal trapping adjacent to the fauna crossings in spring 2014 and autumn 2015. This report also discusses performance in relation to benchmark criteria for each structure.

1.2 Survey methods

1.2.1 Survey sites

Two sets of glider poles (Old Station Road South and Old Station Road North) were monitored which were located at chainage 121300 and chainage 122650 respectively and shown on Figure 1. One rope ladder was also monitored, which was located adjacent to Bingis Lane, at chainage 117200 and also shown on Figure 1.

1.2.2 Remote cameras

A total of nine Buckeye Cam X7D cameras are installed across the study area, consisting of three cameras on the glider poles at Old Station Road north, four cameras on the glider poles at Old Station Road south and two cameras on the rope bridge at Bingis Lane. Each X7D camera is powered by a solar panel and allows for passive download from the ground via a wireless receiver. The cameras run continuously and were downloaded on four occasions for this report, being on 29th November 2014, 14th January 2015, 17th February 2015 and 1st May 2015. The spring (1st September 2014- 30th November 2014) and autumn (1st March-31st May 2015) form the core consideration for this report, however any important incidental records outside of that time are also discussed. Cameras 1 (Old Station Road poles north), 6 (Old Station Road poles south) and 8 (Bingis Lane) failed to connect to the wireless receiver and thus could not be downloaded, although at least one camera was still operable on each structure.

1.2.3 Arboreal trapping

Both sides of each crossing structure were surveyed via arboreal trapping, thus producing three sites on the east of the highway and three sites to the west of the highway. At each of the six sites, arboreal tree trapping was undertaken using a trap grid of five by two tree mounted Elliot B traps, with a distance of approximately 40 metres between the traps, producing a trapping grid of approximately 1 ha. The location of the trapping grids are shown on Figures 2 – 4. The traps were baited with a mixture of rolled oats, peanut butter, tuna and honey and each Elliot B trap was positioned on a bracket approximately two metres above the ground. The host tree of each trap was also sprayed with a mixture of brown sugar and tuna oil as an additional attractant. Traps were left open over four consecutive nights producing a trapping effort of 40 trap nights per site and a total trapping effort of 480 trap nights over the two sampling periods. Traps were checked within two hours of sunrise each morning and the following details were recorded for any fauna captured:

- Trap location
- Sex
- Age class
- Breeding condition.

Larger species that were captured (i.e. any arboreal marsupial >150 g in weight) were implanted with a scanning microchip. Due to their short life expectancy, Brown Antechinus (*Antechinus stuartii*) were not microchipped as they were unlikely to be recaptured in future monitoring events. The location and identification of any other fauna captured within the traps was also recorded.

1.2.4 Roadkill

The areas around the rope bridges were also searched during visits to the site and records inspected for any signs of road kill of species expected to use these bridges. Fences were inspected on each visit to assess for signs of breaches or damage.

1.2.5 Weather

The weather conditions and dates of the field surveys (from Kempsey weather station) are included in Table 1 below.

Table 1. Weather conditions experienced during the field surveys, from the Kempsey weather station

Weather conditions	Rainfall (mm)	Wind speed and direction at 9am (km/h)	Min temp (°C)	Max temp (°C)
17/11/2014	0	9 W	17.3	26.6
18/11/2014	0	6 NW	20.3	29.4
19/11/2014	5.4	17 S	19	25.5
20/11/2014	0	17 N	8.5	30.2
21/11/2014	2.4	11 NE	19.8	32
13/04/2015	0	20 SW	17.6	24.4
14/04/2015	0	7 NNW	13	23.7
15/04/2015	0	11 NNW	15.8	25.6
16/04/2015	0	9 NW	15.5	27.4
17/04/2015	0	2 S	16.5	26.8

1.3 Results

1.3.1 Arboreal trapping

No gliders were captured during either the spring 2014 or autumn 2015 arboreal trapping surveys. Two Brush-tailed Phascogales (*Phascogale tapoatafa*) individuals were captured at Bingis Lane west (rope bridge west) in autumn 2015. Three sub adult (about 2 kg) Common Brushtail Possums (*Trichosurus vulpecula*) were captured at Bingis Lane east, Bingis lane west and northern poles east, and were microchipped. It should be noted that mature animals cannot fit within the Elliott B traps. Brown Antechinus were captured at Old Station Road north poles, east. A summary of the trapping results are provided in Table 2 and Table 3, while the microchip number of each animal is included in Table 4.

Table 2. Results from arboreal trapping completed in spring 2014. Where OSR = Old Station Road

Site name	Night 1 (17/11)	Night 2 (18/11)	Night 3 (19/11)	Night 4 (20/11)
Bingis Lane Rope bridge east	Nil	Nil	Nil	Nil
Bingis Lane Rope bridge west	Nil	Nil	Nil	Nil
OSR South poles east	Nil	Nil	Nil	Nil
OSR South poles west	Nil	Nil	Nil	Nil
OSR North poles east	1 <i>A.stuartii</i>	1 <i>A. stuartii</i>	2 <i>A. stuartii</i>	2 <i>A. stuartii</i>
OSR North poles west	Nil	Nil	Nil	Nil

Note due to their short lifespan, no A. stuartii were permanently marked

Table 3. Results from arboreal trapping completed in autumn 2015. Where OSR = Old Station Road

Site name	night 1 (13/4)	night 2 (14/4)	night 3 (15/4)	night 4 (16/4)
Bingis Lane Rope ladder east	Nil	Nil	Nil	1 <i>T. vulpecula</i>
Bingis Lane Rope ladder west	Nil	1 <i>P. tapoatafa</i>	Nil	1 <i>T. vulpecula</i> , 1 <i>P. tapoatafa</i>
OSR South poles east	Nil	Nil	Nil	Nil
OSR South poles west	Nil	Nil	1 <i>A. stuartii</i>	Nil
OSR North poles east	1 <i>Rattus rattus</i>	1 <i>T. vulpecula</i>	Nil	Nil
OSR North poles west	Nil	Nil	Nil	Nil

Table 4. Microchipped animals recorded during this study

Microchip	Species	Sex	Site
7633996	<i>T. vulpecula</i>	Sub-adult female	Bingis Lane west
77E6D1E	<i>P. tapoatafa</i>	Adult female (120g)	Bingis Lane west
7635582	<i>P. tapoatafa</i>	Adult female (130g)	Bingis Lane west
77E7EA4	<i>T. vulpecula</i>	Sub-adult male	Old Station Road North east
7634EOA	<i>T. vulpecula</i>	Sub-adult female	Bingis Lane east

1.3.2 Remote cameras

No mammals were recorded using the Bingis Lane rope ladder. The Feathertail Glider (*Acrobates pygmaeus*) was recorded using both the Old Station Road north and Old Station Road south poles (Table 5). Small gliders, either Sugar (*Petaurus breviceps*) or Squirrel Gliders (*Petaurus norfolcensis*), were recorded infrequently using the Old Station Road north and Old Station Road south poles (Table 6). A juvenile Common Brushtail Possum was recorded on one of the poles at Old Station Road south in spring 2014. Photographic examples of each species are included as Plates 1-3 below.

The remote cameras on the overpasses also recorded four bird species using the glider poles, for both diurnal and nocturnal roosting, specifically the Laughing Kookaburra (*Dacelo novaeguineae*), Common Koel (*Eudynamys orientalis*), Australian Magpie (*Cracticus tibicen*) and Common Myna (*Sturnus tristis*).

There was no evidence of road kill of species expected to use the rope bridges and no faults were noted in the fences.

Table 5. The number of nights where the Feathertail Glider was recorded by each camera

Camera number	Camera location	Number of nights recorded during the Spring monitoring period	Number of nights recorded during Autumn monitoring period
2	Old Station Road poles south	1	Nil
3	Old Station Road poles south	1	1
4	Old Station Road poles north	4	2
5	Old Station Road poles north	Nil	Nil
7	Old Station Road poles north	Nil	1
9	Bingis Lane rope ladder	Nil	Nil

Table 6. The number of nights where the Sugar/ Squirrel Glider was recorded by each camera

Camera number	Camera location	Number of nights recorded during the spring monitoring period	Number of nights recorded during autumn monitoring period	Records in summer monitoring period
2	Old Station Road poles south	Nil	Nil	Nil
3	Old Station Road poles south	Nil	2	Nil
4	Old Station Road poles north	Nil	Nil	Nil
5	Old Station Road poles north	Nil	Nil	Nil
7	Old Station Road poles north	Nil	Nil	1
9	Bingis Lane rope ladder	Nil	Nil	Nil

Photographic examples of each species



Plate 1. Feathertail Glider recorded at camera 2 on 14/2/2015



Plate 2. Sugar/Squirrel Glider recorded on the 18/3/2015 by camera 3



Plate 3. Sugar/Squirrel Glider observed on 20/1/2015 by camera 7

1.3.3 Comparison with 2014 results

In 2014, the arboreal trapping captured a similar number of Brush-tailed Phascogales (n=1) at Bingis Lane west compared to this survey (ERM 2014a). However, ERM (2014a) reported catching a number of Sugar Gliders at both Old Station Road North east and Old Station Road South east. Sugar Gliders were not captured at those, or any other sites in this survey.

This monitoring period was the first occurrence where a Sugar/ Squirrel Glider had been observed using the glider poles.

1.3.4 Outcomes against performance criteria

The analysis of these results against the performance criteria are provided in Table 7. This shows that two of the three identified performance measures for the Bingis Lane rope bridge have not been met to date during the monitoring, being arboreal fauna using the rope bridge and the absence of marked animals being detected crossing the highway. There is still one year of monitoring to be undertaken.

Table 7. Outcomes against performance criteria for the Bingis Lane Rope Bridge

Success indicators	Non-success indicators	Results against performance measure
<ul style="list-style-type: none"> Use of the rope bridge by one of more individuals from the following three fauna groups: possum, glider and scansorial fauna. Individual fauna with ear tag/notch occurring on the opposite side of the carriageway. 	<ul style="list-style-type: none"> a) Absence of any arboreal fauna being recorded using the rope bridge. b) No evidence of mixing in the captured arboreal fauna between western and eastern side of the carriageway. c) Unacceptable levels of road strike for arboreal fauna (>1 of 1 or more arboreal fauna groups). 	<ul style="list-style-type: none"> a) No arboreal fauna have been recorded using the rope bridge. b) There is no evidence of mixing of fauna from the east to the west of the carriageway. c) No fauna have been observed to have been subjected to vehicle strike in this area.

