- Fan-tailed Cuckoo – Marine
- Common Koel - Marine
- Black-faced Cuckoo-shrike - Marine
- Cicadabird – Marine

The sightings of the Glossy Black Cockatoo were generally in the same area, which is in the south-eastern corner of the property. However, feeding trees are also prevalent over the northern slopes and this detail is given in Table 19 and Figure 33. This species is listed on the *Threatened Species Conservation Act, 1995*.

Table 19 – Details of Glossy Black Cockatoo habitat and sightings

Date	Grid co-ordinates	Details
12 July 2007		2 x birds lower slope
30 October 2007		2 x birds eastern side of property
12 December 2008		4 x birds lower northern slope
1December 2008	427768E, 6416015N	2 x birds
3 December 2008		2 x birds lower northern slope
4 December 2008		4 x birds lower northern slope
14 February 2010	426754E, 6415012N	2 X birds near eastern boundary
15 February 2010		2 x birds flying over golf course
12 August 2010	426650E, 6414922N	Discarded cones – *Allocasuarina littoralis*
13 August 2010	427484E, 6414295N	Discarded cones – *Allocasuarina littoralis*
13 August 2010	427616E, 6414300N	Discarded cones – *Allocasuarina littoralis*
13 August 2010	427574E, 6414234N	2 x birds feeding in *Allocasuarina littoralis*
13 August 2010	427468E, 6414152N	Discarded cones – *Allocasuarina littoralis*

10.6 Flying-foxes

In February 2010 the Grey-headed Flying-fox *Pteropus poliocephalus* was recorded feeding on fruits of a Cocos Palm *Syagrus romanzoffiana* near the dwelling. The Grey-headed Flying Fox is listed as vulnerable on the TSC Act, 1995 and as vulnerable on the EPBC Act, 1999 and furthermore is included on the action plan for Australian Bats (Environment Australia, 1999).

10.7 Other Mammals

During opportunistic site visits and surveys details of other mammals were recorded. These details are present in Table 20 presented hereunder.

Table 20 – Records of other mammals recorded during opportunistic surveys

SPECIES	DATE	LOCATION	ACTIVITY
Parma Wallaby	14.06.07	Seen in vegetation remnant	Feeding
Parma Wallaby	13.08.07	Cleared paddocks	Moving
Eastern Grey Kangaroo	14.06.07	Tracks beside tributary of Frys Creek	Tracks only
Red-necked Wallaby	14.06.07	Vegetation remnant	Moving away
Squirrel Glider	14.06.07	Near yabbie dams	Calling
Sugar Glider	30.10.07	Alum Mountain	Calling
Parma Wallaby x 2	12. 11.08	Frys Creek	Moving through vegetation
Parma Wallaby x 2	4.12.08	Near dwelling in grassland	Sitting
Parma Wallaby	6.08.10	Near yabbie dams	Feeding
Parma Wallaby x 2	14. 02.10	427475E, 6414207N	Feeding
Parma Wallaby	16.02.10	Near yabbie dams	Feeding
Parma Wallaby	17.02.10	426714E, 6414824N	Feeding
Eastern grey kangaroo x 10	17.02.10	Near house	Feeding
Grey-headed flying Fox	17.02.10	In palm tree near the house	Calling & feeding
Parma Wallaby	16.07.10	Near yabbie dams	Moving away
Eastern Grey Kangaroo x 16	14.07.10	Grassland downslope from dwelling	Feeding
Feral Goat x 20	28. 07.10	Base of Alum Mountain	Moving through
Feral Goat x 10	09.08.10	Near base of Alum Mountain	Feeding on Lantana
Feral Goat camp	13. 08.10	426835E, 6414421N	

The Parma Wallaby, Grey-headed flying Fox and the Squirrel Glider are vulnerable species listed on schedule 2 of the *Threatened Species Conservation Act, 1995* whilst the Feral Goat *Capra hircus* is an introduced species. The latter species can often be seen foraging on Alum Mountain and evidence of a camp was found. Unfortunately the goats are eating the native vegetation on Alum Mountain and large deposits of their scats are present.

The Parma Wallaby is of some consequence because it has a disjunct distribution along the east coast of NSW and probably only occurs in specific habitats. On a number of occasions in the early stages of the surveys the Parma Wallabies were seen near the yabbie dams feeding in grassland. When disturbed they would always move off towards the south-east. Subsequent to this a map and description of their feeding habitat was prepared using a differential GPS (Figure 19). This area is only small being 1770m2 and is the only patch of grassland known on the property. The description of the feeding habitat is provided hereunder.

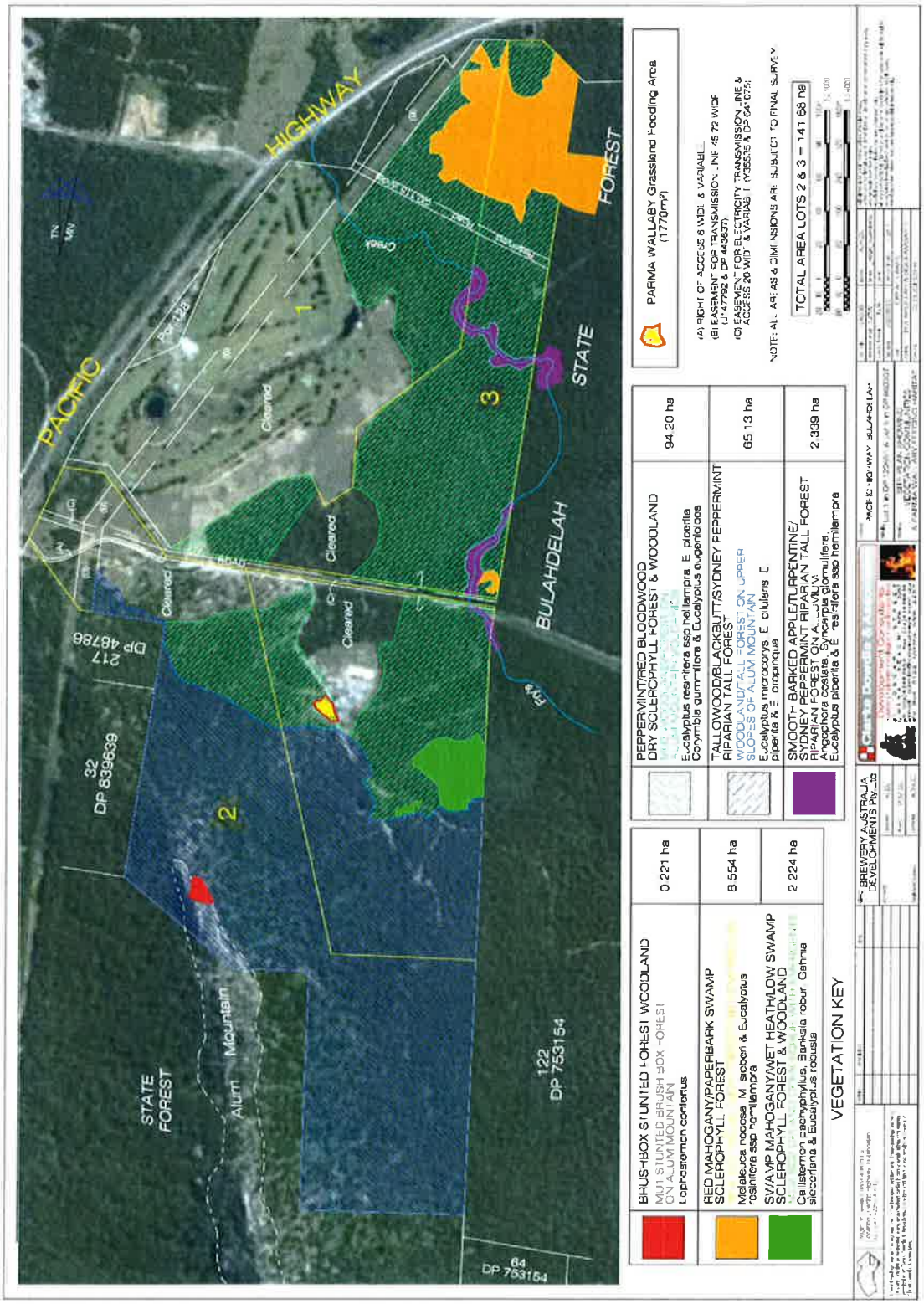

Figure 19 – Map showing where most sightings of the Parma Wallaby feeding occurred.

LOW CLOSED WIRY PANIC GRASSLAND/SEDGELAND WITH MORE RECENT REGENERATING SHRUBLAND (Feeding habitat recorded for the Parma Wallaby)

Structure: Heathland with closed tussock grassland. More recently becoming overgrown by an open scrubland.

Habitat: Mid slope of the Alum Mountain Volcanics on the Watagan SLU. Northern aspect. Substantial seepage evident.

Distribution: Only as a small area near the yabbie ponds (see Figure 19 and Photo 6).

Floristic Composition: The ground layer vegetation is mostly comprised of grasses and sedges between 0.2 and 0.5 metres high with a foliage projective cover of eighty percent. Main species include *Entolasia stricta* Wiry Panic and *Lepidosperma tortuosum* with a lesser abundance of *Andropogon virginicus* Whiskey Grass, *Themeda australis* Kangaroo Grass, *Eragrostis* brownii Brown's Lovegrass and *Ptilothrix duesta*. A taller layer of shrubs and undershrubs is also is present between 0.5 and 1.0 metres high and with a cover of approximately sixty percent giving the appearance of a heathland. The main species occurring in this overlayer are *Leptospermum polygalifolium* Yellow Ti-tree, *Woollsia pungens*, *Eucalyptus eugenioides* Thin-leaved Stringybark, *Phyllanthus hirtellus*, Boronia pinnata and Pimelea linifolia.

More recently the habitat is being overgrown with a layer of shrubs between two and three metres high with a cover of forty five percent. This shrub layer mainly comprises *Dodonaea triquetra* Native Hop Bush, *Allocasuarina littoralis* Black She-oak and occasionally *Acacia longifolia* Sydney Golden Wattle.

Related Mapping Units: LGA scale; Unknown; Regional scale; MU 101 Smooth-barked Apple/Red Bloodwood/Brown Stringybark Wiry Panic heathy open forest Somerville (2009).

Photo 6 – Habitat and feeding area of the Parma Wallaby. Note overgrowing taller shrub layer.

It should be noted that in the late stages of the surveys the Parma Wallabies were absent. Furthermore, the remote infra-red cameras installed did not record the Parma Wallaby at the mapped location for the next two months although other species were recorded (Forest Fauna Surveys, 2011). Their disappearance appeared to be correlated with the land clearing to the south-east although it may have been caused by the habitat being overgrown with taller shrubs (Photo 6).

Other species recorded by infra-red motion cameras include:

- Common Brushtail Possum
- Red-necked Wallaby
- Swamp Wallaby
- Feral Goat.

No evidence of the Spotted-tail Quoll or other larger mammals were recorded in the survey by Forest Fauna Surveys (2011) although one additional species, the Eastern Grey Kangaroo were recorded by the Robert Payne and Kristan Dowdle surveys.

10.8 Large Owls

The large owl survey revealed no owls being detected during the July survey; however in the August survey the Powerful Owl, *Ninox strenua* responded to the call playback and came within half a kilometre of the call station calling from the south-east. The Powerful Owl is listed on Schedule 2 of the *Threatened Species Conservation Act, 1995.*

In addition, time was spent identifying suitable owl roost trees by HWR Ecological with some additions by Robert Payne and Kristan Dowdle as time allowed. The details of these trees are set out in Table 22 and the location of these trees is presented in Figure 4, with a more recent update by Forest Fauna Surveys (2011) which is shown on Figure 20. Given all of the results, the distribution of potential hollows for large forest owls is restricted, with a small cluster of five trees north of Fry's Creek, a group of 13 potential trees in the central portion (Peppermint/Bloodwood Dry Sclerophyll Forest/Woodland) and a group of ten trees in the southern portion (Tallowood/Blackbutt/Sydney Peppermint Tall Forest and Smooth-barked Apple/Turpentine/Sydney Peppermint Riparian Tall Forest) of the subject site (Tables 21 & 22). A recent inspection by Forest Fauna Surveys (2011) revealed that none of the potential habitat trees exhibited recent evidence of use by large forest owls, such as whitewash and regurgitation pellets, in proximity to the trees. Furthermore no recent calls of large forest owls were heard on the subject site during the nocturnal searches for the large owl survey of the subject site.

Table 21 – Large forest owl tree hollow data by habitat

Vegetation Community/Habitat	**Tree hollow data**		
	HWR (2006)	**FFS (2011)**	
	No.	**No.**	**Size (mm)**
Red Mahogany Paperbark Swamp Sclerophyll Forest	6	5	2 x 100-150; 3 x 50-100
Swamp Mahogany/Wet Heath Low Swamp Sclerophyll Forest/ Woodland	0	0	
Tallowood/Blackbutt/Sydney Peppermint Tall Forest	6	9	3 x 50-100; 3 x 100-150; 3 x >150
Brushbox Stunted Forest/ Woodland	0	0	
Smooth-barked Apple/Turpentine/Sydney Peppermint Riparian Tall Forest	0	1	1 x 50-100
Peppermint/Bloodwood Dry Sclerophyll Forest/Woodland	0	13	1 x 0-50; 5 x 50-100; 7 x 100-150

Table 22 – Suitable Owl Roost Tree Details determined by HWR Ecological with additions by Robert Payne and Kristan Dowdle

Number	Species	Height (m)	DBH (m)	Hollow	Easting	Northing
1	Stag	18	2.5	1 x large & 3 x medium branch	427207	6414015
2	Stag	18	1.3		427255	6413989
3	Stag	6	0.7	Medium vertical	427318	6414001
4	Peppermint	18	1.0	5 x medium & 1 x large branch	427501	6414049
5	Stag	16	2.5	Large vertical	427381	6414165
6	*A. costata*	16	1.0	1 x medium to large branch	427498	6414528
7	Peppermint	18	1.0	3 x large trunk	427807	6414264
8	*A. costata*	18	1.3	Large vertical	427994	6413997
9	Stag	8	2.5	Large vertical	427909	6414311
10	*A. costata*	8	1.5	Large vertical	427958	6414353
11	Stag	15	2.0	Large vertical & 1 x trunk	427442	6415110
12	Peppermint	17	2.0	3 x large trunk	427601	6415570
13	Stag	17	0.8	1 x large trunk	427338	6414906
14	*A. costata*	15	0.6	1 x medium to large trunk	427493	6414805
15	*A. costata*	10	0.9	1 x medium trunk	427651	6414299
16	Stringybark	12	1.0		428093	6414792
17	*E. robusta*	8	0.7	Large vertical	427594	6414702
18					427598	6416045
19					427543	6416042
20					427538	6416038
21					427537	6416035
22					427515	6416066
23					427448	6415607
24					427408	6415548

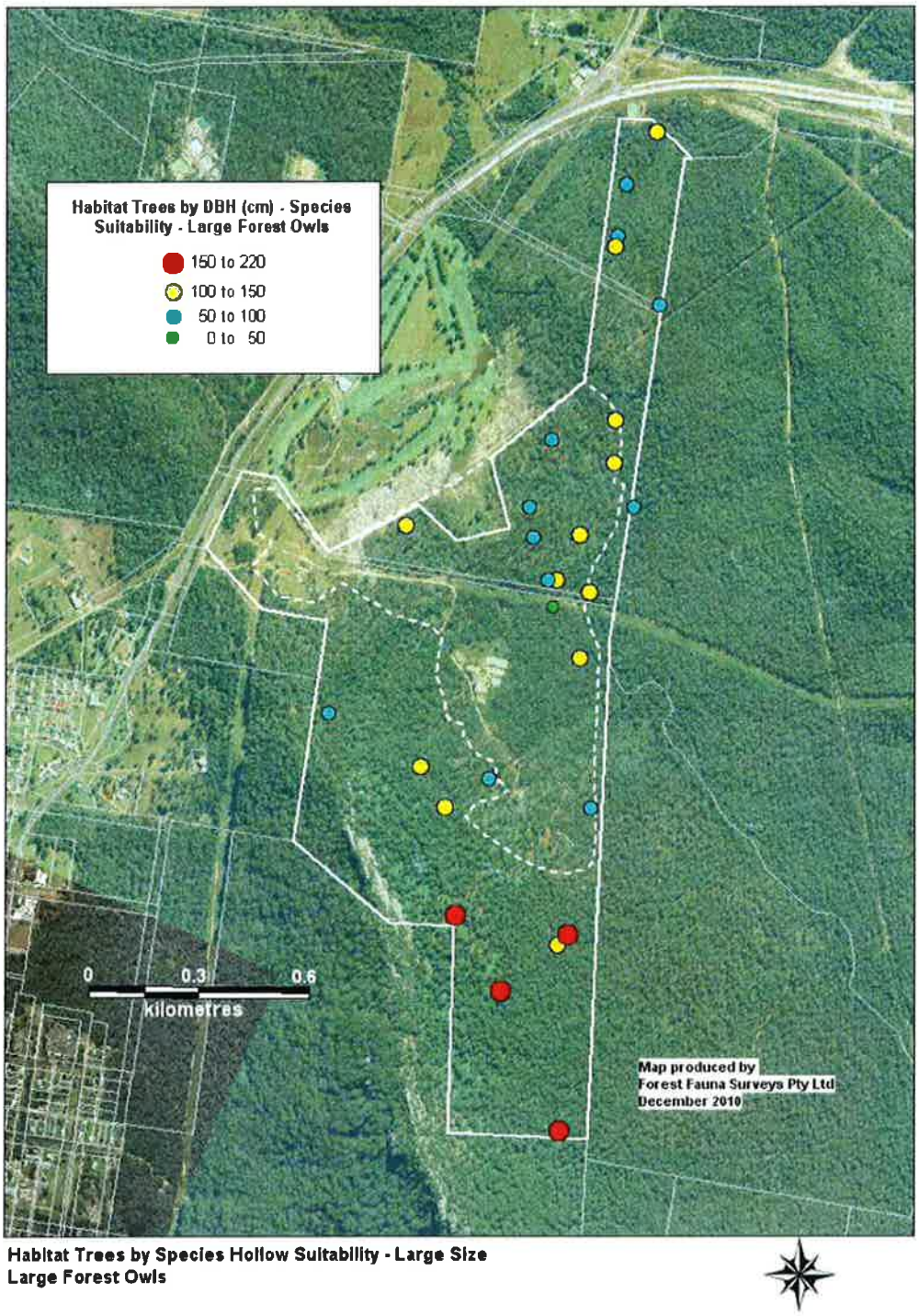

Figure 20 - Distribution of habitat trees by very large hollows (Large Forest Owls) by Forest Fauna Surveys (2011).

10.9 Bush-stone Curlew

No response was received from the Bush-stone Curlew calls from the CD ROM playback call surveys and so it assumed this species is not present on the property.

10.10 Hair tube trapping, scat analysis and anecdotal evidence

The hair tube traps were collected on 28 July 2010 and returned two hair samples over a period of approximately 100 trapnights. One trap was stolen and another had the insert plate removed. Table 23 summarises the results.

Table 23 – Details of hair analysis

Station	MGA co-ordinates	Remarks	Species from analysis
1	426712E, 6415039N	No hair	
2	427302E, 6414000N	No hair	
2B	427466E, 6413861N	Trap removed	
15	427451E, 6414535N	Hair	Common Brush-tailed Possum
13	427465E, 6414620N	No hair	
3	427361E, 6415041N	No hair	
4	427361E, 6415113N	No hair	
A	427489E, 6415259N	Hair	Common Brush-tailed Possum
9	427699E, 6415888N	No hair	
14	427590E, 6416035N	Glue plate stolen	

Numerous tracks of the Eastern Grey Kangaroo *M. gigantea* were found all throughout the subject site, particularly along Frys Creek and near the golf course. To a lesser extent there were occasional tracks of the Red-necked Wallaby *Macropus rufogriseus* along Frys Creek. Tracks of the Common Brush-tailed Possum *Trichosurus vulpecula* were found along the vehicle track leading from the existing dwelling to the upper slopes. The presence of the Common Brush-tailed Possum was confirmed using hair identification collected from the coastal plain and the slopes and from the remote camera (Forest Fauna Surveys, 2011).

Scats of the Red-necked Wallaby, Swamp Wallaby and the Eastern Grey Kangaroo were found with those of the former more common being found in the grassy areas of the coastal plain and along Frys Creek. Scats of the former and the Swamp Wallaby were also present in the Red Mahogany Paperbark Swamp Sclerophyll Forest vegetation of the coastal plain. Reptile eggs, perhaps of the Eastern Water Skink *Eulamprus quoyii*, were found in large fallen ground logs in the same habitat (Photo 2).

Bandicoot diggings were noted amongst the coastal plain vegetation in August 2007, whilst in December 2008 diggings were again found along Frys Creek. Irregular diggings were again found in August 2010 on the upper slopes including the areas of scree.

Fox scats were initially found in the vicinity of the dwelling but further finds were located in August 2010 along the track at the base of Alum Mountain. The analysis of hair, found within the European Fox scat material, were from the Northern Brown Bandicoot *Isoodon macrourus*.

Feral goat droppings were found to be widespread and numerous on Alum Mountain (see Photo 7).

Photo 7 – Feral Goats on the top track below Alum Mountain.

10.11 Weather Conditions

Temperature and humidity for the surveys are presented in Table 24 and 25. For the three main survey periods the recordings show the typical inverse relationship between temperature and humidity for coastal regions. When temperature drops during the evening humidity rises.

The 2008 survey period revealed high temperatures and humidities with an average temperature and humidity of 22.2° and 73.2% respectively, with temperature rising to 32.6°. No rain occurred during this period of survey. During the February 2010 survey period a similar trend between temperature and humidity is evident. Although recordings are only for a two day period the average temperature was 20.9° and relative humidity 89.7%. Slight rain fall occurred on one evening during this survey.

For the July 2010 period temperatures were low for fauna survey requirements generally but the intention was to survey owls (the time when they frequently call) and one frog species which have winter breeding seasons. Bulahdelah experienced a very wet winter in 2010 and thus humidities are higher. Such conditions caused the access tracks to be impassable and the soils to become saturated, which affected the survey. Nevertheless, the wet squally conditions were suitable for trying to detect the Wallum Froglet within suitable habitat and the break in the weather enabled owl calls to proceed.

