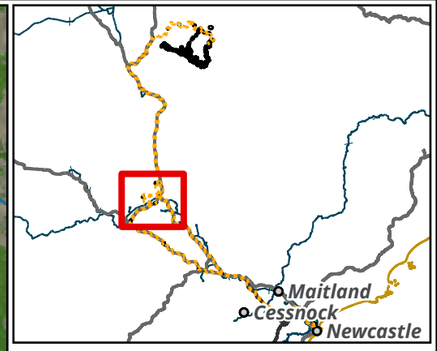
APPENDIX F.4 UPDATED BDAR



Legend

Infrastructure footprint

Landscape assessment buffer (study area)

Patch size

Patch size >=100ha (1194 DNG; 1194 High; 1691 Low; 1194 Low; 1194 Moderate; 1604 Low; 433 Low; 433 Moderate; 434 Low; 486 DNG; 486 High; 486 Low; 486 Moderate; 490 High; 490 Low; 490 Moderate; 492 DNG; 492 High; 492 Low; 492 Moderate; 507 Moderate; 526 High; 526 Moderate; 540 DNG; 540 High; 540 Low; 540 Moderate; 541 DNG; 541 High; 541 Low; 541 Moderate; 586 Low; 599 High; 599 Low; 599 Moderate; 931 High; 931 Low; 931 Moderate; 934 DNG; 934 High; 934 Low; 934 Moderate; 954 High)

Figure 8 Patch size locations, Page 2

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 25 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
Layout: 34963_F8_PatchSize
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_AM.aprx

Acknowledgements: Basemap © Land and Property Information 2016, Imagery © Earthstar Geographics

Legend

- Infrastructure footprint
- Landscape assessment buffer (study area)

Patch size

- Patch size >=100ha (1194 DNG; 1194 High; 1691 Low; 1194 Low; 1194 Moderate; 1604 Low; 433 Low; 433 Moderate; 434 Low; 486 DNG; 486 High; 486 Low; 486 Moderate; 490 High; 490 Low; 490 Moderate; 492 DNG; 492 High; 492 Low; 492 Moderate; 507 Moderate; 526 High; 526 Moderate; 540 DNG; 540 High; 540 Low; 540 Moderate; 541 DNG; 541 High; 541 Low; 541 Moderate; 586 Low; 599 High; 599 Low; 599 Moderate; 931 High; 931 Low; 931 Moderate; 934 DNG; 934 High; 934 Low; 934 Moderate; 954 High)

Figure 8 Patch size locations, Page 3

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

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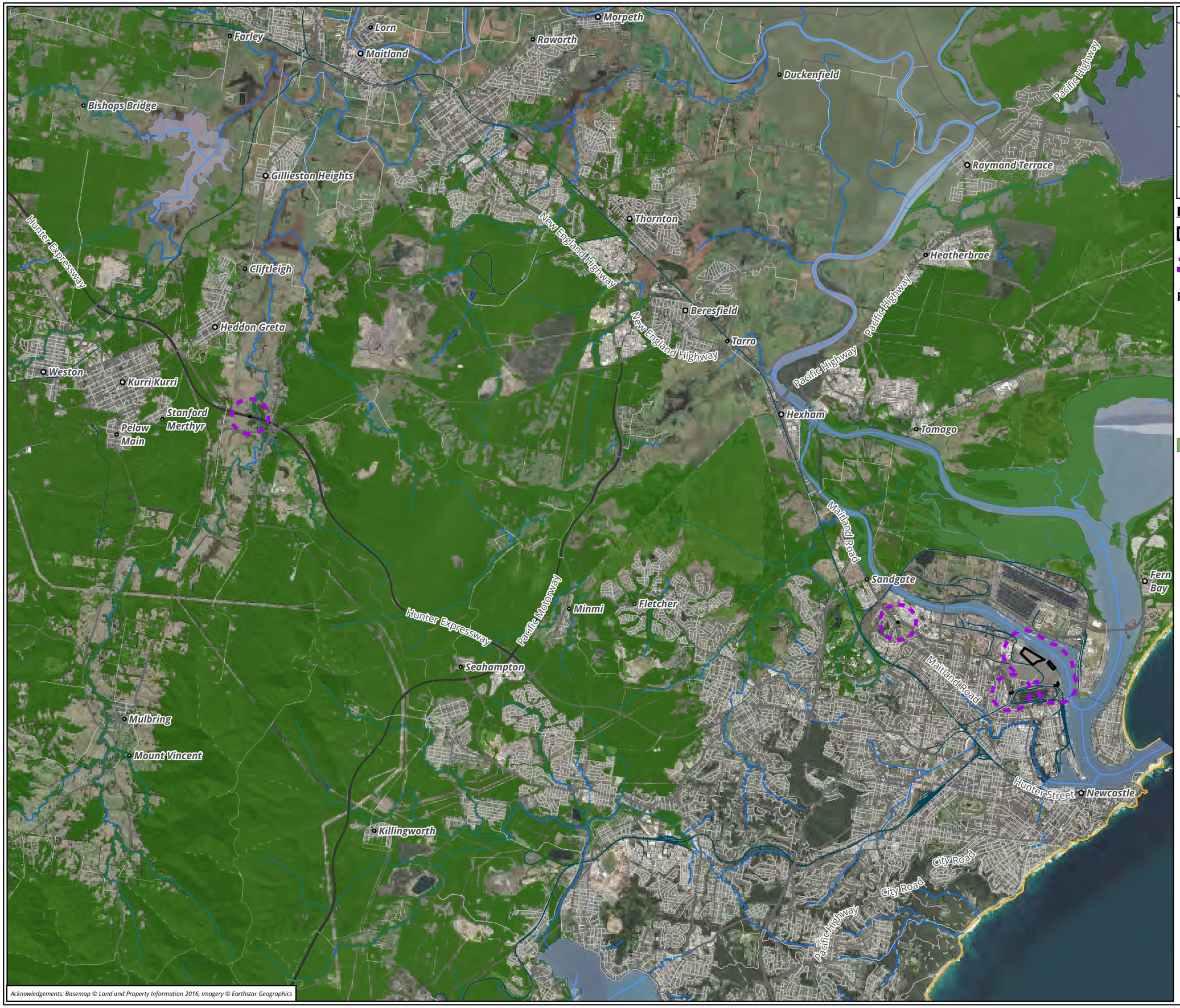

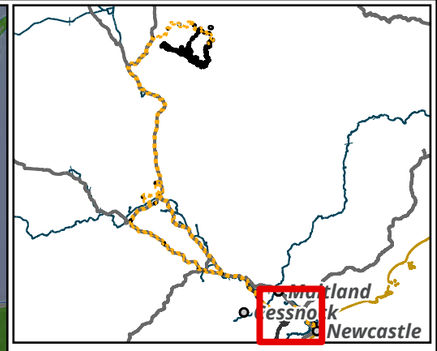

Legend

Infrastructure footprint

Landscape assessment buffer (study area)

Patch size

Patch size >=100ha (1194 DNG; 1194 High; 1691 Low; 1194 Low; 1194 Moderate; 1604 Low; 433 Low; 433 Moderate; 434 Low; 486 DNG; 486 High; 486 Low; 486 Moderate; 490 High; 490 Low; 490 Moderate; 492 DNG; 492 High; 492 Low; 492 Moderate; 507 Moderate; 526 High; 526 Moderate; 540 DNG; 540 High; 540 Low; 540 Moderate; 541 DNG; 541 High; 541 Low; 541 Moderate; 586 Low; 599 High; 599 Low; 599 Moderate; 931 High; 931 Low; 931 Moderate; 934 DNG; 934 High; 934 Low; 934 Moderate; 954 High)

Figure 8 Patch size locations, Page 4

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

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4.3 Threatened ecological communities

Two threatened ecological communities (TEC) were confirmed to occur within and immediately adjacent to the development footprint. These are identified in Table 28, with their occurrence shown in Figure 9.

Table 28 Threatened ecological communities mapped within the development footprint and their conservation status

TEC	PCT	Conservation status[1]		Area (ha)
		EPBC Act	BC Act	
Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion	540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion	Not listed	E	27.24
	PCT 1194 - Snow Gum – Mountain Gum – Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion			
White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	433 - White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion	CE	CE	8.15
	PCT434 - White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion			
	PCT 492 – Silvertop Stringybark – Yellow Box – Apple Box – Rough-barked Apple shrub grass open forest mainly on southern slopes of the Liverpool Range, Brigalow Belt South Bioregion			
	PCT 599- Blakely's Red Gum – Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion			

[1] Conservation status – CE: critically endangered; E: endangered

4.3.1 Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland

Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland is listed as a TEC under the BC Act and its occurrence the subject land is strongly influenced by topography and location within the landscape. This TEC occurs at elevations of between approximately 700 metres and 1,500 metres on deep basalt or loam soils.

Within the development footprint the EEC consists of the following PCTs, where they occur within, or as part of a contiguous patch within, the New England Tablelands IBRA bioregion:

- 540 - Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern Nandewar Bioregion, southern New England Tableland Bioregion and NSW North Coast Bioregion

- PCT 1194 – Snow Gum – Mountain Gum – Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion and eastern New England Tableland Bioregion.

As outlined in the *Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016 Version 2* (NSW TSSC 2018), an ecological community as defined by the BC Act (section 1.6) is 'an assemblage of species occupying a particular area'. For Ribbon Gum-Mountain Gum-Snow Gum Grassy Forest/Woodland this includes the list of species provided in Part 2 of the community's Final Determination for listing under the BC Act, and the occurrence of those species in the New England Tableland Bioregion.

As outlined in the EEC's final determination for listing under the BC Act, the listed community can occurred in degraded states including areas that persist as native grassland where the woody component of the community has been eliminated by clearing. As such the above PCTs occurring in all condition states were considered to conform to the listed EEC.

The location of this EEC within the development footprint is predominantly associated with the upper ridgelines and more shallow slopes at the top of the escarpment (Figure 9). Where it does occur away from the ridgelines the EEC generally exists in in a low or moderate condition and fragmented spatial distribution due to the history of land clearing and grazing.

Due to these topography and soil constraints, the majority of the EEC within the development footprint is impacted by the wind farm and internal road infrastructure type, with the internal roads contributing to the majority of these impacts (Table 29). As much as possible the placement of wind farm infrastructure avoided these areas of TEC, however engineering constraints with steeper slopes and ridgelines require internal access roads to have a concept earthworks design that increases the footprint.

Field surveys also confirmed substantial areas of high quality Ribbon Gum-Mountain Gum-Snow Gum TEC within the adjacent Ben Halls Gap Nature Reserve. These areas were in much higher condition than the patches of this TEC within the development footprint, largely due to the exclusion of cattle grazing pressure and weed management along fence lines. These areas also contained a much higher density of larger eucalypt trees supporting various sized hollows, containing improved habitat resources for native fauna.

Table 29: Distribution of Ribbon Gum-Mountain Gum-Snow Gum EEC within each infrastructure type in the development footprint.

Vegetation condition class	Ribbon Gum-Mountain Gum-Snow Gum EEC area in each infrastructure type (ha)							
	Temporary construction footprint	Wind turbine infrastructure	Internal roads	Quarry	Transmission line	Transmission line access tracks	Transport route road upgrades	Ancillary infrastructure
High condition	4.23	2.45	1.02	-	2.49	0.01	0.04	-
Moderate condition	3.96	1.83	5.42	-	-	-	0.12	0.72
Low condition	1.58	0.89	0.69	-	-	-	0.05	-
DNG	0.45	0.60	0.24	-	-	-	0.44	-
Total (ha)	**10.22**	**5.77**	**7.37**	**-**	**2.49**	**0.01**	**0.66**	**0.72**

4.3.2 White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Box Gum Woodland) is a CEEC listed under both the EPBC Act and the BC Act. Its distribution is strongly associated with more fertile soils on lower elevations across the known range in Queensland, New South Wales and Victoria. Over much of its range, this CEEC has been subject to extensive clearing and modification for agriculture and grazing, so it often occurs as derived native grasslands with no overstorey.

Within the development footprint, the CEEC consists of the following PCTs:

- PCT 433 - White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, Brigalow Belt South Bioregion.
- PCT 492 - Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest mainly on southern slopes of the Liverpool Range, Brigalow Belt South Bioregion.
- PCT 599- Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion.

It has been conservatively assumed that all condition states of the above listed PCTs support the required floristic diversity to represent the CEEC. Based on this conservative assumption, within the revised development footprint, there is a total of 8.15 hectares of Box Gum Woodland, which meets the listing requirements of both the EPBC Act TEC and the BC Act.

The CEEC was found to occur along the transmission line corridor, mainly to the west of the wind farm, with a small area in the central portion of the development site downslope (and north) of the wind farm itself. Furthermore the CEEC was found to occur at the far northern end of the access track servicing the central portion of the transmission line, and the northern portion of the new site access from Crawney Road. Small occurrences also occur in areas requiring upgrades for the transport route including just east of Nundle, and below Devil's Elbow (Figure 9). Consistent with the topographic, geological and soils requirements of this CEEC, it was not recorded across the ridgelines where the wind turbines and internal roads are located (Table 30).

Table 30 provides a summary of the condition states which the CEEC was recorded in within the footprint. As it can be seen over 67% of the CEEC occurs in Low of DNG condition, with the majority of the areas mapped as occurring in moderate condition occurring as small fragmented and isolated patches within a generally highly disturbed landscape (Figure 9).

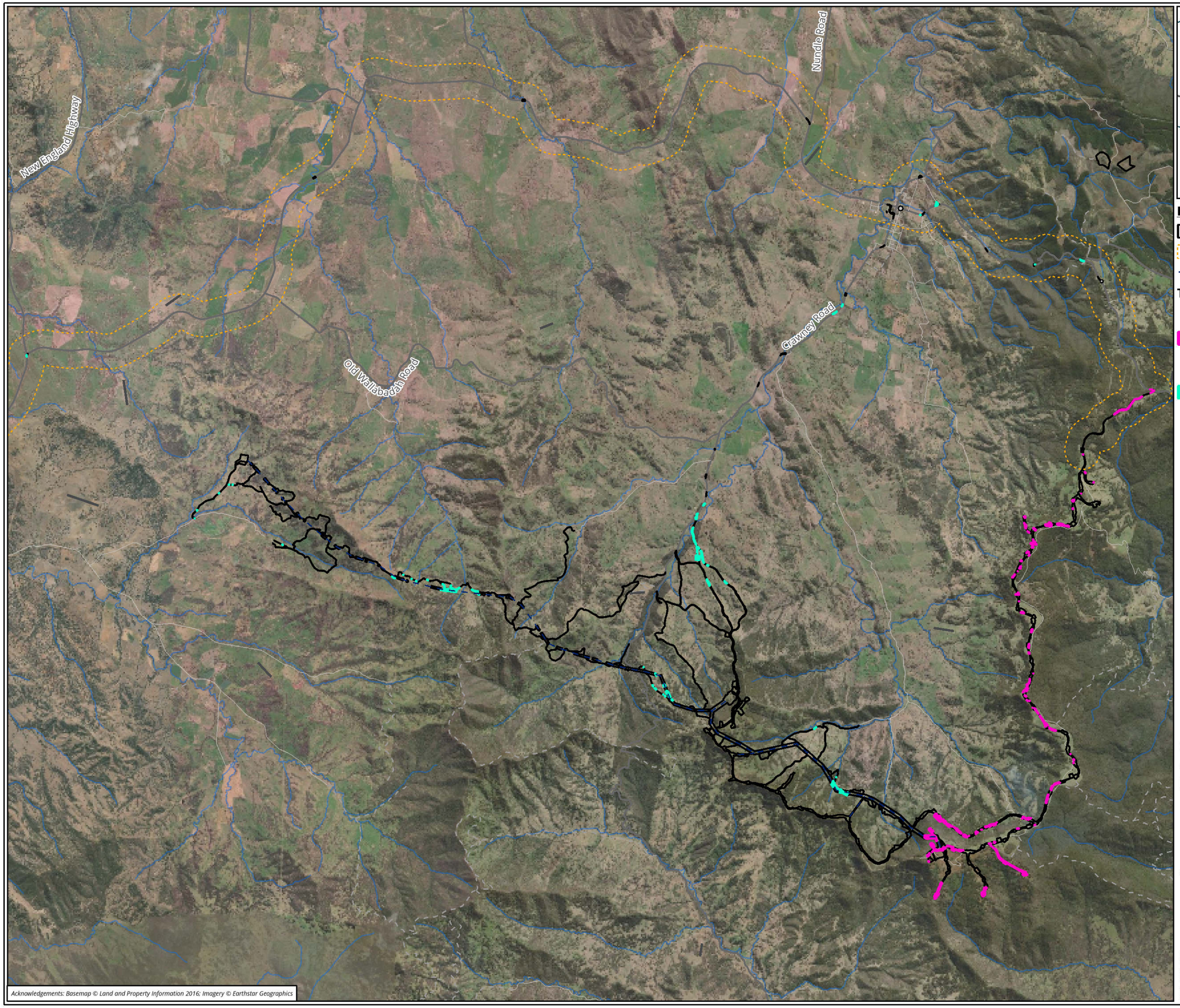
Table 30 Distribution of Box Gum Woodland CEEC within each infrastructure type in the development footprint

Vegetation condition class	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland TEC area in each infrastructure type (ha)							
	Temporary construction footprint	Wind turbine infrastructure	Internal roads	Quarry	Transmission line	Transmission line access tracks	Transport route road upgrades	Ancillary infrastructure
High condition	-	-	0.25	-	0.06	0.00	0.50	
Moderate condition	-	-		-	1.33	0.15	0.46	
Low condition	-	-	0.27	-	1.33	0.29	1.19	1.23
DNG	-	-		-	0.66	0.44		
Total (ha)	**-**	**-**	**0.52**	**-**	**3.37**	**0.88**	**2.15**	**1.23**

4.3.3 Sphagnum Moss Cool Temperate Rainforest

In addition to the TECs that have been mapped within the development footprint and subject land, desktop investigations have also mapped patches of the endangered Ben Halls Gap Nature Reserve Sphagnum Moss Cool Temperate Rainforest. This TEC is listed as endangered under the BC Act however, is also subject to draft conservation advice under the EPBC Act for potential Endangered or Critically Endangered listing. The community is mapped within Ben Halls Gap Nature Reserve, over 135 metres outside the closest extent of the development footprint. The project will not result in any direct impacts to this TEC and indirect impacts associated with the construction and operation of the Project are highly unlikely, but will be considered in the Erosion and Sediment Control Plan which will include specific actions to identify and protect sensitive receptors associated with the National Park estate, including waterways and the adjacent Sphagnum Moss TEC. Additionally, specifically actions relating to bushfire management, with inappropriate fire regimes a proposed key threatening process in the EPBC listing advice, have been addressed with mitigation listed in Section 8.5 and Section 8.9 (B9) and within the detailed bushfire risk assessment and management strategy.