Monitoring has indicated the success of the glider poles in achieving the required mitigation outcomes and cessation of this monitoring has been agreed to with the Environment Protection Authority (EPA). Refer EPA and Road and Maritime Services correspondence in Appendix 1.

1.4 Discussion

This monitoring showed that both sets of poles were used by gliders, with the Sugar/ Squirrel Glider and the Feathertail Glider both being observed on poles at both Old Station Road North and Old Station Road South. It couldn't be determined if complete crossings were occurring due to the absence of the complete photo sequence from multiple cameras.

No mammals were observed using the Bingis Lane Rope ladder, despite the Common Brushtail Possum being recorded from both sides of the ladder and the Brush-tailed Phascogale being captured on the western side of the ladder. There is no evidence that the ladder is being used by mammals at this time. However, one camera on the rope ladder is not operating, which has reduced the opportunities to detect animals attempting to use the rope ladders. RMS is currently investigating options to repair the defective camera.

No gliders were captured during this monitoring period or detected in the nest box monitoring completed in February 2015 by Niche. The nest boxes installed adjacent to the highway upgrade also did not contain any Sugar or Squirrel Gliders, nor signs of them using the boxes. This suggests that gliders were uncommon or absent in the monitoring areas during this monitoring event and therefore records of crossings would be unlikely.

1.4.1 Proposed actions for the Bingis Lane rope ladder

The Ecological Monitoring Program document requires consideration of two actions as a result of the non-completion of performance measures at Bingis Lane:

- Review planting schedules/status of vegetation bordering the rope bridge
- Review monitoring program and make necessary adjustments.

In regards to the first point, some of the mature trees near the connection point for the rope on the western side of the rope ladder have died, thus connectivity may have been reduced. However, additional ropes have been set in place and this is expected to assist in improving accessibility to the rope ladder.

In regards to the monitoring program, the very low recording rates in the last monitoring period mean that it is difficult to conclude how effective mitigation has been. More records would be preferred in order to provide more certainty in regards to the presence and abundance of resident fauna.

It is recommended that the two remaining monitoring events (2015/2016) be completed and, if the number of records of captures and images are similarly as low as the 2014/2015 results, that the RMS and EPA discuss to consider whether adjustments to the program are justified.

2. Nest Box Monitoring Program

2.1 Introduction

Niche Environment and Heritage (Niche) were engaged by the NSW Roads and Maritime Services to undertake fauna monitoring for the Kempsey bypass project. This project consisted of upgrading the Pacific Highway between South Kempsey and Frederickton, along a distance of approximately 14.5 kilometres. An Ecological Monitoring Program was developed (Lewis 2012) which specified the need for the installation and monitoring of nest boxes to compensate for the loss of hollow-bearing trees. The purpose of this report is to summarise the results of the summer 2014/15 nest box monitoring surveys of the 90 nest boxes installed adjacent to the Kempsey Bypass.

2.2 Survey Methods

A total of 90 nest boxes were inspected with a telescopic pole and endoscope in February 2015. A variety of fauna were targeted by the nest boxes, via differences in the physical dimension and diameter of the entrance hole. Fauna groups specifically targeted by the nest boxes include microbats, parrots, possums, gliders and small owls. The location of each nest box is shown on Figure 5. Weather conditions were recorded during field surveys using the Kempsey weather station (Table 8).

Table 8. Weather conditions experienced during the field surveys, from the Kempsey weather station

Weather conditions	Rainfall (mm)	Wind speed and direction at 9am (km/h)	Min temp (°C)	Max temp (°C)
10/02/2015	0.2	9 S	18.9	29.6
11/02/2015	3.8	9 WSW	18.2	28.7
12/02/2015	2.8	7 WNW	18.5	29.6
13/02/2015	2.2	7 WSW	17.4	28.4
16/02/2015	3.8	CALM	17.5	28.7
17/02/2015	0.2	6 WSW	16.1	28.8
18/02/2015	1.4	7 W	17.2	28.4
19/02/2015	4.2	7 S	19.1	27.5
23/02/2015	13.4	9 SSW	20.6	26.2
24/02/2015	9.0	7 W	20.0	27.1

2.3 Results

Year Four summer surveys resulted in 17 (19%) of the 90 nest boxes showing signs of occupation by native fauna. Fourteen of these were direct observations of fauna, representing an occupancy rate of 15.6%. This consisted of 11 Common Brushtail Possums (*Trichosurus vulpecula*), one Rainbow Lorikeet (*Trichoglossus moluccanus*), one unidentified bird nest and one Green Tree Snake (*Dendrelaphis punctulata*). All occupied boxes contained a single animal.

One parrot box and one glider box showed signs of fauna presence, with unidentified scratches on the tree trunk or around the box. The unidentified bird nest was found in a bat box. One glider box was found with unidentified scats at the base. Six boxes had ants present and one box had honey bees present.

2.3.1 Comparison with 2012-2014 monitoring results

Year One monitoring (Lewis 2013) recorded an occupancy rate of 14% in summer, increasing to 25% in winter 2012. Commonly encountered species included the Sugar Glider, Common Ringtail Possum and Common Brushtail Possum, which were each recorded inhabiting more than 15 nest boxes. The Brush-

tailed Phascogale was recorded in eight (5%) of nest boxes. The Squirrel Glider was recorded in four (2%) of nest boxes. Eleven native species of fauna were recorded after Year One.

The Year Two winter 2013 survey recorded fauna within 39 of the 167 nest boxes checked, representing an overall occupancy rate of 23% (ERM 2014b). The mammalian fauna recorded, including the number of boxes that each species was present in (presented in brackets) included Common Brushtail Possum (16), Common Ringtail Possum (3), Sugar or Squirrel Glider (14), Feathertail Glider (1), Brown Antechinus (1) and Brush-tailed Phascogale (1).

In Year Three, the summer survey (ERM 2014c) resulted in an occupancy rate of 17% of nest boxes, including six native fauna species. Sixteen Squirrel Gliders were recorded across seven nest boxes. One Brush-tailed Phascogale was recorded. The winter 2014 survey (ERM 2014d) resulted in fauna occupying 38 of the 167 checked nest boxes, representing an occupancy rate of 23%. A total of 52 individuals were recorded, including eight different fauna species. Four gliders were positively identified as Squirrel Gliders (in two nest boxes). Eleven individuals were identified as being either a Sugar Glider or a Squirrel Glider (in nine nest boxes). One possible nest of a Brush-tailed Phascogale was identified.

During the Year Four summer survey in 2015, the only mammalian species recorded was the Common Brushtail Possum, representing a decrease in use compared with previous years. This was the first monitoring event at which neither the threatened Squirrel Glider nor Brush-tailed Phascogale were recorded.

The nest boxes were found to be in good condition with no clear need for replacements.

2.3.2 Compliance with performance measures from Kempsey Bypass Ecological Monitoring Plan

The following performance measures were identified for the nest boxes within the Kempsey Bypass Ecological Monitoring Plan (Lewis 2012):

- Use of nest boxes by a wide range of native fauna.
- Use of nest boxes designed for specific species by those species (i.e. Brush-tailed Phascogale nest box being used by this species).
- Low rates of exotic fauna using nest boxes.
- Reduced maintenance requirements (<10% requiring attention).

As noted in the results, the first two performance measures were not met during this monitoring event. The third and fourth were met during this monitoring event. Despite this, all performance measures are considered to have been met when the monitoring program as a whole is considered.

2.4 Discussion

This monitoring period detected less diversity and a lower occupation rate by fauna within the nest boxes than in previous surveys. It is unclear why there has been the change in occupancy. It may represent an overall decline in fauna abundance in the monitoring areas or that the fauna are present, but are now choosing to avoid the nest boxes. Or it may be random chance.

Arboreal trapping completed by Niche as part of the aerial crossings monitoring program completed 480 trap nights, across six sites in spring 2013 and autumn 2014 and failed to capture any gliders, but did capture two Brush-tailed Phascogales on the western side of Bingis Lane. Niche also completed 240 trap nights as part of the Brush-tailed Phascogale monitoring program in autumn 2014, across six sites and again

did not capture any gliders, but did catch a single Brush-tailed Phascogale. Overall, the comparison of the results obtained from previous monitoring shows a decline in captures, with the reasons for this unknown.

Despite the results of this specific survey, all performance measures are considered to have been met when the monitoring program as a whole is considered.

No feral animals were observed within the boxes and evidence of termite attack was not recorded. All boxes were observed to be in a good condition, thus no management actions are required to remove feral animals or replace dilapidated or missing nest boxes.

3. Brush-tailed Phascogale Monitoring Program

3.1 Introduction

Niche Environment and Heritage (Niche) has been engaged by the NSW Roads and Maritime Services (RMS) to undertake monitoring of the Brush-tailed Phascogale (*Phascogale tapoatafa*) on the Kempsey Bypass, in accordance with the approved Kempsey Bypass ecological monitoring program (Lewis 2012). One requirement of the ecological monitoring program, in accordance with the Minister for Planning’s Condition of Approval (MCoA) 3.1 was to ‘implement a Brush-tailed Phascogale monitoring program to assess patterns of habitat use, both during construction and operational phases of the Kempsey Bypass project.’ Survey data available from 2004 and 2005 recorded a single Brush-tailed Phascogale adjacent to Bingis Lane. This report summarises the results of the autumn 2015 monitoring event and compares the results to those obtained during monitoring events undertaken between 2011 and 2014.

3.2 Survey Methods

3.2.1 Survey sites

Three areas have been included for monitoring, adjacent to different fauna mitigation structures (Figure 6). These are:

- Boat Harbour Creek (Ch 115 750) where a combined drainage and fauna underpass occurs via a 5.5 m reinforced concrete arch.
- Bingis Lane (Ch 116 900) where a rope ladder and 3 X 3 m fauna underpass both occur.
- Pola Creek (Ch 120 000) where twin bridges occur over the creek that includes passage for fauna.

Trapping occurred on each side of the mitigation structures, with a total of six sites being surveyed. To date, the Brush-tailed Phascogale has only been recorded on the western side of Bingis Lane. Habitat descriptions of each site are included in Annexure 3.

3.2.2 Survey Method

Surveys were completed over four nights between 27th April 2015 and 1st June 2015 (i.e. autumn), in accordance with the Kempsey Bypass Monitoring Plan (Lewis 2012). The weather conditions during the sampling period are summarised in Table 9 below.