During the specialized bat surveys in October 2010 temperates at night were still cool (minimum 9.2°C) but overall during the survey period the mean temperature was 15.0°C. The temperature only reached 21.6°C during this survey period. Humidity's were average with a range between 54.8-100% with a mean of 83.5%. Temperatures at dusk were

15.6°C and 16.7°C for the 19th and 20th October respectively. There was no apparent rain during this survey.

Table 24 – Summary of weather conditions during main fauna surveys

Date	Humidity (%)			Temperature (°C)		
	Min	Max	Mean	Min	Max	Mean
1-5 Dec 2008	0	100	73.2	15.0	32.6	22.2
16-18 Feb 2010	53.1	100	89.7	17.3	29.9	20.9
7-10 July 2010	75.7	100	98.5	7.1	16.4	11.8
Date	**Dusk Temperatures (°C)**			**Moon Phase**		
1-5 Dec 2008	23.9, 21.3, 22.1, 19.6			Full moon waning to first quarter		
16-18 Feb 2010	22.8, 21.9			New moon waning		
	12.5, 10.9			Last quarter waning		

Forest Fauna Surveys (2011) experienced rainy periods during their Squirrel Glider trapping surveys, which is presented in Table 25. All information was gathered from the Bureau of Meteorology website for Nelson Bay weather station.

Table 25 – Weather conditions during recent Squirrel Glider trapping surveys

Date	Min.Temp. °C	Max.Temp. °C	Cloud cover	Rainfall (mm)	Moon Phase
2/11/2010	13.9	20.8	6/8	20.4	0
3/11/2010	14.0	24.0	8/8	0	0
4/11/2010	14.5	19.5	8/8	66.0	0
15/11/2010	21.0	26.3	6/8	0	2/4
16/11/2010	18.6	21.5	8/8	20.2	-
17/11/2010	16.5	21.5	8/8	8.6	-
24/11/2010	18.5	23.0	1/8	0	4/4
25/11/2010	18.0	24.0	0/8	0	4/4
26/11/2010	18.2	25.0	0/8	0	4/4
27/11/2010	18.5	24.5	0/8	0	-

Further details are shown in Appendix 8 and 23.

11.0 SUMMARY OF FAUNA SPECIES

Table 26 summarises all of the fauna species for the vegetation groups across the site. Bird species, listed in Appendix 4, occur across most habitats of the property. Two habitats, Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland and *Smooth-barked Apple/Turpentine/Sydney Peppermint Riparian Tall Forest*, are very small, which makes it difficult, to determine species presence, especially in the case of bird species (e.g. if the calls were in fact from these habitats or the adjoining habitat). Nevertheless the larger forested areas (Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland and Tallowwood/Blackbutt/Sydney Peppermint Riparian Tall Forest) are the most diverse for fauna species. Red Mahogany/Paperbark Swamp Sclerophyll Forest vegetation lacks species information because this habitat was only purchased after most of

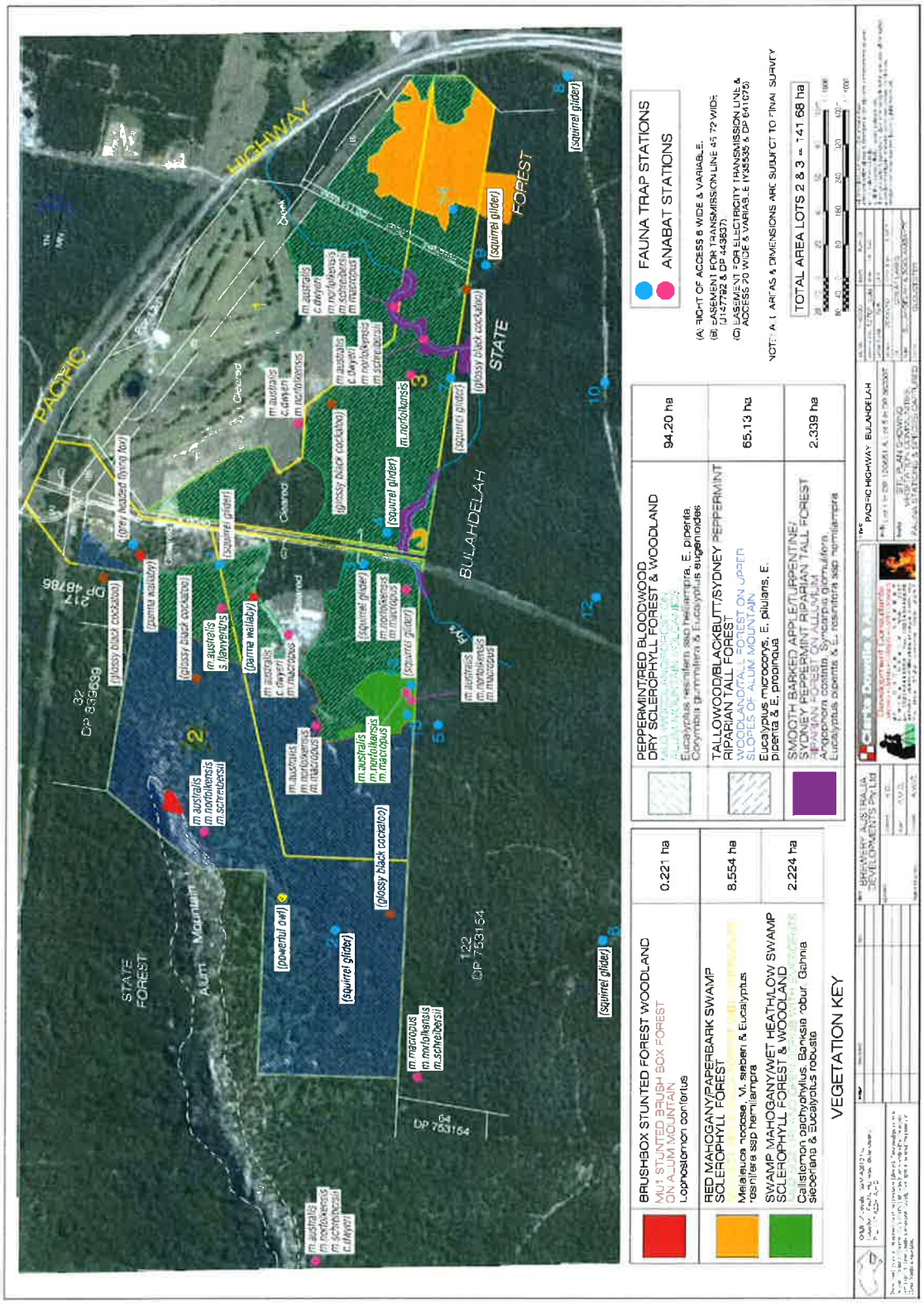

Figure 21 – Site Plan and air photograph showing location of fauna stations and the threatened species recorded.

Table 26 – Mammal species recorded according to habitat type

Fauna Species	**Vegetation Group**					**Microhabitat**
Mammals	**2/1**	**2/2**	**3**	**4**	**5**	
Squirrel Glider *Petaurus norfolkensis* **(listed on schedule 2 of the TSC Act)**						Coastal plain & upper slopes habitat with tree hollows and nectar producing plants. Several individuals captured.
Sugar Glider *Petaurus breviceps*						All habitats
Common Bush Rat *Rattus fuscipes*						Coastal plain & slopes
Black Rat *Rattus rattus* *						
Brown Antechinus *Antechinus stuartii*						Coastal plain & slopes
Yellow-footed Antechinus *Antechinus flavipes*						Rocky slopes
Brush-tailed Possum *Trichosurus vulpecula*						Coastal plain & slopes
Eastern Grey Kangaroo *Macropus gigantius*						Coastal plain, Frys Creek & slopes
Red-necked Wallaby *Macropus rufogriseus*						Frys Creek
Parma Wallaby *Macropus parma* **(listed on schedule 2 of the TSC Act)**						Mainly seen in the vicinity of the artificial dams and sometimes in cleared grassland. Small group.
Feral Goat *Capra hircus*						Mainly on Alum Mountain
Little Bent-wing Bat *Miniopterus australis* **(listed on schedule 2 of the TSC Act)**						Probably roosts in Alum Mountain caves and forages elsewhere over the property
Eastern Bent-wing Bat *Miniopterus schreibersii* **(listed on schedule 2 of the TSC Act)**						Probably roosts in Alum Mountain caves and forages elsewhere over the property
Gould's Wattled Bat *Chalinolobus gouldii*						Predicted based on calls. All forest areas.
Chocolate Wattled Bat *Chalinolobus morio*						All forest areas
Large-eared Pied Bat *Chalinolobus dwyeri* **(listed on schedule 2 of the TSC Act & commonwealth EPBC Act)**						Predicted from calls only. Probably roosts in Alum Mountain caves and forages elsewhere over the property
Lesser Long-eared Bat *Nyctophilus geoffroyi*						All forest areas
Gould's Long-eared Bat *Nyctophilus gouldii*						All forest areas
Eastern Forest Bat *Vespadalus pumilus*						Predicted based on calls. All forest areas
Eastern Cave Bat *Vespadalus Troughtoni* **(listed on schedule 2 of the TSC Act)**						Predicted. Probably roosts in Alum Mountain caves and forages elsewhere over the property
Little Forest Bat *Vespadalus vulturnus*						All forest areas.
A Freetail Bat *Mormopterus sp2*						Predicted based on calls. All forest areas.
Eastern Freetail-bat *Mormopterus norfolkensis* **(listed on schedule 2 of the TSC Act)**						Predicted based on calls. Roosts in tree hollows and forages elsewhere over the property

(cont.)

Large-footed Myotis *Myotis macropus* **(listed on schedule 2 of the TSC Act)**						Predicted based on calls Roosts in tree hollows near water and forages elsewhere over the property, especially water bodies
Eastern Horseshoe Bat *Rhinolophus megaphyllus*						Definite calls. Probably roosts in Alum Mountain caves and forages elsewhere over the property
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* **(listed on schedule 2 of the TSC Act)**						Predicted based on calls. Roosts in tree hollows and forages elsewhere over the property
Eastern Broad-nosed Bat *Scotorepens orion*						Predicted based on calls. All forest areas.
White-striped Freetail-bat *Tadarida australis*						Predicted based on calls. All forest areas.
Grey-headed Flying Fox Pteropus poliocephalus **(listed on schedule 2 of the TSC Act; EPBC Act, 1997)**						Would have camps elsewhere but recorded feeding on Cocos palm fruit near dwelling. Small group.
Sub-total	**0**	**11**	**24**	**23**	**14**	
Amphibians						
Common Eastern Froglet *Crinia signifera*						Puddles
Red-backed Toadlet *Pseudophryne coriacea*						Moist soils north of Frys Creek
Uperoleia fusca						Damp grassy areas
Eastern Dwarf Tree Frog *Litoria fallax*						Sedges in dams
Litoria jervisiensis						Frys Creek
Litoria latopalmata						Frys Creek
Peron's Tree Frog *Litoria peroni*						Dams
Brown-striped Frog *Limnodynastes tasmaniensis*						Dams
Sub-total	**1**	**2**	**8**	**2**	**2**	
Reptiles						
Boiga irregularis						Mid dense forest at night
Red-bellied Black Snake *Pseudechis porphyriacus*						Around dams
Eastern Brown Snake *Pseudonaja textilis*						Rocky slopes
Diamond Python *Morelia spilota*						Moist vegetation
Egernia mcpheei						Probably all habitats
Lampropholis delicata						Coastal plain
Varanus varius						Coastal plain & slopes
Cryptoblepharus virgatus virgatus						
Sub-total	**0**	**0**	**4**	**5**	**0**	
Birds						
Brown Quail						Grassland near golf course
Grey Teal						Dams
Pied Cormorant						Dams
White-bellied Sea Eagle **(listed as migratory terrestrial of the EPBC Act)**						Heard along Frys Creek and on Alum Mountain. One pair.
Peregrine Falcon						Summit Alum Mountain
Powerful Owl **(listed on schedule 2 of the TSC Act)**						Near summit Alum Mountain
Common Bronzewing						
Bar-shouldered Dove						

(cont.)

Glossy Black-Cockatoo **(listed on schedule 2 of the TSC Act)**						Allocauarina trees. Appears to be always present on slopes east of Alum Mountain. Small group.
Yellow-tailed Black-Cockatoo						Overhead
Sulphur-crested Cockatoo						Forest/woodland
Rainbow Lorikeet						Forest/woodland
Australian King-Parrot						Forest/woodland
Eastern Rosella						More open regenerating areas and grassland
Fan-tailed Cuckoo						Forest/woodland
Horsefield's Bronze-Cuckoo						Forest/woodland
Common Koel						Forest/woodland
Channel-billed Cuckoo						Forest/woodland
Pheasant Coucal						Wet areas e.g. transmission line
White-throated Nightjar						Forest/woodland
Laughing Kookaburra						Forest/woodland
White-throated Treecreeper						Forest/woodland
Superb Fairy-wren						Dense undergrowth
Variegated Fairy-wren						Forest/woodland
Spotted Pardalote						Road embankments
White-browed Scubwren						Dense undergrowth
Brown Gerygone						Frys Creek
White-throated Gerygone						Frys Creek
Brown Thornbill						Forest/woodland
Yellow Thornbill						Forest/woodland
Red Wattlebird						Forest/woodland & coastal plain
Noisy Friarbird						Forest/woodland & coastal plain
Noisy Miner						Cleared areas
Lewin's Honeyeater						Forest/woodland
Yellow-faced Honeyeater						Forest/woodland & coastal plain
Tawny-crowned Honeyeater						Alum Mountain
Eastern Spinebill						Forest/woodland & coastal plain
Jacky Winter						Old fence lines
Eastern Yellow Robin						Forest/woodland & coastal plain
Eastern Whipbird						Dense undergrowth
Varied Sittella **(listed on schedule 2 of the TSC Act)**						Recorded on the summit of Alum Mountain. Several individuals
Golden Whistler						Forest/woodland & coastal plain
Rufous Whistler						Forest/woodland & coastal plain
Grey-shrike-thrush						Forest/woodland & coastal plain
Leaden Flycatcher						Forest/woodland & coastal plain
Grey Fantail						Forest/woodland & coastal plain
Black-faced Cuckoo-shrike						Forest/woodland & coastal plain
Cicadabird						Forest/woodland & coastal plain
Grey Butcherbird						Forest/woodland & coastal plain
Pied Butcherbird						Transmission line
Australian Magpie						More open areas
Pied Currawong						Forest/woodland & coastal plain
Australian Raven						Forest/woodland & coastal plain
Red-browed Finch						Grassy areas
Welcome Swallow						More open areas
Sub-total	**2**	**0**	**36**	**33**	**2**	
Indirect evidence from scat and hair analysis						
Trichosurus velpecula						
Isoodon macrourus						
Sub-total	**0**	**0**	**0**	**2**	**0**	
Total Species	**2**	**13**	**68**	**65**	**18**	

12.0 SUMMARY OF THREATENED FAUNA SPECIES

12.1 Threatened Species Recorded

Table 27 sets out the detail required on threatened and listed fauna species recorded and most likely to occur throughout the property. Detail on previous records is provided in Tables 1 and 2. Several species, the Parma Wallaby, the Eastern Freetail Bat, the Large-footed Myotis, and the Yellow-bellied Sheathtail Bat are not listed as having been previously recorded within a 10km range of the property and the Squirrel Glider has been recorded only once. Table 27 also shows the habitat requirements for each species as it relates to the property. Fourteen species are listed in all.

Table 27- Threatened fauna and migratory species that was recorded and most likely to occur on the subject site.

SPECIES	CATEGORY	DETAILS
Squirrel Glider *Petaurus norfolkensis*	schedule 2 of the TSC Act	One previous record; tree hollows and nectar plants important
Parma Wallaby *Macropus parma*	schedule 2 of the TSC Act	No previous records; moist slopes habitat and mountainous terrain
Little Bent-wing Bat *Miniopterus australis*	schedule 2 of the TSC Act	Alum Mountain; caves important for roosts and elsewhere on property for foraging
Eastern Bent-wing Bat *Miniopterus schreibersii*	schedule 2 of the TSC Act	Alum Mountain; caves important for roosts and elsewhere on property for foraging
Eastern Freetail-bat *Mormopterus norfolkensis*	schedule 2 of the TSC Act	No previous records. Trees with hollows important for roosts and elsewhere on property for foraging
Large-footed Myotis *Myotis Macropus*	schedule 2 of the TSC Act	No previous records. Trees with hollows near water and waterbodies important
Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris*	schedule 2 of the TSC Act	No previous records. Trees with hollows and areas of forest important. High flying species feeding on insects above canopy.
Eastern Cave Bat *Vespadalus troughtoni*	Probably roosts in Alum Mountain caves and forages elsewhere over the property	Alum Mountain; caves important for roosts and elsewhere on property for foraging
Large-eared Pied Bat *Chalinolobus dwyeri*	schedule 2 of the TSC Act; EPBC Act, 1997	Alum Mountain; caves important for roosts; creeks on property for foraging
Grey-headed Flying Fox *Pteropus poliocephalus*	schedule 2 of the TSC Act; EPBC Act, 1997	Within 3 km. Fleshy fruits and nectar plants required to sustain population

(cont.)

SPECIES	CATEGORY	DETAILS
White-bellied Sea Eagle *Haliaeetus leucogaster*	migratory terrestrial on the EPBC Act	Tall trees for nesting required.
Powerful Owl *Ninox strenua*	listed on schedule 2 of the TSC Act	No previous records. Forest with possums and gliders for foraging
Glossy Black-Cockatoo *Calyptorhynchus lathami*	schedule 2 of the TSC Act	Pockets of Allocasuarina required with roost trees.
Varied Sittella *Daphoenositta chrysoptera*	schedule 2 of the TSC Act	Woodland with rough-barked trees required for foraging.
Varied Triller *Lalage leucomela*	schedule 2 of the TSC Act	Eucalypt forests & woodlands

Further detail on the recorded threatened species is given hereunder. and in relation to microbats a summary from the action plan for Australian bats recommending objectives for these species is included (Environment Australia, 1999).

12.2 The Squirrel Glider

No evidence of the Squirrel Glider was recorded during the surveys in late 2010 (Forest Fauna Surveys, 2011), but the species was recorded by trapping at five locations within the subject site in 2006. Populations of the species were also recorded off-site in the adjoining Bulahdelah State Forest. The absence of Squirrel Glider records in 2010 indicates the population has declined since 2006, possibly due to impacts such as fire, but also natural variation in preferred foraging resources may have occurred. The areas of preferred habitat for the Squirrel Glider (see Figure 10) include the following vegetation communities mapped by Clarke Dowdle & Associates (2010a);

- Group 2 Sub-community 2; Upland Open Scrub with Emergents of Swamp Mahogany in Areas of Permanent High Water Tables. The Great Lakes Council vegetation community equivalent is Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland.
- Group 3 Woodland / Forest on Alum Mountain Volcanics over Lower Coastal Slopes and Plains. The Great Lakes Council vegetation equivalent is Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland.

The stand of Swamp Mahogany in the wet heath area is considered highly significant for the Squirrel Glider due to the restricted extent of this vegetation type in the subject site. Furthermore, Swamp Mahogany is a very important foraging resource for the Squirrel Glider (and other nectar and pollen dependent fauna) due to the regularity of flowering each autumn through to winter.

The Group 3 *Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland* described by Clarke Dowdle & Associates (2010a) contains abundant *Banksia spinulosa* in the understorey vegetation layer. A winter source of exudates (nectar, sap or gum) appears to be critical for persistence of squirrel glider populations. Winter flowering *Banksia sp.* are known to be a particularly important foraging resource for gliders and other nectarivores (see Tables 4 & 5) because they generally flower reliably ever year and provide a source of both energy and protein when other food resources (insects, gums and saps) are less abundant (Payne, 1992; Smith and Murray, 2003).

The distribution of habitat trees with hollows potentially suitable for the Squirrel Glider is widespread across the subject site. Habitat trees within, and also in close proximity to these two vegetation communities, are likely to be more significant to the Squirrel Glider than habitat trees more distant. The low density of preferred sap trees for the Squirrel Glider, namely Red Bloodwood *Corymbia gummifera* is either a natural reflection of the vegetation communities on the subject site, or possibly their selective removal during past logging.

12.3 The Parma Wallaby Macropus parma

Forest Fauna Surveys (2011) found no evidence of the Parma Wallaby during the most recent visit but the wallabies were regularly seen during the earlier visits by Robert Payne and Kristan Dowdle. Following these sightings a description was prepared of the vegetation where the animals were also seen feeding. The feeding habitat is grassland of Wiry Panic (see Section 10.7).

There has been limited published information on the ecology of this species (Maynes, 1977; Read & Fox, 1991; Short & Smith 1994). Initially, the Parma Wallaby was thought to be extinct on the Australian mainland, with the only known population discovered in New Zealand at that time, where it had previously been introduced. Surveys conducted during the period 1972 to 1974 from the south to north coast of NSW located the species at eight localities extending from Olney State Forest near Gosford in the south, to Barrington Tops, Gibraltar Range, Dorrigo and Glen Innes in the north of the state. At most of the known localities, the sites experience high rainfall and support a moist or rainforest understorey or wet sclerophyll forest with a thick shrubby understorey near grassy areas where it feeds. Similar tree species found at this site, such as *Eucalyptus saligna* Sydney Blue Gum and *E. microcorys* Tallowwood are present below Alum Mountain although they do not occur in wet sclerophyll forest. Additional sites where the species was recorded included young eucalypt plantations and can include abundant Tussock and Blady Grass in the ground layer vegetation (Read and Fox, 1991).

The Parma Wallaby is confined to scattered forests in NSW. It is found in montane areas such as the Dorrigo Plateau, the Gibraltar Range and Barrington Tops but was once more common in coastal forests. This description aptly fits the montane habitat at Alum Mountain. The Parma Wallaby can also be found in dry sclerophyll forest with tussock grasses.