An updated assessment of site gradients and risk to this TEC is provided in the updated Soil and Water report including project commitments to avoid impact in the Amendment Reports.



Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line

Threatened ecological community

- Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/ Woodland of the New England Tableland Bioregion
- White Box Yellow Box Blakely's Red Gum Woodland

Figure 9 Threatened ecological communities, Page 1

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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biosis

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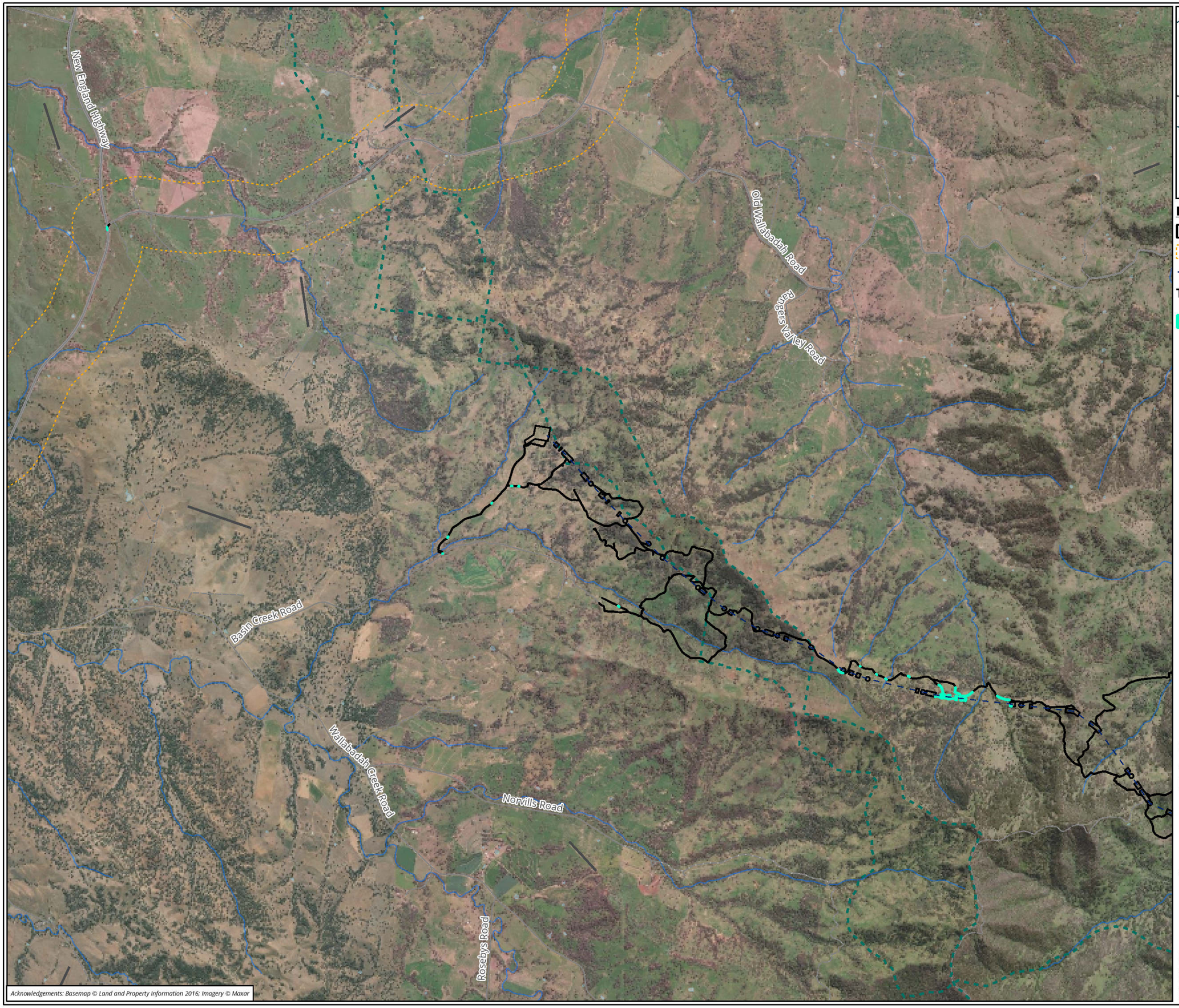

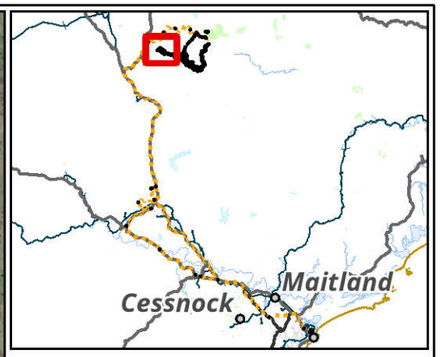

Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line

Threatened ecological community

- White Box Yellow Box Blakely's Red Gum Woodland

Figure 9 Threatened ecological communities, Page 2

0 500 1,000 1,500 2,000

Meters

Scale: 1:50,000 @ A3

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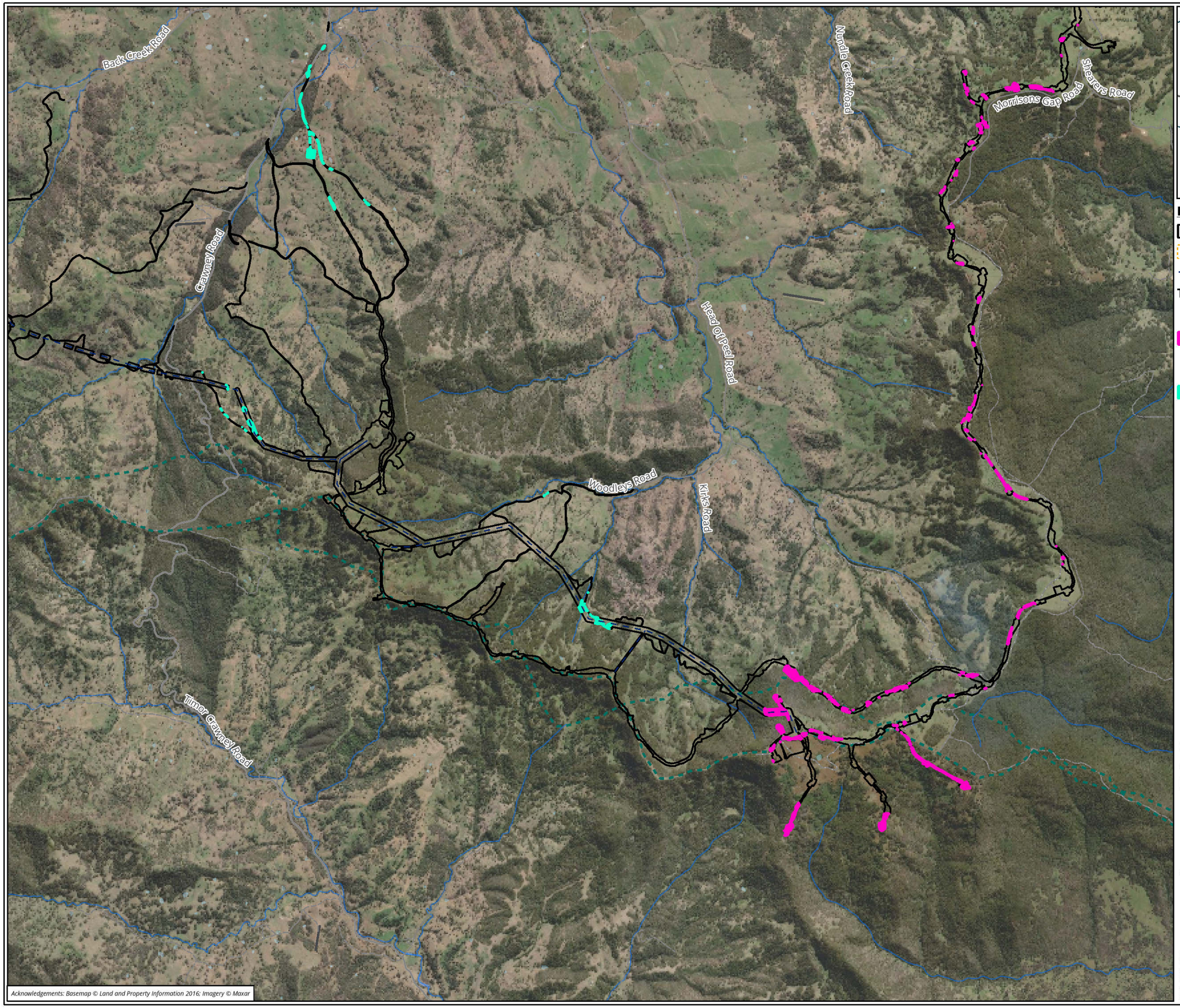

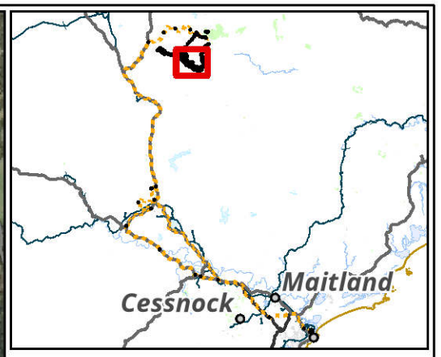

Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line

Threatened ecological community

- Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/ Woodland of the New England Tableland Bioregion
- White Box Yellow Box Blakely's Red Gum Woodland

Figure 9 Threatened ecological communities, Page 3

0 500 1,000 1,500 2,000

Meters

Scale: 1:50,000 @ A3

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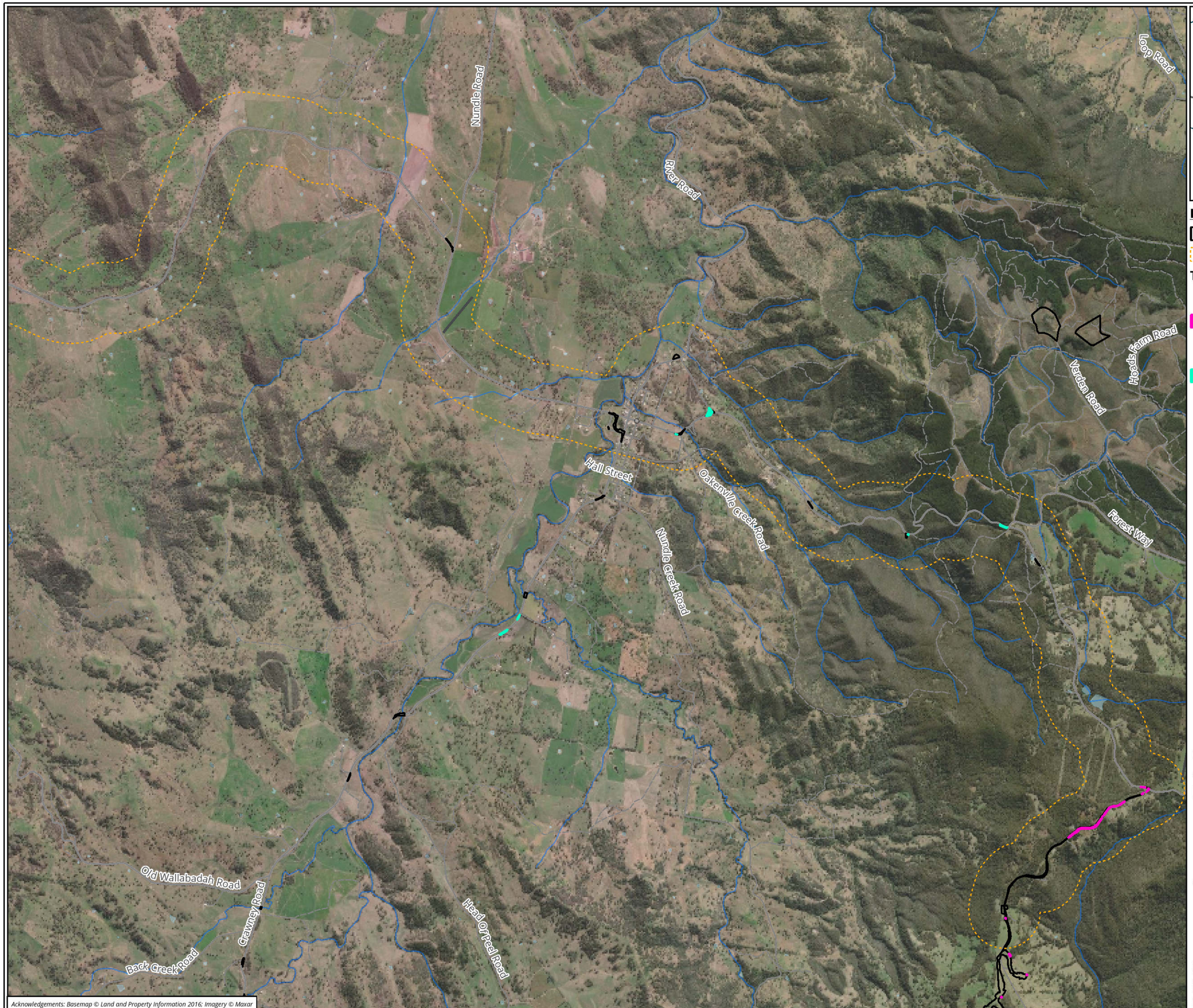

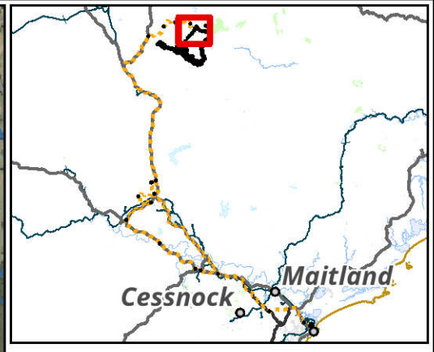

Legend

- Infrastructure footprint
- Transport haul routes

Threatened ecological community

- Ribbon Gum—Mountain Gum—Snow Gum Grassy Forest/ Woodland of the New England Tableland Bioregion
- White Box Yellow Box Blakely's Red Gum Woodland

Figure 9 Threatened ecological communities, Page 4

0 500 1,000 1,500 2,000

Meters

Scale: 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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4.4 Groundwater dependent ecosystems

Review of the Groundwater Dependent Ecosystem (GDE) Atlas (BOM, 2020) indicates the presence of low, moderate and high potential GDEs within and immediately adjacent to the development footprint. High potential GDEs identified for the development footprint are detailed in Table 31.

Table 31 Groundwater dependent ecosystem PCTs with a high potential of occurring within the development footprint

Groundwater dependent ecosystem name	Extent within the development footprint (ha)
Blakely's Red Gum - Yellow Box grassy woodland of the New England Tablelands Bioregion	5.0
Messmate - Mountain Gum tall moist forest of the far southern New England Tableland Bioregion	4.4
Messmate open forest of the tableland edge of the NSW North Coast Bioregion and New England Tableland	24.6
River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt	0.1
River Oak moist riparian tall open forest of the upper Hunter Valley, including Liverpool Range	4.5
Silvertop Stringybark - Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liver	1.9
Silvertop Stringybark - Ribbon Gum - Rough-barked Apple open forest on basalt hills of southern land	67.5
Silvertop Stringybark - Yellow Box - Apple Box - Rough-barked Apple shrub grass open forest mainly	3.2
Snow Gum - Mountain Gum - Mountain Ribbon Gum open forest on ranges of the NSW North Coast Bioregion	43.8
White Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills	0.01
White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region	0.01

Further assessment of the potential for the vegetation within the assessment area to be a GDE reliant on the subsurface presence of groundwater was undertaken based on the information provided in the GDE Atlas and the rulesets detailed Atlas of Groundwater Dependent Ecosystems (GDE Atlas), Phase 2 Task 5 Report: Identifying and mapping GDEs (SKM 2012).

From the results of the field surveys and observation made of the location and topography, it is considered unlikely that any of these ecosystems are actually dependent on the subsurface or surface expression of groundwater. These PCTs occur on the top of ridgelines or steep slopes. A single spring was observed during the field investigations on top of the ridge, however, it had been historically cleared, modified and utilised for agricultural purposes.