Table 9. Weather conditions experienced during the field survey (taken from the BOM Coffs Harbour weather station, due to equipment failure at Kempsey)

Weather conditions	Rainfall (mm)	Wind 9am	Max temp	Min temp
27/04/2015	0	19 SW	11.6	22.4
28/04/2015	0	15 SW	9.7	22.6
29/04/2015	51.6	13 NW	12.9	21.9
30/04/2015	16.2	6 WNW	13.8	19.4
1/05/2015	80	11 SSW	15.4	23.4

At each of the six sites arboreal tree trapping was undertaken using a trap grid of five by two (10) tree mounted Elliot B traps, with a distance of approximately 40 m between traps, producing a trapping grid of approximately 1 ha. The traps were baited with a mixture of rolled oats, peanut butter, tuna and honey.

The traps were positioned on brackets approximately two metres above the ground and were left open over four consecutive nights, producing a site trapping effort of 40 trap nights and a total trapping effort of 240 trap nights. The host tree of each trap was also sprayed with a mixture of brown sugar and tuna oil as an additional attractant. Traps were checked within two hours of sunrise each morning and the following details were recorded for any Phascogales captured:

- Trap location
- Sex
- Weight
- Age class and
- Breeding condition.

Captured Phascogales were also implanted with a scanning microchip. While this was the final phascogale monitoring event, additional results may be obtained in future through monitoring of the arboreal crossings as some of these correspond with phascogale monitoring locations. The location and identification of all other fauna captured within the traps was also recorded.

3.3 Results

Brush-tailed Phascogales were caught at one site (Bingis Lane West) during the monitoring period, where one adult female (weight of 122 grams and no evidence of breeding), was caught. Previous monitoring at Bingis Lane East two weeks prior (for the aerial crossings monitoring) caught two female Brush-tailed Phascogales, including the animal that was recaptured during this monitoring event (Table 4).

Other fauna captured during the monitoring included Black Rat (*Rattus rattus*), Brown Antechinus (*Antechinus stuartii*) and Common Brushtail Possum (*Trichosurus vulpecula*). A summary of the species captured is included in Table 10.

Table 10 Summary of mammals captured at each site during the autumn 2015 Phascogale monitoring period

Site name	Night 1 (27/4)	Night 2 (28/4)	Night 3 (29/4)	Night 4 (30/4)
Pola Creek E	Nil	Nil	Nil	1 <i>R. rattus</i>
Pola Creek W	Nil	1 <i>R. rattus</i>	1 <i>R. rattus</i>	2 <i>R. rattus</i>
Boat Harbour Creek E	Nil	Nil	Nil	Nil
Boat Harbour Creek W	1 <i>R. rattus</i>	1 <i>A. stuartii</i>	1 <i>T. vulpecula</i>	1 <i>R. rattus</i>
Bingis Lane E	Nil	Nil	1 <i>R. rattus</i>	Nil
Bingis lane W	Nil	Nil	Nil	1 <i>P. tapoatafa</i>

3.3.1 Comparison with previous surveys (2011-2014)

Low densities of Brush-tailed Phascogale were recorded during targeted arboreal trapping between 2011 and 2014. During the autumn 2014 surveys, one Brush-tailed Phascogale was captured during the Phascogale monitoring and another individual was captured during arboreal crossing monitoring, with both captures also at Bingis Lane West (ERM 2014f). Brush-tailed Phascogales have been recorded in nest boxes previously, with one deceased and five living animals being recorded in nest boxes in 2012, and one animal in 2013 (ERM 2014f). However, nest box monitoring that occurred in February 2015, did not detect any Brush-tailed Phascogales within the checked nest boxes.

3.3.2 Compliance with performance measures

The performance measures identified in the Kempsey Bypass Ecological Monitoring Program (Lewis 2012) were:

- Continued presence of Phascogale which are known from Bingis Lane.
- Presence of Phascogale at Boat Harbour Creek and Pola Creek which represent potential habitat.
- Presence of sub adults and/or lactating Phascogale.

The EMP stated 'Signs of the mitigation being unsuccessful will be based on absence of Phascogale from Bingis Lane'.

One Brush-tailed Phascogale was caught during this monitoring period, while another individual was captured two weeks prior during the aerial crossing surveys. These results confirm the continued presence of Brush-tailed Phascogale on the western side of Bingis Lane. No Brush-tailed Phascogale were recorded at either Boat Harbour Creek or Pola Creek, however surveys completed since 2011 have produced no records of this species from those locations. Subsequently their apparent absence during these surveys is not unexpected and they are likely not present. The record of a Brush-tailed Phascogale at Bingis Lane is enough for the performance measure to be met and no actions are required.

3.4 Discussion

One Brush-tailed Phascogale was captured during this survey period, while two animals, including the previously caught individual, were also captured during concurrent arboreal marsupial monitoring at the same site. The recapture of a previously captured animal and the absence of new animals, suggests the population at Bingis Lane West is relatively small. There is an apparent, continued absence of the Brush-tailed Phascogale at the other sites.

4. Fauna Underpass Monitoring Program

4.1 Introduction

Niche Environment and Heritage (Niche) were engaged by the NSW Roads and Maritime Services to undertake fauna monitoring for the Kempsey Bypass project. This project consisted of upgrading the Pacific Highway between South Kempsey and Frederickton, along a distance of approximately 14.5 kilometres. The Ecological Monitoring Program developed by Lewis (2012) specified the need to monitor the fauna underpass structures and the effectiveness of the fauna fencing installed immediately adjacent to those structures. The purpose of this report is to summarise the results of the summer 2014/15 and autumn 2015 monitoring surveys for the fauna underpasses and associated infrastructure.

4.2 Survey methods

4.2.1 Survey sites

Three underpasses were monitored, being one dedicated 3 m X 3 m reinforced box culvert underpass at Bingis Lane, one combined 9 m X 5 m reinforced concrete arch culvert at Boat Harbour Creek and a bridge underpass at Pola Creek. 'Floppy top' fauna fencing was also installed for at least 250 m either side of each underpass. The location of each underpass is shown on Figure 6.

4.2.2 Survey Methods

Surveys investigating the use of the fauna underpasses occurred in January-February 2015 and in April 2015. Infrared remote cameras (Scoutguard SV 550) were placed within each underpass in order to capture any fauna passing through. In January-February 2015, 10 cameras were placed at Boat Harbour Creek, four cameras at Bingis Lane and four cameras at Pola Creek (two of these cameras were stolen). In April 2015, three cameras were installed at each location. The cameras were set to take a photo burst of three photos every five seconds at all times over a 30 day period (27th January- 28th February 2015 and 13th April- 14th May 2015). To supplement the remote cameras, particularly to enable detection of smaller species such as Brown Antechinus (*Antechinus stuartii*) and rats (*Rattus* sp.), 10 hair tubes were also placed within each underpass, for 15 consecutive nights in both summer and autumn (29th January-14th February 2015 and 29th April- 14th May 2015). Each hair tube was baited with a mixture of tuna oil, brown sugar and peanut butter. The hair tubes were placed at even spacing throughout the underpass and where possible were mounted above the ground on underpass furniture. Hair tubes were analysed by Barbara Triggs ('Dead Finish') and identified to species level where possible.

Opportunistic searches for scats and tracks occurred within each underpass while placing and collecting the field equipment. Inspections of the fauna fence adjacent to each underpass was undertaken to determine whether any breaches had occurred, as well as survey of the carriageway within 500 m of the fauna underpasses to search for roadkill.

4.3 Results

4.3.1 Summer 2015

Fauna were recorded on the remote cameras at the combined underpasses (Pola Creek and Boat Harbour Creek), but not at the dedicated underpass (Bingis Lane) in summer 2015. At Pola Creek, the Swamp Wallaby (*Wallabia bicolor*) and Red Fox (*Vulpes vulpes*) were recorded, while at Boat Harbour Creek, the Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallaby (*Macropus rufogriseus*), Common Brushtail Possum (*Trichosurus vulpecula*) and Feral Cat (*Felis catus*) were recorded. No hairs were found in any of the hair tubes. The tracks of the Feral Cat were found within the culvert (Bingis Lane). In general,

detections were uncommon, with the Common Brushtail Possum and Eastern Grey Kangaroo being recorded on two occasions within Boat Harbour Creek and the Swamp Wallaby being recorded on two occasions at Pola Creek. The Red Fox was recorded on one occasion at Pola Creek. The only species recorded on multiple occasions was an individual black Feral Cat, which was often observed within the Boat Harbour Creek culvert.

4.3.2 Autumn 2015

No fauna were recorded on the remote cameras at the combined underpasses (Pola Creek and Boat Harbour Creek), however a range of species were recorded at the dedicated fauna underpass at Bingis Lane. These were the Eastern Grey Kangaroo, Swamp Wallaby, Common Brushtail Possum and Red Fox. One human was recorded walking a dog through the Bingis lane underpass, on one occasion. In general detections were infrequent, with the Common Brushtail Possum, Eastern Grey Kangaroo and Swamp Wallaby each being recorded on one occasion.

The Black Rat (*Rattus rattus*) was the only species recorded via the hair tubes, being present in six of the 30 hair tubes, distributed across all sites. The scats of the Red-necked Wallaby were observed adjacent to the entrance to the Bingis Lane culvert. An Eastern Water Dragon (*Physignathus lesueurii*) was observed within the Boat Harbour Creek culvert. Table 11 summarises the species recorded at each of the crossing structures.

Table 11. Summary of species recorded on remote camera, scat and track searches, or via remote cameras at each site, during each monitoring period

Species	Pola Creek		Boat Harbour Creek		Bingis Lane	
	Summer 2015	Autumn 2015	Summer 2015	Autumn 2015	Summer 2015	Autumn 2015
Common Brushtail Possum						
Swamp Wallaby						
Red-necked Wallaby						
Eastern Grey Kangaroo						
Red Fox						
Feral Cat						
Eastern Water Dragon						
Black Rat						

There were no fauna fence breaches or road kills reported during the summer or autumn 2015 monitoring periods.

Plates 4 to 7 show images of species captured with the remote infrared cameras.

4.3.3 Comparison with 2014 results

Monitoring of all these sites occurred previously in autumn 2014, with the results summarised in ERM (2014d) and summer 2014/15, which are summarised in ERM (2014g).