At a finer scale Read & Fox (1991) recorded the Parma Wallaby in Forest Type 52 and 60 in Olney State Forest (Baur, 1979). Forest type 52 is Round-leaved Gum- Turpentine Forest dominated by *Eucalyptus deanei* Deanes Gum and *Syncarpia glomulifera* found normally along sheltered gullies and would be considered wet sclerophyll forest. This type of vegetation has similar characteristics to the Smooth-barked Apple/Turpentine/Sydney Peppermint Riparian Tall Forest along Frys Creek and the stand of Sydney Bluegum *Eucalyptus saligna* and Tallowood *Eucalyptus microcorys* below the northern face of Alum Mountain. Forest Type 60, also a wet sclerophyll forest, is found as a transitional forest between Forest Type 52 and slope forest and is dominated by *E. acmenoides* White Mahogany and *E. resinifera* Red Mahogany and perhaps this has some affinity to Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland, although it is not regarded as wet sclerophyll forest. In Chichester State Forest the species was found in unclassified forest with a moist understorey dominated by *E. laevopinia* Silvertop Stringybark, *E. saligna* Sydney Bluegum, *E. campanulata* New England Blackbutt and *E. microcorys* Tallowood and in Moonpar State Forest they were associated with Forest Types 46 and 47. The forests are the wet sclerophyll forests dominated by *E. saligna* Sydney Blue Gum and *S. glomulifera* Turpentine along the gullies and on moist slopes. The latter at least has affinities with the Great Lakes Council vegetation community classification

Tallowwood/Blackbutt/Sydney Peppermint Riparian Tall Forest; although in this particular case it is not a riparian habitat but a slope habitat.

Vegetation structure appeared to have no significant association with Parma Wallaby sites although in several cases the animals were sighted feeding on grasses along roadsides. The authors state that *Imperata cylindrical var. major* Blady Grass may also be a contributing factor to presence in habitat and on one occasion during this survey two animals were sighted feeding on Blady Grass south of the existing dwelling on the slope. Tussock grass dominance and absence of other grass is more than likely to be associated with the Parma Wallaby. This is certainly the case where the animals were seen near the yabbie ponds.

Forest Fauna Surveys (2011) also supports the view that there is also a similarity between the structure of the forest on part of the subject site at Bulahdelah compared to other known sites of Parma Wallaby especially in relation to young eucalypt plantations. The subject site near the yabbie ponds has been extensively logged in the past and presently supports a young forest with high density of young stems <30 cms dbh beside a Wiry Panic grassland which may explain the sightings of the Parma Wallaby in the central part of the subject site.

The habitat assessment matrix based solely of distribution of preferred grasses (as per Read and Fox, 1991) indicates the area of higher quality habitat is restricted to the southern portion of the subject site. However, the majority of previous records of the Parma Wallaby records on the subject site occur outside of the predicted higher quality habitat. Combining distribution of known trees occurring at other sites (i.e. Tallowwood), expands the potential habitat distribution on the subject site to include areas where the Parma Wallaby has previously been recorded. Based on what is little known of the ecology of the Parma Wallaby, the habitat matrix with data pooled from both grasses and distribution of Tallowwood more closely reflects known records of the species on the subject site, than just assessment based on Blady Grass distribution alone (see Figure 22 & 23).

Whilst *Entolasia stricta* Wiry Panic, present at the Parma Wallaby sighting areas, is a grass that is widely distributed in the region it mainly occurs in the sub shrub layer of many vegetation communities. It is also not a dominant in this layer. However, these communities are mainly those growing on impoverished soils in the Wollombi and Central Coast areas although there are some occurrences recorded in Tallowwood dominated forests in the lower north coast and Barrington areas further north (see MU 30, 32, 38, 39, 46 and 47 of Somerville, 2009). In addition there is one community identified as Smooth Barked Apple/Red Bloodwood/Brown Stringybark/Wiry Panic Heathy Open Forest (MU101) located around Lake Macquarie. The Tallowood dominated forests may have some value for Parma Wallaby habitat but the others mentioned are unlikely to support such habitat characteristics.

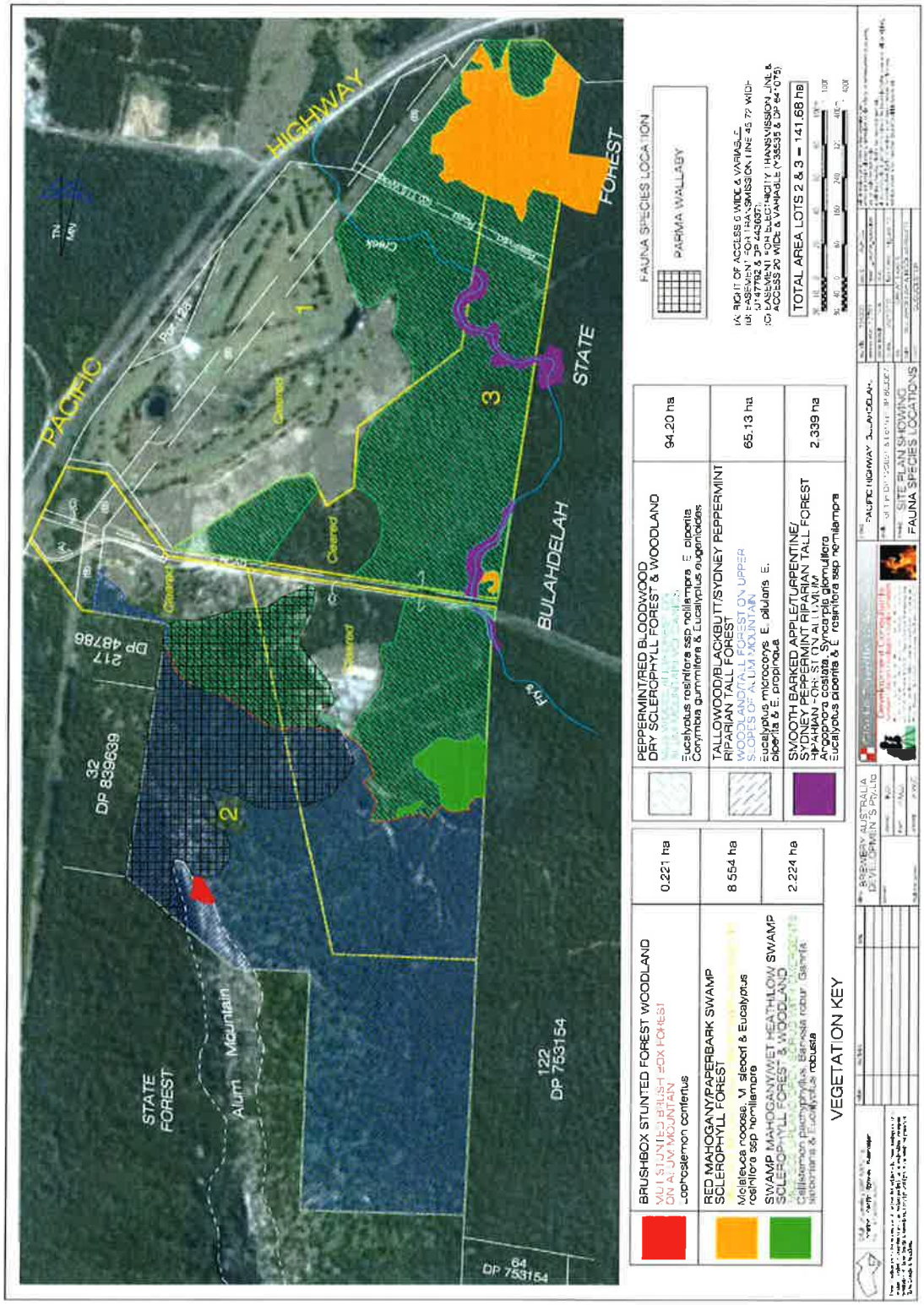

Figure 22– Main habitat areas for the Parma Wallaby based on sightings and movements

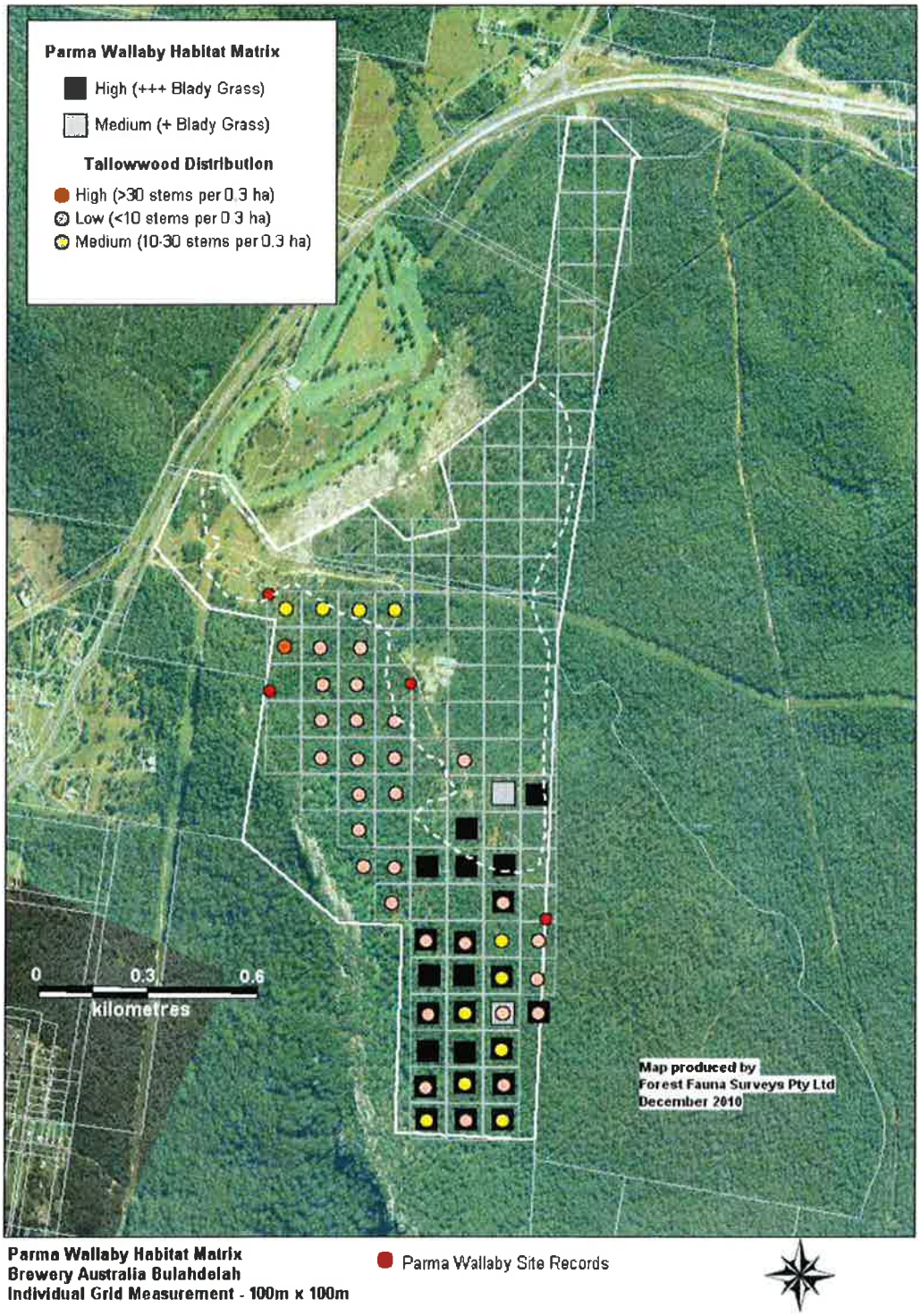

Figure 23 – Habitat matrix of the Parma Wallaby based on tussock grasses and Tallowwood.

12.4 The Little Bent-wing Bat *Miniopterus australis* (see Figure 24)

The national distribution of this species occurs along the coast and ranges of eastern Australia from Cape York to near Wollongong in New South Wales. Populations in the south of the range are predominantly limited to coastal areas. The little bent-wing bats roosts in caves, stormwater drains and tunnels, with populations sometimes numbering into the thousands. Roosts are often shared with the larger eastern bent-wing bat (Hoye & Hall 2008b). This species has also been observed roosting in the base of a hollowed out tree and within dense foliage (Schulz 1997), thereby increasing the significance of large mature trees in forest situations. This species has been reported to feed on small insects beneath the canopy in well timbered forest, but has also been reported utilising coastal swamps and rainforest. A foraging range of 20 km from roost sites has been reported.

The ecology of this species is very similar to the Eastern Bent-wing Bat except that it is a more tropical species with the southerly range generally limited to the central coast of New South Wales, possibly because of the need for access to hot caves. It is interesting to note that the southerly extent of the distribution was given as Kempsey in 1968 (Dwyer 1968) and that the range of the species has now extended to near Wollongong by 2009 (Martin Schulz pers. comm.). Whether this range expansion is a recent occurrence or the result of limited bat surveys is unclear however the southerly range of the species by 2000 was estimated to be just north of the Hawkesbury River (Williams and Hoye 2000).

Over the last few years this species has been recorded at locations in the northern beaches of Sydney (Ray Williams, Ecotone pers. obs.). Males are sexually active over winter with mating taking place in July and August. There is no delayed implantation and births occur in December. Only a few maternity caves are known for this species and most are shared with the Eastern Bent-wing Bat. It is suspected that the nearest maternity roost to the subject land is at Willi Willi caves near Kempsey. Evidence to support this is the finding of two Little Bent-wing Bats that were banded at Willi Willi at Alum Mountain sometime after the breeding season in 2001 (Glenn Hoye pers. comm.).

The life span of this species probably exceeds five years and green tree frogs, pythons, owls and foxes are known predators. The major threat arises from the disturbance of roost sites, particularly nursery caves.

The Little Bent wing Bat has been recorded roosting in the old alum mine workings at the southern end of Alum Mountain on several occasions however it does not appear to be a major roost. Numbers recorded at the mine are generally small, the largest reported group being about 1,000 in 2001 (Glenn Hoye pers. com). Larger more permanent roosts are also known to occur in a disused mine at Cureeki Creek to the north, Balickera near Raymond Terrace to the southwest and a sea cave at Yacaaba Headland to the south (Ecotone Ecological Consultants, 2000).

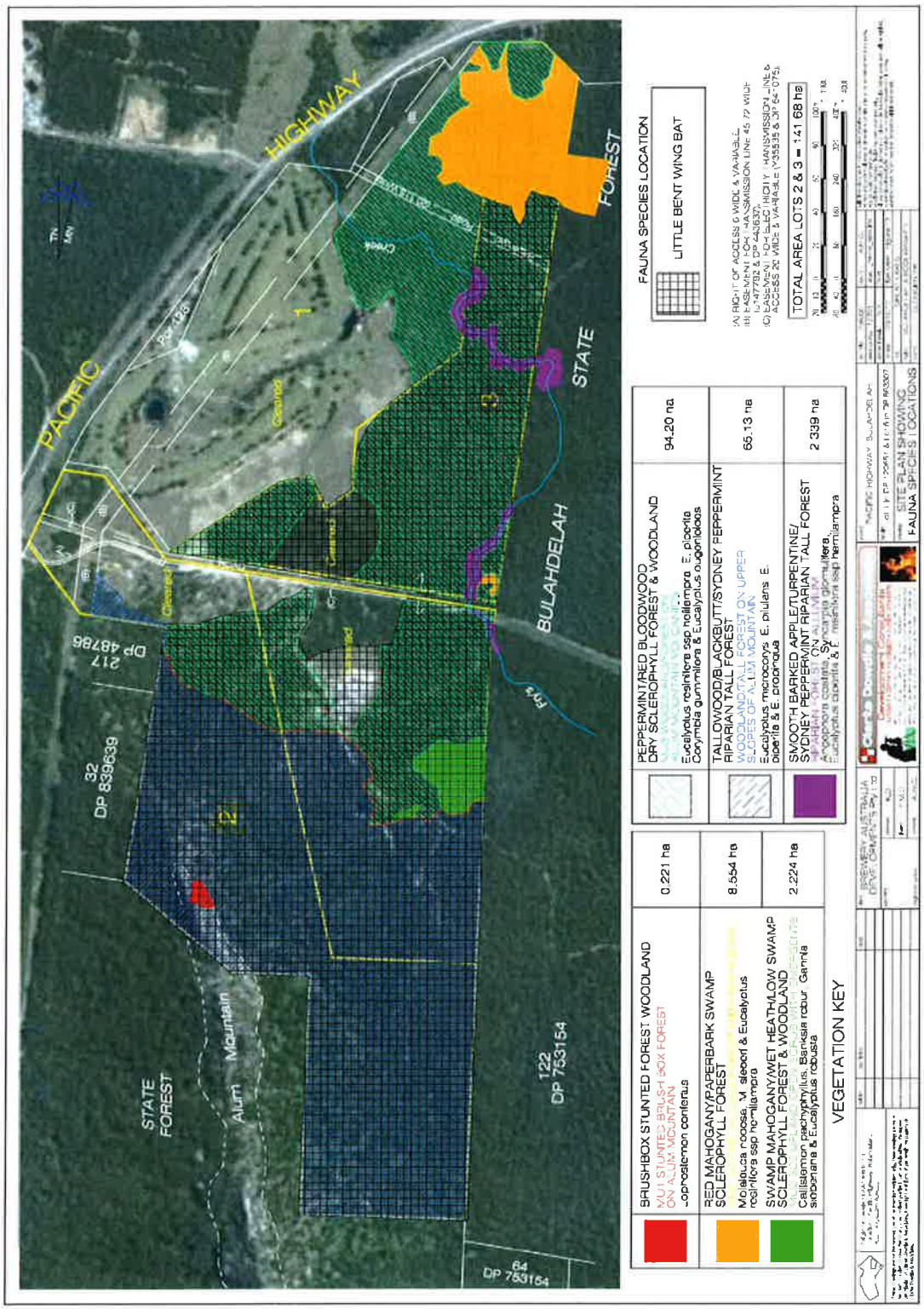

Figure 24– Potential habitat for the Little Bent-wing Bat

12.5 The Eastern Bent-wing Bat Miniopterus schreibersii oceanensis (See Figure 25)

This species is widely distributed from the coast and of eastern Australia, extending from Cape York Peninsula, through eastern Queensland, New South Wales and Victoria. Other subspecies occur in western Victoria and south-eastern South Australia, north Western Australia and the Northern Territory. In New South Wales, it is found from the coast to the western slopes of the Great Dividing Range. This species is widespread and can be locally common where suitable caves or tunnels are available as roost sites.

However, the major threat to this species is the loss of roost sites, particularly caves. Their dependence upon relatively few nursery caves suggests that threats to the existence or structural integrity of these may place regional populations in jeopardy. Frequent disturbance of roosts used for winter hibernation or periods of torpor is known to significantly increase mortality (Hoye and Hall, 2008a). Toxic accumulation of agricultural chemicals in body fat used during winter torpor may also reduce populations. Habitat loss through clearing for development or agriculture and subsequent reductions in insect prey availability may also adversely affect this species. The Eastern Bent-wing Bat is reportedly preyed upon by feral cats and occasionally foxes (Churchill 2008).

Eastern bent-wing bats are known to forage within a variety of habitat types adjoining roost sites. Dwyer (1995) regarded typical habitat as well-timbered valleys, however this species is often recorded utilising bushland remnants as well as developed land in urban areas where it often forages around street lights (Ray Williams, Ecotone pers. obs.). Eastern Bent-wing bats are known to feed mainly on moths as well as cockroaches, beetles and flies and forages above the tree canopy (Churchill 2008). This is a mobile species and is estimated to forage within a 20 km radius of the roost site with a known distance of 65km recorded in a single night (Churchill 2008).

The limiting factor for this species is availability of roost sites. Suitable caves, mines, tunnels, road culverts and buildings are essential. Maternity roosts are particularly important and are known from limestone and sandstone caves, disused gold mines, concrete bunkers and lava tubes (Hoye and Hall 2008b). Long migrations between roost sites, according to seasonal needs or reproductive status, have been recorded (Hoye and Hall 2008a). Recorded nursery caves are few in number and widespread, which leaves this species vulnerable should any of these areas be destroyed.. Within nursery caves, large populations of females, numbering up to 100,000 individuals gather prior to the birth of their young in December (Churchill 2008). In New South Wales mating occurs in late May and early June, just prior to winter. Delayed implantation occurs and development of the young does not commence until late August. A single young is born in December and juveniles are independent between February and March when nursery colonies disband and individuals disperse over long distances. The bats are sexually mature in their second year and may live to over 17 years of age (Hoye and Hall 2008a).

The eastern bent-wing bat has been recorded at a number of sites within the location, and appears to be relatively well represented in the area. A known roost site occurs in the disused alum mine on Alum Mountain and some of the deeper caves may provide roost sites. Roosts are also known to occur in a disused mine at Cureeki Creek to the north, Balickera Tunnel near Raymond Terrace and to the south-west and a sea cave at Yacaaba Headland to the south (Ecotone 2000). The mine at Alum Mountain does not appear to be permanent roost although the species has been recorded foraging in the study area in winter and in summer (December and February).