Review of groundwater wells carried out as part of the EIS investigations identified that the groundwater aquifer occurs at depths significantly greater than would be intercepted by earthworks associated with the Project construction. The project has been assessed to not have any material impact on groundwater flows, so impacts to GDEs are considered unlikely to occur.

5 Threatened species and habitat

This section outlines the field survey methods and results for identifying threatened flora and fauna, and their habitats within the development footprint, in accordance with Section 5 of the BAM. Prior to the detailed assessment, some preliminary descriptions of the broad habitat types and their conditions is provided.

5.1 General habitat types and features

5.1.1 Exotic pasture

The most common habitat type across the development footprint is exotic grasslands, which also has the lowest value to threatened flora and fauna (Photo 1). These areas are prevalent due to the current and historical use of the development footprint and surrounding landscape for grazing and agriculture. Habitat features for native fauna are limited in these areas; however, they may be utilised by common species adapted to disturbance.

Areas of open, exotic pasture can also provide foraging opportunities for large, diurnal raptors who predate on small mammals and birds. Exotic pastures within the development footprint are also used by common, large-bodied birds that do not require forest cover for shelter and foraging. These birds will forage in more open areas, however, will require adjacent forests for breeding.

Other fauna species observed utilising these areas of exotic pasture include bare-nosed wombat *Vombatus ursinus* and red-bellied black snake *Pseudechis porphyriacus*. Wombat burrows are common throughout these cleared areas, as well as areas of derived native grasslands.

Habitat for threatened flora is very limited in areas of exotic grassland due to altered plant community dynamics, with exotic pasture grasses being more completive. Changed light, water and nutrient dynamics in this habitat type will also limit the suitability of this habitat to support threatened flora species.

5.1.2 Derived native grasslands

Derived native grasslands occur where the canopy and shrub layer has been historically cleared and native grasses and forbs have been retained or regenerated within the ground layer (Photo 2).

Photo 1 Exotic pasture located within the internal road infrastructure footprint

Photo 2 Derived native grassland with Poa spp. dominant with exotic grasses and forbs sub-dominant. Retained eucalypt trees form extremely sparse canopy

5.1.3 Open eucalypt forest and woodland

Open eucalypt forests and woodlands are the most common, intact habitat type within the development footprint and assessment area (Photo 3). These habitat types represent the dominant important habitat type for threatened native fauna within the development footprint and have a strong influence on the flora and fauna composition observed. Eucalypt forest vegetation types within the development footprint include:

- Grassy woodlands.
- Open eucalypt forest.
- Tall moist eucalypt forest.
- Riparian open forest and woodland with co-dominant river oak *Casuarina cunninghamiana*.

These eucalypt woodlands provide foraging, shelter, movement and breeding resources for native fauna. Within the development footprint, patches of eucalypt forest in a high or moderate condition contained mature eucalypt trees that contained hollows of varying size. These hollows provide roosting and breeding resources for threatened mammals observed on the development footprint, including Greater Glider *Petauroides volans*, and microbat species.

5.1.4 Steep cliffs and rocky outcrops

Adjacent to the development footprint and on the edges of the ridgeline associated with the wind farm infrastructure and internal roads, there are a number of steep sections with exposed rock outcroppings (Photo 4). These areas provide habitat resources, including shelter and roosting opportunities, for native fauna. In particular two areas have been identified as potential diurnal roost sites for cave-dwelling bat species recorded on the site during field surveys. These areas were identified and have been avoided by the development footprint during the project design and are not located within the development footprint.

Photo 3 Grassy open eucalypt forest in the development footprint, showing Mountain Gum and stringybark eucalypts over a grassy ground layer

Photo 4 Example of rocky outcrops, with rounded boulders in the foreground and steep, incised cliffs in the background

5.1.5 Waterways

The waterways which intersect with the development footprint are dominated by first order streams due to the steep topography of the location and location on a ridgeline at the top of catchments. On top of the ridgeline and upper slopes, waterways are highly ephemeral and are likely to experience flows only immediately following rainfall. These waterways are unlikely to provide habitat for any threatened frogs or fish.

Further down the catchment in areas of the development footprint covered by the transmission line and haul route, there several 3rd and 4th order waterways. These waterways are characterised by shallow banks, with rocky substrates. A very thin zone of riparian vegetation is usually present, with substantial evidence of impacts from cattle grazing and incursion of exotic pasture grasses (Photo 5).

Photo 5 4th order waterway located along Head of Peel road transport haul route

5.2 Identifying habitat suitability for threatened species

A preliminary assessment was undertaken using the BAM Calculator to identify threatened flora and fauna species with potential to occur within the assessment area. Ground-truthed PCTs were entered into the BAM calculator including maximum values for native vegetation cover, patch size and vegetation integrity. Ecosystem credit species and species credit species predicted for the assessment area are provided in Appendix C.

A search of relevant government databases, including the Bionet database and the EPBC Act Protection Matters Search Tool (PMST) was also carried out for a 10 kilometre radius to the development footprint to identify any additional threatened species not identified by the BAM calculator. Desktop sources for the review are detailed in Section 1.8.

A wider desktop assessment area was developed for reviewing potential bat roost sites, including possible maternity roosts to understand more detail on cave systems where known threatened bats may have important roosts. This resulted in an additional three sites in known cave networks, in the landscape surrounding the development footprint, being assessed for microbat activity.

The suitability of habitat in the assessment area was assessed according to the steps outlined in BAM Section 6.4- *Steps for identifying habitat suitability for threatened species* (Appendix C). The results of the assessment are presented in the following sections and form the basis for the removal of species from the assessment where relevant.

5.2.1 Ecosystem credit species

Under the BAM, threatened species with a likelihood of occurrence that can be predicted by vegetation surrogates and landscape features or for which targeted survey has a low probability of detection are identified as ecosystem credits species. These species are not required to be subject to targeted surveys, and their habitat within the development footprint is linked directly to the PCTs present. Habitat for these ecosystem credit species is assumed to be present and their impacts are addressed as part of impacts and loss of habitat. Despite no requirement under the BAM to carry out targeted surveys for these species, the survey design employed for species credit species was sufficient to detect these.

Table 32 identifies ecosystem credit species predicted for the development footprint and an assessment of habitat suitability. The assessment indicates one identified ecosystem species that is unlikely to occur within the development footprint and can be removed from the assessment.

One predicted ecosystem species can be discounted from the assessment due to a lack for both foraging and breeding habitat is the white-bellied sea eagle. The development footprint does not occur within 1 kilometre of coastal rivers, lakes, large dams or creeks, wetlands and coastlines, with the exception of the minor road upgrade works in the Hunter Bioregion. These small impacts do not contain suitable breeding habitat for white-bellied sea-eagle. Where Peel River occurs within 1 kilometre of the development footprint it is considered a minor watercourse for the purpose of white-bellied sea-eagle habitat.

Table 32 Ecosystem credit species relevant to the assessment

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
Anthochaera phrygia	Regent Honeyeater (Foraging)	CE	CE	No	Potential forage habitat present	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
Artamus cyanopterus	Dusky Woodswallow	-	V	Yes - 2 records	Potential forage habitat present	Yes
Callocephalon fimbriatum	Gang-gang Cockatoo	-	V	Yes – 1 record	Potential forage habitat present	Yes
Calyptorhynchus lathami	Glossy Black Cockatoo (Foraging)	-	V	No	Potential forage habitat present	Yes
Chthonicola sagittata	Speckled Warbler	-	V	No	Potential forage habitat present	Yes
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies	-	V	No	Potential forage habitat present	Yes
Daphoenositta chrysoptera	Varied Sittella	-	V	No	Potential forage habitat present	Yes
Glossopsitta pusilla	Little Lorikeet	-	V	Yes - 3 records	Potential forage and breeding habitat present	Yes
Grantiella picta	Painted Honeyeater	V	V	No	Potential forage habitat present	Yes
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	-	V	No	No habitat present	Yes
Hieraaetus morphnoides	Little Eagle (Foraging)	-	V	No	Potential forage habitat present	Yes
Lathamus discolor	Swift Parrot (Foraging)	CE	E1	No	Potential forage habitat present, but vagrant species	Yes
Lophoictinia isura	Square-tailed Kite (Foraging)	-	V	No	Potential forage habitat present	Yes
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	No	Potential forage and breeding habitat present	Yes
Melithreptus gularis	Black-chinned Honeyeater	-	V	No	Potential forage habitat present	Yes
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	-	V	No	Potential forage habitat present	Yes
Neophema pulchella	Turquoise Parrot	-	V	No	Potential forage habitat present	Yes
Ninox connivens	Barking Owl	-	V	No	Potential forage	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
					and habitat present	
Ninox strenua	Powerful Owl (Foraging)	-	V	Yes - 4 records	Potential forage habitat present	Yes
Pachycephala olivacea	Olive Whistler	-	V	No	Potential forage habitat present	Yes
Petroica boodang	Scarlet Robin	-	V	Yes - 3 records	Potential forage and breeding habitat present	Yes
Pomatostomus temporalis	Grey-crowned Babbler (eastern species)	-	V	No	Potential forage habitat present	Yes
Petroica phoenicea	Flame Robin	-	V	Yes - 1 record	Potential forage and breeding habitat present	Yes
Stagonopleura guttata	Diamond Firetail	-		No	Potential forage and breeding habitat present	Yes
Tyto novaehollandiae	Masked Owl (Foraging)	-		No	Potential forage habitat present	Yes
Tyto tenebricosa	Sooty Owl (Foraging)	-		No	Potential forage habitat present	Yes
Dasyurus maculatus	Spotted-tailed Quoll	E	V	Yes - 2 records Also recorded by survey within assessment area	Potential forage and breeding habitat present	Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	V	Yes - 11 records	Potential forage habitat present	Yes
Kerivoula papuensis	Golden-tipped Bat	-	V	No	Potential forage habitat present	Yes
Miniopterus australis	Little Bentwing-bat (Foraging and Breeding)	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Miniopterus orianae oceanensis	Large Bentwing-bat (Foraging)	-	V	No Recorded by	Potential forage habitat present	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
				survey within assessment area		
Mormopterus norfolkensis	Eastern Freetail Bat	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	No	Potential forage habitat present	Yes
Petaurus australis	Yellow-bellied Glider	-	V	No	Potential forage and breeding habitat present	Yes
Phascolarctos cinereus	Koala (Foraging)	V	V	No Recorded by survey within assessment area (3 individuals)	Potential forage and breeding habitat present	Yes
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	V	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	No Recorded by survey within assessment area	Potential forage habitat present	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	Yes - 2 records. Recorded by survey within assessment area	Potential forage habitat present	Yes
Thylogale stigmatica	Red-legged Pademelon	-	V	No	Potential forage habitat present	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	-	V	No Recorded by survey within assessment	Potential forage habitat present	Yes

Scientific name	Common name	EPBC Act status	BC Act status	Bionet records within 10km of site	Habitat suitability	Species relevant to the assessment
				area		

Table codes: E- Endangered, V- Vulnerable, C– Critical, CE- Critically Endangered, M- Marine/ Migratory.

5.2.2 Species credit species

Under the BAM, threatened species with a likelihood of occurrence that cannot be confidently predicted by vegetation surrogates and landscape features but can be reliably detected by targeted survey are identified as species credit species.

Table 33 identifies species credit species predicted for the development footprint and an assessment of habitat suitability.

Table 33 Potential species credit species assignment of candidate status

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Adelotus brevis	Tusked Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm infrastructure and internal access roads sections of the subject land. Habitats degraded on transmission line sections of the subject land.	Yes
Litoria booroolongensis	Booroolong Frog	2.00	Marginal habitat supported by a number of minor waterbodies within the wind farm subject land. Low quality potential habitat present where transmission line and access tracks crosses Wombramurra Creek	Yes
Litoria daviesae	Davies' Tree Frog	2.00	Marginal habitat supported by a number of minor waterbodies within the wind farm infrastructure and internal access roads sections of the subject land. Habitats degraded on transmission line sections of the subject land.	Yes
Litoria subglandulosa	Glandular Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm subject land. Habitats degraded on transmission line and access tracks sections of the subject land. Species records associated with large areas on intact vegetation to the east of the subject land, with no records within 100kms of the project site.	No (however species targeted during frog survey)
Mixophyes balbus	Stuttering Frog	3.00	Marginal habitat supported by a number of minor waterbodies within the wind farm sections of the subject land. Habitats degraded on transmission line corridor. Species records associated with large areas on intact vegetation to the east of the project site, with no records within 100kms of the subject land for the wind farm and transmission line.	No (however species targeted during frog survey)
Philoria sphagnicolus	Sphagnum Frog	2.00	Typically found in high rainfall areas at high elevation in Sphagnum Moss beds or seepages on steep slopes. This habitat is not present within the development footprint.	No
Anthochaera phrygia	Regent Honeyeater	3.00	Potential forage habitat supported across the subject land and addressed through ecosystem credits. Subject land does not occur within mapped Important Areas for the species.	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Burhinus grallarius	Bush Stone-curlew	2.00	Species occurs at altitudes much lower than the subject land with the highest elevation record of the species within over 120kms of the wind farm site at an altitude of 500 metres (approx.). The lowest point of the wind farm and transmission line subject land occurs along the transmission line at an altitude of 750 metres (approx.) and as such the subject land does not support habitat for the species. Two records of the species occur at an elevation of approximately 1,000 metres, one hear Armidale over 120kms from the subject land, and the other in Washpool NP, over 270kms from the project site. When these records are compared to the remainder of the 1,350 species' records in BioNet, these occurrences are considered to be vagrants.	No
Callocephalon fimbriatum	Gang-gang Cockatoo	2.00	Of the 16,000 records of the species in ebird (and >600 in BioNet), none occur north of Muswellbrook NSW, except occasional records along coast just south of Coffs Harbour. As such the subject land does not support habitat for the species.	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	2.00	Marginal potential forage habitat supported across the subject land, very few *Casuarina* spp or *Allocasuarina* spp. have been recorded during floristic surveys and fauna habitat assessments, with the exception of some very small (less than 1ha) patches of River Oak riparian forest. Breeding habitat potentially present in the form of hollow-bearing trees.	Yes
Haliaeetus leucogaster	White-bellied Sea-Eagle	2.00	The subject land associated with the wind farm, transmission line, access tracks and internal roads does not occur within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines. Where Peel River occurs within 1km of the subject land it is a minor watercourse. Some areas of the transport haul route subject land are within 1km of the coastline, however, habitat suitability in these areas of minor impact are not considered to support foraging or breeding functions for White-bellied Sea-eagle.	No
Hamirostra melanosternon	Black-breasted Buzzard	1.50	Riparian habitats are degraded within the subject land.	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Hieraaetus morphnoides	Little Eagle	1.50	Potential forage and breeding habitat supported across the subject land.	Yes
Lathamus discolor	Swift Parrot	3.00	Potential forage habitat supported across the subject land. Project site does not occur within mapped Important Areas for the species.	No
Lophoictinia isura	Square-tailed Kite	1.50	Potential forage and breeding habitat supported across the subject land.	Yes
Ninox connivens	Barking Owl	2.00	Potential forage and breeding habitat supported across the subject land.	Yes
Ninox strenua	Powerful Owl	2.00	Potential forage and breeding habitat supported across the subject land.	Yes
Tyto novaehollandiae	Masked Owl	3.00	Potential forage and breeding habitat supported across the subject land.	Yes
Tyto tenebricosa	Sooty Owl	3.00	Potential forage and breeding habitat supported across the subject land.	Yes
Aepyprymnus rufescens	Rufous Bettong	2.00	Marginal and degraded potential habitat occurs within areas of the subject land associated with the wind farm and transmission corridor.	Yes
Cercartetus nanus	Eastern Pygmy-possum	2.00	Potential habitat is present within the subject land.	Yes
Chalinolobus dwyeri	Large-eared Pied Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Macropus parma	Parma Wallaby	2.00	Potential habitat occurs in higher condition areas connected to Ben Halls Gap Nature Reserve. Potential habitats within the transmission line corridor are degraded.	Yes
Miniopterus australis	Little Bent-winged Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Miniopterus orianae oceanensis	Large Bent-winged Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Myotis macropus	Southern Myotis	2.00	Habitat occurs within and adjacent to the subject land.	Yes
Petaurus norfolcensis	Squirrel Glider	2.00	Potential habitat is present within the subject land.	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	3.00	Potential habitat is present within the subject land.	Yes