The diversity of fauna previously recorded was higher than was found in 2015 surveys. Species that were not detected in these surveys but that were detected by ERM (2014d and g) were:

- Northern Brown Bandicoot (*Isoodon macrourus*), which was recorded at Bingis Lane and Boat Harbour Creek in summer 2014/15 via hair tubes and in autumn 2014 at Bingis Lane. Remote cameras recorded this species at Bingis Lane in autumn 2014.
- Brown Antechinus, which was recorded via hair tubes in summer 2014/15 and autumn 2014 at Bingis Lane and Boat Harbour Creek. Remote cameras recorded this species at Bingis Lane and Boat Harbour Creek in autumn 2014.
- Common Ringtail Possum (*Pseudocheirus peregrinus*), which was recorded on remote cameras at Pola Creek in autumn 2014 and summer 2014/15.
- Wild Dog (*Canus lupus*), an introduced species, was recorded on remote cameras at Pola Creek in autumn 2014 and summer 2014/15.
- House Mouse (*Mus domesticus*), an introduced species, was recorded via hair tubes and remote cameras at Pola Creek in autumn 2014.
- Lace monitor (*Varanus varius*) was recorded on remote cameras at Bingis Lane in autumn 2014.

4.3.4 Compliance with performance measures from Kempsey Bypass Ecological Monitoring Plan

The following performance measures were identified for the underpasses within the Kempsey Bypass Ecological Monitoring Plan (Lewis 2012):

- Use of fauna underpass by nominated indicator species.
- Use of fauna underpass by key target species.
- Use by fauna with low dispersal abilities.
- Low rate of fauna road strike.
- No breaches in the fauna fence.

These performance measures and the results of this monitoring period are discussed in Table 12 , including suggested actions in response to these results, if required. It should be noted that two more underpass survey campaigns are yet to be undertaken.

Table 12 Underpass monitoring performance measures, 2015 monitoring results and any actions required

Potential Problems	Outcomes from this monitoring program	Contingency measures/Required actions
a) Low usage rates of native fauna.	The usage of the underpasses from this monitoring program, in terms of the diversity and frequency of fauna was less than recorded in 2014. It is not clear however if this is low enough to be considered a low usage level and trigger a contingency measure. It is assumed that it is not.	No action required.
b) One or more of the indicator species groups not using the underpass structure.	Frogs and reptiles were not recorded. However, the methods used are unlikely to detect these taxa. Mammals were recorded using the underpass, although variably. Macropods and possums were found to be using the underpasses. The introduced Black Rat was the only species of small mammal found to be using the underpasses in this monitoring event. The Northern Brown Bandicoot and Brown Antechinus were not recorded in this monitoring event.	No action required.
c) High visitation/usage rates by exotic predators.	Feral cat and Red Fox were recorded at Boat Harbour Creek and Bingis Lane respectively. However, their visitation was not high.	No action required.
d) Unacceptable rates of road strike in the vicinity of the underpasses (<250 m).	No road strike was recorded within the vicinity of the underpasses, however road kills were observed beyond the fauna fencing.	No action required.
e) Road strike of species which the fence is designed to exclude.	No road strike was recorded adjacent to the installed fauna fencing.	No action required.

Examples of photos from the remote camera surveys



Plate 4. Common Brushtail Possum recorded on underpass furniture at Boat Harbour Creek, during the summer 2015 monitoring

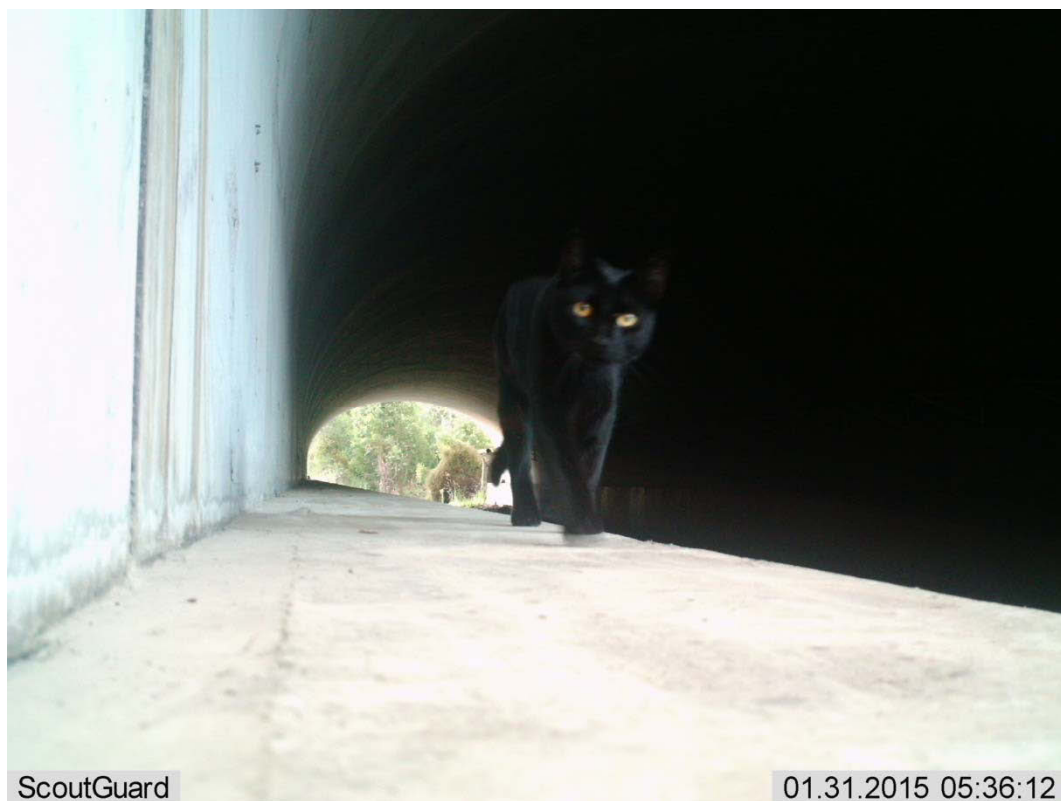


Plate 5. Feral Cat recorded at Boat Harbour Creek during summer 2015



Plate 6. Swamp Wallaby recorded at Pola Creek during the summer 2015 monitoring



Plate 7. Red Fox recorded at Pola Creek during the summer 2015 monitoring

4.5 Discussion

The summer and autumn 2015 monitoring surveys had a lower diversity and number of fauna than the summer and autumn 2014 surveys. In particular the Brown Antechinus, Common Ringtail Possum and Northern Brown Bandicoot were not recorded using the underpasses, despite the Antechinus and Bandicoot being reasonably common in 2014. Despite the 2015 survey results being relatively poor, when considered in conjunction with the results from previous surveys it can be stated that performance measures have been met. However, reptiles and amphibians are listed as indicator species (Lewis 2012) and they were not detected, but this can be attributed to the fact that the survey methods (hair tubes, remote cameras and limited opportunistic surveys) are not suitable methods for detecting these taxa.

It should be noted that two more underpass survey events are to be undertaken and the results from this should assist to provide a better understanding of fauna utilisation of the underpasses.

5. Green-thighed Frog Monitoring

5.1 Introduction

Niche were engaged by the NSW Roads and Maritime Services to undertake fauna monitoring in accordance with the Ecological Monitoring Program, Kempsey Bypass Project (Lewis 2012). Green-thighed Frog breeding ponds were proposed as a mitigation tool to maintain breeding opportunities. The presence of Green-thighed Frog tadpoles/metamorphs would indicate that the ponds are being used for breeding and thus are an effective mitigation strategy, which has yet to be demonstrated in any area of the Pacific Highway. The purpose of this report is to summarise the results of the spring and summer 2014-2015 monitoring surveys.

5.2 Survey Methods

5.2.1 Survey sites

Three sites were monitored for Green-thighed Frog (Table 13 and Figures 7-9) using a two-stage process. The nocturnal surveys were carried out on the 20th January 2015 following heavy rains (Table 15). Diurnal surveys for tadpoles and/or metamorphs were conducted on the 4th March 2015.

Table 13. Monitoring sites for the Green-thighed Frog.

Site number	AMG (WGS 84)	Chainage	Description
1	483945 6557283	114975	<ul style="list-style-type: none"> • Five 4x2 m (8m²) • Maximum depth 600-750 mm • 1:4 battered slope
2	488766 6562119	122170	<ul style="list-style-type: none"> • Five 3x4 m (12m²) ponds • Maximum depth 300-400 mm • 1:4 battered slope
3	488930 6562232	122340	<ul style="list-style-type: none"> • Monitoring existing depressions immediately east of 114975

Table 14 Weather conditions experienced during the field surveys, Kempsey BOM weather station.

Weather conditions	Rainfall (mm)	Wind speed and direction at 9am (km/h)	Max temp	Min temp
20/01/2015	121.2	11 WSW	24.6	19.0
04/03/2015	0	2 ENE	30.5	17.8

5.2.2 Survey methods

Surveys followed the baseline monitoring techniques as outlined in Lewis (2005), involving an initial Stage 1 nocturnal aural/visual search of the sites after a period of rainfall sufficient to flood the breeding sites (preferably 75 mm of rain over 24 hours). The surveys included call playback for the Green-thighed Frog, along with targeted nocturnal searching, for at least 30 minutes per site. Stage 2 involved 20 minute searches of the sites preferably 30-45 days after the nocturnal surveys to search for the presence of Green-thighed Frog tadpoles and/or metamorphs. In addition, these sites were opportunistically surveyed during other programed works in case breeding events were missed.

5.3 Results

All three artificial ponds were surveyed for calling frogs during ideal survey conditions (121 mm rainfall over the previous 24 hours). Green-thighed Frog were not detected at Sites 2 or 3, but 3 males were heard calling in the proximity of Site 1. They were using an ephemeral water course adjacent to the constructed ponds and not at the ponds themselves. Females were not located. The Rocket Frog (*Litoria nasuta*) were present and calling at all three sites, while Peron's Tree Frogs (*Litoria peronii*) and Dainty Green Tree Frogs (*Litoria gracilentia*) were heard calling at Site 1 during the night of the survey.

A reference site was not required as the presence of individuals at Site 1 established that frogs were active on the night of survey.

No Green-thighed Frog tadpoles or metamorphs were observed in the monitoring sites during the follow-up daytime surveys. All three sites had water present in the potential breeding areas. Rocket Frog (*Litoria nasuta*) tadpoles and metamorphs were present at Sites 1 and 2, and a *Limnodynastes* spp. tadpole was detected through sweep netting at Site 3.

5.3.1 Comparison with Spring 2013 – Summer 2013/14 results

Monitoring undertaken in January 2012 (Monitoring Episode 1) failed to detect the Green-thighed Frog at any site. Follow up tadpole surveys in March also failed to locate any tadpoles or metamorphosed frogs (evidence of successful breeding) at any site .