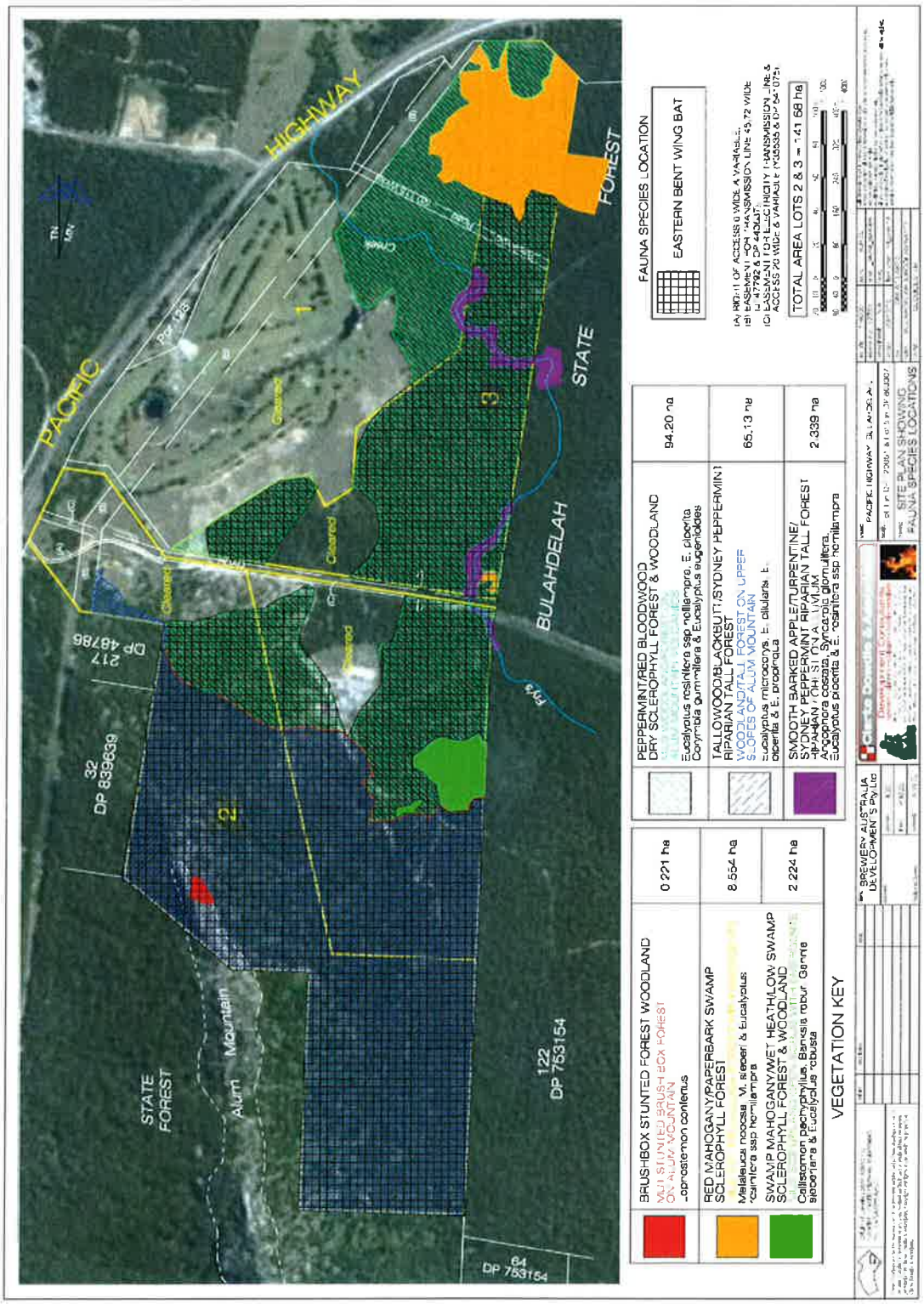

Figure 25– Potential habitat for the Eastern Bent-wing Bat

12.6 The Eastern Free-tail Bat, *Mormopterus norfolkensis* (see Figure 26)

The commonwealth conservation status of this species is "data deficient" and is thought to be uncommon and distributed east of the Great Dividing Range to the coast from Picton in New South Wales to as far north as South-east Queensland(Environment Australia, 1999).

This bat has been recorded from the coast and adjacent ranges of south-eastern New South Wales, north from Pambula, to south-eastern Queensland. Although the habitat preferences are unclear, most records of this species have been reported from dry eucalypt forest and woodland on the eastern side of the Great Dividing Range. Individuals however, have been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Hoye et al., 2008b). The species has also been recorded foraging over open paddocks and wetlands in the Hunter River catchment and north coast of NSW (Ray Williams, Ecotone pers. obs.) and a study of habitat use on a landscape scale found higher activity levels in cleared and semi-cleared landscapes than within forested and urban landscapes (McConville 2010).

It is a predominantly tree-dwelling species (roosting in hollows or behind loose bark in mature eucalypts), but one individual has been recorded roosting in the roof of a hut, together with a number of Gould's Wattled Bats and an Eastern Broad-nosed Bat (Hoye 2008). This species has recently been found roosting and breeding in hollow mangrove trees (Anna McConville pers. comm.).

Females give birth in late November to early December and flying young enter the population in January (Hoye 2008). The diet is thought to consist of small insects including leafhoppers, chafers, weevils and other beetles.

The main threat to this species is believed to be the of tree hollows which are used as roost sites through clearing or apiary (honey bees taking over suitable hollows). Habitat modification through inappropriate burning regimes and grazing, and clearing for agriculture or urban development may reduce foraging habitat and insect prey availability. However, given the apparent preference for more open environments some habitat modification may be an advantage to this species. Although few records occur for the study locality, the east-coast freetail bat appears to be widespread across the coastal plains of the north coast of NSW.

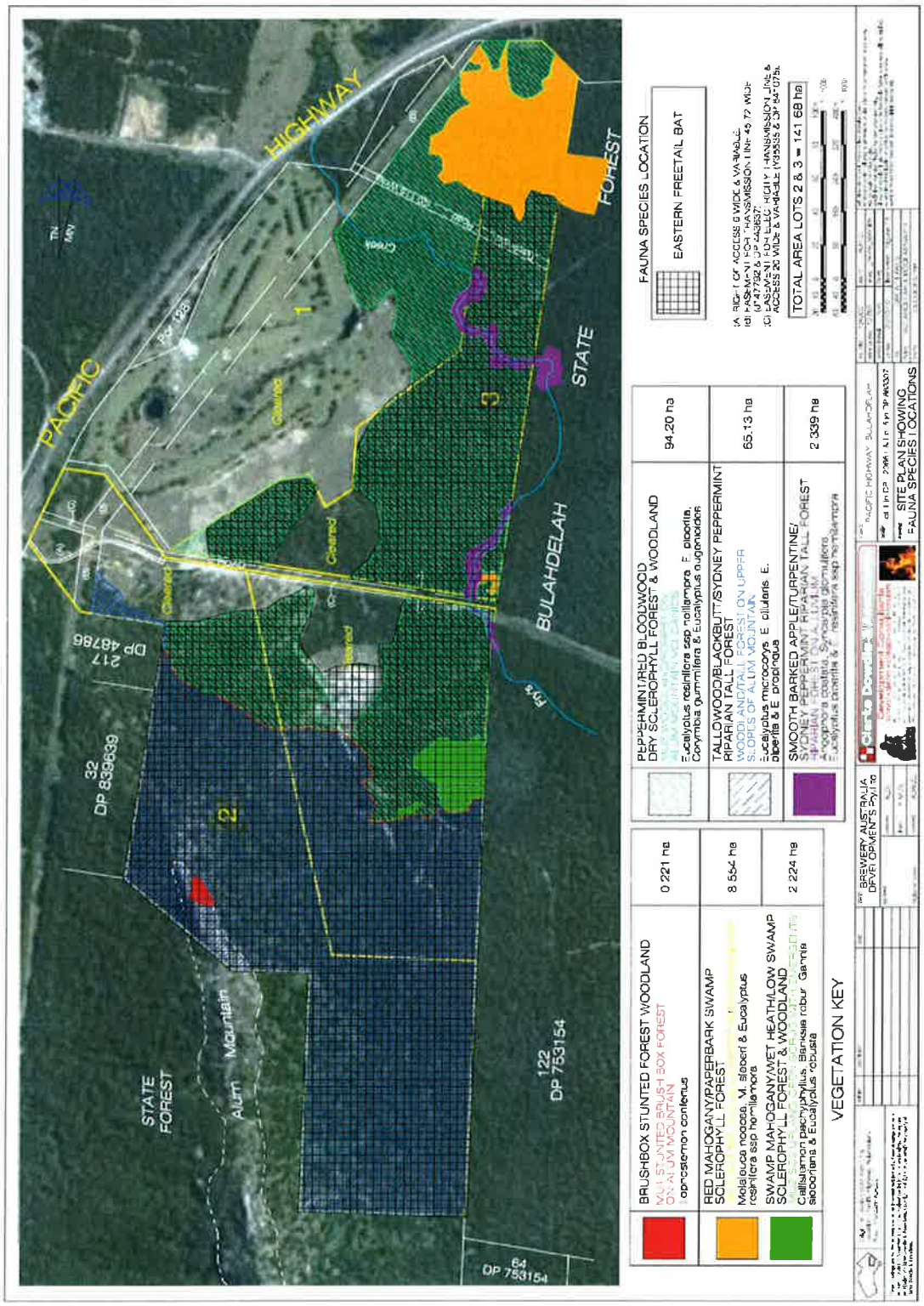

Figure 26– Potential habitat for the Eastern Free-tailed Bat

12.7 The Large-footed Myotis, *Myotis macropus* (See Figure 27)

The Large-footed Myotis is known to occur in a wide coastal band from northern Western Australia, Northern Territory, Queensland, New South Wales, Victoria, and into far south-eastern South Australia. The distribution of this species extends inland from coastal South Australia, along the Murray River (Churchill 2008). The species is considered to be common over its limited national range (Richards 2008).

The Large-footed Myotis has a strong affinity to open water, including farm dams, where it flies low over the water, feeding on flying insects as well as larvae and small fish, raked from the water surface (Robson 1984). Within the locality, there are many large water bodies (Myall River and its tributaries, wetlands, farm dams and pools within ephemeral creek lines) and these provide ideal foraging habitat for this species. Long movements between the roost site and foraging area have been recorded. In Victoria, Caddle and Lumsden (1999) found that the Large-footed Myotis travelled up to 20 km from the roost site to a feeding site despite both locations being over water. In southern Queensland, Barclay (2000) found that individual myotis travelled many kms from the roost site in a disused railway tunnel to the foraging area over a man made lake and that two journeys were often made in one night.

Roost sites are often over or near water within caves and manmade structures, such as tunnels, buildings, culverts and bridges, as well as tree hollows (Churchill 2008). The use of manmade structures gives the potential for a high incidence of disturbance, particularly where maternity roosts are involved. Colonies usually number between 10 and 30 individuals, but up to several hundred individuals have been reported in a single roost (Richards 2008). Small breeding clusters form within colonies, consisting of a male and a harem of females. This territory is defended by the dominant male (Dwyer, 1970), however, banding studies have shown that both individual male and female members of the colony frequently change indicating that more than one roost is used by the local population at any one time (Ecotone 2001). In NSW, births occur between October and February and from limited information, it that each female may produce only a single young per year. Births within the colony appear to be staggered through the breeding season, with peaks in late October and early February. It is possible that young from the previous year give birth later in the breeding season (Ray Williams, pers. obs.). When not breeding, dominant males roost alone, defending their territory, whereas, surplus males may form predominantly all male groups of up to individuals. Lactation lasts some eight weeks and after weaning the young forms a strong bond its mother for at least four weeks, when it is probably taught how to catch food (Richards 2008). In the cool southern latitudes, individuals may enter extended torpor to survive adverse winter weather conditions, however, in warmer coastal areas this species is active on most nights throughout the year, although they appear to return to the roost earlier in the night during winter.

The Large-footed Myotis can be relatively common where suitable habitat and roost sites occur and although its presence within the subject land cannot be positively confirmed by ultrasonic call analysis alone, it is expected to forage over the farm dams, although no other records for the locality could be found.

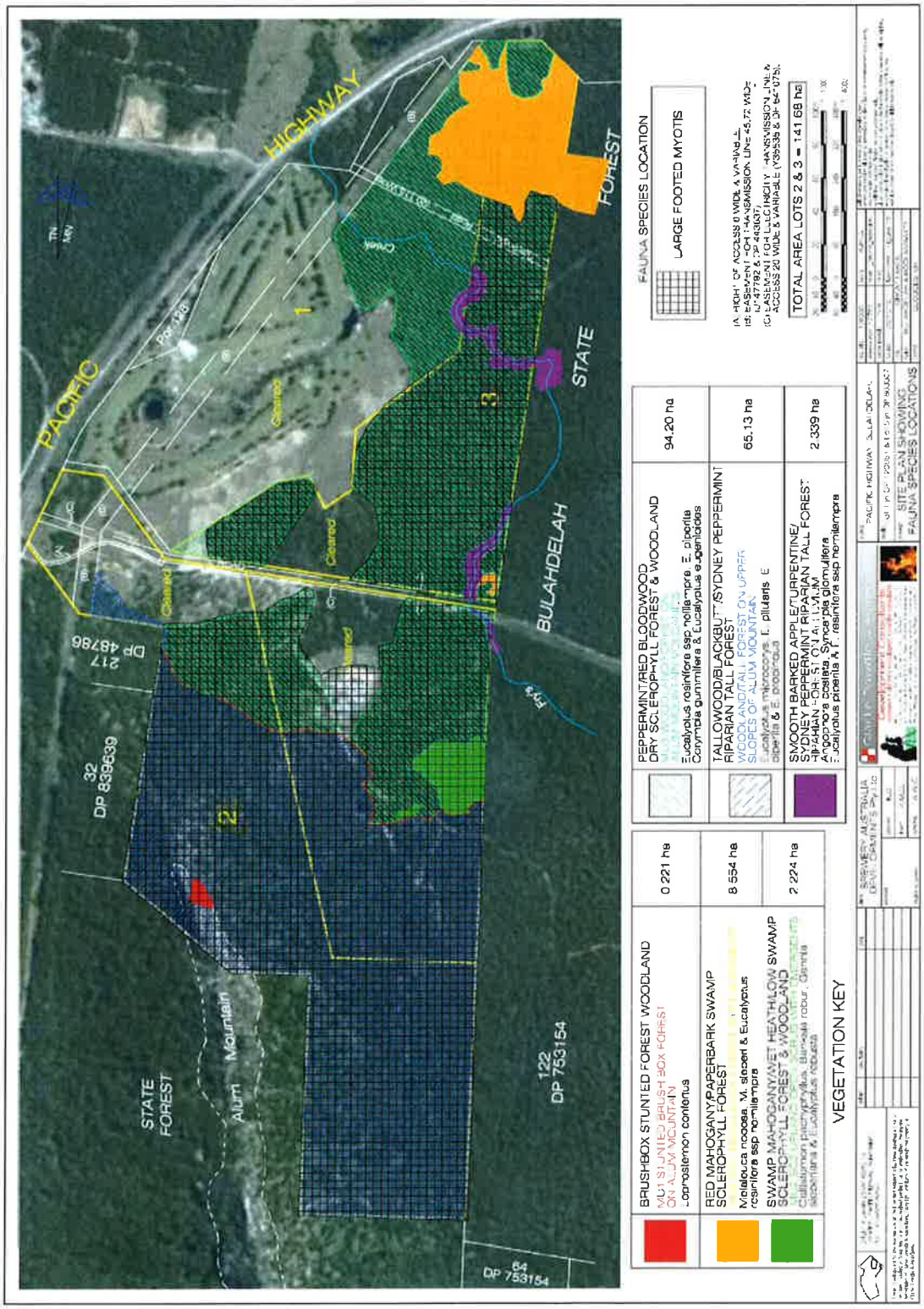

Figure 27– Potential habitat for the Large Footed Myotis

12.8 The Yellow-bellied Sheathtailed-bat *Saccolaimus flaviventris* (see Figure 28)

The Yellow-bellied Sheathtail-bat is a large, insectivorous bat, which is distributed throughout a large portion of eastern and northern Australia. It is widely distributed throughout a range of habitats in New South Wales but the relative infrequency of recorded sightings suggests that the species is sparse across its range (Richards 2008). The species is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats.

This species is thought to forage for prey above the tree canopy and is therefore difficult to catch using conventional trapping techniques. Most foraging observations have been estimated at 15 - 20 metres above the ground; however the bat has been recorded lower in cleared areas and stunted vegetation types (mangroves). Flying insects (particularly beetles, grasshoppers, chafers and bugs) are taken above the forest canopy, and closer to the ground in low vegetation types (e.g. mallee, heath, mangroves). The fast direct flight pattern allows for prey to be encountered at a greater rate in cleared and open areas (Rhodes & Hall 1997).

This species is apparently usually solitary, but small colonies of up to 10 individuals are not uncommon with maternity colonies of 100+ reported (Richards 2008). In one case, a colony of 29 individuals was found within a hollow in the top of a dead eucalypt in predominantly cleared grazing land south-west of Brisbane. This clumping may have resulted from a lack of suitable roosting hollows in the locality or aggregations during winter by this species (Rhodes & Hall 1997).

The breeding biology of this species is poorly known, with births occurring from December to March (Churchill 2008).

The only record found for the study locality was made during studies on the subject land (Clarke Dowdle 2010). In the lower Hunter region this species has been recorded foraging over wetlands and open grassland on coastal floodplains, therefore a population could potentially occur within the local region, including the subject lands.

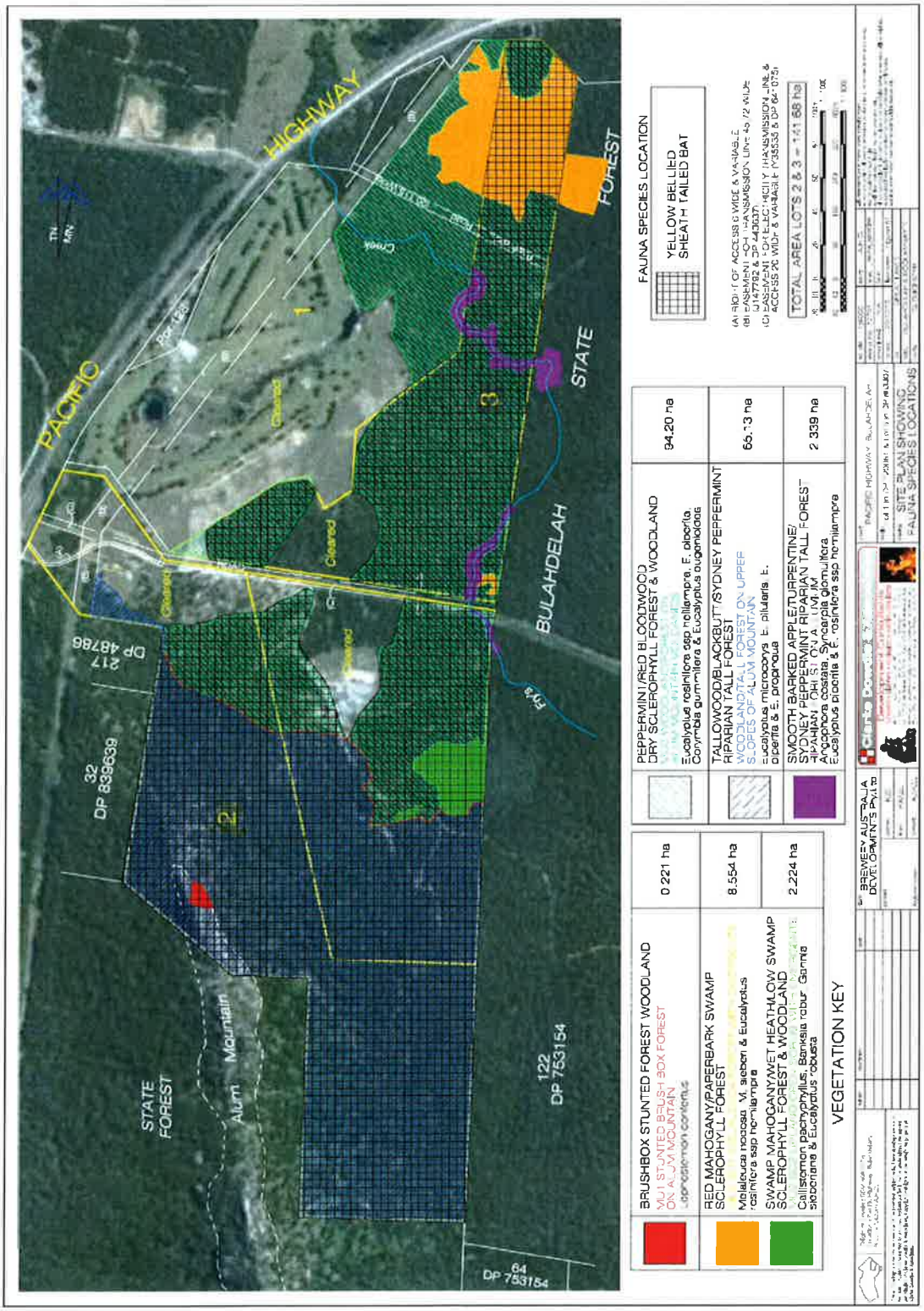

Figure 28– Potential habitat for the Yellow Bellied Sheath-tailed Bat

12.9 The Large-eared Pied Bat Chalinolobus dwyeri (See Figure 29)

At the Commonwealth level this species is listed as vulnerable and its distribution is poorly known, being recorded mostly in north-eastern New South Wales and the Blackdown Tableland in central eastern Queensland (Environment Australia, 1999). The Large-eared Pied Bat species is known to occur from Blackdown Tableland in central-eastern Queensland to Ulladulla in southern New South Wales, particularly in the sandstone escarpments of the Sydney Basin and the Hunter Valley and extending inland into the drier sclerophyll forests and woodlands to the west of the Great Dividing Range, as far as the Pilliga Scrub. There have been isolated records to 1 500 m (ASL) (Hoye and Schulz 2008). The national status of the large-eared pied bat is described by Hoye & Schulz (2008) as rare, scattered and possibly underestimated.

The habitat is also poorly understood having been recorded from a range of vegetation types. Roosting requirements are also poorly documented although it is known from sandstone outcrops, disused mine shafts, caves, overhangs and disused Fairy Martin nests. Disturbance to roost sites are reasons for its decline and such factors are present on Alum Mountain. The action plan states that all known roost sites should be protected and that the knowledge of the current distribution and the abundance of the species should be expanded in terms of its habitat requirements, roost and maternity sites and threatening processes. Within cave systems, this bat often chooses to roost in positions closer to the twilight zone rather than the dark zone and has regularly been recorded in shallow sandstone caves and overhangs using the honeycomb rock formations on ceilings and walls (Hoye & Schulz 2008).

The wing morphology suggests that the large-eared pied bat has a manoeuvrable flight, and probably forages for small insects below the forest canopy (Hoye & Schulz 2008). Little is known of the reproductive biology of this species, although females at one site were found to give birth to two, sometimes one, young during late November and early December, with young weaned by late January (Hoye & Schulz 2008). Females can reproduce at the end of their first year with mating thought to occur in early winter (Hoye & Schulz 2008). Breeding colonies consisting of 20 to 40 females have been recorded in shallow sandstone domed caves which may be used as a breeding site for many years (Churchill 2008). Large-eared pied bats have been observed in deep torpor during winter, suggesting the species hibernates through the coolest months (Hoye & Schulz 2008).

The only record of this species found for the locality was that of possible calls recorded on the subject lands (Clarke Dowdle 2010). Potential roost and breeding caves occur on Alum Mountain and the species could occur in potential habitat in the undulating forested land to the west of the study area.