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Phascogale tapoatafa	Brush-tailed Phascogale	2.00	Potential habitat is present within the subject land. However, BioNet notes the species occurrences in the following IBRA subregions relevant to the project site. Walcha Plateau IBRA - Known to occur, but a geographic restriction exists stating "East of the Tia River". This river's headwaters occur >50kms north-east of the assessment area. Nearest record of the species is 56kms east. Tomala IBRA - species known, with no geographic restrictions listed. However, only records of the species comprise an inaccurate record (10kms) noted as Mount Royal SF (or NP) from 1991, one more low accuracy (10kms) in similar location (but in Barrington Tops IBRA), one further single record in the IBRA from 1974, and >66kms from the assessment area. Peel IBRA - Species predicted to occur (i.e. not known), no geographic restrictions listed. Species never recorded in IBRA.	No
Phascolarctos cinereus	Koala	2.00	Breeding and foraging habitat occurs within and adjacent to the subject land.	Yes
Potorous tridactylus	Long-nosed Potoroo	2.00	Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. This habitat is not present within the development footprint, furthermore the species was not recorded during terrestrial mammal camera trap surveys	No
Pteropus poliocephalus	Grey-headed Flying-fox	2.00	Potential forage habitat supported across the subject land.	Yes
Vespadelus troughtoni	Eastern Cave Bat	3.00	Habitat occurs within and adjacent to the subject land.	Yes
Hoplocephalus bitorquatus	Pale-headed Snake	2.00	Species known only to occur at altitudes much lower than the subject land, within highest elevation BioNet records including 550m elevation (approx.) north of Bindarri NP (>200kms from the project site), 390m elevation (approx.) west of Kwiambal NP (>150km from the project site) and 375m elevation (approx.) west of Gunnedah (>100kms from the project site). The lowest point	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			of the project site occurs along the transmission line at an altitude of 750m (approx.) and as such the subject land does not support habitat for the species.	
Hoplocephalus stephensii	Stephens' Banded Snake	2.00	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude. The species uses very old primary forest with many large old hollow bearing trees. Habitat needs to be well connected and geographically large. Potential habitat combining old primary forest <950m elevation does not occur within the development footprint.	No
Uvidicolus sphyrurus	Border Thick-tailed Gecko	2.00	Species distribution is north of the subject land associated with the wind farm and transmission line corridor and has never been recorded (or predicted to occur in) Tomala or Walcha Plateau IBRA subregions. Peel IBRA has records 20-25kms north of the site across cleared land, which are at the southern extent of the species' occurrence. Peel IBRA abuts parts of the wind farm subject land and includes the western 60% of the transmission line section of the subject land.	Yes
Acacia atrox	Myall Creek Wattle	3.00	Known populations more than 200km north/ northwest of the assessment area. No records within proximity to the site. Potential habitat in PCT599 is marginal and unlikely to support the species.	No
Callistemon pungens	Callistemon pungens	2.00	Habitats range from riparian areas dominated by *Casuarina cunninghamiana* subsp. *cunninghamiana* to woodland and rocky shrubland. Often in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. Marginal habitat may occur along the transmission line corridor however the subject land occur outside the known area of occurrence of the species.	No
Chiloglottis anaticeps	Bird Orchid	3.00	Often grows near streams or on the edges of low, flat rock outcrops, in grows in eucalypt forest in areas with very little ground cover, in gravely loam soils. Very broad habitat descriptions do not fit well with the habitats or soils present within the development footprint. Furthermore the subject land occurs well outside the species known area of occurrence.	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
Chiloglottis platyptera	Barrington Tops Ant Orchid	2.00	Potential habitat within grassy woodland and open forests within the wind farm infrastructure section of the subject land.	Yes
Cryptostylis hunteriana	Leafless Tongue Orchid	1.50	EPBC Act SPRAT profile sates habitat associated for the species in the NSW Northern Tables lands regions include New England Blackbutt (*Eucalyptus andrewsii*) Grassy Forest and New England Blackbutt Shrubby Forest and Large-fruited Blackbutt (*Eucalyptus pyrocarpa*) / Strawberry Gum (*Eucalyptus olida*) Woodland. These habitats do not occur within the subject land.	No
Dichanthium setosum	Bluegrass	2.00	Potential habitat within dry sclerophyll forests, derived native grassland and forested wetlands within the subject land.	Yes
Digitaria porrecta	Finger Panic Grass	2.00	Habitat within box woodland marginal for the species. No other suitable habitat within the site.	No
Diuris pedunculata	Small Snake Orchid	2.00	Grows on grassy slopes or flats, often on peaty soils in moist areas, also on shale and trap soils, on fine granite, and among boulders. This habitat is not present within the development footprint.	No
Eucalyptus magnificata	Northern Blue Box	2.00	Occurs in grassy open forest or woodland on shallow, sandy or loamy soils, on moderately hilly sites and at the edge of gorges, usually at altitudes from 900 - 1050 m. Potential habitat combining grassy open forest or woodland on shallow, sandy or loamy soils at 900 - 1050 m elevation does not occur within the development footprint.	No
Eucalyptus nicholii	Narrow-leaved Black Peppermint	2.00	Potential habitat within grassy woodland and dry sclerophyll forests within the subject land.	Yes
Eucalyptus oresbia	Small-fruited Mountain Gum	3.00	Habitat suitability within subject land for *Eucalyptus oresbia* was assessed by Arup. It was concluded that the subject land is not suitable to support this species due to the lack of 'very steep valleys and deeply incised creek lines with primarily south to southwest exposure' (NSW BioNet, DPIE 2021). Due to this habitat limitation, the species was excluded from assessment under the BAM. Survey of former impacts to Devil's Elbow area were undertaken and the species was not found to be present within the former extent of the	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			development footprint in that location.	
Euphrasia ciliolata	Polblue Eyebright	2.00	Species Flowers December to May and occurs on the edge of montane and sub-alpine swamps and on open grassy slopes bordering swamps, Snow Grass meadows, Snow Gum woodland, open boggy meadows amidst Black Sallee woodland, and in seasonally inundated upland grassland. Potential habitat for the species within the development footprint, comprising PCT 586, is degraded by weed invasion. Furthermore the species was not recorded during targeted meander and plot surveys undertaken within degraded habitats in March 2021.	No
Haloragis exalata subsp. velutina	Tall Velvet Sea-berry	2.00	Areas of associated PCTs (PCT 84) within the development footprint occur as highly degraded creek crossing, these areas do not support habitat for the species	No
Homoranthus prolixus	Granite Homoranthus	2.00	No suitable habitat within the subject land.	No
Monotaxis macrophylla	Large-leafed Monotaxis	2.00	No suitable habitat within the subject land.	No
Picris evae	Hawkweed	2.00	Open Eucalypt woodland within site does not support *Dichanthium* spp. dominated ground layer and is marginal for the species.	No
Polygala linariifolia	Native Milkwort	2.00	Potential habitat within PCT 1194 in the wind farm sections of the subject land.	Yes
Prasophyllum sp. Wybong	Prasophyllum sp. Wybong	3.00	BioNet notes that the species is known to occur in open eucalypt woodland and grassland, however species records to not occur in habitats that are remotely similar to the those present within the development footprint. Impacts associated with the transport haul routes are to highly degraded road edges, that do not support habitat for the species.	No
Pterostylis elegans	Elegant Greenhood	2.00	BioNet notes that the species restricted distribution from the Barrington Tops to the Walcha district, which is exists outside the occurrence of the subject land	No
Pterostylis riparia	Pterostylis riparia	3.00	BioNet notes the species grows on the edge of small streams under shrubs, and is restricted to the Barrington Tops. Riparian habitats within the	No

Scientific name	Common name	Biodiversity risk weighting	Habitat suitability	Candidate species requiring targeted survey
			development footprint are degraded and generally relate to ephemeral first order watercourses at the highest point of the catchment. These areas do not support habitat for the species.	
Commersonia procumbens	Commersonia procumbens	2.00	No PCTs known to be associated with the species occur within the subject land. Species has habitat constraint of Pilliga Sandstone.	No
Senna acclinis	Rainforest Cassia	2.00	Species grows on the margins of subtropical, littoral and dry rainforests. The subject land does not support habitat for the species.	No
Tasmannia glaucifolia	Fragrant Pepperbush	3.00	Eucalypt forest within PCT 934, 931 and 927 offers marginal habitat for the species.	Yes
Tasmannia purpurascens	Broad-leaved Pepperbush	2.00	Suitable habitat within open woodland and forest within the site (PCT 934, 931, 927 and 1194).	Yes
Thesium australe	Austral Toadflax	1.50	Suitable habitat within the assessment area.	Yes
Tylophora linearis	Tylophora linearis	2.00	Associated PCTs within the development site occur at higher altitudes than recorded for the species.	No
***Asterolasia* sp. 'Dungowan Creek'**	Dungowan Starbush	3.00	Marginal habitat within PCT 934.	Yes
Homopholis belsonii	Belson's Panic	2.00	Site lacks suitable habitat.	No
Euphrasia arguta	Euphrasia arguta	3.00	Suitable habitat within the assessment area.	Yes

5.3 Candidate threatened species and targeted survey methods

Candidate species credit species requiring targeted survey include 33 threatened fauna species and 10 threatened flora species. Table 34 presents a summary of field survey methods for candidate species credit species relative to BAM survey requirements, with additional detail on the survey methods in the following section.

Table 34 Candidate species credit species and survey design employed

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Frogs					
Adelotus brevis	Tusked Frog	Oct – Feb	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	Frog surveys were undertaken in spring 2019 and autumn 2020. 12 sites were surveyed between 18 and 21 November 2019. Six sites were surveyed between 24 and 27 March 2020.
Litoria booroolongensis	Booroolong Frog	Nov - Dec	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Litoria daviesae	Davies Tree Frog	Sep – Jan	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Litoria subglandulosa	Glandular Frog	Oct - Dec	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Mixophyes balbus	Stuttering Frog	Sep - Mar	Field survey methods for amphibians (DECC 2009).	Spotlighting, call playback surveys and active searches.	
Birds					
Anthochaera phrygia	Regent Honeyeater	Sep – Dec	Commonwealth Survey Guidelines for threatened birds (DEWHA 2010).	Diurnal bird surveys during the migration period/survey timing and habitat mapping.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Calyptorhynchus lathami	Glossy Black Cockatoo	Mar - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Habitat mapping, hollow-bearing tree mapping and diurnal bird surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Hamirostra melanosternon	Black-breasted Buzzard	Sep - Nov	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Hieraaetus morphnoides	Little Eagle	Aug - Oct	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Lathamus discolour	Swift Parrot	May - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Winter diurnal bird survey targeting flower eucalypts.	Bird surveys undertaken at 17 sites in August 2019.
Lophoictinia isura	Square-tailed Kite	Sep - Jan	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Stick-nest surveys.	Bird surveys undertaken at 17 sites in August 2019, 21 sites in November 2019 and 21 sites in February 2020.
Ninox connivens	Barking Owl	May - Aug	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Targeted diurnal habitat and sign of use surveys. Nocturnal call playback, stag-watching, listening, hollow observations, and spotlighting.	Nocturnal bird surveys undertaken between: • 26-30 August 2019 (2 nights) • 18-21 November 2019 (2 nights) • 24-26 March 2020 (3 nights) • 11-12 May 2020 (2 nights) • 5-9 September 2022 (4 nights) A total of 41 days targeted fauna surveys and habitat assessment between August 2019 and August 2020. Targeted diurnal habitat (hollow) surveys between 30 May and 3 June 2022.
Ninox strenua	Powerful Owl	May - Aug			
Tyto novaehollandiae	Masked Owl	May – Aug			
Tyto tenebricosa	Sooty Owl	May – Aug			
Mammals					
Aepyprymnus rufescens	Rufous Bettong	Year round	Draft Threatened Species Survey and Assessment	Deployment of baited terrestrial camera traps and	Total of 1362 trap nights using ground deployed infrared motion

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
			Guidelines (DECC 2004).	spotlighting.	sensing cameras.
Cercartetus nanus	Eastern Pygmy Possum	Oct - Mar	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited arboreal camera traps and spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.
Chalinolobus dwyeri	Large-eared Pied Bat	Sep - Mar	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Dasyurus maculatus	Spotted-tailed Quoll	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Macropus parma	Parma Wallaby	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Miniopterus australis	Little Bentwing-bat	Dec - Feb	"Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Miniopterus orianae oceanensis	Large Bentwing-bat	Nov - Feb	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Myotis macropus	Southern Myotis	Nov - Mar	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Petauroides volans	Greater Glider	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.
Petaurus norfolcensis	Squirrel Glider	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited arboreal camera traps and spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Petrogale penicillata	Brush-tailed Rock-wallaby	Year round	Draft Threatened Species Survey and Assessment Guidelines (DECC 2004).	Deployment of baited terrestrial camera traps and spotlighting.	Total of 1362 trap nights using ground deployed infrared motion sensing cameras.
Phascolarctos cinereus	Koala	Year round	EPBC Act referral guidelines for the vulnerable koala (DoE 2014).	SAT surveys in high quality habitat (high abundance of feed trees), and spotlighting.	Total of 1014 trap nights using arboreal deployed infrared motion sensing cameras.
Pteropus poliocephalus	Grey-headed Flying-fox	Year round	Survey-guidelines-bats (DEWHA 2010).	Habitat mapping and active searches for camps.	No suitable camp habitat within the assessment area.
Vespadelus troughtoni	Eastern Cave Bat	Nov - Jan	'Species credit' threatened bats and their habitats (EES 2018).	Ultrasonic detection and habitat mapping.	24 Ultrasonic bat detectors were deployed for a total of 1042 trap nights.
Reptiles					
Uvidicolus sphyrurus	Border Thick-tailed Gecko	Nov - Mar	Survey guidelines for Australia's threatened reptiles (DSeWPaC 2011)	Targeted searches and habitat mapping.	A total of 3 nights spotlighting and active searches in marginal habitat present on site.
Plants					
***Asterolasia* sp. 'Dungowan Creek'**	Dungowan Star Bush	Year round	NSW Guide to Surveying Threatened Plants (OEH, 2016) as far as practicable	Seasonal surveys involving transects and targeted random meanders, depending on the density of vegetation. All surveys were carried out within the suitable seasonal window for candidate flora except: • Barrington Tops Ant Orchid: surveys were completed from 18-22 November. Conditions	A reasonable survey effort was employed including: • A spring survey over 5 days from 18-22 November 2019- limited to suitable habitat within the subject land. • Summer survey over 5 days in February 2020- including suitable habitat within the subject land and transmission line corridor (where accessible).
Chiloglottis platyptera	Barrington Tops Ant Orchid	Sep - Oct			
Dichanthium setosum	Bluegrass	Dec - May			
Digitaria porrecta	Finger Panic Grass	Dec - Jan			
Eucalyptus nicholii	Narrow-leaved Peppermint	Year round			
Euphrasia arguta	Euphrasia arguta	Nov - March			

Scientific name	Common name	BAM survey period	Survey guidelines	Survey design employed	Survey effort
Polygala linariifolia	Native Milkwort	Year round		were exceptionally dry for much of spring 2019 due to drought. Review of BOM (2020) indicates there was little change in local conditions from September to October. • Finger Panic Grass: Surveys were completed in February.	• Autumn 2021 surveys over 5 days in March by two Biosis senior botanist during supplementary BAM plot surveys. • Surveys of additional projects areas in January 2021, May 2022 and September 2022.
Pterostylis elegans	Elegant Greenhood	Dec - May			
Tasmannia glaucifolia	Fragrant Pepperbush	Year round			
Tasmannia purpurascens	Broad-leaved Pepperbush	Year round			
Thesium australe	Austral Toadflax	Sep - Feb			

5.3.1 Terrestrial flora survey methods

Surveys for candidate threatened flora were carried out over two seasons by Arup and Biosis botanists and under the direction of accredited assessor Matt Davis, as follows:

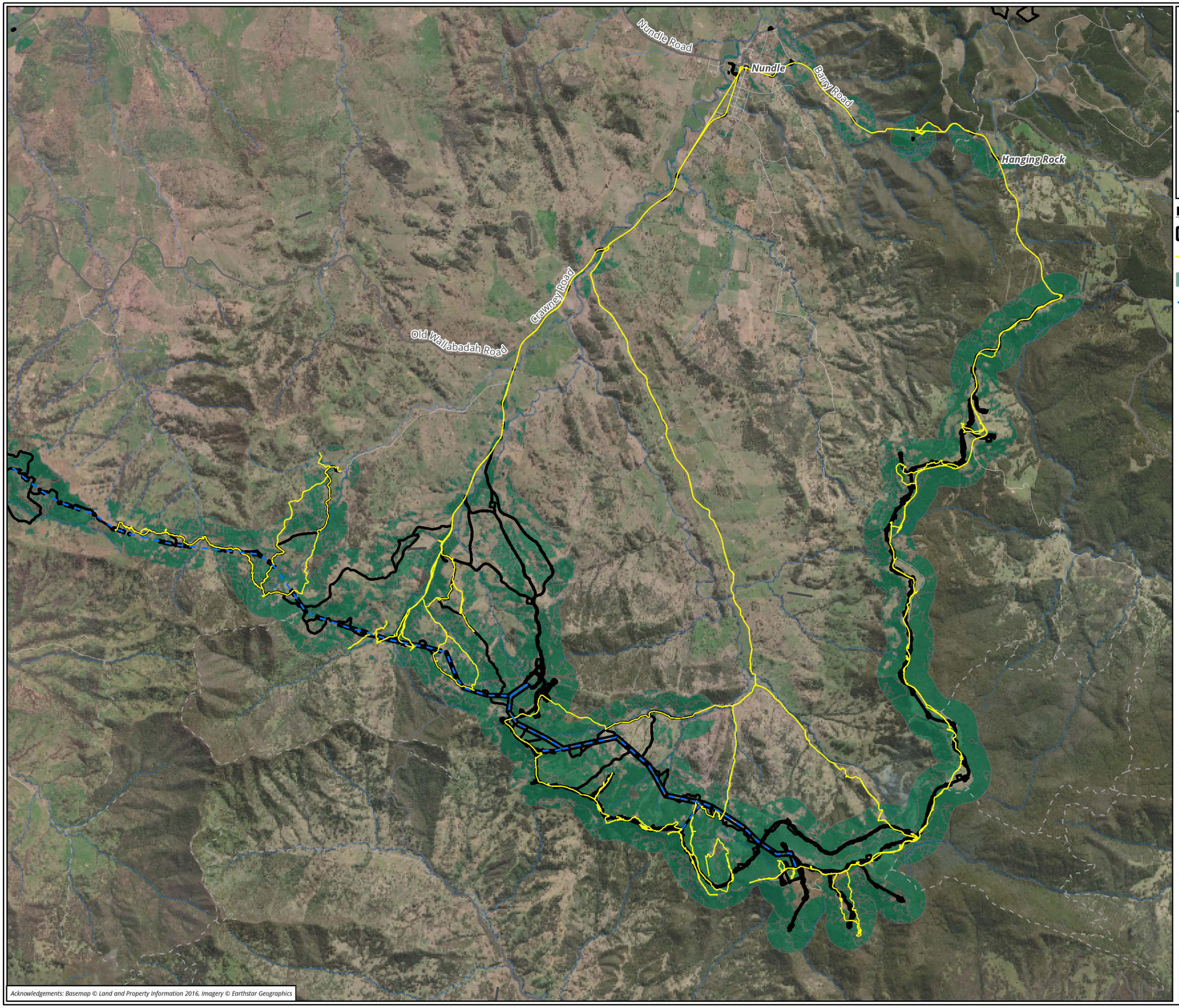
- Survey of the wind farm development footprint over 5 days from 18-22 November 2019.
- Survey of the wind farm development footprint and accessible parts of the transmission line corridor over 5 days in February 2020.
- Supplementary vegetation community survey to verify PCTs, with incidental searches for threatened species conducted of the internal access roads, Ben Halls Gap Nature Reserve buffer and transport haul route portions of the development footprint over 5 days in August 2020.