Monitoring Episode 2 was conducted in January 2013 during which no frogs were detected at Sites 2 and 3. However, two males were located calling at a constructed pond at Site 1. Follow up surveys in March did not detect any evidence of tadpoles or metamorphosing frogs at any of the three sites.

Comparing these results indicates that the Green-thighed Frog remains present at Site 1, although the males were not using the constructed ponds, but rather an adjacent ephemeral stream bed. As for previous surveys, males were not recorded using Sites 2 or 3.

As was the case in Monitoring Episodes 1 and 2, no signs were found of reproduction occurring in any of the three sites. The water did last long enough to allow metamorphosis to take place and the ponds therefore had a sufficient hydroperiod for successful reproduction. The ponds were also all noted to have dried out in the spring of 2014 and so are ephemeral.

5.3.2 Compliance with performance measures from Kempsey Bypass Ecological Monitoring Plan

The following performance measures were identified for the Green-thighed Frog breeding ponds within the Kempsey Bypass Ecological Monitoring Plan (Lewis 2012):

- Continued presence of Green-thighed Frog at Sites 1, 2 and 3.
- Green-thighed Frogs calling from the edge of the constructed ponds.
- The presence of tadpoles, juveniles or metamorphs during follow up surveys.

Signs of the mitigation being unsuccessful will be based on the:

- Absence of Green-thighed Frogs from the area.
- Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis.
- Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).

Lewis (2012) suggests the following options for contingency measures for any noted problems:

- Survey adjacent areas to confirm frogs remain in the area.
- Review/modify ponds to improve potential site suitability problems.
- Review/modify ponds either by placing a semi permeable layer or further excavation.
- Improve drainage.
- Modify pond to ensure it dries out (if fish are noted to be present).

Table 15 compares the survey results against the performance measures.

Table 15. Breeding ponds performance measures and outcomes from the 2015 monitoring program

Potential Problems	Outcomes from this monitoring program
a) Continued presence of Green-thighed Frogs at Sites 1, 2 and 3.	No presence of Green-thighed Frogs were recorded using the constructed ponds at Sites 2 or 3. Three were observed at Site 1, but they were not using the constructed ponds, but rather a nearby water course.
b) Ponds not holding water long enough to enable breeding success.	Ponds flooded for more than 30 days.
c) Ponds holding water for too long, encouraging competition from non-target frog fauna.	Ponds have been noted to dry out.
d) Exotic fish fauna recorded in breeding ponds	No exotic fish recorded.

5.4 Discussion

The 2015 monitoring event provided a very similar result to the previous two monitoring periods, with frogs being located at Site 1 (although not using the constructed ponds) but absent from Sites 2 and 3, and no successful reproduction recorded at any site. The results from this monitoring event provide no indication that the constructed breeding sites are being used successfully by the Green-thighed Frog and that the species has also moved from the previously used natural breeding site. However, Green-thighed Frogs remain in the vicinity of Site 1.

The changed structure of the vegetation associated with the Upgrade may have made the sites, at least temporarily, unfavourable for the Green-thighed Frog. This species prefers denser and more enclosed habitats (Lemckert et al. 2006) and the construction of the Bypass has necessarily resulted in the removal of vegetation to allow construction of the road. The consequence has been to open up the breeding site on at least one side and allow increased light levels and wind access to the site. This is more typical of habitat used by the Rocket Frog (*Litoria nasuta*) and this species is currently present at all three sites. The two species are not usually recorded calling from the same location and so the presence of the Rocket Frog may indicate that the habitat is not completely suitable for the Green-thighed Frog. It is notable that the vegetation at Site 1 provides a more complete closure around the water bodies and this is the site where the Green-thighed Frog remains present. It is possible that the Green-thighed Frog will return to Sites 2 and 3 once the vegetation has regenerated further.

The intended monitoring program for the Green-thighed Frog has been completed with the provision of the 2015 surveys. Hence, at this time, it can only be concluded that the compensatory ponds do not appear to be utilised by the Green-thighed Frog for breeding at Sites 2 and 3.

The Ecological Monitoring Program (Lewis 2012) requires the modification of the ponds to be considered as a contingency action should evidence of breeding not be recorded. Although the ponds are smaller than

the preferred pond size reported by Ledlin (1997), their hydroperiod (time with water) was sufficient to allow breeding.

It is recommended RMS and EPA consider the results and the need for any contingency actions considered necessary under the approved Ecological Monitoring Program (Lewis 2012).

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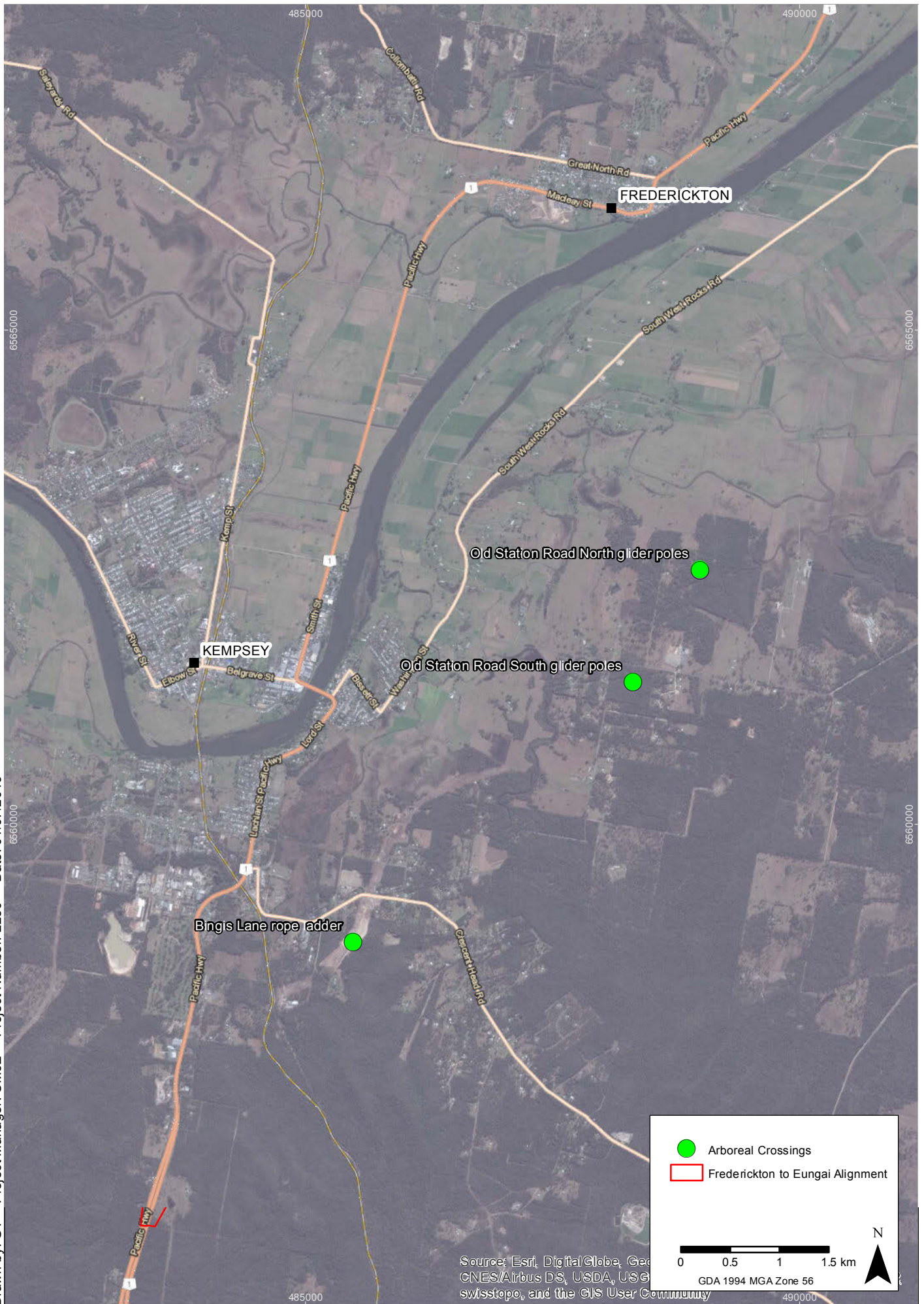
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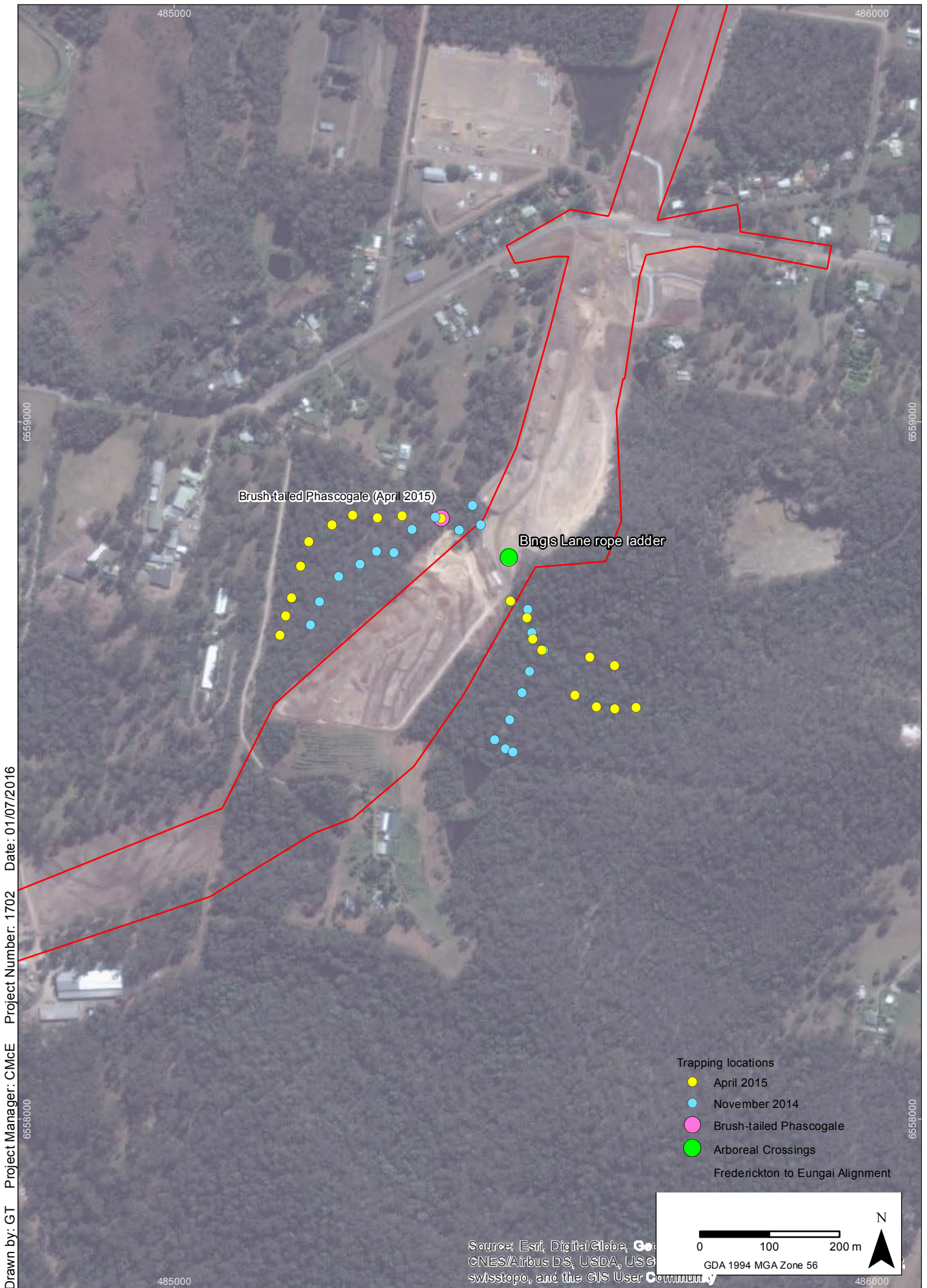
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Figures