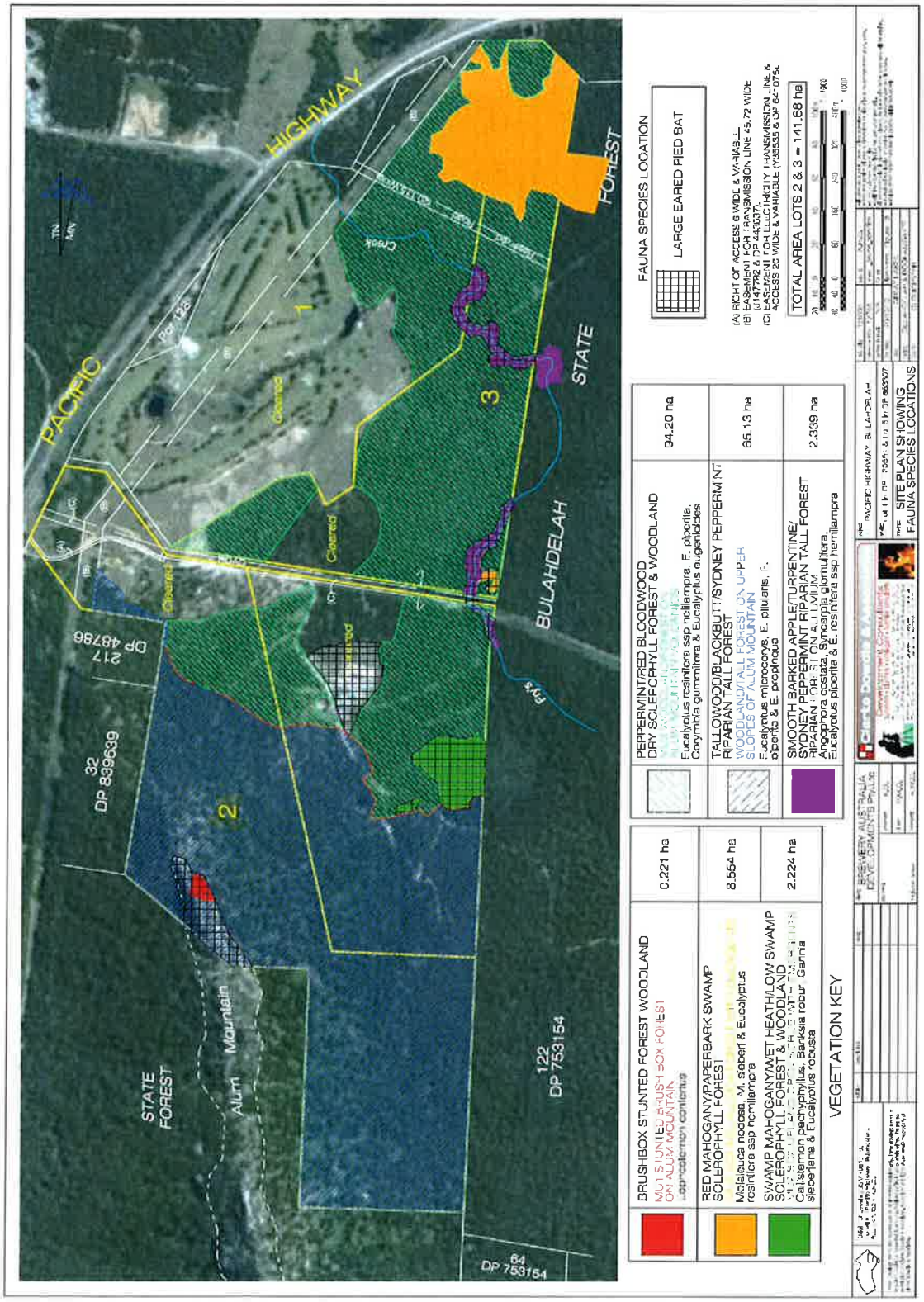

Figure 29– Potential habitat for the Large-eared Pied Bat

12.10 The Eastern Cave Bat *Vespadalus troughtoni* (See Figure 30)

The Eastern Cave Bat occurs on the coast and ranges of eastern Australia from the Iron Range in the Cape York Peninsula south to at least Sydney where suitable rocky habitats occur (Parnaby *et al.* 2008). Isolated populations from western Queensland and the south coast of NSW have been reported (Churchill 2008). Although listed as vulnerable in the NSW TSC Act, this species is regarded as being common nationally although it is limited by the availability of rocky escarpments (Parnaby *et al.* 2008).

In NSW this species has been recorded in wet and dry sclerophyll forest along the coastal plains and drier forest on the western slopes of the Great Dividing Range. All records have been in areas close to rocky escarpments where shallow caves and large rock overhangs occur (Churchill 2008). As with the Large-eared Pied Bat, this species often roosts in the twilight zone of shallow sandstone caves, boulder piles, mines and occasionally in buildings (Churchill 2008). Colonies of up to 100 individuals have been reported (Churchill 2008) with maternity colonies swelling up to 500 females (Parnaby *et al.* 2008). Although sandstone caves are usually chosen, hot roosts in the roofs of buildings have been chosen as maternity sites (Parnaby *et al.* 2008). One or two young are born in mid to late November and the roost site is changed on a regular basis (Churchill 2008).

This species has only been recorded by ultrasonic call analysis within the subject lands and given the difficulty in identification between the more common little forest bat, some doubt on the true identification of this species occurs. However suitable roosting and breeding habitat occurs in shallow caves on Alum Mountain, therefore this species cannot be completely discounted.

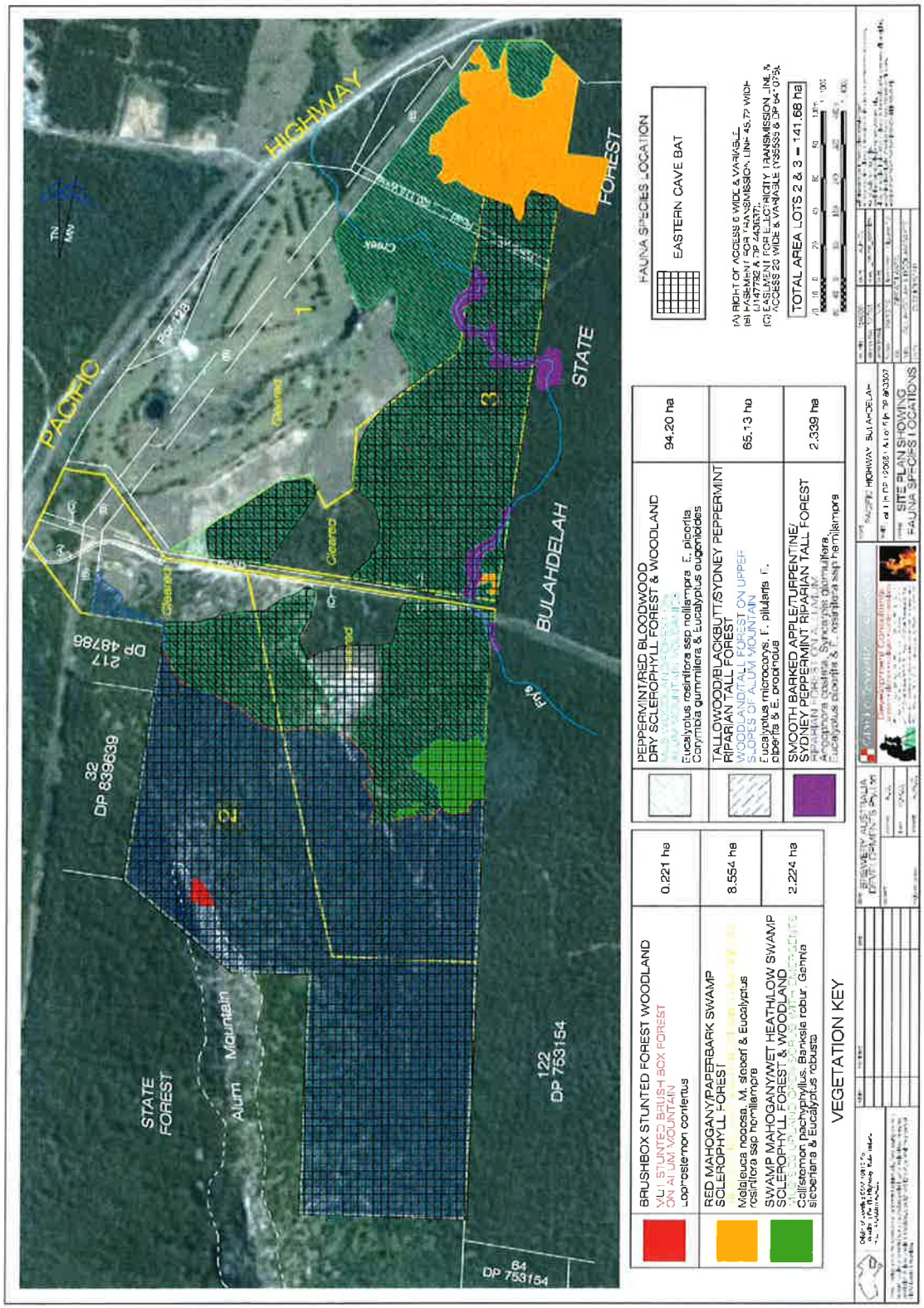

Figure 30– Potential habitat for the Eastern Cave Bat

12.11 The Grey-headed Flying Fox *Pteropus poliocephalus* (See Figure 31)

This species is listed at the Commonwealth level as vulnerable (Environment Australia, 1999). Currently, the Grey-headed Flying Fox is found from Hervey Bay in Queensland to Melbourne in Victoria. This species requires foraging resources and roosting sites and is a canopy feeding fruitivore and nectarivore. Thus, it feeds throughout various vegetation communities such as rainforest, open forest, woodland, heath, melaleuca swamp and banksia woodland as well as introduced species on properties such as fruit crops. However, with primary food source is Eucalyptus blossom, but in other areas it utilises rainforest fruit.

The reliable food resources for the Grey-headed flying Fox are only restricted to a small number of coastal vegetation communities in North New South Wales and Queensland. Mainly these resources are Eucalyptus which are produced seasonally according to climatic conditions. The Grey-headed Flying Fox roosts in small to large colonies beneath the tree canopy in branches and are currently roosting in urban areas such as the Royal Botanic Gardens in Sydney. Here they remain for long lengths of time and it is suggested that suitable roosting sites are the reason for the species restricted coastal range. A further reason for the species limited coastal range is the limited distribution for its food resources and as a result the species becomes vulnerable as land use decisions are made. Importantly, the Winter flowering food resources such as Swamp Mahogany and Broad-leaved Paperbark are sought by the Grey-headed Flying Fox.

Within the Sydney-Central Coast area several years of research have been undertaken on this species. The Grey-headed Flying Foxes, in this area occupied the Matcham colony site but have since disbanded. Research shows the pattern of occupation of colony sites is irregular and is related to the temporal changes in myrtaceous blossom (Parry-Jones and Augee, 2001). In general colony sites are deserted in winter, but in the southern part of its range, the Grey-headed Flying Fox forms large aggregations in response to the local abundance of blossom of native trees. A census over 62 months of the Gordon colony in Sydney, showed a large number of Flying Foxes present in autumn when mating occurred, again in spring when young were observed and in summer when the young became independent. At no time were Flying Foxes absent from the colony site (Parry-Jones and Augee, 2001).

An analysis of droppings and 'spat out' food material showed the Grey-headed Flying Fox relies on pollen, fruit and leaves. At Gordon, pollen was found in all months and mostly belonged to the families' *Myrtaceae* and *Proteaceae*. The highest frequencies were in winter and spring when, *Banksia integrifolia* Coast Banksia flowers were available at high densities during winter and other *Banksia spp*. became available in spring. Fruit fragments in droppings were found to be lowest in winter, but also high in spring and summer.

Winter fruit consisted of *Ficus spp*. and some introduced fruit, such as cultivated stone fruit. Cultivated fruit is substituted for native food when abundances are low.

Both leaves of the Grey Mangrove, *Avicenna marina* and *Poplar spp*. are eaten but some fern and bark are also chosen. Mangrove leaf is eaten in all months of the year whilst the *Poplar spp*. is eaten most commonly between February and May. There is a strong correlation between numbers of Flying Foxes in a colony and the abundance of native fruit, particularly *Ficus spp*.

Parry-Jones and Augee (1991a; b) in their study of the Matcham colony between 1996 and 1990 found that *Myrtaceae* and *Proteaceae* blossom and rainforest fruit were important elements in their diet. This data was based on identification of pollen grains in faecal pellet

material and staining native fruit residue. In some respects the study was inconclusive because the rainforest fruit and pollen grain was unable to be identified to species level. However, the authors did determine a number of *Myrtaceae* species from correlations between time of flowering of particular species and peak pollen grain counts.

The tree species the authors were able to identify were *Syncarpia glomulifera* Turpentine, *Angophora costata* Sydney Red Gum, *Angophora floribunda* Rough-barked Apple, *Melaleuca quinquenervia* Broad-leaved Paperbark, *Corymbia gummifera* Red Bloodwood, *Corymbia maculata* Spotted Gum and *Eucalyptus robusta* Swamp Mahogany. Blossom of *Proteaceae* included *Banksia integrifolia* Coast Banksia, *Banksia serrata* Old Man Banksia, *Grevillea robusta* Silky Oak and *Stenocarpus sinuatus* Queensland Firewheel Tree. Blossom from the, *Livistonia australis* Cabbage Tree Palm is also utilised, as well as blossom from *Lauraceae,* which could not be identified. Native Figs also showed up predominantly in their droppings.

Payne (1992) continued this study of the Matcham Flying Fox colony and found an abundance of *Ficus obliqua* Small-leaved Fig fruits in their droppings between the beginning of February and the end of April. *Schizomeria ovata* the Crab Apple, was also found to be common in faecal pellet material at this time, which is the season when rainforest fruits are most abundant. During this study Payne (1992) observed that the Flying Foxes arrived at the Matcham colony at the end of January when rainforest fruit initially became available and when there was a sudden change in fruit colour to a ripened state.

The analysis of droppings involved microscopic examination of stamens of blossom, which were matched against the blossoms of flowering trees at the time. Payne (1992) concluded that the flying foxes were mainly feeding on *Corymbia gummifera* Red Bloodwood, *Angophora floribunda,* Rough-barked Apple and *Melaleuca quinquenervia* Broad-leaved Paperbark, between January and April. In autumn-winter, the Grey-headed Flying Fox utilized *Eucalyptus maculata* Spotted Gum and Eucalyptus *robusta* Swamp Mahogany. However, the presence of the colony being present at Matcham was found to be related to fruit production of *Ficus obliqua* Small-leaved Fig. The colony arrives and departs according to fruit availability of this species (Payne, 1992). Thus the Small-leaved Fig and Swamp Mahogany are considered to be 'Keystone Species' because they are essential to the survival of the Grey-headed Flying Fox.

Female Grey-headed Flying Foxes give birth in August and September, adjacent to food supplies in small ephemeral aggregations. At Gordon, the presence of Flying Foxes at this time is not correlated with native food supply, but planted exotic species (Parry-Jones and Augee, 2001), but at Matcham the pattern of occupation is correlated with relative frequency of occurrence of *Myrtaceae* pollen and fruit availability of rainforest fruits (Parry Jones and Augee, 1992; Payne, 1992).

Given the vegetation mapping that has been prepared the Grey-headed Flying Fox would feed on *Melaleuca quinquenervia* and *Eucalyptus robusta* in vegetation communities Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland and Red Mahogany/Paperbark Swamp Sclerophyll Forest, the mature rainforest trees that bear succulent fruit along Frys Creek, any isolated flowering trees of *Corymbia gummifera* throughout the coastal plain and the mature Port Jackson Fig trees that occur on Alum Mountain. Forest Fauna Surveys (2011) also state that no camps of the species occur on, or in the immediate vicinity of the subject site and would therefore, not be disturbed by any future development on the subject site. The stand of Swamp Mahogany forest in the centre of the subject site would be an important winter foraging resource for the Grey-headed Flying-fox.

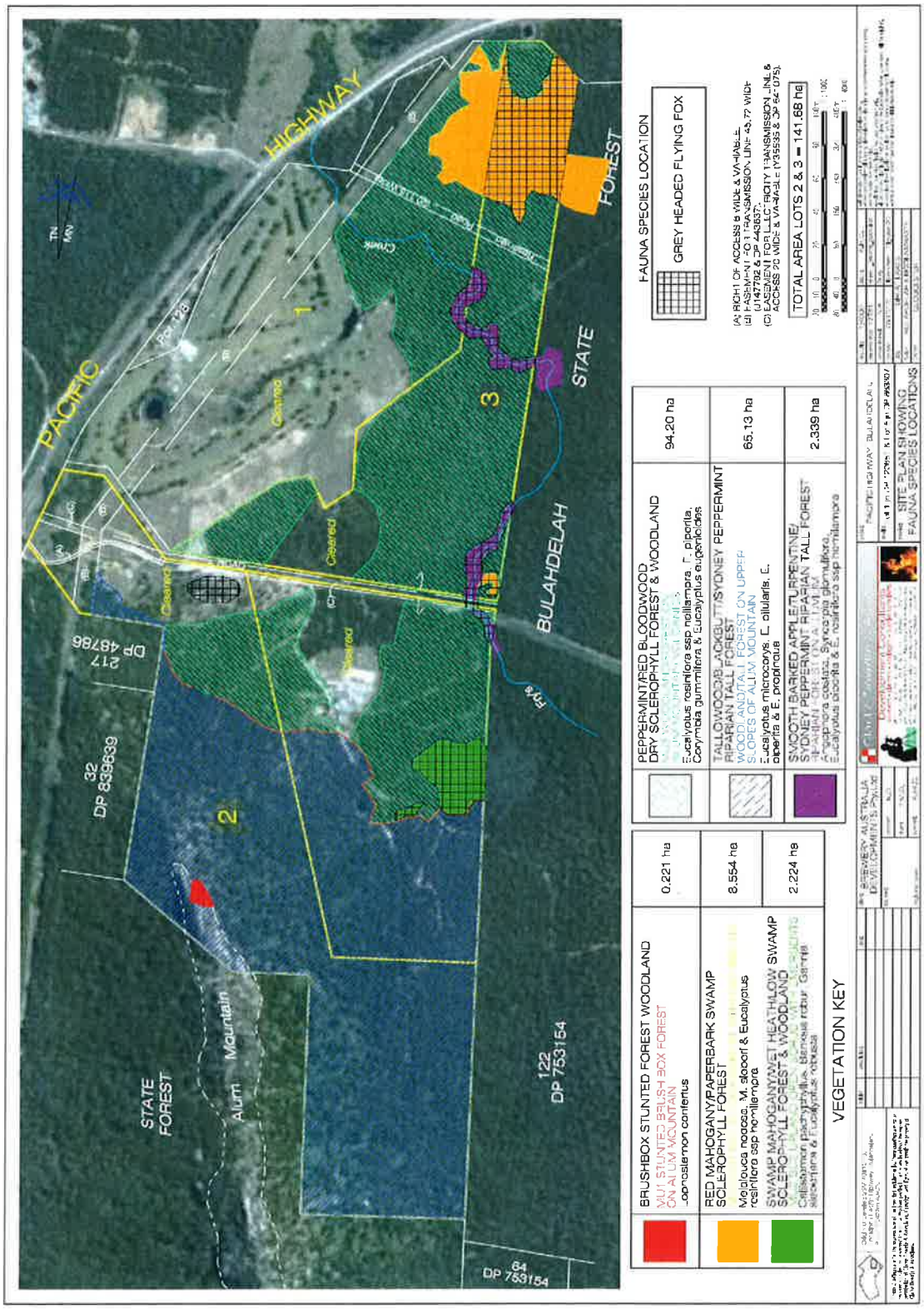

Figure 31– Potential habitat for the Grey Headed Flying-fox

12.12 The Powerful Owl *Ninox strenua* (See Figure 32)

The Powerful Owl is the largest of the forest owls and is a solitary species of wet sclerophyll forest, dry sclerophyll forest, woodland and riverine woodland (Debus, 2009). Roost and nest sites are usually found along gullies, where there is a dense cover of midstorey trees. The species is distributed from mid eastern coastal Queensland to western Victoria where it inhabits the area between the coast and Great Divide sometimes extending to the inland slopes. Pairs of Powerful Owls can be found remote from or with nesting sites in gullies beneath a leafy tree canopy to protect them from being mobbed by other birds.

However, they have large permanent home ranges up to 600 ha in coastal forest and up to 3000 ha in inland forest. Breeding occurs in autumn-winter and pairs breed solitarily. They feed on possums, gliders, other arboreal mammals, flying foxes and a range of birds.

In the context of this study the Powerful Owl occupies coastal forest and escarpment habitats (NSW DECC, 2006) and there is no seasonal variation in distribution. They also forage in urban areas from adjoining forested areas. The species is widespread throughout its range but its habitat is becoming fragmented due to urbanisation, mining, agriculture and other infrastructural developments. It is possible that the habitat of the Powerful Owl has suffered a decline varying between 25-50% since European settlement. The Powerful Owl occupies a range of forest and woodland types due to its extensive range in NSW. Habitat clearing and fragmentation, especially on the coastal lowlands and foothills, is listed as a threatening process to the Powerful Owl by NSW DEC (2006) because it decreases its foraging range and breeding habitat.

At a finer scale the higher quality foraging habitat for the Powerful Owl occurs along the riparian zone of Fry's Creek. This area also supports dense canopy and tall understorey vegetation providing roost sites for the Powerful Owl. Additional roost habitat for the Powerful Owl exists along the upper parts of several small drainage lines, and also the denser stands of mature *Allocasuarina torulosa* and *A. littoralis* trees on the upper slopes of Alum Mountain (Forest Fauna Surveys, 2011).

The subject site also supports large to very large tree hollows required by each of the large forest owls as nesting sites. The proposal for future development of the subject site will need to ensure persistence of riparian forest along the length of Fry's Creek as foraging and roosting habitat. Additionally, the subject site supports several very large mature habitat trees with hollows suitable for nesting. The proposal to develop parts of the subject site should aim to minimise the loss of habitat trees with very large tree hollows as potential nesting sites for the Powerful Owl.