Targeted surveys involved searches for target species and random meanders, depending on the density of vegetation. A summary of survey requirements and deployed field methods is provided for all candidate threatened flora in Table 34 above. The extent of targeted surveys for threatened flora is shown in Figure 10.

Following identification of the candidate threatened flora species list, a field survey plan was devised by Arup ecologists in accordance with the *NSW Guide to Surveying Threatened Plants* (OEH 2016). This plan included identification of potential habitat for each of the candidate threatened flora species based on known vegetation associations, review of threatened species profiles, PlantNet profiles, Recovery Plans Conservation Advices and other available literature to determine the presence of suitable areas of potential habitat for species within the assessment area, as well as BioNet records available for each species.

Optimum timeframes for surveys, and which species would be targeted when, were also determined based on the recommended survey times for the candidate species provided by the BAM calculator, literature review, as well as prevailing weather conditions on site. Estimation of the survey effort required to adequately assess the species was undertaken in accordance with Table 3 of the *NSW Guide to Surveying Threatened Plants* (OEH 2016) and was based on the distance required between the minimum separation of parallel traverses (20 metres), and the hectares of potential habitat calculated for each of the candidate species. A field guide of identification information was prepared, taken into the field and used as required.

Additional searches for threatened flora were undertaken during PCT verification and habitat assessments completed in Ben Halls Gap Nature Reserve and additional infrastructure elements in August 2020. Further threatened flora surveys were undertaken during January 2021, March 2021, and May and September 2022.



Legend

- Infrastructure footprint
- Targeted survey tracklog
- Native vegetation
- Transmission line

Figure 10 Threatened flora survey tracks

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:80,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 24 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
Layout: 34963_F10_ThrFloraSurvey
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_AM.aprx

5.3.2 Terrestrial fauna survey methods

A range of targeted terrestrial fauna survey methods were planned and implemented by Biosis ecologists over all four seasons between November 2018 and May 2020, further supplemented in winter 2022, to detect the candidate threatened species assessed as likely to occur on the site. Field surveys were generally carried out during optimal seasonal conditions and weather conditions, with rainfall and temperature (BOM, 2020) during all survey events provided in Table 35.

Weather and observations for the deployment of camera traps and passive acoustic detectors which remained in the field for several months have been presented as monthly averages for temperature and total monthly rainfall (Table 36). Note, temperature measurements on the wind farm development footprint are likely to be several degrees lower due to higher elevation; however, the BOM station presented below is the closest station with temperature data. The monthly observations during the fauna survey period show the drought conditions from November and December 2019, with substantially lower than average total monthly rainfall recorded in these months. These conditions were alleviated from January 2020, with an opposite trend of substantially higher falls than monthly means experience from January 2020 – May 2020, covering a large portion of the field survey campaign.

Also linked to the weather conditions during the field survey was the severe bushfire conditions that were experienced across south-eastern Australia in the 2019/20 summer (refer Section 3.2). During the field survey campaign, the area experienced bushfires within the transmission line and access track footprints. Habitat mapping has taken into consideration these fire events, with the vegetation and condition assessments assuming pre-fire condition for the purpose of PCT mapping, condition assessment and likelihood of occurrence for threatened fauna.

The following sections describe the fauna field methods in detail, with locations of all targeted fauna surveys shown on Figure 12,

Table 35 Weather conditions during targeted fauna surveys[1]

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum	Maximum	
12 November 2018	10.1	30.6	0.0
13 November 2018	12.8	32.2	0.0
14 November 2018	12.8	26.1	0.0
15 November 2018	9.3	32.2	0.0
26 August 2019	1.4	24.5	0.0
27 August 2019	3.4	23.5	0.0
28 August 2019	1.2	22.5	0.0
29 August 2019	0.6	20.9	0.0
30 August 2019	0.5	18.4	0.0
31 August 2019	5.0	19.8	0.0
18 November 2019	11.2	30.4	0.0
19 November 2019	10.8	36.4	0.0
20 November 2019	14.6	35.4	0.0

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum	Maximum	
21 November 2019	13.6	37.0	0.0
22 November 2019	20.8	31.0	0.0
24 February 2020	22.4	25.8	3.4
25 February 2020	16.2	30.3	11.4
26 February 2020	19.0	31.0	1.2
27 February 2020	16.6	30.5	15.2
28 February 2020	13.6	30.4	0.2
29 February 2020	15.2	No recorded	0.0
23 March 2020	15.4	27.5	0.0
24 March 2020	15.9	29.1	0.0
25 March 2020	16.6	23.6	0.0
26 March 2020	14.4	22.9	24.4
11 May 2020	-0.4	Not recorded	0.0
12 May 2020	0.3	20.5	0.0
13 May 2020	4.4	19.5	0.0
14 May 2020	2.4	19.5	0.0
15 May 2020	5.1	19.4	0.0
17 August 2020	4.2	16.0	1.0
18 August 2020	4.4	19.0	0.0
19 August 2020	3.8	20.0	0.0
20 August 2020	7.8	15.8	0.0
21 August 2020	3.0	15.6	0.0
30 May 2022	4.5	10.4	0.0
31 May 2022	4.7	8.7	10.4
01 June 2022	2.7	9.1	0.0
02 June 2022	0.3	9.6	0.0
03 June 2022	4.0	11.2	0.0
5 September 2022	5.6	14.3	0.4
6 September 2022	4.3	14.8	0.0
7 September 2022	4.7	17.2	0.2
8 September 2022	8.8	18.0	0.0

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum	Maximum	
9 September 2022	9.3	16.0	12.2

[1] Recorded at Murrurundi Gap AWS, BOM station 061392

Table 36 Monthly weather observations during camera and acoustic detector deployment

Month deployed	Temperature (°C)[1]		Total rainfall[2,3]
	Mean daily minimum[3]	Maximum	
November 2019	13.1 (12.1)	31.5 (28.7)	42.4 (89.6)
December 2019	16.8 (14.8)	36.0 (31.3)	19.8 (131.8)
January 2020	20.8 (16.6)	36.8 (32.4)	137.6 (81.4)
February 2020	18.4 (16.2)	29.8 (31.5)	203.0 (66.7)
March 2020	13.9 (13.6)	27.2 (29.3)	71.8 (56.5)
April 2020	9.9 (9.0)	24.8 (25.0)	95.2 (40.6)
May 2020	4.7 (5.1)	19.0 (20.5)	112.0 (57.5)

[1] Recorded at Quirindi Post Office, BOM station 055049.

[2] Recorded at Head of Peel station, BOM station 55336.

[3] Numbers in brackets represent summary mean for all years recorded.

Bird strike collision risk survey and diurnal bird survey

This method provides a standardised measure of bird activity. It is important that a sufficient quantum of utilisation data for a fully representative annual cycle is obtained, for collision risk modelling. A representative sample of point counts were taken across the assessment area.

Surveys were conducted over three seasons:

- 17 survey points between 27-30 August 2019.
- 21 survey points between 18-22 November 2019.
- 21 survey points between 25-29 February 2020.
- 17 survey points 15-19 August 2022

All survey locations were near proposed turbines as this provided the best access and visual for surveys. The majority of the utilisation survey points were located in open areas between stands of native vegetation.

Method for the bird utilisation surveys is as follows:

- Observers walk to each transect and to move between fixed points on transects. When reaching an observation point on the transect observers stop and allow time for birds to habituate to their presence (approximately 10 minutes). The area is then scanned for 5 minutes, during which all birds present are recorded. Scanning involves observing at a steady rate in a circle while remaining on the spot (over 360 degrees).
- Observers record all birds as far as the eye can see over 20 minutes at each observation point (which does bias large birds over smaller ones, as the former are more conspicuous, however this can be

accounted for in the analyses). Observations are to be made using the naked eye only. Binoculars can only be used to assist with the identification of a bird.

- As it is the number of movements of birds that is the important variable for modelling, all movements were noted even if it is the same individual. Only birds that were seen are to be recorded, although bird calls can be used to alert the observer to the presence of a bird and its location.
- The order in which transects were sampled was randomised to ensure that transects are equally sampled over the various times of day.

The information collected included:

- Time of the observation
- Point and transect number
- Species
- Number
- Direction of flight
- Height above ground
- Distance from observer
- Behaviour

The location of all bird surveys is shown on Figure 12.

Surveys for hollow-dependant birds and raptors in breeding season

A total of 41 days targeted fauna surveys and habitat assessment were undertaken between August 2019 and August 2020 by teams of between 1 and 4 ecologists/zoologists where the presence of stick nests, tree hollows and evidence of nesting / breeding was captured.

The aim of this survey was to determine whether the assessment area supports breeding habitat for the target species of birds, and whether that habitat is being used for breeding, tree hollows and stick nests were assessed for their suitability in providing breeding habitat, and evidence of use was recorded.

Additional targeted habitat surveys for potential breeding habitat for Barking Owl, Masked Owl and Powerful Owl were undertaken over 100 person hours from two experienced Zoologists, between 30 May and 3 June 2022. The survey was timed to coincide with the BioNet prescribed breeding survey period for each of the target species to allow for the greatest chance to detect breeding activity within areas of potential habitat.

The TBDC defines potential breeding habitat for the three target owl species as living or dead trees with hollows greater than 20 centimetre diameter (and greater than 4 metres above the ground for Barking Owl only). Further prescriptions outlined in the TBDC relate to a requirement for a species polygon to extend outwards from a potential nest tree based on a circular buffer with a 100 metre radius. Based on this requirement the removal of native vegetation within the development footprint must be assumed as an impact to the species when a potential nest tree occurs within 100 metres of the development footprint, unless it can be shown that the nest tree is not being utilised for breeding.

The presence of trees supporting hollows greater than 20 centimetre diameter within 100 metres of the development footprint were therefore the target of the field investigation.

Nocturnal bird surveys and spotlighting

Spotlighting was aimed to detect small macropods, owls and arboreal mammals.

General and targeted spotlighting and call-broadcast surveys for candidate (and potential candidate) threatened mammal, reptile and bird fauna species over nine nights total between:

- 26-30 August 2019 (2 nights)
- 18-21 November 2019 (2 nights)
- 24-26 March 2020 (3 nights)
- 11-12 May 2020 (2 nights)

During the August 2019 winter survey event, call playback was conducted at six locations, near areas identified as supporting some potential suitable owl roosting/breeding habitat, to detect the presence of owls in the area. Species targeted which included Barking Owl *Ninox connivens*, Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae* and Sooty Owl *Tyto tenebricosa*.

Further nocturnal bird surveys undertaken to assess areas of identified better quality habitat for threatened owls, and additional to the two nights at six locations within the windfarm corridor between 26-30 August 2019, were two additional nights between 11-12 May 2020. These call-broadcast surveys included 1 location near area of highest potential habitat.

Additional targeted nocturnal survey work to detect the presence of large forest owls, specifically Barking Owl, Powerful Owl and Masked Owl were undertaken over four nights between 05 September and 08 September 2022. It is acknowledged that these surveys are technically outside the specified breeding season window for these species, which ends in August, however following consultation with BCS, it was agreed that these surveys could be undertaken in the first two weeks of September, in this instance (and in this particular season), with a combination of stag watches and call-playback to be employed.

Owl surveys were undertaken targeting areas of potential breeding habitat, further detailed below, and consisted of a combination of methods including:

- Stag watch - 30 minutes before and 1 hour after sunset each night (as many hollows in view as possible), surveying trees/hollows over two consecutive nights.
- Call playback for Barking Owl, Powerful Owl, Masked Owl at predefined survey locations over consecutive nights.
- Spotlighting, listening for calls, and hollow watches after sunset over consecutive nights.
- Owl whitewash/pellet searches, visual search of vegetation for roosting owls before and after sunset during each survey.

In total targeted surveys for large forest owl species undertaken in preparation of this BDAR comprise:

- Eight nights nocturnal surveys within breeding season (across multiple years) for Barking Owl, Powerful Owl, Masked Owl and Sooty Owl, employing a combination of the methods outlined above.
- Five nights outside breeding season (November and March) for Powerful Owl, Masked Owl and Sooty Owl, two of which (November) occur within the breeding season for Barking Owl, employing spotlighting and call-playback.
- Multiple diurnal searches within and outside breeding season, searching for evidence of owls and hollow utilisation (as described above).

During the Stage 2 spring survey, spotlighting survey was conducted in the subject land along the edge of Ben Halls Gap Nature Reserve to gain additional information on the presence of potential nocturnal birds. The intent of this survey was to provide additional data about the specie present within the interface between the development footprint and the Nature Reserve.

The location of nocturnal bird surveys and spotlighting transects shown on Figure 12.

Camera trapping

A total of 19 Reconyx Hyperfire camera trap units were deployed within the subject land. Of these, 12 were targeted to terrestrial fauna and 7 were targeted for arboreal fauna. Three cameras were also deployed along the transmission line corridor; however, two arboreal cameras and one terrestrial camera were destroyed during the bushfires in the summer 2019 fire season.

Deployment methods included:

- Units with strong-odour meat bait for Spotted-tailed Quoll and Brush-tailed Phascogale.
- Units passively deployed (without bait) for Parma Wallaby and Brush-tailed Rock Wallaby, Eastern Pygmy-possum, Greater Glider, Koala and Rufous Bettong.

Total of 12 baited ground deployed infrared motion sensing cameras set 20-21 November 2019 and collected on 9 April 2020 (1 camera) and 11-15 May 2020 (8 cameras), with 3 cameras destroyed in January 2020 bushfires affecting the assessment area. Camera batters and memory cards were checked in February 2020, allowing for up to 1,539 trap nights (burnt camera traps excluded).

Total of 7 baited arboreal deployed infrared motion sensing cameras set 20-22 November 2019 and collected on 9 April 2020 (1 camera) and 11-15 May 2020 (5 cameras), with 1 camera destroyed in January 2020 bushfires affecting the assessment area. Camera batters and memory cards were checked in February 2020, allowing for up to 1,009 trap nights (burnt camera traps excluded). An example of the arboreal camera trap set up is provided in Photo 6.

Camera trap deployment locations are shown on Figure 12.

Photo 6 Arboreal camera trap set up

Nocturnal frog surveys

During the 2019 spring survey event, a total of 26 creeks were characterised for habitat considered potentially to support threatened frogs. Of these, eight were suitable for targeted frog survey. This is largely due to the prevalence of first order streams within the development footprint, providing a lack of permanent water even during optimal rainfall conditions.

Spotlighting and call playback surveys were conducted at sites identified as frog habitat and were damp or containing water at the time of survey.

Frog surveys were undertaken in spring 2019 and autumn 2020 and included:

- 18-21 November 2019 - Areas of potential habitat in the within the windfarm corridor were surveyed as follows:
  - 6 nights watercourse spotlight / call-playback / active search transect, including 300m, 250m, 500m transects.
  - 4 nights spotlight / call-playback / active search dam surveys.

- 6 nights spotlight / call-playback / active search pool surveys.

- 23-25 March 2020 - Wombramura Creek (transmission line corridor) was surveyed over 3 x 2 nights watercourse spotlight / call-playback / active search transect over approx. 200m of creekline.

All frog survey and habitat assessment locations are shown on Figure 12.

Koala Spot Assessment Technique (SAT) surveys

SAT surveys are the Commonwealth recommended survey method used to determine the presence/absence of Koalas across the assessment area, the activity levels to determine resident aggregation and/or transient sites, the population density and size, and habitat availability. Searches are undertaken to identify direct/indirect evidence of activity of Koala including evidence of scats or characteristic, scratches on the trunks of trees. Preferred Koala feed trees will be recorded during flora surveys (i.e. Ribbon Gum Eucalyptus viminalis) and during the habitat feature surveys.

All SAT surveys were undertaken between the 24-28 February 2020 within the subject land and 11-15 May 2020 within the transmission line corridor. SAT surveys are recommended by the Commonwealth DCCEEW to assess Koala activity levels within the project area. Additional targeted surveys for Koala were also carried out through the deployment of terrestrial and arboreal camera traps, with confirmed photos of the species obtained in March 2020 (Photo 18).