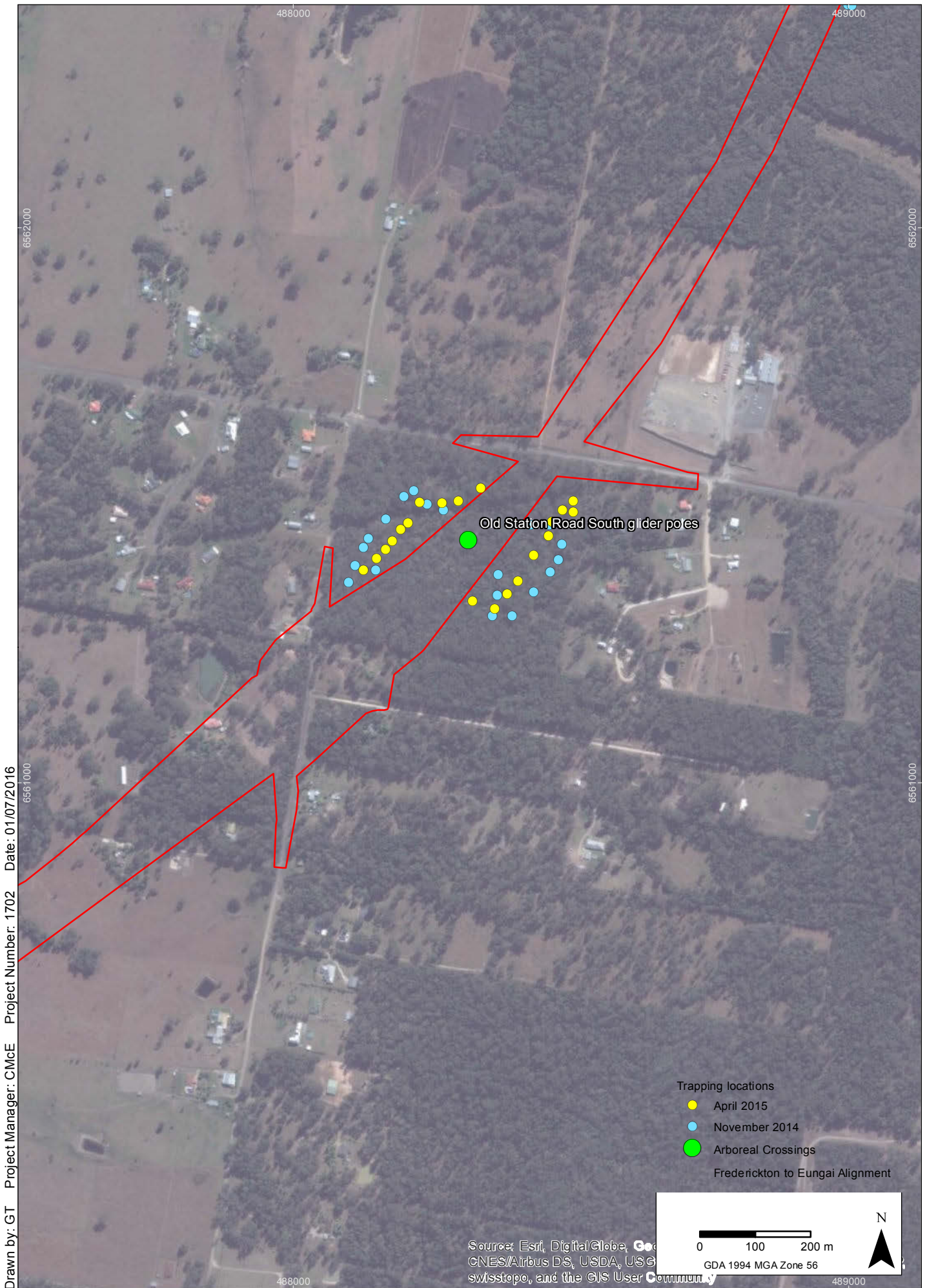
Study area and location of arboreal crossings
Pacific Highway Upgrade - Kempsey Bypass

FIGURE 1



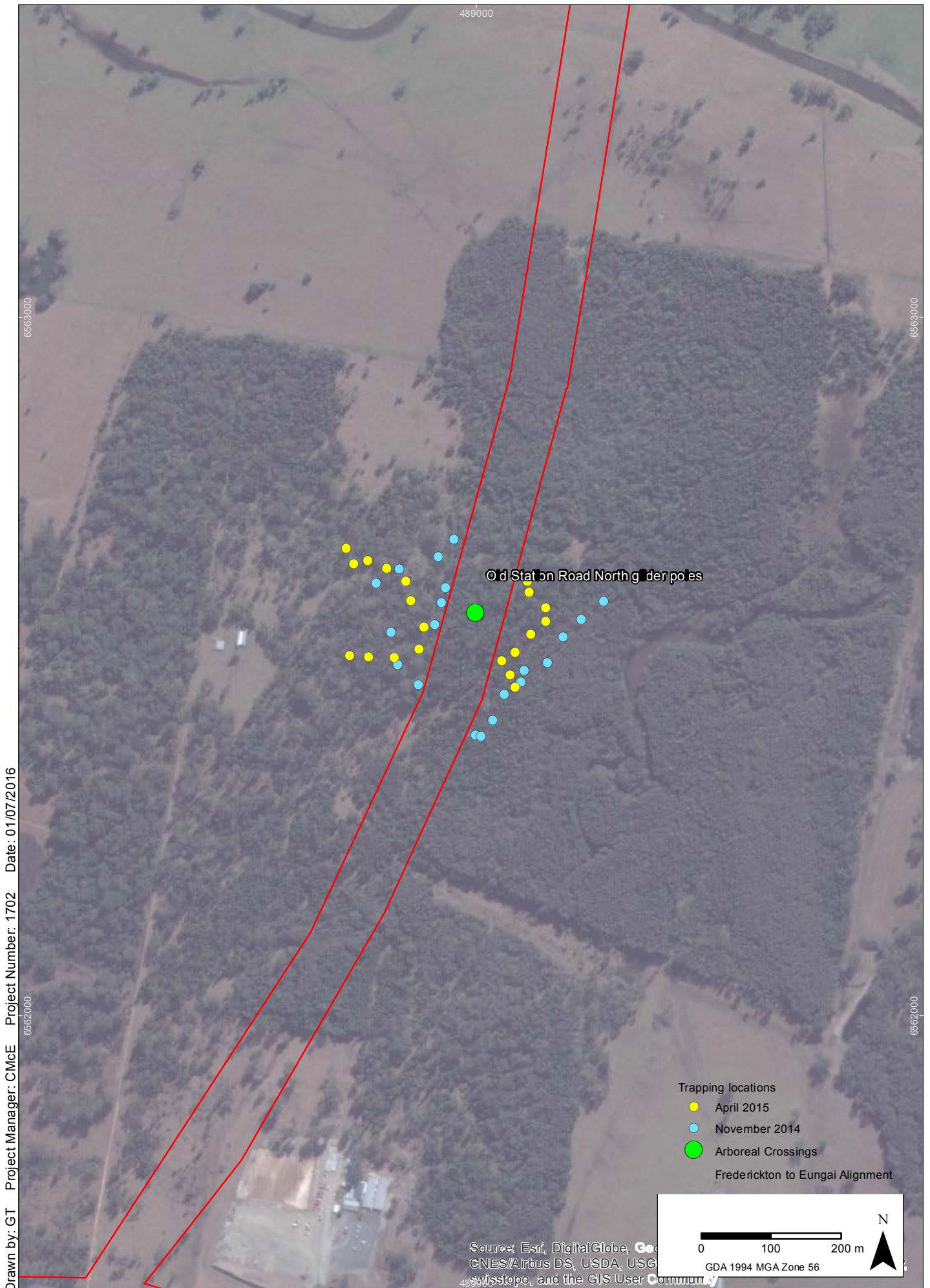
Arboreal trapping locations adjacent to Bingis Lane rope ladder
Pacific Highway Upgrade - Kempsey Bypass