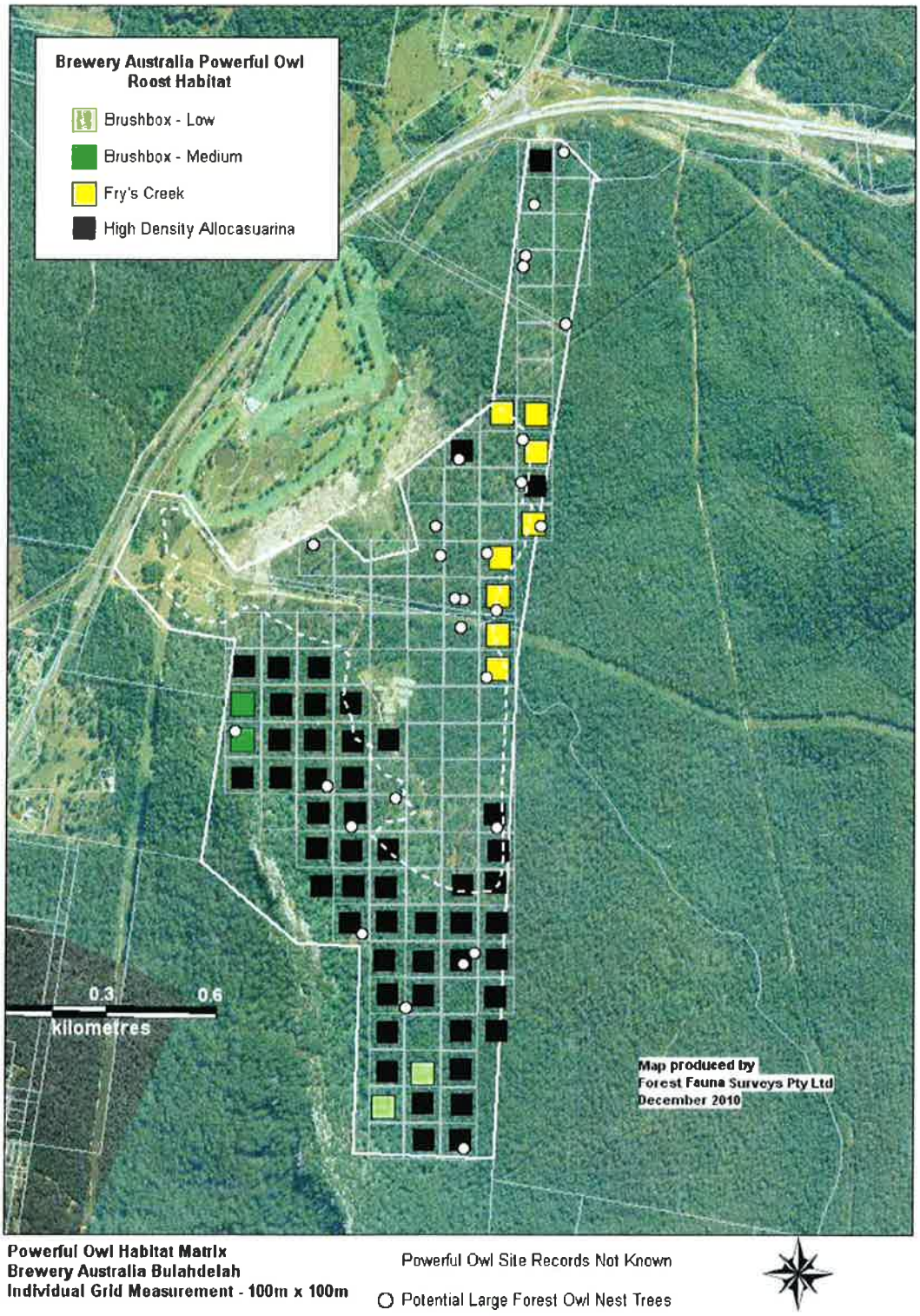

Figure 32– Potential habitat for the Powerful Owl

12.13 The Glossy Black-Cockatoo *Calyptorhynchus lathami* (See Figure 33)

The distribution of the Glossy Black Cockatoo is patchy between eastern Victoria and central Queensland on the coast and inland to the tablelands with a small population in the Riverina area of NSW. It is found in woodlands and forests in these areas where there is an abundance of *Allocasuarina littoralis* Black she-oak, *A. torulosa* Forest she-oak and *A. verticillata* Drooping she-oak. The birds extract the seeds from the casuarina cones for food and are dependant upon large eucalypts with hollows for breeding and raising young.

The species breeds in tree hollows or large limbs with hollows. It appears the birds have specific feed trees which are mature but sparsely foliaged and between 2-10 metres tall. Sometimes these trees may occur amongst dense undergrowth. Roosting is known to occur in the canopy of live leafy trees, usually eucalypts, which are located 30m from the hollow bearing tree. Their movements are poorly known (Higgins, 1999).

NSW DEC lists nine recovery actions for the species and those that apply to this property include the reduction of burning practices to promote the longevity of she-oak trees, protect existing and future hollow bearing trees, protect the areas where the she-oaks grow and establish corridors for movement.

The Glossy Black Cockatoo was recorded on the subject site during all of the investigations. Frequent sightings of the species during each of the fauna surveys suggest the Glossy Black Cockatoo either regularly visits parts of the subject site for foraging resources or is a permanent resident. The area of high quality foraging habitat for the Glossy Black Cockatoo occurs on the mid to upper slopes of Alum Mountain. Mature *Allocasuarina littoralis* and *A. torulosa* trees to a height of 15-20 metres occur in high density (>30 stems per hectare) in this area.

At a finer scale the lower lying parts of the subject site support more marginal foraging habitat, with stands of low density trees, or individual trees occurring at low height (i.e. 2-3 metres). The Glossy Black Cockatoo also utilises large to very large tree hollows for nesting. Potential nesting sites (large to very large tree hollows) are widespread across the subject site.

No evidence of breeding behaviour was noted during fauna investigations over the period 2007 to 2010, although several surveys coincided with known breeding period for the species. Analysis of habitat trees with large to very large size hollows indicate a total of 28 habitat trees could potentially provide nesting sites for the Glossy Black Cockatoo.

Potential development of the subject site may remove foraging and nesting resources for the species. To minimise the impact of proposed development on the local Glossy Black Cockatoo population, the retention of mature *Allocasuarina torulosa* and/ or *Allocasuarina littoralis* trees and also habitat trees with large to very large tree hollows as potential nesting sites, should ensure their continued persistence. Where mature feeding trees may be lost as a consequence of clearing for proposed development, opportunities to re-plant *Allocasuarina* sp. trees as a component of the landscaping may offset these losses. Sites for replanting should be situated in areas adjoining remnant forest / woodland, rather than isolated stands in areas of open space (Forest Fauna Surveys, 2011).

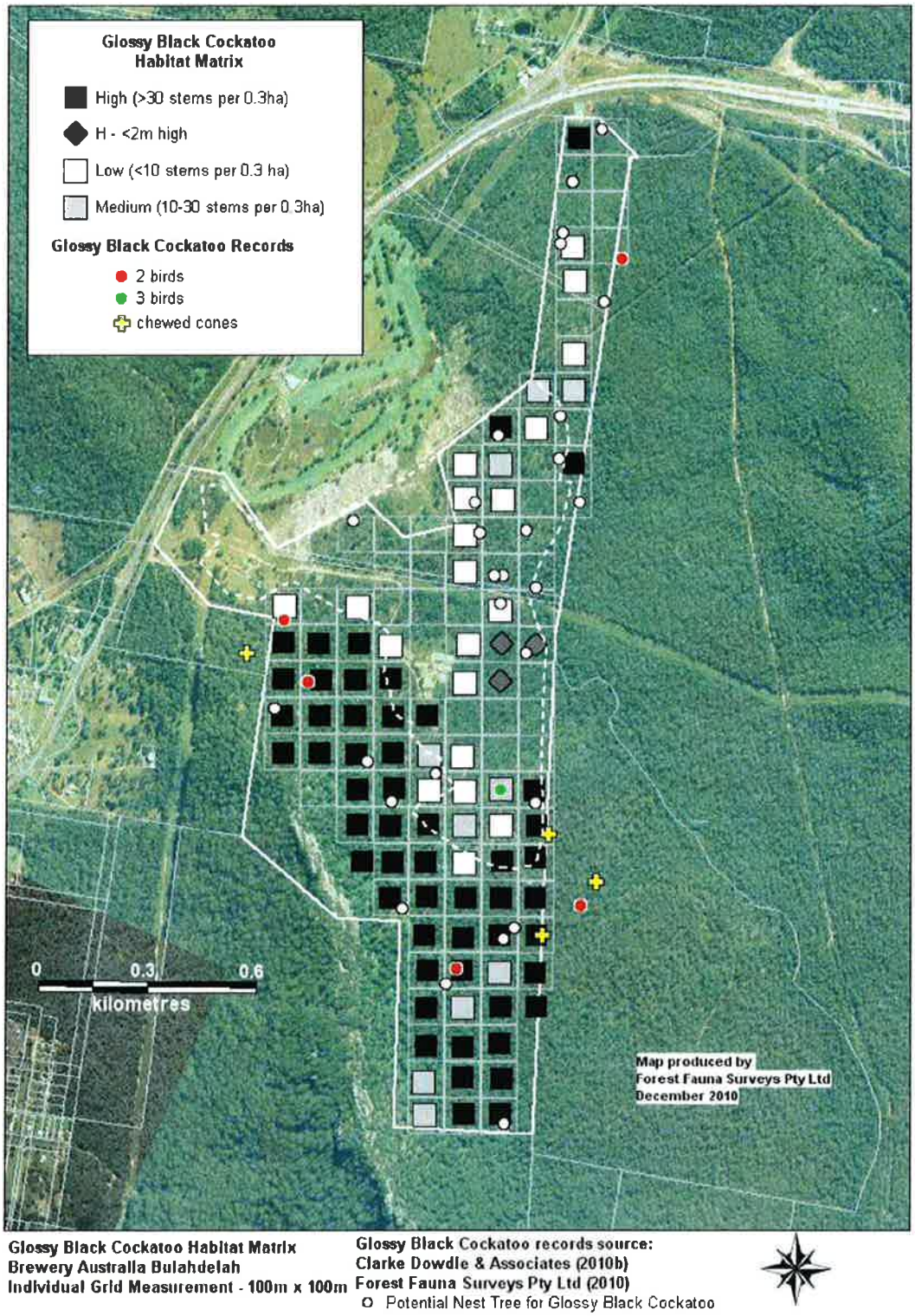

Figure 33– Potential habitat for the Glossy Black Cockatoo

12.14 Varied Sittella *Daphoenositta chrysoptera* (see Figure 34)

The Varied Sittella is often observed foraging for insects in small groups moving through forest and woodland and in their typical pattern on rough-barked tree trunks from the top downwards. They occur in eucalypt forest and woodland in all climatic zones and they usually inhabit areas which support rough-barked trees such as stringybarks, ironbarks, paperbarks and mulga. They have a preference for dry eucalypt forests and will roost on mature eucalypts with dead branches. They tend to be sedentary (Higgins and Peter, 2002).

However, Noske (1985) says the species is a communally breeding passerine, which throughout the year the group roosts together. They choose a dead branch and huddle together with all facing the same way. The outermost male positioned on the branch takes on a guard role whilst there is submissive behaviour on the part of the non-breeding male towards the breeding male. This suggests dominant relations are incorporated into their way of life.

The Varied Sittella would utilise the entire forested canopy on the subject site for foraging and this fact is supported by Forest Fauna Surveys (2011).

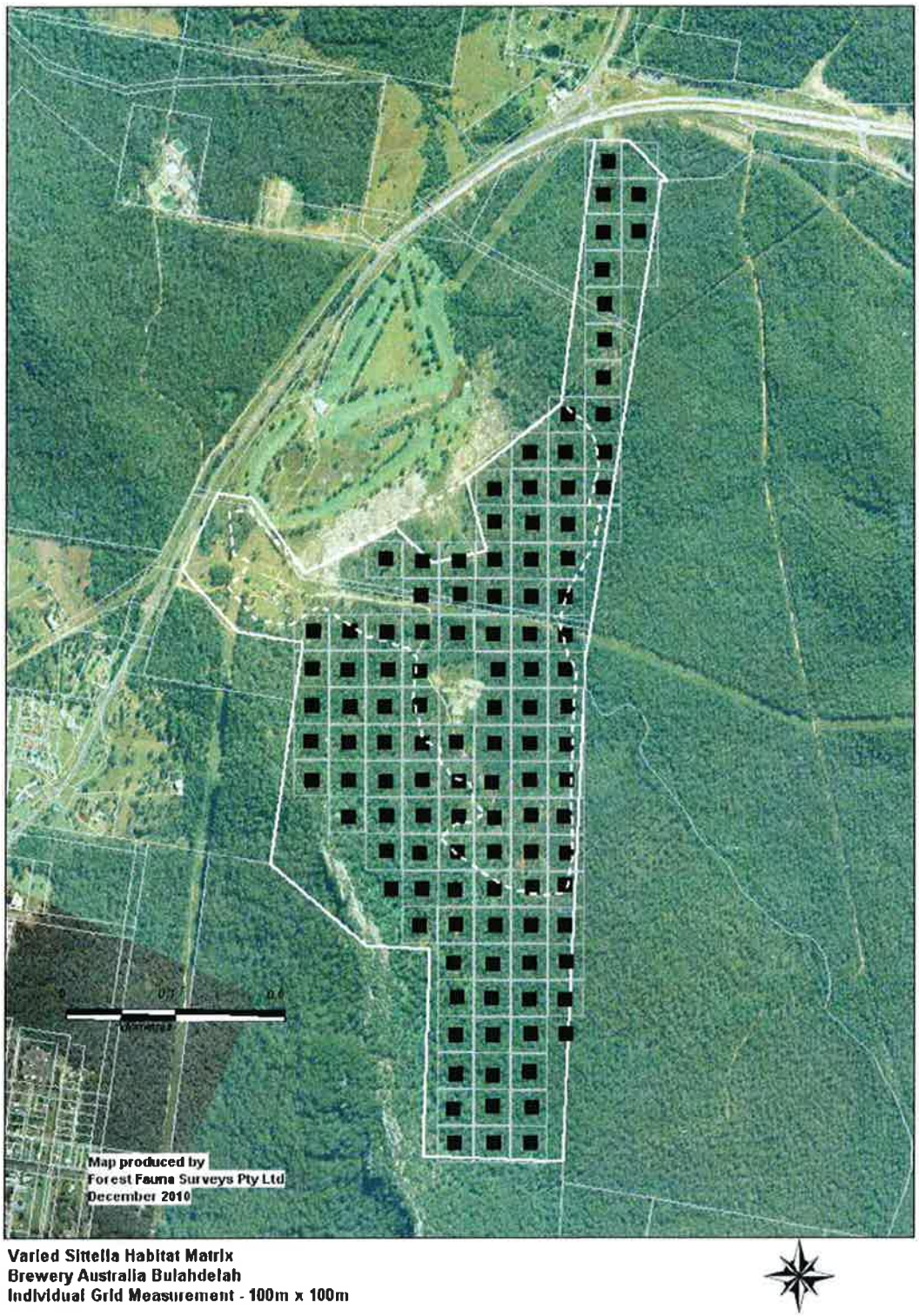

Figure 34– Potential habitat for the Varied Sittella and Varied Triller

12.15 Varied Triller *Lalage leucomela* (see also Figure 34)

The Varied Triller is rarely seen as it forages in foliage which makes it difficult to detect. Habitats include rainforests, eucalypt forests and woodlands as well as paperbark forests, watercourses and even urban gardens. The species could occur all through the subject site with a focus on Frys Creek and within the Woodland and Red Mahogany/Paperbark Swamp Sclerophyll Forest. During the survey the species was seen along by Frys Creek.

13.0 OTHER THREATENED FAUNA SPECIES LIKELY TO OCCUR

From an analysis of the wildlife atlas records dated July 2010 for the Great Lakes local government area these additional threatened species may occur on the subject site (Table 28). Table 29 lists those threatened species which have been recorded for the Great Lakes local government area but are unlikely to occur on the subject site. Sea birds and sea mammals have been excluded.

Table 28- Additional threatened fauna species that are likely to occur on the subject site

SPECIES	CATEGORY	RELEVANCE
Eastern Chestnut Mouse *Pseudomys gracilicaudatus*	schedule 2 of the TSC Act	No previous records. Could occur in group 2/1 & 2/2 vegetation.
Eastern Pigmy Possum *Cercartenus nanus*	schedule 2 of the TSC Act	Possibly present and would be revealed with long-term establishment of nest-boxes.
Spotted-tailed Quoll *Dasyurus maculates*	schedule 2 of the TSC Act; endangered EPBC Act.	Possibly present in all habitats.
Brush-tailed Phascogale *Phascogale tapoatafa*	schedule 2 of the TSC Act	Possibly present in all habitats.
Koala *Phascolarctos cinereus*	schedule 2 of the TSC Act	Possibly present in all habitats as a vagrant
Yellow-bellied Glider *Petaurus australis*	schedule 2 of the TSC Act	No previous records. Group 4 vegetation.
Long-nosed Potoroo *Potorous tridactylus*	schedule 2 of the TSC Act; Vulnerable EPBC Act	No previous records. Possibly present in all habitats.
Brush-tailed Rock Wallaby *Petrogale penicillata*	**schedule 1 of the TSC Act; Vulnerable EPBC Act**	**No previous records; Could occur on Alum Mountain;**
Golden-tipped Bat *Kerivoula papuensis*	schedule 2 of the TSC Act	Could occur along Frys Creek
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	schedule 2 of the TSC Act	Could occur in the vicinity of Alum Mountain where tall emergent hollow bearing trees occur.
Common Blossom-bat *Syconycteris australis*	schedule 2 of the TSC Act	Could possibly occur based on previous sighting at Hawks Nest north
Greater Broad-nosed Bat *Scoteanax rueppellii*	schedule 2 of the TSC Act	Could occur in forested areas.
Wallum Froglet *Crinia tinnula*	schedule 2 of the TSC Act	No previous records; Could occur in group 2/1 & 2/2 vegetation

(cont.)

SPECIES	CATEGORY	RELEVANCE
Broad-palmed Frog *Litoria brevipalmata*	schedule 2 of the TSC Act	Frys Creek and group 2/1 vegetation
Stephens Banded Snake *Hoplocephalus stephensii*	schedule 2 of the TSC Act	No previous records. Could occur in group 3 & 4 vegetation
Black-necked Stork *Ephippiorhynchus asiaticus*	schedule 1 of the TSC Act	One previous breeding record; Could occur in group 5, 2/1 & 2/2 vegetation
Bush-stone Curlew *Burhinus grallarius*	schedule 1 of the TSC Act	No previous records; prefers open grassland with shelter & cover nearby.
Magpie Goose *Anseranas semipalmata*	schedule 2 of the TSC Act	No previous records; Could occur in group 5 vegetation
Black Bittern *Ixobrychus flavicollis*	schedule 2 of the TSC Act	No previous records. Could occur in group 5 & 2/2 vegetation
Australasian Bittern *Botaurus poiciloptilus*	schedule 2 of the TSC Act	Could occur in group 5 & 2/2 vegetation
Little Eagle *Hieraaetus morphnoides*	schedule 2 of the TSC Act	No previous records. Could occur in groups 3 & 4 vegetation
Square-tailed Kite *Lophoictinia laura*	schedule 2 of the TSC Act	No previous records. Could occur in groups 3, 4 & 5 vegetation
Wompoo Fruit-dove *Ptilinopus magnificus*	schedule 2 of the TSC Act	No previous records. Could occur in group 5 vegetation
Rose-crowned Fruit- dove *Ptilinopus regina*	schedule 2 of the TSC Act	No previous records. Could occur in group 5 vegetation and just below Alum Mountain
Superb Fruit-Dove *Ptilinopus superbus*	schedule 2 of the TSC Act	Could occur in group 5 vegetation and just below Alum Mountain
Little Lorikeet *Glossopsitta pusilla*	schedule 2 of the TSC Act	No previous records. Could occur in any vegetation type
Turquoise Parrot *Neophema pulchella*	schedule 2 of the TSC Act	No previous records. May occur at vegetation edges
Swift Parrot *Lathamus discolor*	schedule 1 of the TSC Act	Could occur in group 2/1 & 2/2 vegetation
Grass Owl *Tyto capensis*	schedule 2 of the TSC Act	No previous records. May occur at vegetation edges and previous clearing near golf course
Masked Owl *Tyto novaehollandiae*	schedule 2 of the TSC Act	No previous records. Could occur in Group 3 vegetation
Barking Owl *Ninox connivens*	schedule 2 of the TSC Act	Could occur on Alum Mountain – foraging only
Sooty Owl *Tyto tenebricosa*	schedule 2 of the TSC Act	No previous records. Could roost on Alum Mountain and forage over remainder of site
Speckled Warbler *Pyrrholaemus saggitatus*	schedule 2 of the TSC Act	No previous records. Could occur on Alum Mountain.

(cont.)

SPECIES	CATEGORY	RELEVANCE
Black-chinned Honeyeater *Melithreptis gularis gularis*	schedule 2 of the TSC Act	No previous records. Could occur on with *E. fergusonii subsp. fergusonii.*
Regent Honeyeater *Xanthomyza phrygia*	schedule 1 of the TSC Act	Could occur in group 2/1 & 2/2 vegetation
White-fronted Chat *Epthianura albifrons*	schedule 2 of the TSC Act	According to previous landowner occurred on Alum Mountain
Scarlet Robin *Petroica boodang*	**schedule 2 of the TSC Act**	**No previous records. Could occur in groups 3, 4 & 5 vegetation**
Flame Robin *Petroica Phoenicia*	schedule 2 of the TSC Act	No previous records. Could occur in group 4 vegetation
Barred Cuckoo-shrike *Coracina lineata*	schedule 2 of the TSC Act	Possibly
Diamond Firetail *Stagonopleura guttata*	**schedule 2 of the TSC Act**	**No previous records. May occur at vegetation edges and previous clearing near golf course**
White-bellied Sea Eagle *Haliaeetus leucogaster*	migratory terrestrial of the EPBC Act	Tall trees for nesting required. All habitats.

* Those species highlighted in green are likely to occur but have not been recorded for the Great Lakes LGA.

Table 29- Threatened species recorded for the Great Lakes LGA but not considered relevant to the subject site

SPECIES	CATEGORY	NON-RELEVANCE
Stuttering Frog *Mixophyes balbus*	schedule 1 of the TSC Act	Prefers rainforest and wet sclerophyll forest
Giant Barred Frog *Mixophyes iteratus*	schedule 1 of the TSC Act	Prefers rainforest and wet sclerophyll forest
Davies Tree Frog *Litoria daviesae*	schedule 2 of the TSC Act	Montane species occurring >400m elevation
Green & Golden Bell Frog *Litoria aurea*	schedule 1 of the TSC Act	Prefers permanent water, swamps and lagoons. Not found during surveys.
Emu *Dromaius novaehollandiae*	Endangered population	Habitat present but not sighted.
Blue-billed Duck *Oxyura australis*	schedule 2 of the TSC Act	Prefers open water and freshwater swamps.
Spotted Harrier *Circus assimilis*	schedule 2 of the TSC Act	Prefers open farmland, swamps and wetlands
Red Goshawk *Erythrotriorchis radiatus*	schedule 2 of the TSC Act	Unlikely mainly found further north
Osprey *Pandion haliaetus*	schedule 2 of the TSC Act	Requires estuaries and oceans
Comb-crested Jacana *Irediparra gallinacea*	schedule 2 of the TSC Act	Unlikely requires vegetated wetlands
Rufous Scrub-bird *Atrichornis rufescens*	schedule 2 of the TSC Act	Unlikely near temperate rainforest

(cont.)