The location of Koala SAT surveys is provided on Figure 12.

Microbat surveys and monitoring

Ultrasonic bat detectors were deployed at a total of 24 locations across the windfarm corridor for a total of up to 1,268 trap nights. Detectors were deployed between 26-29 February 2020 and collected between late March and early May 2020. Five units were relocated within the site in April 2020, when batteries and memory cards were also checked and replaced. An example of a ground-deployed detector used on the site is shown in Photo 7 to Photo 9 and all microbat detectors are shown on Figure 12.

Photo 7 Ground-deployed acoustic detectors

Photo 8 Met mast deployed acoustic detector at head height

Photo 9 Met mast deployed acoustic detector at canopy height

During the 2019 spring survey, an acoustic/ultrasonic transect assessment for threatened microbats was conducted between 19 – 21 November 2019 (three nights), targeting a variety of habitats such as open-space areas, open waterbodies, riparian corridors, vegetated edges, hollow-bearing trees and areas with rocky outcrops and overhangs that are suitable for foraging and roosting. These habitat types were characterised throughout the day and then subsequently surveyed during the evening.

The transects were approx. 1 hour each and on average 1 kilometre long with a range of 100 metres either side. This rapid assessment method was a preliminary survey to provide a perception of species richness and abundance throughout the assessment area and refine areas to primarily target during the summer survey event, where acoustic detectors were deployed.

The handheld acoustic equipment (Echo Meter 2 with a directional microphone – Wildlife Acoustics) using live mode and Real Time Expansion (RTE) function, allowed the observer to simultaneously view the spectrogram and identify bat species in audible (transformed data) and ultrasonic frequencies. Species were identified using the app compatible with the recording device (Echo meter) and in most cases; the species was identified via spotlight. The acoustic data was reviewed and cross-referenced using Kaleidoscope analysis software, the observers personal call library and Bat Calls of New South Wales (Pennay et al. 2004).

Further microbat survey was undertaken to assess for impacts relating to the likelihood of bat species being impacted by turbine strike and possibly barotrauma, the rate of impact per turbine per year, and the impacts to the bioregional populations. This relates not only to bats resident within (or adjacent to) the assessment area, but those that may fly through the site from surrounding habitats, such as local cave/karst systems.

Additional surveys consisted of deployment of acoustic devices on three meteorological masts within the assessment area to determine the activity level of bats at different elevations. Consultation was undertaken with BCD in order to confirm the suitability of the location of the masts, height and number of data points suggested.

Three acoustic detectors were deployed per meteorological mast at heights of 10 metres, 30 metres and 60 metres (Figure 11). These detectors were fitted with an omni-directional microphone capable of detecting and recording calls within a 100 metre radius in all directions. This capability allowed the detection of calls from ground level to a total height of 160 metre, capturing a large area within the potential rotor swept path of the wind turbines.

Additional acoustic devices were deployed within three separate cave systems identified within or nearby the assessment area. All acoustic devices on the met masts and within cave systems in wider landscape were deployed between the 8-9 April 2020 and were collected on the 11-15 of May 2020.

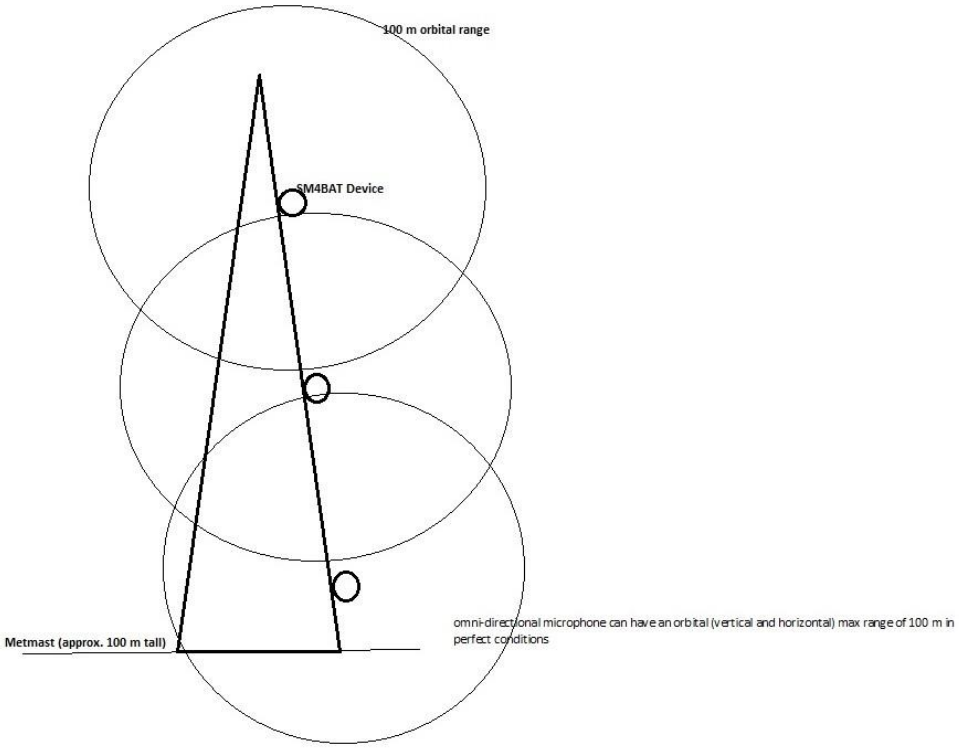
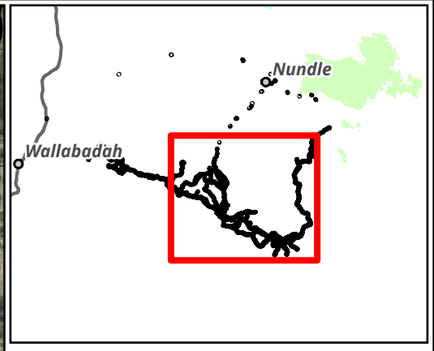


Figure 11 Schematic diagram of installation of acoustic bat detectors on meteorological masts

Additional on ground assessment of areas identified as potential microbat roost habitat was then undertaken between 29 March and 1 April 2021, by two experienced zoologist staff over 80 person hours. High priority areas were able to be visually inspected from the nearest accessible point. Due to the large size of the subject land, not all areas previously mapped as potential habitat were able to be ground-truthed, and a sampling approach was undertaken. However, suitable conclusions were able to be reached for all areas not visited on ground based on the results of the desktop assessment and extrapolation of ground observations across other areas of the development footprint. Further detail is provided in Section 5.4.2.



Legend

- Infrastructure footprint
- Transmission line
- Bird utilisation survey
- Owl call playback - Aug 2019
- Owl call playback - May 2020
- Sept 2022 targeted owl survey locations
- Koala SAT

TAMWORTH REGIONAL

UPPER HUNTER

Figure 12 Threatened fauna survey locations, Page 1

0 450 900 1,350 1,800

Meters

Scale: 1:50,000 @ A3

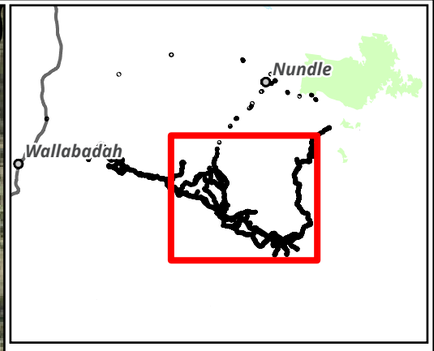
Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 26 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
Layout: 34963_F12_ThrFaunaSurvey
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_AM_v2.aprx

Acknowledgements: Basemap © Land and Property Information 2016, Imagery © Maxar



TAMWORTH REGIONAL

UPPER HUNTER

Legend

- Infrastructure footprint
- Transmission line
- Frog survey points - Mar 2020
- Frog survey point - Nov 2019

Microbat passive detector

- Met mast
- Ground level
- Microbat active transects

Figure 12 Threatened fauna survey locations, Page 2

0 450 900 1,350 1,800

Meters

Scale: 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 26 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
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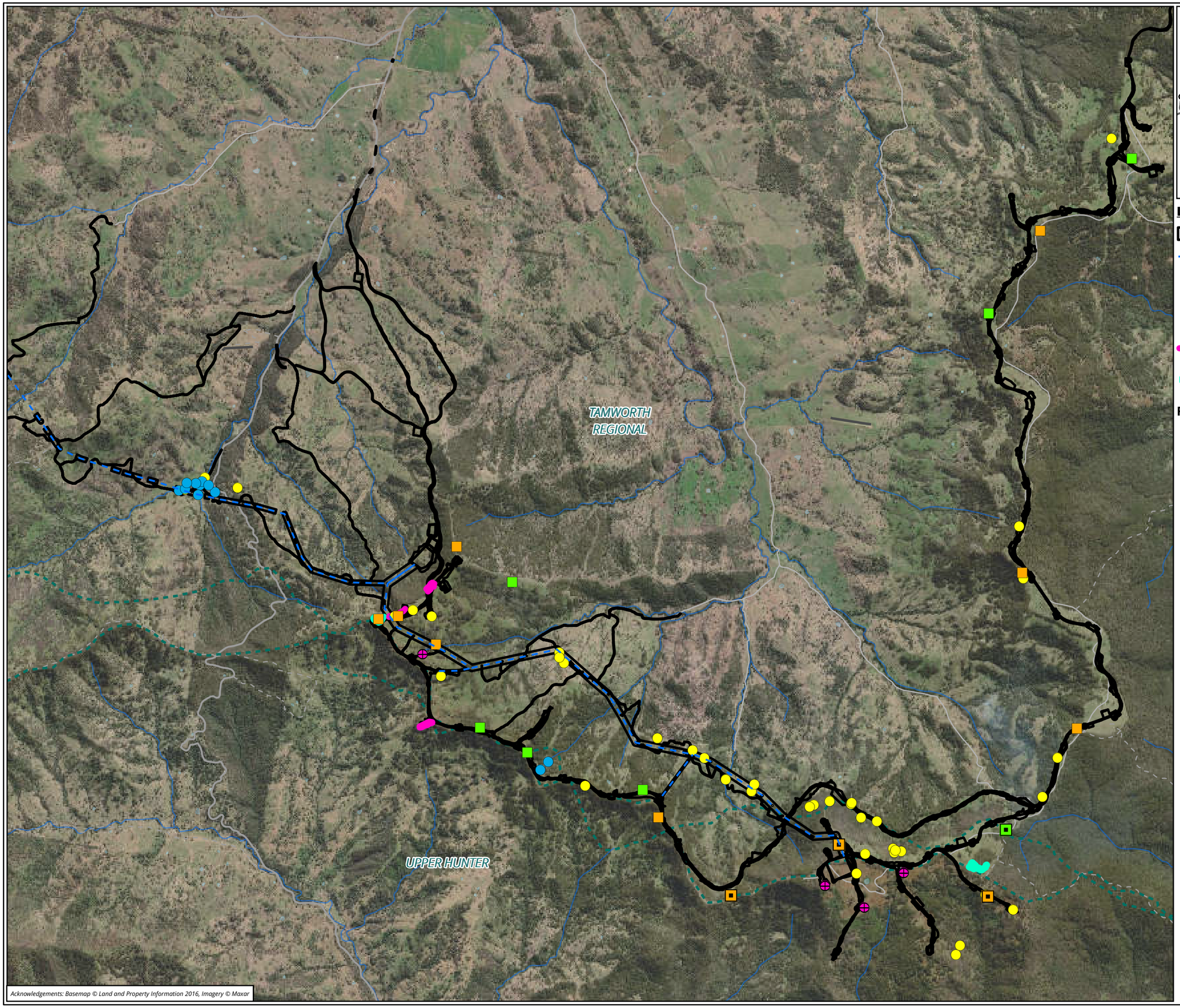
Acknowledgements: Basemap © Land and Property Information 2016, Imagery © Maxar



Legend

- Infrastructure footprint
- Transmission line
- Spotlighting - Nov 2019
- Habitat assessment
- Photopoint
- Spotlighting transect - Mar 2020
- Border Thick-tailed Gecko search - Mar 2020

Remote camera

- Arboreal
- Terrestrial
- Burnt (arboreal)
- Burnt (terrestrial)

Figure 12 Threatened fauna survey locations, Page 3

0 450 900 1,350 1,800

Meters

Scale: 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 26 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
Layout: 34963_F12_ThrFaunaSurvey
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_AM_v2.aprx

Acknowledgements: Basemap © Land and Property Information 2016, Imagery © Maxar

5.4 Threatened species results

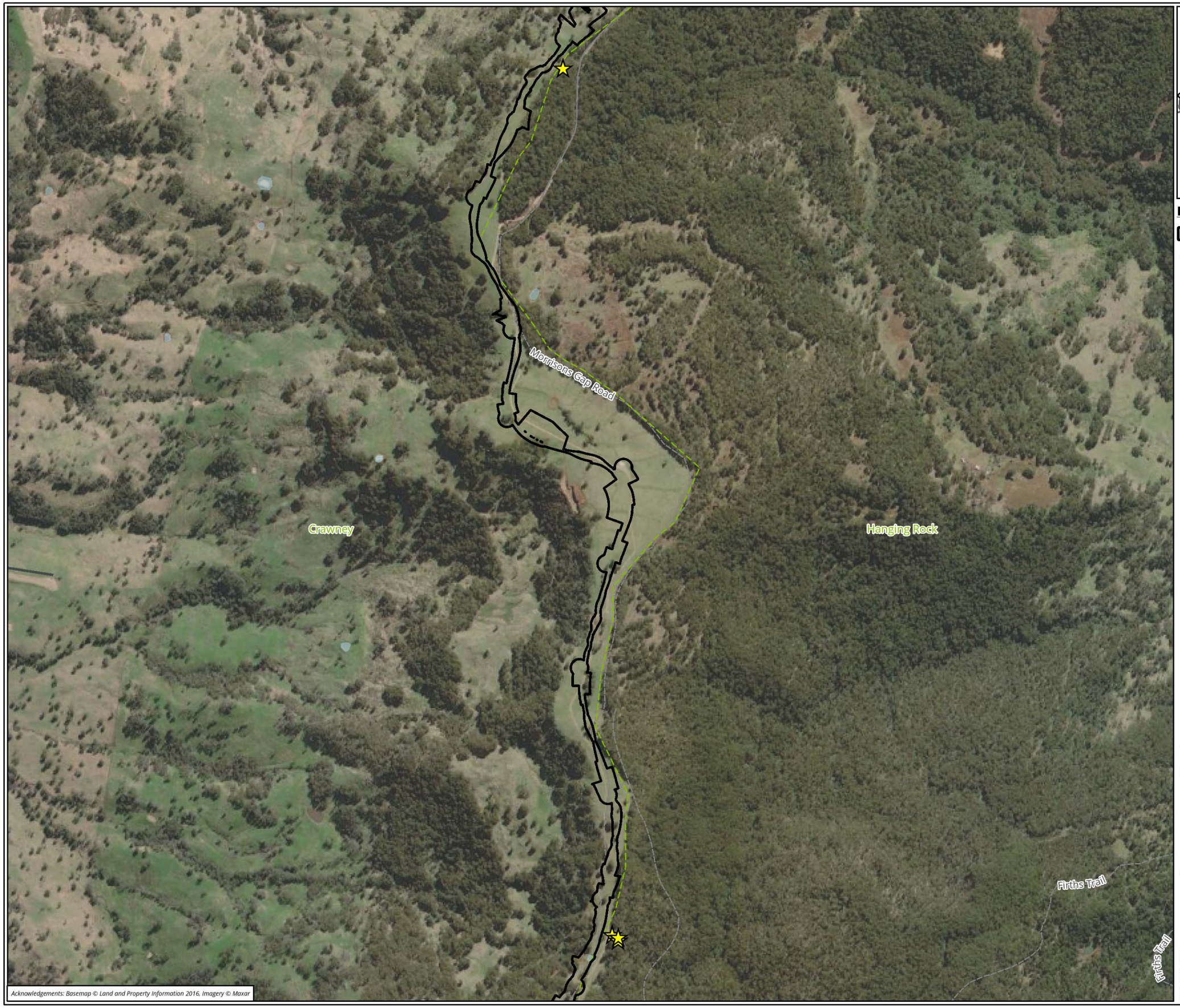
5.4.1 Threatened flora

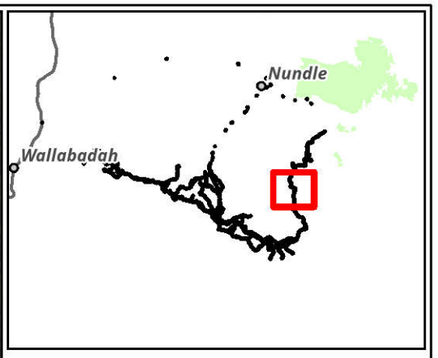
One threatened flora species, Broad-leaved Pepperbush *Tasmannia purpurascens*, was identified within the project area, as detailed in Table 37. The species was recorded in two locations adjacent to the north-eastern section of the wind farm infrastructure section of the development footprint, as shown in Figure 13. They were not recorded within the development footprint.

The northern-most record of this species was located in an area of PCT 934, with Messmate *Eucalyptus obliqua* as the dominant canopy tree and an open shrub cover with Broad-leaved Pepperbush being locally abundant in areas. The second, more southerly record for Broad-leaved Pepperbush was within an area of good quality PCT 1194 dominated by Snow Gum *Eucalyptus pauciflora* with a grassy understory and an open shrub layer. The development footprint avoids direct impacts to both of these recorded locations of Broad-leaved Pepperbush.