FIGURE 2

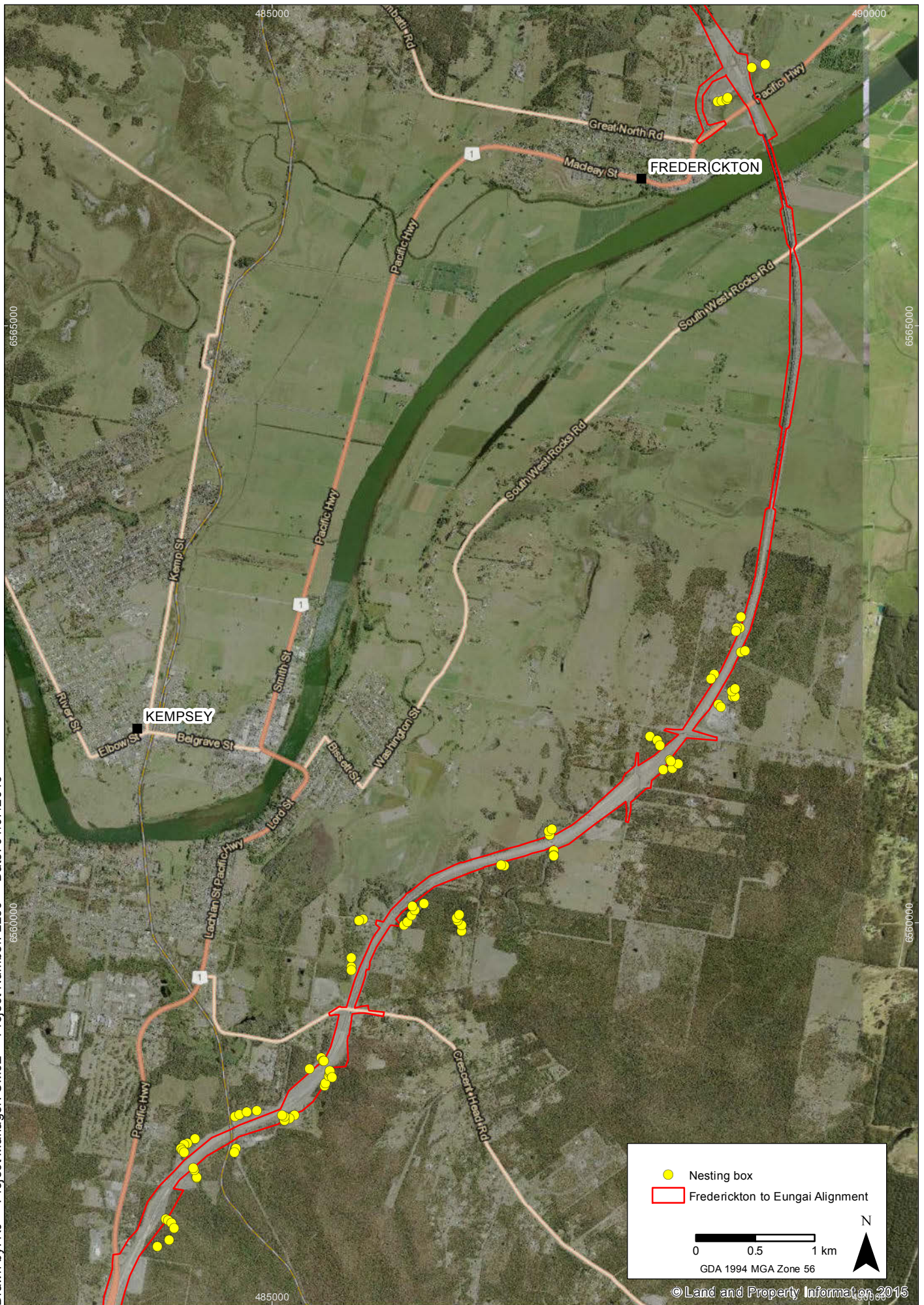


Arboreal trapping locations adjacent to Old Station Road South glider poles
Pacific Highway Upgrade - Kempsey Bypass

FIGURE 3



Arboreal trapping locations adjacent to Old Station Road North glider poles
Pacific Highway Upgrade - Kempsey Bypass

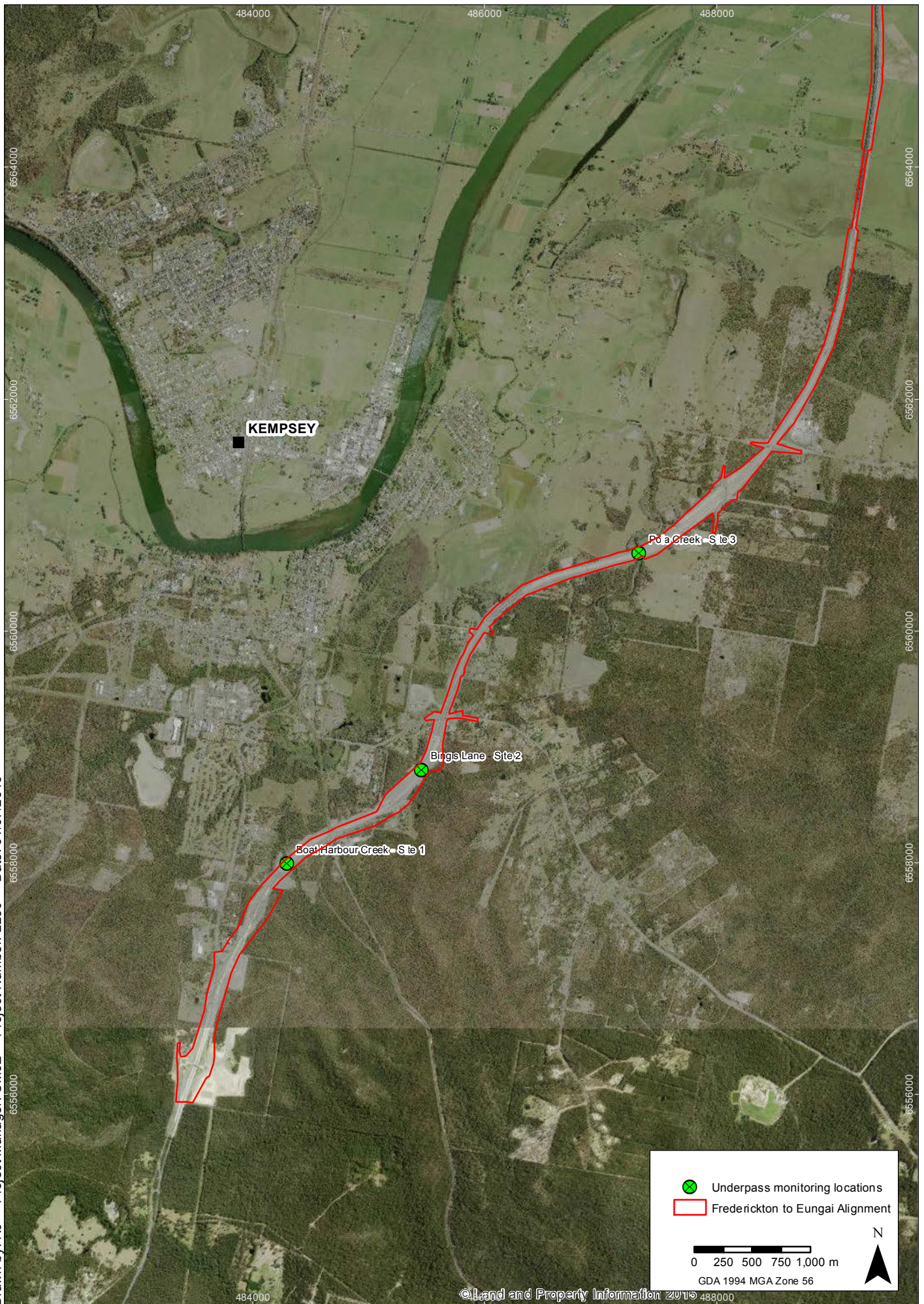


Study area and location of nesting boxes.
Pacific Highway Upgrade - Kempsey Bypass