SPECIES	CATEGORY	NON-RELEVANCE
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	schedule 2 of the TSC Act	Unlikely prefers drier woodlands
Olive Whistler *Pachycephala olivacea*	Schedule 2 of the TSC Act	Prefers wet forests >500m
Hooded Robin *Melanodryas cucullata*	schedule 2 of the TSC Act	Prefers drier habitats
Red-legged Pademelon *Thylogale stigmatica*	schedule 2 of the TSC Act	Prefers rainforest

13.1 Eastern Chestnut Mouse *Pseudomys gracilicaudatus* (See Figure 35)

The Eastern Chestnut Mouse *Pseudomys gracilicaudatus* was studied by Luo, Fox and Jeffreys (1994) and Luo and Fox (1994). Diet was examined by these authors to determine its dietary composition and from 200 faecal pellet samples it was found that the diet consisted of fungi (20%), insects (10%), seed, leaf and stem (between August and February). The diet varied significantly between the seasons and in different successional stages of vegetation. These findings indicate that the species is a generalist herbivore which forages opportunitisically and therefore it maximises its diet diversity.

The habitat where the species has been captured tends to be wet heath and shrubland where the range of dietary resources is found. It is likely to occur in the Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland and *Red Mahogany/Paperbark Swamp Sclerophyll Forest*.

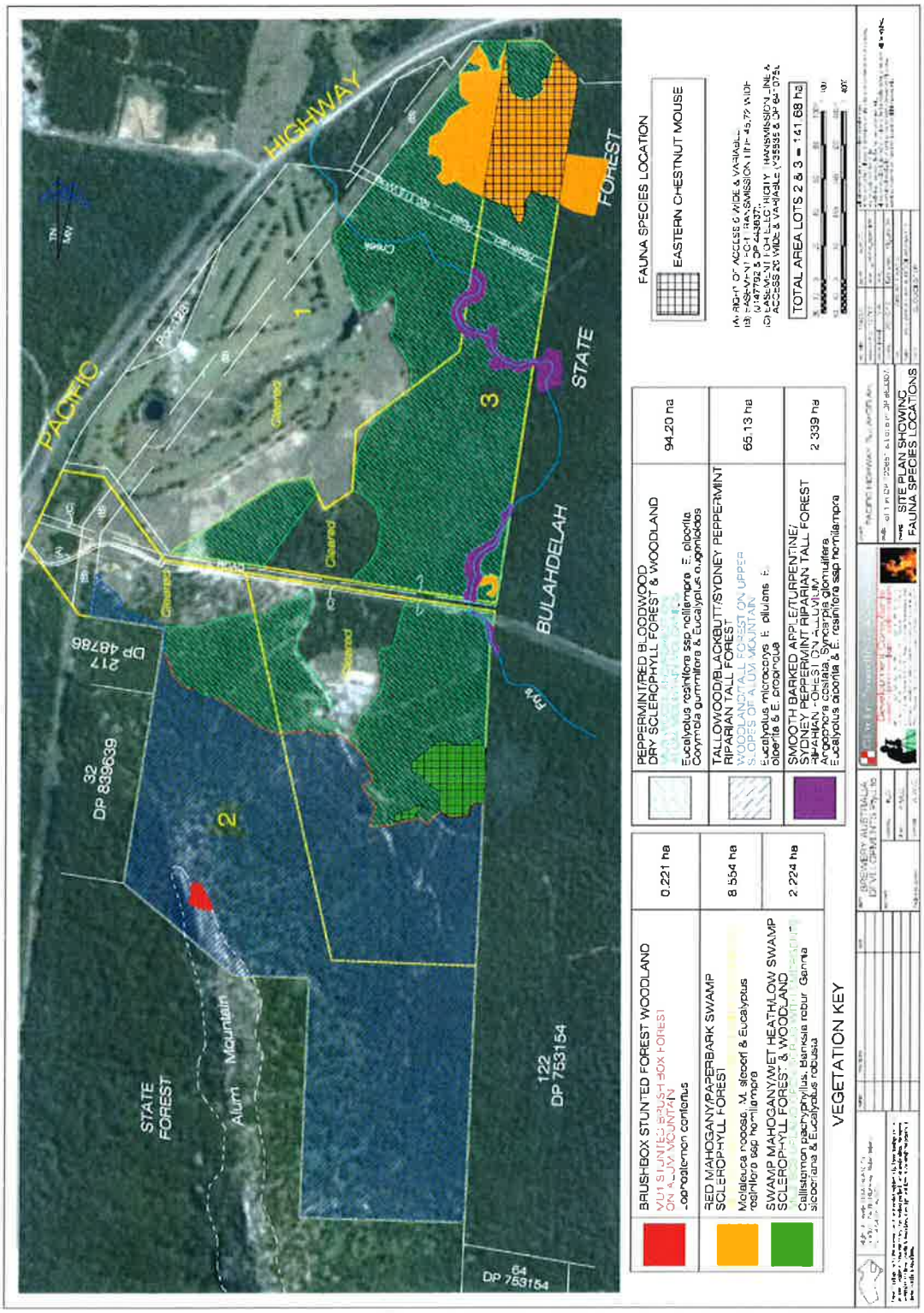

Figure 35– Potential habitat for the Eastern Chestnut Mouse

13.2 Eastern Pigmy Possum *Cercartetus nanus* (See Figure 36)

From surveys in Brisbane Water National Park over successive years (Payne, 2009; 2010) the Eastern Pigmy Possum has been found to gradually colonise nest boxes that have been installed in various habitats. The main habitat that it appears to prefer is low shrubland dominated by a mixture of winter flowering Banksia spp. such as *B. spinulosa, B. oblongifolia* and *B. robur*. Nesting material which is required for warmth and has been examined from within the nest boxes is *Leptospermum polygalifolium* and *Petrophile pulchela* and more lately leaves of *Eucalypt spp*.

Forest Fauna Surveys (2011) also states that within the subject site the extent of potential habitat for the Eastern Pygmy Possum is quite extensive but the highest quality habitat is considered to occur in the low lying parts where there is more abundant pollen and nectar, particularly from post fire Myrtaceae and Proteaceae species such as *Banksia spinulosa* and *B. oblongifolia* occur. This area also has quite abundant tree hollows that may be utilised by the species. Also, the upper slopes of the subject site support abundant arboreal *Xanthorrhoea malacophylla* (Appendix 2 image BULST2US3) which may provide foraging and nesting sites for the species.

This species is likely to be found in a number of habitats within the property being Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland, Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland, Red Mahogany/Sydney Peppermint/Red Bloodwood Dry Sclerophyll Forest and Woodland and Tallowwood/Blackbutt/Sydney Peppermint Riparian Tall Forest. Two of the vegetation communities support pockets of winter flowering Banksia and the third supports pockets of grasstrees.

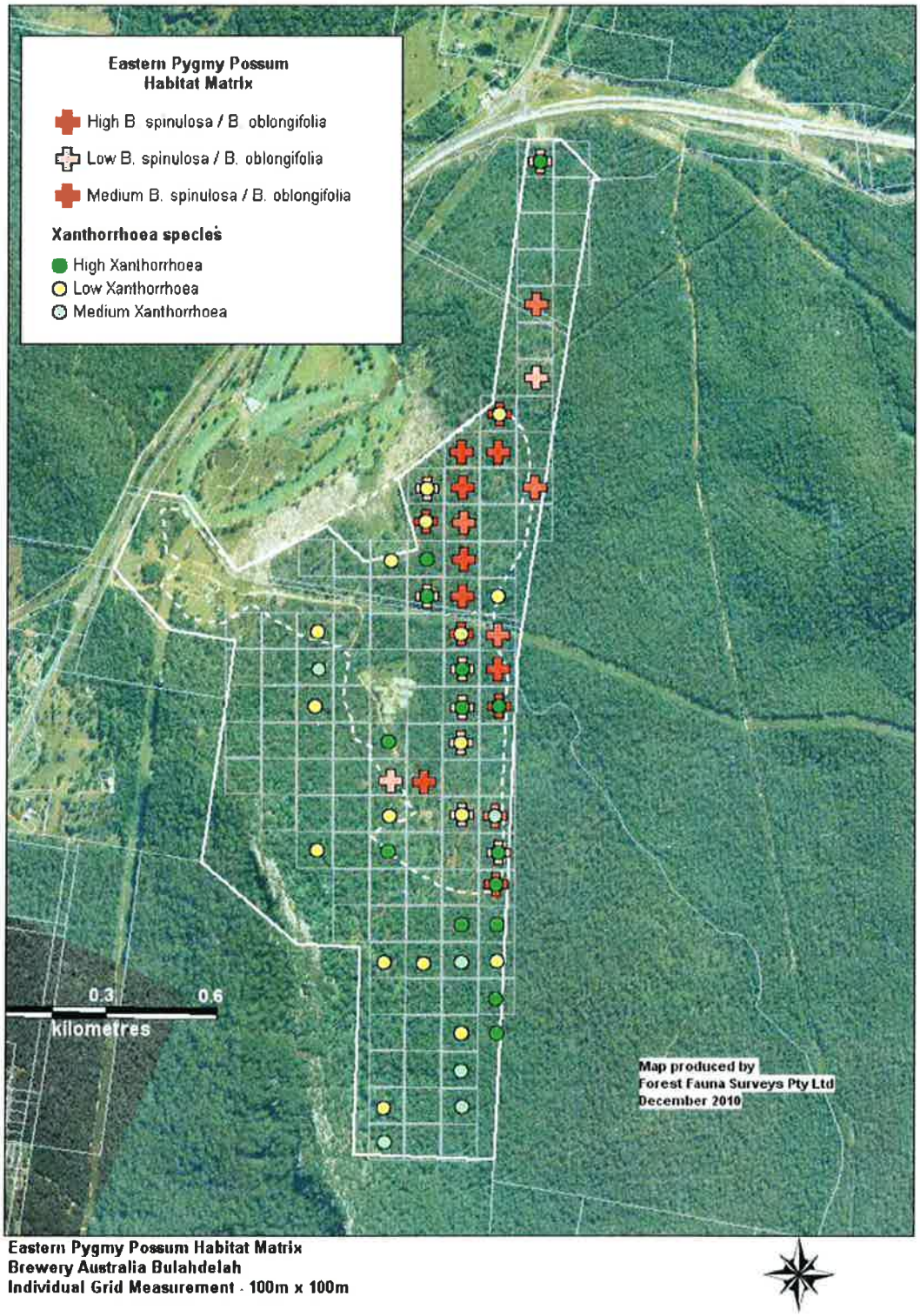

Figure 36– Potential habitat for the Eastern Pigmy Possum

13.3 Spotted-tailed Quoll *Dasyurus maculatus* (See Figure 37)

The Spotted-tailed Quoll is listed as vulnerable in New South Wales and endangered at the Commonwealth level. Quolls are difficult to capture in traps and one of the best methods to determine their presence is evidence of scats at latrine sites. Although no such sites were determined to be present during this study, Dawson (2005) studied this species over a three year period in Kosciuszko National Park. Ninety latrine sites were found and they were located throughout all parts of the topographical range, particularly amongst rocky outcrops and rocky sections of riparian habitat. Hair analysis of scats samples revealed that the Spotted-tailed Quoll had a varied diet. Twenty-two species of mammals were determined from the analysis of their scats and the most common category were medium sized mammals, followed by small mammals, large mammals (perhaps carrion), and non-mammalian prey such as birds, reptiles, insects and plants. Brush-tailed Possums in particular were the most important single prey item by both frequency of occurrence and percentage biomass in all years followed by rabbits, hares, bush rats and swamp wallabies. A Recovery Plan is being prepared for this species.

The Spotted-tail Quoll forages widely, with males known to occupy a home range of >60 hectares and within the subject site, it is considered likely the species would forage over the entire extent of remnant forest. Additionally, the presence of large ground logs in parts, plus the number of habitat trees with larger hollows that could be utilised by the quoll, suggests the majority of the subject site is suitable. The species may also utilise the caves and rock outcrops on the summit of Mt Alum for sheltering sites and foraging areas.

It is predicted that this species could occur opportunistically throughout all habitats.

Figure 37– Potential habitat for the Spotted Tailed Quoll

13.4 Brush-tailed Phascogale *Phascogale tapoatafa* (See Figure 38)

The Brush-tailed Phascogale is also a species which is seldom seen in the forest during spotlight surveys and it is seldom trapped. Although it has a coastal patchy distribution, its main areas are the north-east and south-east of New South Wales within forested habitats on the Great Dividing Range. The preferred habitat for this species is dry sclerophyll open forest with a sparse ground cover of herbs, grasses, shrubs or leaf litter, but they may also inhabit heathland, swamps, rainforest and wet sclerophyll forest. At a finer scale, the Brush-tailed Phascogale is an agile climber and is often observed hanging down from overhead branches. Preferentially they prefer rough-barked trees with a DBH of 21-171cms (mean 80cms) (Van der Ree et. al., 2005) and utilise many hollows throughout their home range. The species is nocturnal and carnivorous and feeds on insects such as spiders, centipedes, beetles and cockroaches, nectar and small vertebrates (Scarf et. al., 1998).

Tree hollows are used for shelter and nesting sites and in particular the species uses many different hollows. The hollows are lined with leaves, bark and pungent faeces.

It is likely that this species could occur anywhere on the property although it has not turned up in trapping activity. NSW DECC (1999) states that the threat to this species are loss and fragmentation of habitat through clearing, loss of hollow bearing trees suitable for nesting and predation by foxes and cats.

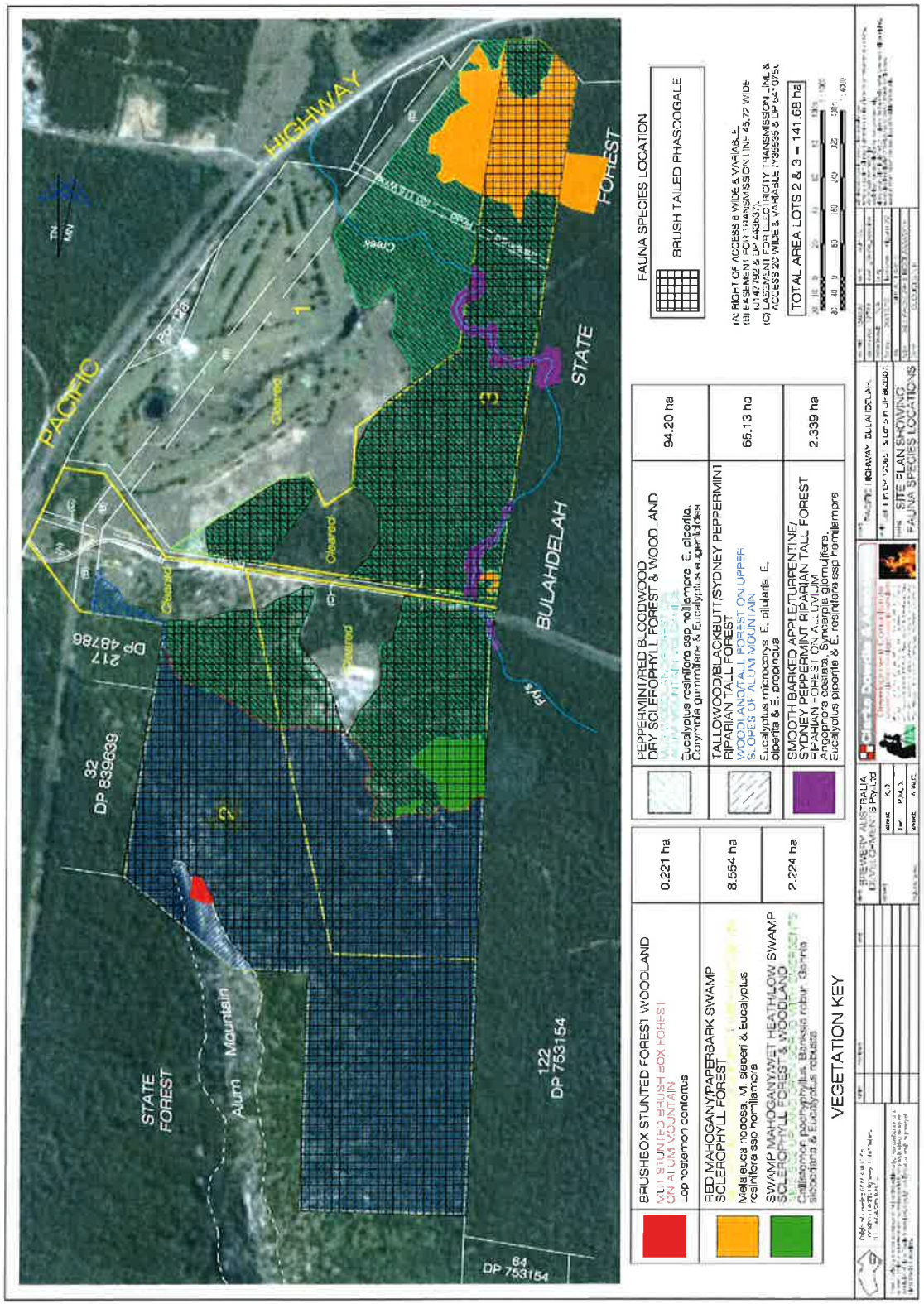

Figure 38– Potential habitat for the Brush-tailed Phascogale

13.5 Yellow-bellied Glider *Petaurus australis* (See Figure 39)

The Yellow-bellied Glider was not recorded on the property during the many nocturnal surveys that were carried out. This species also has a patchy distribution in a wide range of forest habitats throughout eastern Australia. The species is commonly found in Tall Open Forests where the forest canopy comprises old growth trees containing large hollows and other eucalypts that are used to provide them with a diversity of food resources. Specifically they require specialist food resources such as nectar and pollen from winter flowering eucalypts, trees that will provide phloem and those with shredding bark to gather insects. Honeydew and manna gum is also eaten.

Although no sap site trees were found during the survey, they could be present. Particularly on *Eucalyptus propinqua* the Small-fruited Grey Gum and the few remaining trees of Sydney Blue Gum *Eucalyptus saligna* that on the upper slopes of the property (see Photo 7).

Photo 7 Example of Yellow-bellied sapsite tree – *Eucalyptus maculata* Spotted Gum- showing V shaped scars from where phloem is extracted.

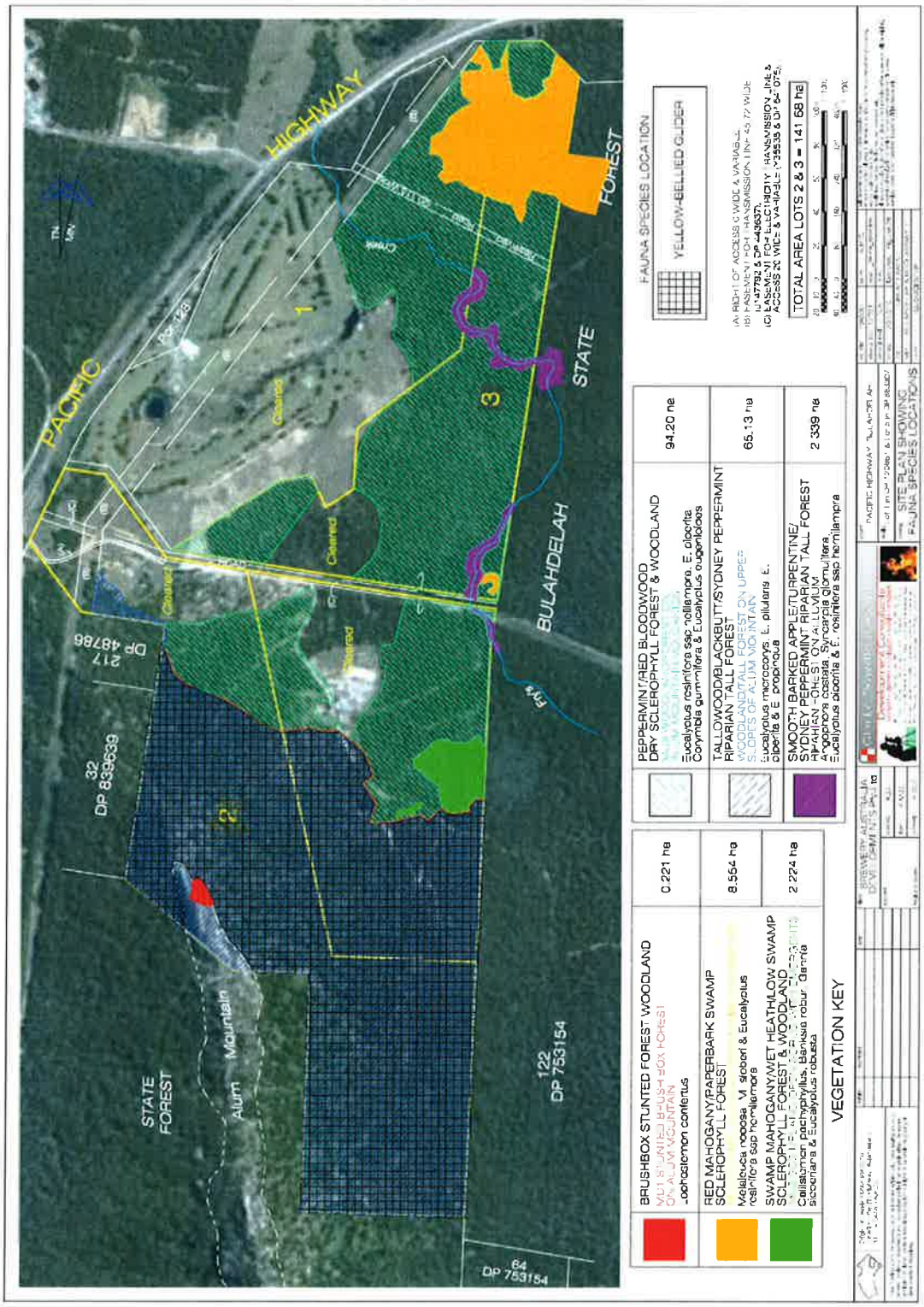

Figure 39– Potential Habitat for the Yellow Bellied Glider

13.6 Long-nosed Potoroo *Potorous tridactylus* (see Figure 40)

The Long-nosed Potoroo is listed as vulnerable at the State and Commonwealth level. Potoroos are seldom trapped although it is known to be widespread through a number of habitats ranging from rainforest and wet sclerophyll forest to heathland. Whilst this is the case its preferential habitat is related to micro-habitat factors (Bennet 2003). Research in Victoria found that this species occurred in dense vegetation within the ground and shrub strata, but was not clearly associated with any floristic group or structural characteristic of the vegetation. For example, the dense vegetation cover provided shelter and protection from predators, but the food resources where found in the adjoining more open areas. Thus the Long-nosed Potoroo prefers to use of vegetation mosaics and ecotones that allows it to move, shelter and feed between contrasting habitats.