Table 37 Threatened flora identified in the assessment area

Scientific name	Common name	EPBC Act Status	BC Act Status	Count
Tasmannia purpurascens	Broad-leaved Pepperbush	-	V	10





Legend

- Infrastructure footprint
- Broad-leaved pepperbush

Figure 13 Threatened flora recorded during field surveys

0 150 300 450 600

Meters

Scale: 1:14,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 21 October 2022 ,
Prepared for: CW, Prepared by: AM, Last edited by: amackegard
Layout: 34963_F13_ThrFloraRecords
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_AM.aprx

5.4.2 Threatened fauna

Survey results - bird utilisation survey and diurnal bird survey

The raw data from all bird utilisation surveys, including survey location, species names, abundance, vertical and horizontal distances and flying directions are provided in the Collision Risk Model Report in Appendix D.

During the bird utilisation surveys, 51 bird species were recorded with 18 of these species recorded flying at the maximum rotor swept height of 230 metre (Table 38). During the bird utilisation surveys, 224 bird movements (flights) were recorded comprising 33 different bird species. Of the 224 flights recorded, 190 (or 85%) were recorded at between 5 and 20 metres vertical distance (height), indicating that the majority of bird activity within the development footprint will not be at risk of blade strike.

Table 38 Bird species recorded flying at rotor swept height

Common name	Species name
Brown Goshawk	*Accipiter fasciatus*
Galah	*Cacatua roseicapilla*
Nankeen Kestrel	*Falco cenchroides*
White-browed Treecreeper	*Climacteris affinis*
Australian Magpie	*Gymnorhina tibicen*
Yellow-tailed Black- Cockatoo	*Calyptorhynchus funereus*
Laughing Kookaburra	*Dacelo novaeguineae*
Red Wattlebird	*Anthochaera carunculata*
Spotted Pardalote	*Pardalotus punctatus*
Common Starling	*Sturnus vulgaris*
Rainbow Lorikeet	*Trichoglossus haematodus*
Crimson Rosella	*Platycercus elegans*
Little Wattlebird	*Anthochaera chrysoptera*
Pied Currawong	*Strepera graculina*
White-breasted Woodswallow	*Artamus leucorynchus*
Australian Raven	*Corvus coronoides*
Sulphur-crested Cockatoo	*Cacatua galerita*
Wedge-tailed Eagle	*Aquila audax*

In the interests of ensuring a conservative assessment, the impact assessment for bird collision risk assumes that all bird species that were recorded flying within the rotor swept height, even if only a single flight was recorded at this height. When the average flight heights are assessed, the majority of these 18 species were flying below the rotor swept height in most recorded flights (Figure 14).

The average flight heights shows that only four species have an average recorded flight height that is within the rotor swept height, including Australian Raven, Brown Goshawk, Wedge-tailed Eagle and White-breasted

Woodswallow. This indicates that for most flights, there are only a small number of native birds that are considered at risk of collision with turbines.

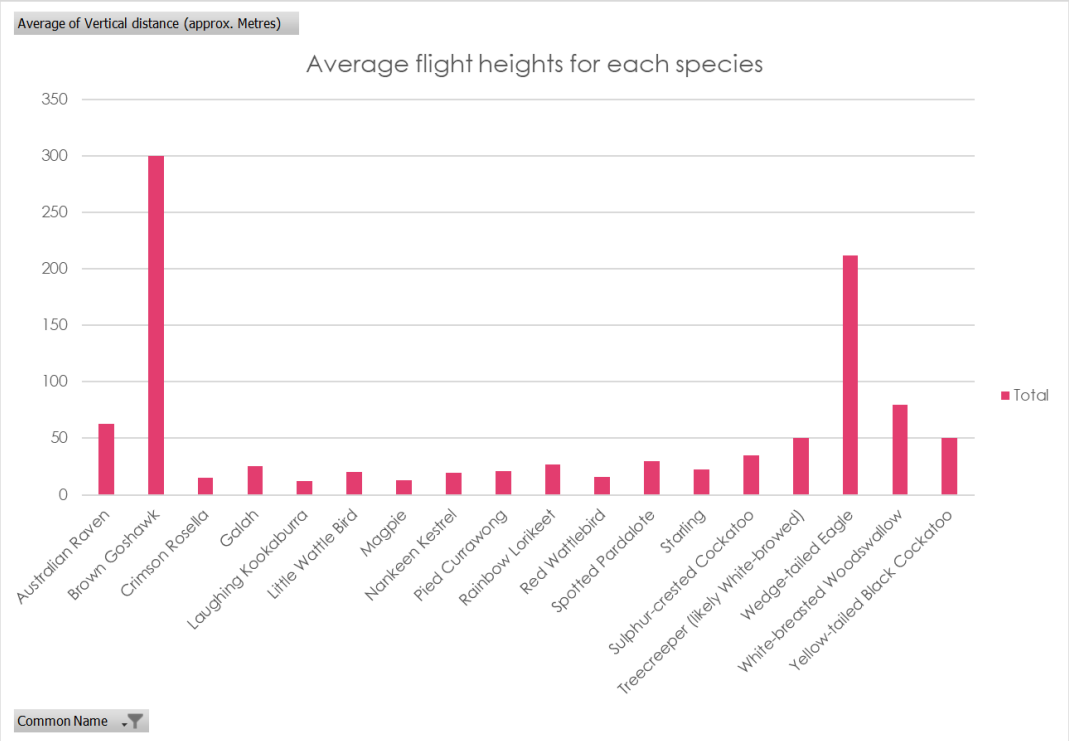


Figure 14 Average flight height for bird species recorded flying within rotor swept height

This list of 'at risk' species is based on flight height and number of observed movements. All of the birds considered most at risk of collision with turbines are listed as least concern under the NSW BC Act and are not listed as listed threatened species or migratory species under the EPBC Act.

Regarding other diurnal, winter-specific threatened bird species that were assessed as having the potential to occur in the subject land with Glossy Black Cockatoo *Calyptorhynchus lathami*, listed as vulnerable under the BC Act, were considered unlikely to utilise the site for breeding, but suitable locations for breeding and foraging were observed down slope of the western section of the wind farm transmission line development footprint. Despite survey during suitable seasons and climatic condition, no Glossy Black Cockatoos were observed.

There were no records of Little Eagle *Hieraaetus morphnoides* during the diurnal bird surveys and no stick nests were recorded, suggesting areas of suitable habitat were not currently being utilised for breeding. There were also no records of Swift Parrot *Lathamus discolour* during the diurnal surveys and there is also a lack of preferred foraging trees within the subject land. Swift Parrot breed in Tasmania from September to January, meaning breeding habitat for this species is not a consideration for this project and field surveys are sufficient to rule out presence as a foraging species.

Hollow-dependent birds and raptors

Areas of high densities of hollows, fallen timber large trees and an intact understorey were mapped as part of the PCT condition classification, with areas in high condition providing fauna habitat to be targeted for threatened bird surveys. These areas are generally the most intact in terms of vegetation structure, and as such likely represent the highest condition vegetation present. Initial targeted hollow-dependent bird and raptor surveys were completed between August 2019 and August 2020, during which time no raptor stick nests or threatened birds were observed within the development footprint.

During additional targeted owl habitat surveys undertaken between 30 May and 3 June 2022, the size of the development footprint, and additional 100 metre buffer surrounding that area, limited targeted habitat surveys to diurnal activities only, which were also hampered by inclement weather reducing visibility and making site access difficult and dangerous due to slippery conditions and fallen vegetation.

Feedback on Biosis' proposed survey methodology provided to BCS for comment prior to the commencement of the survey, stated that only when no breeding activity was detected could potential nest trees be discounted as habitat. With occupancy (breeding activity) surveys requiring that trees be surveyed at night via call-playback and stag watch surveys, with stag watches for each potential nest tree to occur over two consecutive nights. Again due to the size of the area to be surveyed and inclement weather nocturnal surveys were not able to be undertaken in May/June 2022.

As the field survey was limited to diurnal habitat searches, no potential habitat trees could be discounted based on a lack of occupancy, and thus all trees recorded with hollows greater than 20 centimetre diameter were considered potential habitat. No signs of use by the target owl species such as feathers, white-wash, pellets, bones, etc, were recorded at any potential nest trees during the survey, nor were any owls directly observed. This lack of evidence of use recorded during surveys, undertaken within the known and prescribed breeding season for each of the target owl species, suggests the trees are not in fact being utilised for breeding. This is also supported by the lack of recording of any owl species during targeted call play-back and spotlighting surveys completed at 7 separate survey sites undertaken over at minimum of two nights each, and four nights in total over two separate breeding seasons during the main field campaign undertaken during preparation of the BDAR.

A total area of approximately 360 hectares of potential habitat was able to be surveyed for the presence of suitable nest trees over the five day period in May/June 2022, with a total of 157 potential nest trees recorded within the area assessed.

It should be highlighted that the area of potential habitat is much greater than the likely area of habitat actually utilised by the target owl species. Home ranges of breeding individuals have been reported as; 255 hectares for Barking Owl (Taylor et al 2002, NPWS 2003), 350 hectares for Powerful Owl (Kavanagh 1997, DEC 2006), and at least 400 hectares for Masked Owl (DEC 2006), suggesting very few pairs would occur within, and surrounding, the subject land during breeding season. This then suggests that a commensurately low number of potential nest trees would be being used for breeding.

As nocturnal surveys were unable to be completed in May/June, surveys were completed in early September (as described above in Section 5.3.2), the results provided below.

Nocturnal bird surveys and spotlighting

During all initial targeted surveys undertaken for threatened owls completed during the main field campaign for the DAR, no response was detected for the species targeted, despite surveys being undertaken in areas considered to be good habitat for the species. Surveys for threatened owls was focused on areas within and adjacent to the development footprint.

Highest potential breeding habitat for large forest owls s considered to be present in the wetter forested gullies/drainage lines on the three "fingers" in the southern portion of the wind farm corridor. The majority of the site is considered less suitable for owl breeding due to a lack of sheltered gullies, existing disturbances associated with clearing and agricultural land use and highly edge-effected patches of vegetation.

It is noted that in undertaking a total of four nights of targeted call-playback surveys for forest owls during the major field campaign for the BDAR, the assessment was unable to meet the 90% probability requirement outlined in the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004 (DEC 2004) to exclude the species presence. It should be noted that based on

the size of the subject land, to meet the DEC (2004) minimum survey requirements, more than 30 sites (separated by approx. 1km) would be required to be surveyed up to 8 times. This was discussed with BCS and a varied methodology was agreed to progress surveys (as outlined above in Section 5.3.2).

Biosis previously modelled areas of highest potential breeding habitat for the target species within the subject land, as being related to deep undisturbed gullies, as generally supported by literature cited in the BDAR (Section 5.5), and the presence of owl breeding habitat (in accordance with the BAM) was assumed in these areas. However feedback received from BCS determined that additional potential breeding habitat, as defined by the TBDC, was required to be mapped and included in the species polygons if the species' presence was to be assumed.

Targeted habitat surveys (as outlined above) combined with nocturnal surveys were determined as the most suitable means to refine potential impacts and the update species polygons. This approach was consulted to BCS and the approach agreed in the context of the project characteristics.

The following results were recorded during targeted nocturnal surveys undertaken in early September 2022:

- Multiple pairs of Boobook *Ninox boobook* were calling consistently throughout the development footprint and were seen on most nights.
- One Barn Owl *Tyto alba* was recorded calling at the eastern end of the development footprint.
- One Masked Owl was recorded (on one occasion) at the western end of the development footprint (Figure 16). A single call as heard to the south of the development footprint (down slope) after the end of the stag-watch and prior to call playback.
- One hollow was observed as being utilised as a roost during rainy weather by a Nankeen Kestrel.
- One hollow suspected of being used by Boobook due to proximity of calling right at the end of dusk.
- Searches under and around hollows for whitewash/pellets did not detect any signs of owls. In addition, the vegetation was quite open in most places, having limited mid-storey to provide cover for roosting owls, no roosting owls were observed.
- No other owls were observed in any hollows observed or during spotlight surveys.

Multiple observations of non-threatened owl species during these surveys, both during stag-watches / hollow observations, spotlighting, and call playback provide confidence that had other threatened species of owl been present, they would have been detected during survey. The results of these surveys have been incorporated with previous surveys and have been used to refine the impacts to each species (and each species habitat polygons) down from the upper quantum of impact calculated (as requested by BCS) following targeted habitat surveys. Further information on calculation of impacts to threatened owls is provided in Section 5.5.

Table 39 below shows the threatened fauna that were detected during nocturnal surveys. A total of three threatened mammals, and one threatened bird were detected over all survey periods.

Table 39 Threatened fauna detected during spotlighting

Scientific name	Common name	EPBC Act status	BC Act status	Survey period identified
Phascolarctos cinereus	Koala	V	V	Stage 2 winter survey
Petauroides volans	Greater Glider	V	V	Stage 2 winter survey, Stage 2 spring survey

Scientific name	Common name	EPBC Act status	BC Act status	Survey period identified
Dasyurus maculatus	Spotted-tailed Quoll	V	V	Stage 2 winter survey (road kill individual)
Tyto novaehollandiae	Masked Owl	-	V	September 2022 surveys

Nocturnal frog surveys

During the field surveys no threatened frogs were recorded. Details of survey methods employed at each survey location and the results are provided in Table 40 below.

Table 40 Frogs identified during nocturnal frog surveys

Creek/Dam	Survey Methods	Results
HoGCP06	One 200m transect within windfarm development area, surveyed on two separate nights by two ecologists, call play back conducted along transect for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	No frogs found
HoGCP07	One 200m transect within windfarm development area, surveyed on two separate nights by two ecologists, call play back conducted along transect for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 1: 1x *Litoria verreauxii* (observed) Night 2: 1x *Litoria verreauxii* (observed)
HoGCP07g	Survey conducted around the perimeter of the dam on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 1: 2x *Litoria peronii* (heard) Night 2: 1x *Litoria peronii* (heard & observed)
HoGCP07h	Survey conducted around the perimeter of the dam on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	Night 1: 1x *Litoria verreauxii* (heard), several L. *verreauxii* tadpoles identified Night 2: 1x *Litoria verreauxii* (heard), several *L. verreauxii* tadpoles identified
HoGCP22 (Woodleys Ck)	One 200m transect within and immediately downstream of windfarm development area, surveyed on two	Night 1: 1x *Litoria peronii* (heard & observed)

Creek/Dam	Survey Methods	Results
	separate nights by two ecologists, call play back conducted along transect for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. --------- Survey conducted around the perimeter of large dam located upstream of transect on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*.	Night 2: 1x *Litoria peronii* (heard), 1x *Crinia signifera* (observed) -------- Night 1: 3x *Litoria peronii* (heard & observed) Night 2: Multiple Litoria peronii (heard), 4x *Litoria peronii* (observed), Multiple *Crinia signifera* (heard), 3x *Crinia signifera* (observed)
HoGCP24	Survey conducted around the perimeter of the pool on two separate nights by two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	No frogs found
HoGCP26	Survey conducted around the perimeter of the pool on one night two ecologists, call play back conducted during survey for all targeted frog species, boulders and rocks turned over targeting Tusked Frog *Adelotus brevis*. Tadpoles captured with non-abrasive net and photos taken for identification.	No frogs found

Microbats

Bat call analysis was completed from the data collected on the 25 separate detector units over a total of 257 'trap nights', ranging from between 2 nights to 38 nights per detector, with nearly 25,000 calls identified containing over 32,000 passes. Data analysis was undertaken across the temporal range of the survey period, with total 'trap nights' analysed per month including:

- November 2019 – 2 nights
- February 2020 – 49 nights
- March 2020 – 94 nights
- April 2020 – 87 nights
- May 2020 – 25 nights

Bat calls recorded were analysed using a combination of two separate call identification software programs, AnaScheme and Anabat Insight, due to the software requirements of the different detector units used in the survey.

Bat calls were identified to genus or species level using automated call identification software, AnaScheme (Adams et al. 2010) and a key developed for North-western NSW (unpublished data – K. Asplet and M. Gibson of Biosis). Calls with fewer than three valid pulses (i.e. minimum of six data points and model quality of >0.8) are not analysed by AnaScheme due to a paucity in data and are assigned as 'unknown'. Because multiple bat species may call simultaneously, calls were assigned to a single species only if > 50% of pulses within a sequence are assigned to that species, and only passes with a minimum of three pulses classified to the same species were identified. Lower frequency calls, such as those produced by Southern Myotis and Freetail bats, cannot be distinguished using AnaScheme, and lower frequency calls were manually identified. Long-eared bat calls are only able to be identified to genus, due to the linear nature of the calls produced.

Additional call analysis was undertaken using Anabat Insight software and relevant published reference call guides (Pennay, Law, & Reinhold 2004). Analysis was run through a custom decision tree created for the project, to remove noise (frequencies below 7kHz) and files/passes with less than three pulses (as above). The decision tree was then run using characteristic frequency and duration to identify calls to genus, or species level where possible. Calls identified by the system as significant or uncommon species were checked manually against visual comparison of sonograms with published reference calls by an experienced bat expert (Pennay, Law, & Reinhold (2004)), to ensure accurate results. In addition, a subset calls were chosen for manual vetting from each species/genus grouping for quality assurance of data.