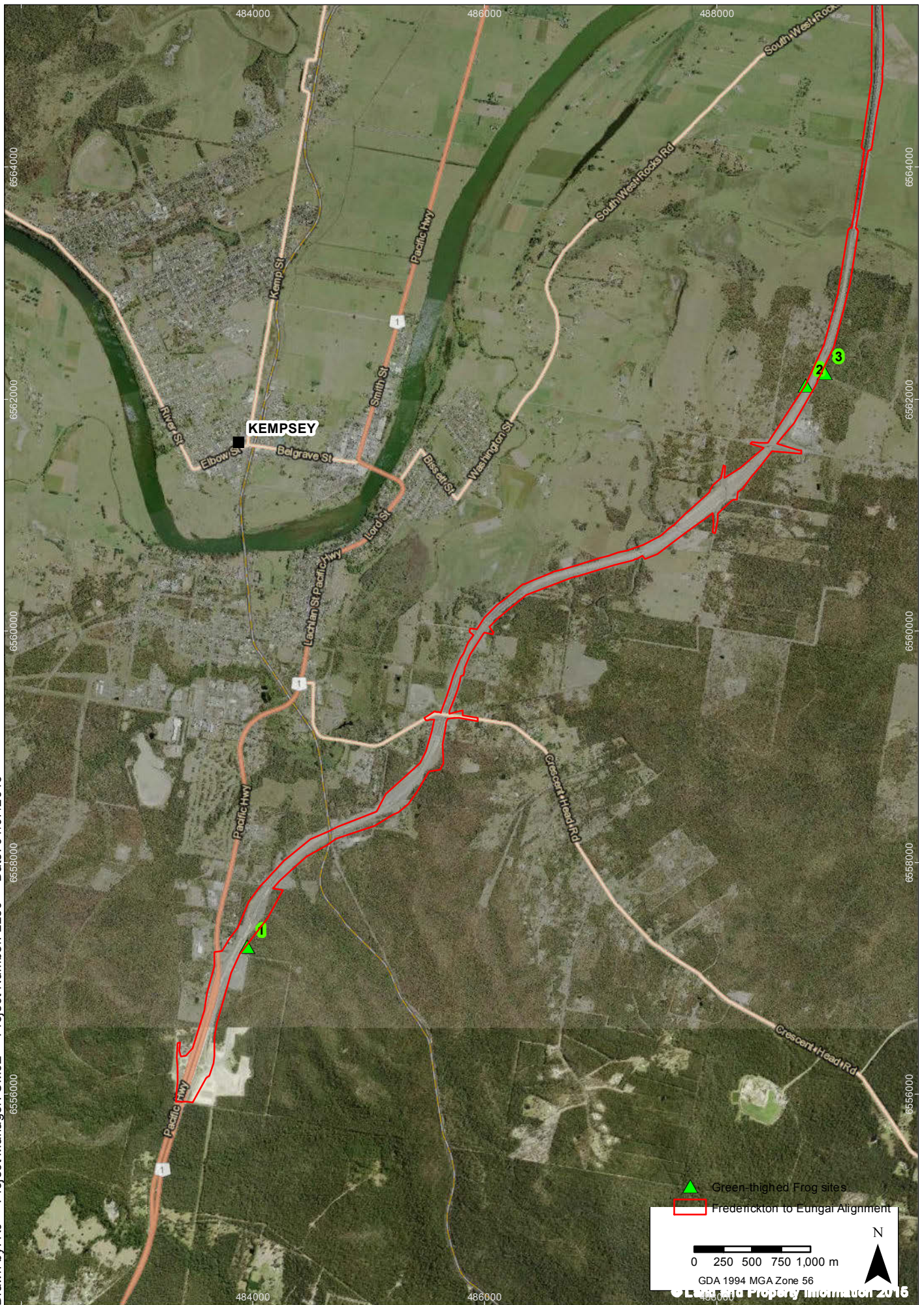
FIGURE 5

Imagery: (c) LPI 2012-11-05

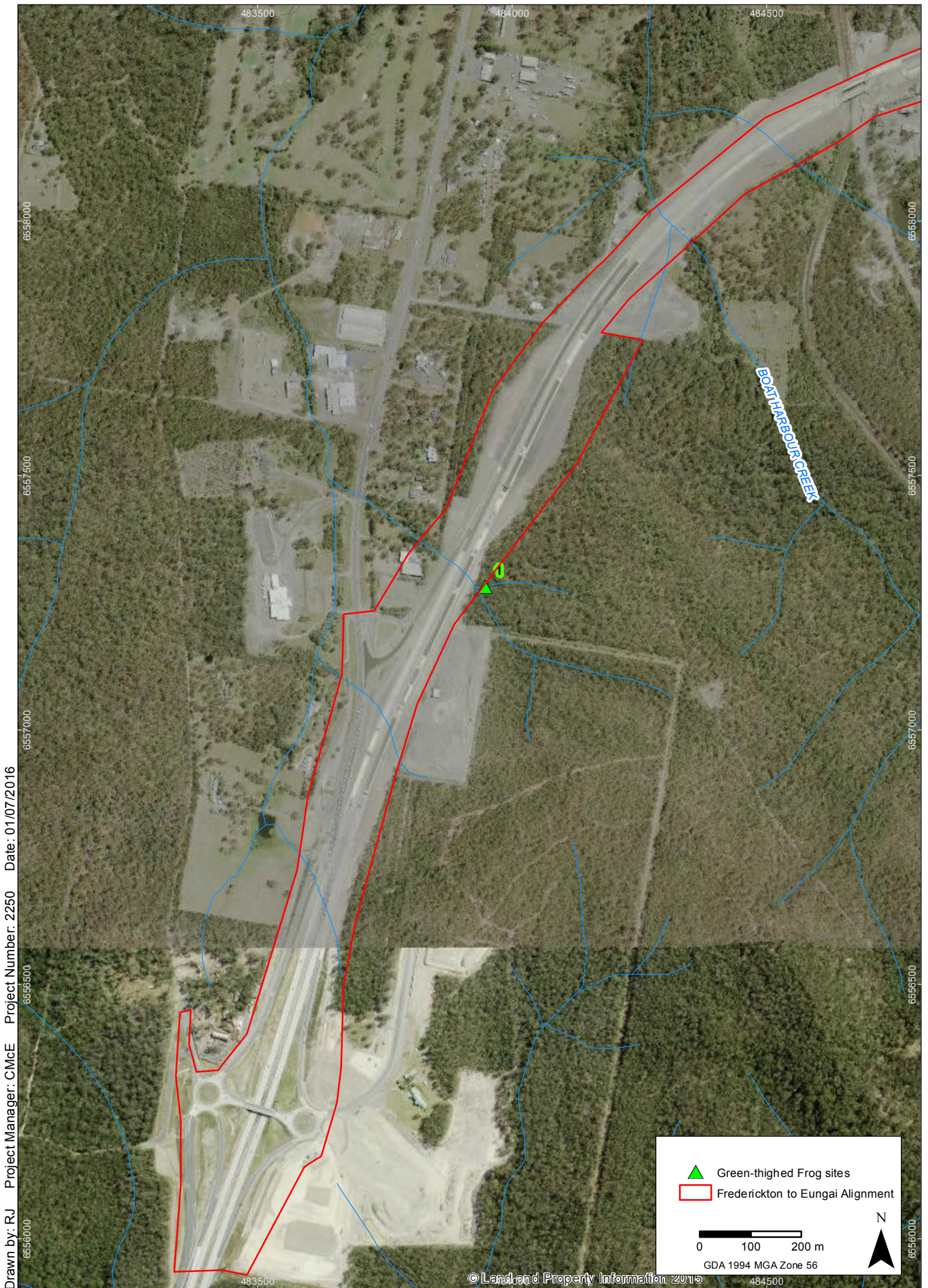
Drawn by: RJ Project Manager: CMcE Project Number: 2250 Date: 01/07/2016



Underpass and Brush-tailed Phascogale monitoring locations
Pacific Highway Upgrade - Kempsey Bypass



Overview of Green-thighed Frog monitoring sites
Pacific Highway Upgrade - Kempsey Bypass



Location of Green-thighed Frog monitoring site 1
Pacific Highway Upgrade - Kempsey Bypass

FIGURE 8



Drawn by: RJ Project Manager: CMcE Project Number: 2250 Date: 01/07/2016

Location of Green-thighed Frog monitoring sites 2 and 3
Pacific Highway Upgrade - Kempsey Bypass

Appendix 1. EPA and Road and Maritime Services correspondence about glider crossing monitoring amendment

From: Brian Tolhurst <Brian.Tolhurst@epa.nsw.gov.au>

Sent: Monday, 13 April 2015 1:36 PM

To: MAYFIELD-SMITH Melissa

Cc: LEDLIN David G

Subject:RE: Kempsey Bypass - proposed amendment to Ecological Monitoring Program

Follow Up Flag: Follow up

Flag Status: Flagged

Hi Melissa, thank you for the information. The EPA very strongly supports the various monitoring programs across the Pacific Highway Upgrade Projects and the information they provide. The EPA is satisfied with your proposal outlined below to amend the Ecological Monitoring Program in line with relevant CoA and the Programs intent for the glider poles.

Regards

Brian

Brian Tolhurst | Senior Threatened Species Officer | NSW Environment Protection Authority | 📞: (02) 6659 8277 | Mobile 📞: 0429 215 388 | 📠: (02) 6651 6187

From: MAYFIELD-SMITH Melissa [mailto:Melissa.MAYFIELD-SMITH@rms.nsw.gov.au]

Sent: Friday, 10 April 2015 3:31 PM

To: Tolhurst Brian

Cc: LEDLIN David G

Subject: Kempsey Bypass - proposed amendment to Ecological Monitoring Program

Hi Brian,

As discussed last week, we are looking to amend the Ecological Monitoring Program for the Kempsey Bypass Project. The proposed amendment is to cease glider crossing monitoring due to issues with the cameras malfunctioning and the cost associated with replacement. Monitoring will continue on the rope crossing.

The Department of Planning and Environment's Conditions of Approval (3.1) required the development of a monitoring program to target the effectiveness of mitigation measures. Subclause d) states that:

c) monitoring shall be undertaken during construction (for construction-related impacts) and from opening of the project to traffic (for operation/ongoing impacts) until such time as the effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods, or as otherwise agreed by the Director General in consultation with DECCW;

The submitted Ecological Monitoring Program states the indicators of success as including one or more of the following:

- * Evidence of use by any glider species using the median pole.
- * Photographic evidence of a glider using both the eastern and western poles; and
- * One or more gliders with left ear tag/notch occurring on the western side of the carriageway and fauna with right ear tag/notch occurring on the eastern side of the carriageway.

Three monitoring events have been undertaken to date (Spring 2013, Autumn 2014 and Spring 2014) and a further monitoring event is being undertaken at the moment. During the first three monitoring events the following results have been achieved relating to the indicators of success:

- * Evidence of both feather-tail and/or sugar gliders using the median poles in all three monitoring events.
- * A total of 33 separate detections on median poles (16 feather-tail gliders and 17 sugar gliders).
- * Photographic evidence of a feather-tail glider using both a median and eastern pole in quick succession.

Attached is a summary of the results of the first three aerial crossing monitoring.

We believe we have demonstrated the effectiveness of mitigation measures for glider monitoring over the minimum three successive monitoring periods. Unless there are any objection we will no longer be monitoring the glider crossings after the current monitoring event is completed. Monitoring will continue on the Bingis Lane rope bridge. Please advise if you have any objections to the proposal.

Feel free to contact me if you would like to discuss further.

Regards,

Melissa Mayfield-Smith

Environment Officer

Environment | Strategy and Engagement

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Appendix 2. Habitat descriptions of each site (aerial crossings monitoring program)

Site	Dominant vegetation	Hollow-bearing tree density	Important habitat features	Other comments
Bingis Lane East	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Moderate (1-4 hollow-bearing trees/ ha)	Grassy ridge	Patch less than 5 ha in size
Bingis Lane West	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Moderate (1-4 hollow-bearing trees/ ha)	Gully including drainage line	Within large patch of native vegetation
Old Station Rd South East	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Moderate (1-4 hollow-bearing trees/ ha)		Occasionally grazed by cattle, sparse understorey.
Old Station Road South West	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Low (<1 hollow-bearing tree/ ha)		Grazed by cattle, low stem density, occasional logging, sparse understorey.
Old Station Road North East	Forest Red Gum (<i>E. tereticornis</i>)/ Broad-leafed Paperbark (<i>M. quinquernervia</i>)	Low (<1 hollow-bearing tree/ ha)	Forested wetland	
Old Station Road North West	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Low (<1 hollow-bearing tree/ ha)		Grazed by cattle, very low stem density, no native understorey.

Appendix 3. Habitat descriptions (Brush-tailed Phascogale)

Site	Dominant vegetation	Hollow-bearing tree density	Important habitat features	Other comments
Boat Harbour Creek East	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Low (less than 1 hollow-bearing tree/ ha)	Along small permanent stream	High degree of disturbance, including large areas of regenerating vegetation.
Boat Harbour Creek West	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Low (less than 1 hollow-bearing tree/ ha)	Along small permanent stream	High degree of fragmentation
Bingis Lane East	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Moderate (1-4 hollow-bearing trees/ ha)	Grassy ridge	Patch less than 5 ha in size
Bingis Lane West	Blackbutt (<i>E. pilularis</i>)/ Tallowwood (<i>E. microcorys</i>)	Moderate (1-4 hollow-bearing trees/ ha)	Gully including drainage line	Within large patch of native vegetation
Pola Creek East	Broad-leaf Paperbark (<i>Melaleuca quinquenervia</i>)	Low (less than 1 hollow-bearing tree/ ha)	Adjacent to freshwater wetland.	
Pola Creek West	Broad-leaf Paperbark (<i>Melaleuca quinquenervia</i>)	Low (less than 1 hollow-bearing tree/ ha)	Adjacent to freshwater wetland.	

Niche Environment and Heritage

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