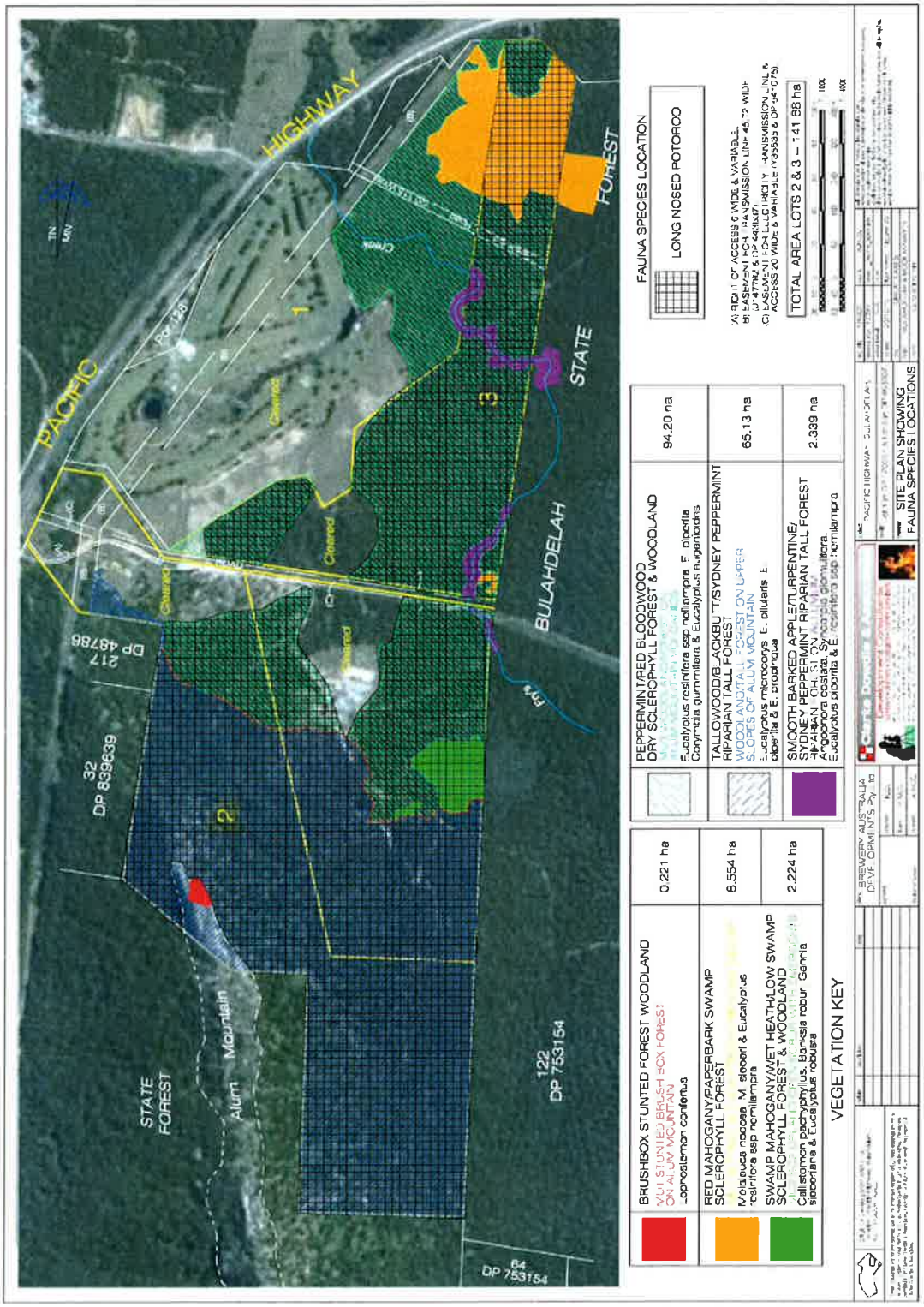

Figure 40– Potential habitat for the Long-nosed Potoroo

Figure 41– Potential habitat for the Brush-tailed Rock Wallaby

13.8 Koala

The Koala has already been addressed in Section 8.0 and maps have been included (Forest Fauna Surveys, 2011). However, there is one outstanding issue which is the Grey Gum species. During the botanical surveys (Clarke Dowdle & Associates, 2011a) the Grey Gums inspected were *Eucalyptus propinqua* the Small-fruited Grey Gum. Forest Fauna Surveys (2011) have mapped the Grey Gum as *Eucalyptus punctata* (Figure 12). The situation needs further clarification as the former species is not listed under SEPP 44 but the latter species is.

13.9 Golden-tipped Bat *Kerivoula papuensis* (See Figure 42)

The Golden-tipped Bat has been recorded in a narrow band in coastal areas and the sub-coastal slopes and ranges from Cape York Peninsula in Queensland south to the New South Wales/ Victorian border. The species is regarded as rare in the National context, although it is not listed on the Commonwealth EPBC Act 1999 (Woodside *et al.* 2008).

Moist closed lowland forests at altitudes of 50 to 150 m (ASL) appear to provide the most favoured habitat type for this species. The majority of captures of the Golden-tipped Bat have been made in coastal forests, near to where wet and dry forest ecotones occur, and often in the vicinity or over creeks. The species is known to occur in areas where dense or tangled vegetation is present, and along creeks, suggesting that the flight habits are suited to foraging in dense vegetation and in ecotonal habitats (Woodside *et al.* 2008).

Rarely travelling more than two kilometres, this species feeds by gleaning, flying slowly in dense vegetation, and hovering to collect insects and spiders from vegetation or out of webs while on the wing. Spiders constitute a high proportion of the diet (Woodside *et al.* 2008). Golden-tipped bats have been located roosting in the base of abandoned yellow-throated scrubwren and brown gerygone nests. These are dome-shaped nests made of bark fibre, moss and lichen and hang from vines and twigs and an entry hole in the base is made by the bat rather than using the bird entrance. This species has also been found to roost in tree hollows, foliage and the roofs of buildings (Churchill, 2008).

In NSW this species gives birth in late November to December and lactating continues until January. Maternity roosts of up to ten females have been recorded in hanging bird nests (Woodside *et al.* 2008) and a breeding colony of up to twenty females has been reported in a rainforest canopy tree hollow (Churchill 2008).

The golden-tipped bat has been recorded within the locality in moist forests to the north-west of the study area. Within the study area, potential roost sites may occur within the dense riparian vegetation of Fry's Creek however few, if any, hanging yellow-throated scrub-wren nest were noted during field work for previous surveys (Robert Payne, Ecological Surveys and Management, pers. comm.).

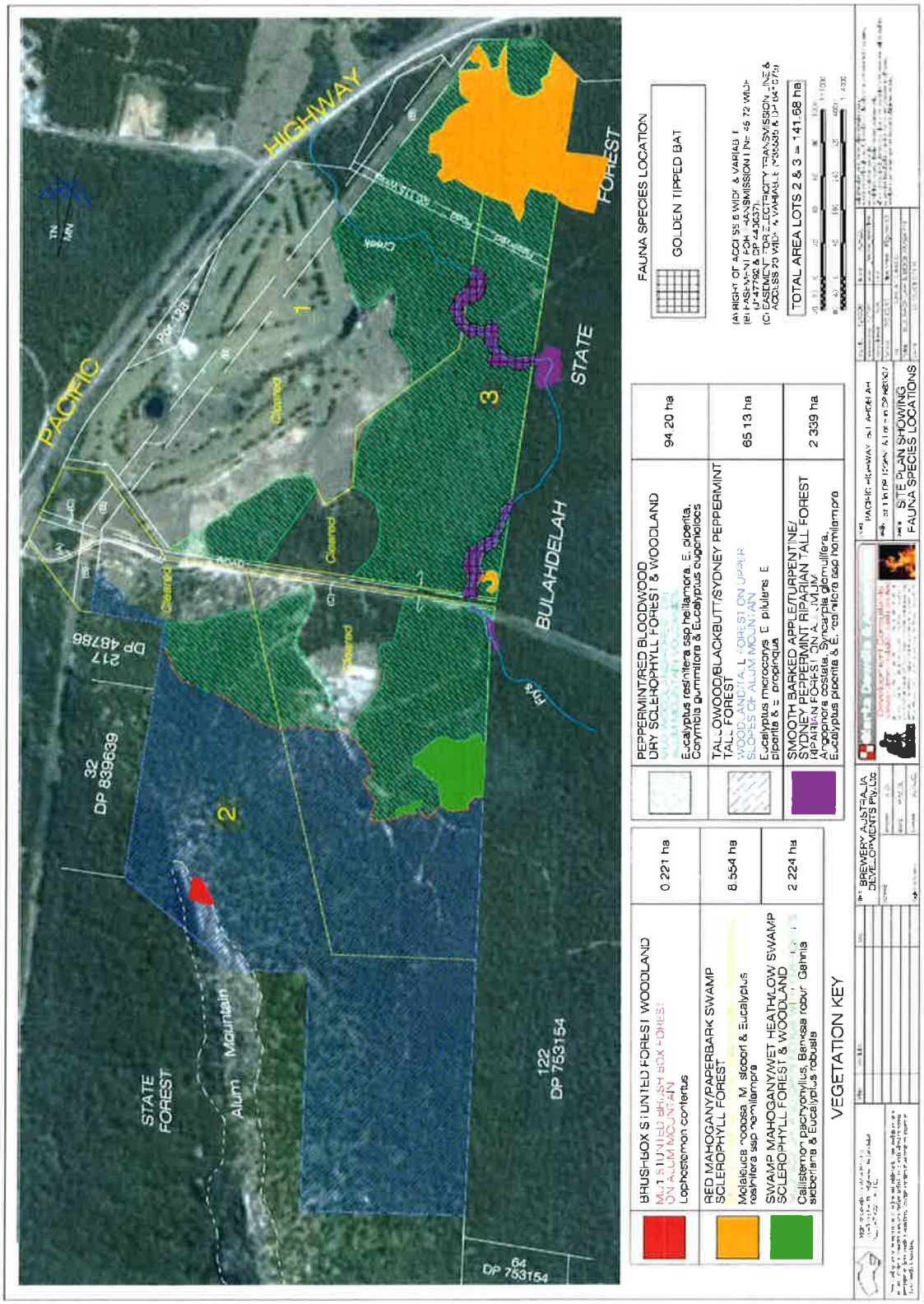

Figure 42– Potential habitat for the Golden-tipped Bat

13.10 Eastern False Pipistrelle *Falsistrellus tasmaniensis* (See Figure 43)

This species is distributed along the coast and ranges of eastern Australia from about Portland in Victoria to Gympie in southern Queensland and Tasmania (Churchill 2008).

The Eastern False Pipistrelle appears to be less common at low altitudes within its distribution, and tends to favour moist forests of the ranges. The species occurs predominantly in forested areas with higher rainfall where it occupies tree hollows often in the trunk of tall live trees for specific roosting requirements (Law *et al.* 2008). Individuals may also be found in caves and abandoned buildings (Churchill 2008). Little is known of the species biology, except that large groups consisting mainly of one sex have been observed suggesting sexual segregation, particularly in the breeding season. Young are born in December and lactation continues into February (Churchill 2008). This species has been recorded to forage up to 12km from its roost site and is known to feed on various invertebrates, particularly moths and beetles, with ants, bugs and flies also consumed (Churchill 2008).

No records could be found for the Eastern False Pipistrelle within the study locality however, although records for coastal areas are less common, this species could occur in the vicinity of Alum Mountain where tall emergent hollow bearing trees occur.

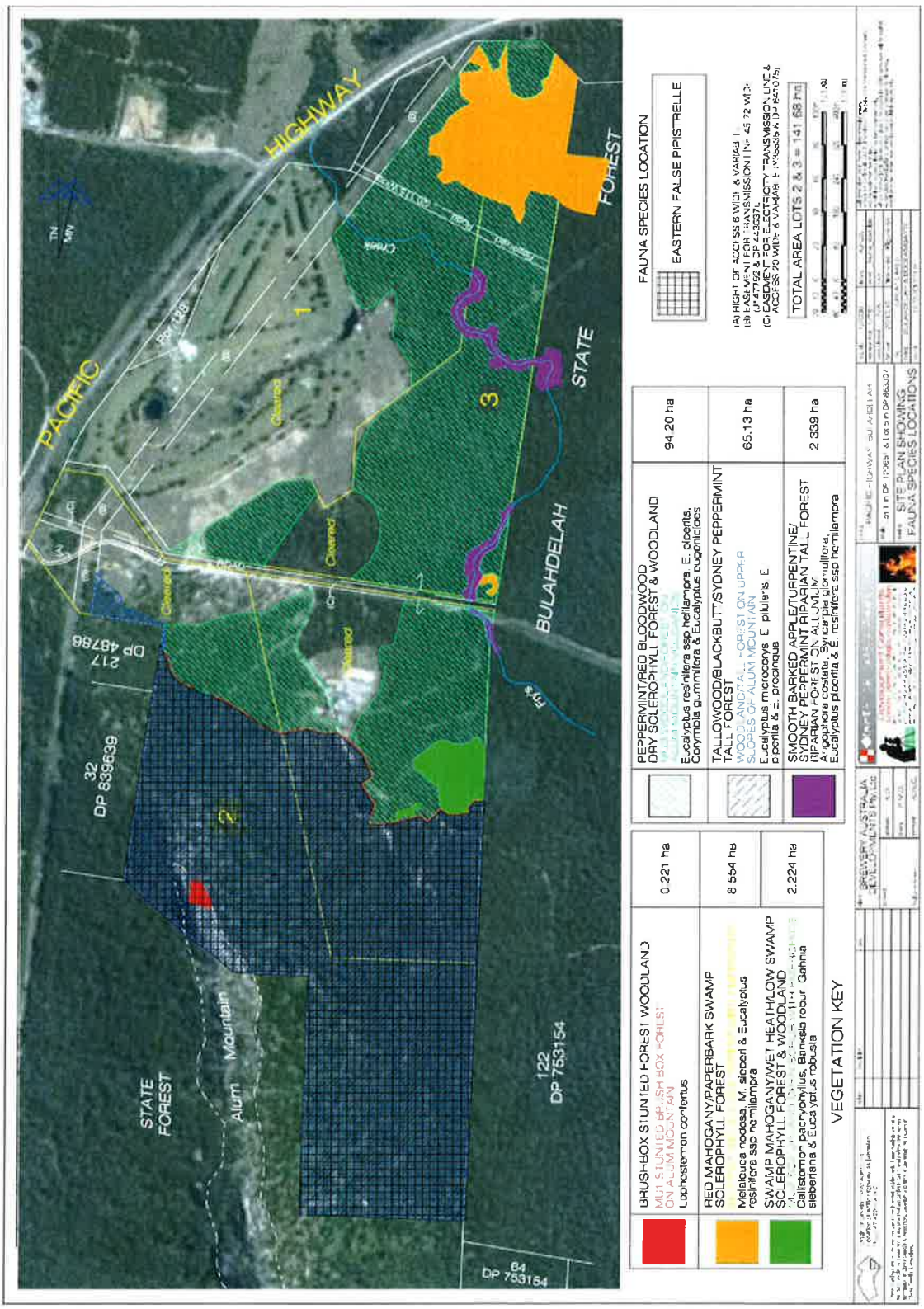

Figure 43– Potential habitat for the Eastern False Pipistrelle

13.11 Greater Broad-nosed Bat *Scoteanax rueppellii* (See Figure 44)

This species is most common in the gullies and river systems draining the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland in tropical Queensland, but it extends to the coast over much of its range (Hoye & Richards 2008). It is regarded as sparse in abundance (Hoye & Richards 2008) but may prove to be more widespread than currently indicated (Parnaby 1992).

This species has been recorded in a variety of habitat types including rainforest, moist and dry eucalypt forest and woodland. Favoured foraging areas for this species appear to be tree-lined creeks and the junction of woodland and cleared paddocks (Churchill 2008). Large emergent trees with hollows, including dead trees and isolated paddock trees, are known to be used as roost sites (Law *et al.* 2000).

The Greater Broad-nosed Bat feeds on moths, beetles and other large slow-flying insects and is also known to prey on bats captured in the same trap. A low, slow-flying species which utilises a large foraging area, the open nature of eucalypt woodland suits its direct flight pattern. Within denser vegetation types, use is made of natural and man-made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 2008).

The reproductive cycle is poorly known, but it has been reported that a single young is produced in January and prior to birth, females congregate at maternity sites, which are located in suitable trees. Males are excluded during birth and rearing of the young (Hoye & Richards 2008).

Only one record of this species could be found within the locality, with an individual recorded by ultrasonic call analysis in March 2001 for the Bulahdelah By-pass studies (Parsons Brinckerhoff 2004).

Figure 44– Potential habitat for the Greater Broad-nosed Bat.

13.12 Common Blossom Bat *Syconysteris australis* (See Figure 45)

If the Common Blossom Bat occurs it would be at its southern limit of distribution at Bulahdelah. The Eastern Blossom Bat also has a coastal distribution between Cape York and Myall Lakes. It can be found in a range of coastal habitats and is often seen roosting in rainforest and Melaleuca Forest. Feeding habitat includes coastal heath and paperbark forests, particularly Banksia and Melaleuca species.

The species could occur north of Frys Creek in Red Mahogany/Paperbark Swamp Sclerophyll Forest and Swamp Mahogany Wet Heath Low Swamp Sclerophyll Forest and Woodland.

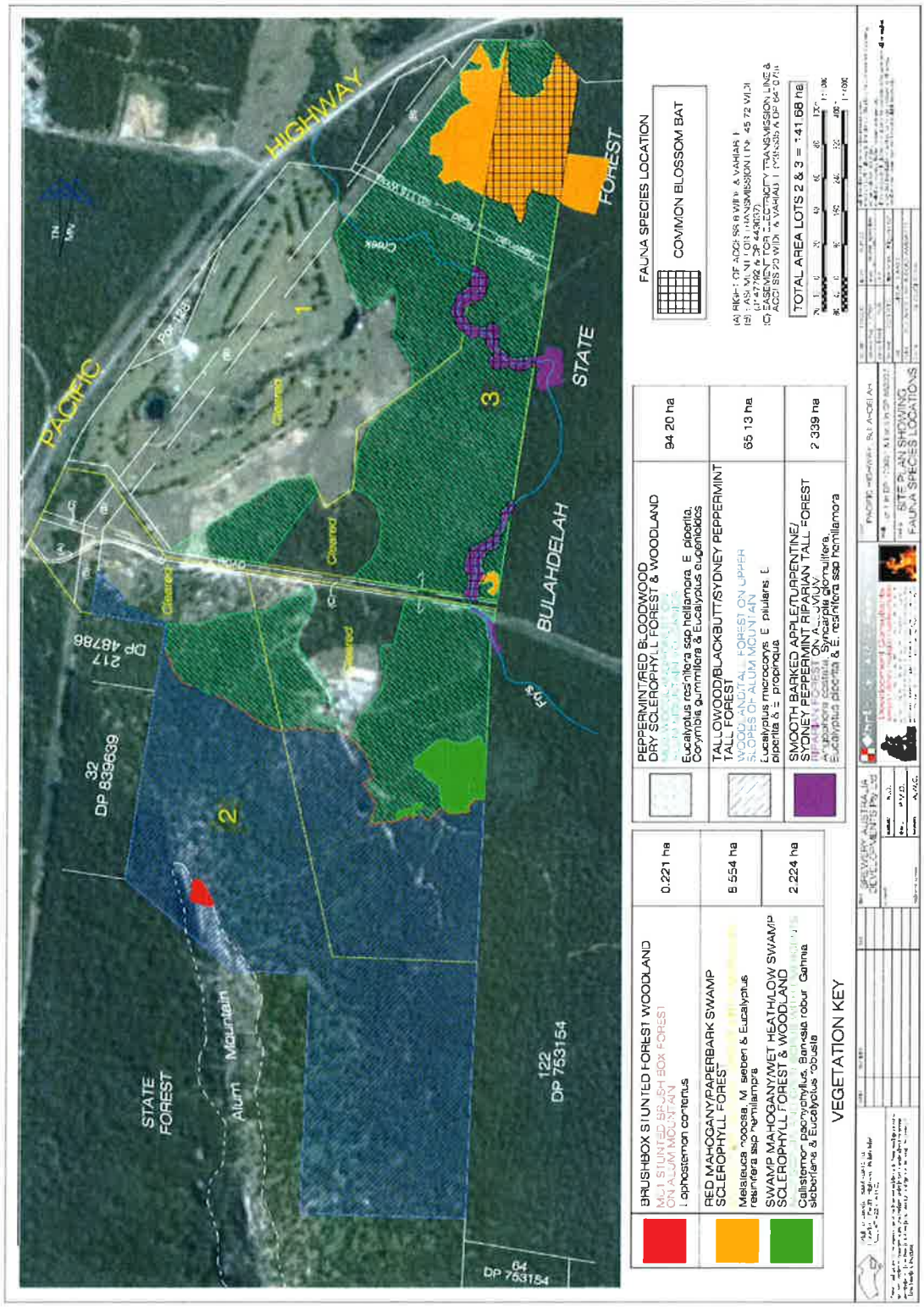

Figure 45– Potential habitat for the Common Blossom Bat.

13.13 Wallum Froglet Crinia tinnula (See Figure 46)

The Wallum Froglet is found along drainage lines in coastal wet heath, acid paperbark swamps and sedge swamps in areas of sandy soil. Whilst surveys did not record the species it could occur north of Frys Creek in Red Mahogany/Paperbark Swamp Sclerophyll Forest. Quite often it is also found in disturbed habitats and it can be detected after rain, calling from the base of sedgelands in shallow water. Eggs are also laid in shallow water and often tannin-stained (Meyer, et. al., 2006).