Microbat acoustic survey results

Bat call activity was found to occur throughout the project area, with 28 species identified to species level from data recorded across 25 acoustic detectors deployed during field surveys (Table 41). The majority of the species recorded were not threatened species listed under the BC Act or the EPBC Act, with 20 least concern species detected.

A total of 28 species is considered to represent a high level of species diversity within the local microbat population. The species with the highest mean calls per night recorded across the site as a whole is the White-striped Freetail Bat *Austronomus australis*, a common bat found throughout most of Australia, with an average of 46.3 calls recorded per night of data analysed. Next most common species include Inland Free-tailed Bat *Ozimops petersi* at 14.3 calls per night and then the BC Act listed threatened species Large Bent-wing Bat *Miniopterus orianae oceanensis* with 10.3 calls detected per night of data analysed. These are considered to be relatively high levels of call activity for each species.

Generally, microbat species known to be dependent (or at least partially dependent) on caves for roosting were less commonly recorded than non-cave dwelling species with just three cave dependent/utilising species, Large Bent-wing Bat, Eastern False Pipistrelle *Falsistrellus tasmaniensis* and Little Pied Bat *Chalinolobus picatus* among the 14 most commonly recorded species. With the remaining five cave dependent/utilising species recorded, occurring at levels among the 14 least commonly recorded bats.

Table 42 provides details of the mean number of calls recorded per night, per species, per detector deployed across the project area. Mean calls per night provides an indication of microbat activity within project area and provides insight into the nature and make-up of the local bat population. Call data can be used to infer how microbats are utilising a site based on analysis of variables such as the time a call has been recorded, the presence of calls on detectors deployed at various elevations, and the presence and relative abundance of species' calls across a temporal scale. Analysis of call data does not allow for the size of a bat population to be determined as a single recorded call does not equate to an individual bat, as a single individual can be responsible for multiple calls recorded on a detector (or multiple detectors). This is a known limitation of acoustic surveys for microbats.

Additional analysis of a number of previous un-analysed nights of data has been able to be undertaken following agency responses. This has been done to provide further detail on the extent and nature of the microbat populations within project area. Furthermore, it should be noted that in re-analysing the microbat call data a small number of mathematical errors were realised and have been corrected. These relate largely to the calculation of mean number of calls per night / detector for the most commonly recorded bat species (White-striped Freetail Bat) during call data analysis, and the total number of nights' data analysed for the November 2019 Echometer transect survey.

Table 41 **Detailed summary of bat detector data listing mean number of calls per night per detector. Detectors were placed in a range of habitats around the Project Area to maximise diversity of bat species recordings in the area**

Species	Detector Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1-30m	MM1 - 60m	MM2 – 2m	MM2-30m	MM2-60m	MM3 – 2m	MM3-30m	MM3 – 60m	Nov 2019 Echometer transects
White-striped free-tailed bat *Austronomus australis*	25.73	173.00	48.43	116.00	1.00	14.33	27.00	25.10	13.50	20.50	5.67	3.00	31.50	56.50	141.25	88.25	38.50	20.72	42.71	111.61	62.19	60.00	37.75	33.97	5.00
Large-eared Pied Bat *Chalinolobus dwyeri #**	0.36	0.00	0.04	0.50	0.00	0.67	1.33	0.40	0.00	0.10	0.17	2.00	0.75	5.33	0.00	7.25	1.50	0.06	0.71	0.26	0.14	1.75	0.50	0.03	0.00
Gould's Wattled Bat *Chalinolobus gouldii*	14.36	14.75	9.14	6.50	0.75	6.33	9.67	13.80	17.20	3.80	15.17	7.00	9.00	27.00	5.50	15.50	4.00	2.25	1.14	6.76	2.05	4.50	3.50	2.97	1.00
Chocolate Wattled Bat *Chalinolobus morio*	0.09	10.00	0.32	8.00	0.00	3.50	6.50	0.10	0.40	0.60	0.33	2.00	6.25	24.00	5.75	7.00	0.17	0.00	0.14	0.32	0.10	2.00	5.25	0.30	0.50
Little Pied Bat *Chalinolobus picatus +**	1.00	4.00	0.11	12.50	0.25	5.67	14.50	1.10	0.00	0.00	0.00	8.00	3.75	5.17	5.00	15.50	5.00	0.16	1.00	0.00	0.33	2.50	2.50	0.18	0.00
Eastern False Pipistrelle *Falsistrellus tasmaniensis +**	9.64	0.50	1.07	0.00	0.00	0.50	0.00	9.00	7.70	4.20	0.50	0.00	0.00	2.17	1.25	0.00	0.17	1.06	0.57	5.03	0.38	0.00	0.00	1.85	1.00
Eastern Coastal Free-tailed Bat *Micronomus norfolkensis +*	30.91	0.00	0.00	0.00	0.00	0.00	0.00	32.10	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.39	1.29	0.00	0.00	0.15	0.00
Little Bent-winged Bat *Miniopterus australis #**	3.45	0.00	0.25	0.00	0.00	0.00	0.17	3.60	5.50	2.60	0.17	0.00	0.00	1.83	0.00	0.00	0.00	0.25	0.29	0.74	3.29	0.00	0.00	1.06	4.00
Large Bent-winged Bat *Miniopterus orianae oceanensis #**	17.18	19.75	14.32	49.00	0.00	11.83	20.83	15.90	3.50	6.00	1.33	0.00	4.50	14.33	27.50	18.00	3.83	1.63	3.14	13.89	0.24	1.25	2.25	1.39	7.00

Species	Detector Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1-30m	MM1 - 60m	MM2 – 2m	MM2-30m	MM2-60m	MM3 – 2m	MM3-30m	MM3 – 60m	Nov 2019 Echometer transects
Southern Myotis *Myotis macropus #**	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lesser Long-eared Bat *Nyctophilus geoffroyi*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Nyctophilus* sp.**	5.45	2.00	1.75	3.00	0.00	0.67	0.50	5.00	2.60	2.30	0.33	0.00	2.50	4.17	0.75	0.25	0.33	0.19	0.29	8.24	0.38	0.00	0.00	0.27	0.50
Northern Free-Tailed Bat *Ozimops lumsdenae*	0.00	0.75	0.46	0.00	0.00	0.00	0.00	0.00	2.80	0.10	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.25	0.29	1.66	0.00	0.25	0.75	1.79	0.00
Inland Free-tailed Bat *Ozimops petersi*	0.00	50.50	0.00	15.50	0.00	7.00	51.67	0.00	0.00	0.00	1.50	0.00	64.50	22.00	67.50	26.50	14.00	0.00	2.43	0.00	0.00	18.50	30.00	0.00	0.00
South-eastern Free-tailed Bat *Ozimops planiceps*	0.00	8.00	0.00	2.00	1.75	10.50	4.33	0.00	0.00	0.00	1.33	0.00	11.50	16.00	1.25	3.75	1.67	0.00	0.29	0.00	0.00	0.25	0.75	0.00	0.00
Ride's Free-Tailed Bat *Ozimops ridei*	0.09	0.00	3.82	0.00	0.00	0.00	0.00	0.10	0.80	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.59	0.00	1.71	0.10	0.00	0.00	5.48	0.50
Golden-tipped Bat *Phoniscus papuensis*	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smaller Horseshoe Bat *Rhinolophus megaphyllus **	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.30	0.00	0.00	0.00	0.00	0.17	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris*	0.00	0.00	0.82	12.00	0.00	1.67	4.33	0.00	0.50	0.10	2.83	0.00	0.00	3.33	0.00	1.75	7.00	0.13	2.71	0.55	0.33	0.25	0.00	0.76	1.50

Species	Detector Number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	MM1 – 2m	MM1-30m	MM1 - 60m	MM2 – 2m	MM2-30m	MM2-60m	MM3 – 2m	MM3-30m	MM3 – 60m	Nov 2019 Echometer transects
Greater Broad-nosed Bat *Scoteanax rueppellii*	19.91	0.00	0.86	0.50	0.00	0.00	0.00	18.20	9.00	1.00	1.33	0.00	0.00	0.50	0.00	0.00	0.00	1.91	0.43	6.53	1.71	0.00	0.00	1.85	1.50
Scotorepens balstoni	0.00	0.25	0.00	0.00	0.25	0.00	0.17	0.00	0.00	0.00	0.83	0.00	0.00	0.83	0.00	0.00	0.17	0.00	0.43	0.00	0.00	0.25	0.00	0.00	0.00
Scotorepens greyii	3.09	13.00	5.25	6.00	0.00	2.83	15.67	3.20	0.20	0.30	0.17	0.00	4.00	9.67	5.25	3.50	0.67	6.00	1.57	26.92	0.38	1.25	0.50	1.91	5.00
Scotorepens orion	0.00	0.00	5.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vespadelus darlingtoni	5.18	9.25	8.00	0.00	0.00	0.83	10.67	5.20	7.80	4.10	0.67	0.00	9.50	8.50	7.50	0.00	0.50	0.03	0.14	0.37	0.14	0.50	0.00	0.61	1.00
Vespadelus regulus	0.00	4.75	0.04	32.00	0.00	7.17	12.67	0.00	0.00	0.00	1.17	0.00	0.25	1.83	0.50	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00
***Vespadelus* sp.**	0.00	0.00	0.00	0.50	0.00	0.00	2.50	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	4.50	0.17	0.00	0.00	0.00	2.14	1.25	0.25	0.00	0.00
Eastern Cave Bat *Vespadelus troughtoni #**	0.00	0.25	0.00	0.00	0.00	0.83	7.83	0.00	0.00	0.00	0.00	0.00	0.50	2.17	0.25	1.00	0.33	0.00	0.00	0.00	0.00	1.75	0.00	0.00	0.00
Vespadelus vulturnus	0.55	0.00	0.93	40.00	0.00	11.17	20.83	0.50	0.70	0.10	0.83	0.00	2.00	7.33	9.25	4.00	7.33	0.00	2.71	0.00	0.00	2.25	3.50	0.42	0.00

Assessment of microbat activity at different elevations

Acoustic detectors were deployed at varying elevations on meteorological masts (met masts) across the project area to allow for the relative abundance of microbat species flying at different heights to be determined. This analysis is critical to determine the potential impacts of the project with regards to blade strike and possibly barotrauma.

Acoustic detectors deployed at ground level were most common and comprise 19 of the 25 detectors deployed. Ground level detectors were found to have recorded similar results to the project area as whole, with the top three species recorded (based on mean calls per night) including White-striped Freetail Bat, Inland Free-tailed and Large Bent-winged Bat, with non-cave dependent species again more frequently recorded. For detectors mounted on met masts at canopy height (three detectors at approximately 30 metres above the ground) White-striped Freetail Bat and Inland Free-tailed Bat were again the most common, with *Scotorepens greyii* the third most commonly recorded, and Large Bent-winged Bat fourth ranked. Most commonly recorded species flying above canopy (three detectors deployed approximately 60 metres above the ground) again include White-striped Freetail Bat and *Scotorepens greyii*, with Ride's Free-Tailed Bat *Ozimops ridei*, Gould's Wattled Bat *Chalinolobus gouldii* and the BC Act listed Greater Broad-nosed Bat *Scoteanax rueppellii* among the top five most commonly recorded species. It should be noted that the mean number of calls for White-striped Freetail Bat at 60 meters elevation is far greater than the next most common species with a mean of 39 calls recorded per night of data analysed, compared to the next most common species with a mean of 2.8 calls per night.

Other BC Act and/or EPBC Act listed threatened species recorded by the detectors deployed at above canopy height (60 metres), and thus within the expected rotor swept area include:

- Little Bent-winged Bat *Miniopterus australis* – Mean of 1.5 calls recorded per night.
- Eastern False Pipistrelle– Mean of 1.1 calls recorded per night.
- Large Bent-winged– Mean of 1.1 calls recorded per night.
- Eastern Coastal Free-tailed Bat *Micronomus norfolkensis* – Mean of 0.6 calls recorded per night.
- Yellow-bellied Sheathtail-bat Saccolaimus flaviventris – Mean of 0.4 calls recorded per night.
- Little Pied Bat – Mean of 0.2 calls recorded per night.
- Large-eared Pied Bat *Chalinolobus dwyeri* – Mean of 0.1 calls recorded per night.

Of the 28 species recorded across the site, 23 were recorded by detectors mounted on meteorological masts at canopy height (30 metres), and 19 recorded at the above canopy level (60 metres). A total of eight species recorded at the above canopy level were recorded with a mean of more than one call per night of analysed data, seven species were recorded with a mean of between 0.7 calls per night and 0.2 calls per night, and the remaining four species were recorded as having a mean of 0.1 calls per night.

There is a general trend for reduced activity levels with increased elevation with ground detectors averaging a total of 130.3 mean calls per night, detectors deployed at 30 metres averaging a total of 107.5 mean calls per night, and detectors deployed at 60 metres averaging a total of 56.0 mean calls per night. Table 42 and Table 43 provide a comparison of total mean activity across the paired detectors deployed at each of the three met masts and illustrates the decrease in activity at higher elevations.

Table 42 Mean calls per night on met mast deployed detectors

Met mast location	2m height	30m height	60m height
MM1	193.8	85.7	37.6

Met mast location	2m height	30m height	60m height
MM2	61.0	185.0	75.2
MM3	98.5	87.5	55.2
Averages	117.8	119.4	56.0

Table 43 Mean calls per night on met mast deployed detectors White-striped Freetail Bat removed

Met mast location	2m height	30m height	60m height
MM1	109.5	47.2	16.9
MM2	18.3	73.4	13.0
MM3	38.5	49.8	21.2
Averages	55.4	56.8	17.0

The above tables also illustrate that with White-striped Freetail Bat included in the analysis, the activity at 60 metres elevation is approximately half that recorded below canopy and at canopy height, whereas with the species removed the relative activity level at 60 metres falls to approximately one third of that closer to the ground. This illustrates that not only is White-striped Freetail Bat the most commonly recorded species across the project area, it is also contributing to a higher proportional representation of the species abundance higher in the air column. Furthermore, it should be noted that White-striped Freetail Bat has a loud, low frequency call that is likely to be recorded from further away, so the detectors are likely to be recording this species from a larger volume of air than for other species.

When the results of the bat detectors installed on met masts are reviewed for the threatened microbats, there is also a similar trend for the majority of species having decreased activity at rotor swept height (Table 44). Generally, activity of the threatened bats at the 60m height was found to be low, with the highest number of mean calls per night recorded being 3.3 for Little Bent-winged Bat. The majority of threatened bats detected recorded less than 1 mean calls per night at each detector installed at 60 metres, with Southern Myotis and Eastern Cave Bat absent from the data at this elevation. The highest activity at met mast sites, based on mean calls of 17.3 (Large Bent-winged Bat) and 15.3 (Little Pied Bat) per night, were recorded at the ground level (2 metre height).

The BC Act and EPBC Act listed Large-eared Pied Bat showed a marked reduction in the mean number of calls per night with increasing height. The species mean nightly activity across all ground deployed detectors was found to be 0.7 calls per night, 0.6 calls per night across detectors deployed at canopy height and less than 0.1 calls per night at 60 metres elevation. A very similar trend was observed for the Little Pied Bat. This suggests that bats of this genus (*Chalinolobus* spp.) prefer to forage below canopy height.

The two bent-wing bat species belonging to the genus *Miniopterus*, Greater Broad-nosed Bat and Eastern False Pipistrelle recorded the highest nightly mean calls at the 60 metres height. These species are known to forage above the canopy and for most of the met mast sites there was a greater number of mean calls per night detected at the 30 metres detector height.

Large Bent-winged Bat was the most commonly recorded threatened species with a mean of 10.3 call per night across all detectors. The highest mean nightly calls were recorded at Site 4 with 49 calls per night, this is however only based on data captured for two nights, in late February / early March, with the majority of other detectors recording between 6 and 27.5 calls per night. The species was recorded at all but two sites, with sites representing highest activity spread throughout the development footprint. The species was recorded

with highest levels of activity on detectors deployed at ground level, with a mean of 12.39 calls per night, activity was seen to decrease at canopy level by approximately half with a mean of 6.66 calls per night recorded, and activity fell further again at the above canopy (60 meter) elevation where the species was recorded on average at 1.09 calls per night.

Table 44 provides details of all threatened species of microbats and the relative activity at different elevations based on data from paired detectors deployed on met masts. As is the case with Large-eared Pied Bat and Large Bent-winged Bat, activity can be seen to generally decrease with increasing elevation for the majority of species.

Notable exceptions to this, based solely on met mast data are Little Bent-winged Bat, Greater Broad-nosed Bat and Eastern Coastal Free-tailed Bat.

When data collected across the site as a whole is considered Little Bent-winged Bat, it is found to be more active at ground level with 1.15 mean nightly calls, and at above canopy height with 1.53 mean nightly calls recorded, and least active at the canopy level with only 0.25 mean nightly calls recorded. Greater Broad-nosed Bat and Eastern Coastal Free-tailed Bat show the more common trend of decreasing levels of activity with increasing elevation, with calls most commonly recorded at ground level and to a lesser degree at canopy and above canopy levels.

Table 44 Mean calls per night for threatened microbats detected at paired met mast locations

Threatened species	MM1			MM2			MM3		
	2m	30m	60m	2m	30m	60m	2m	30m	60m
Chalinolobus dwyeri* #	7.25	1.50	0.06	0.71	0.26	0.14	1.75	0.50	0.03
Chalinolobus picatus* +	15.50	5.00	0.16	1.00	0.00	0.33	2.50	2.50	0.18
Falsistrellus tasmaniensis* +	0.00	0.17	1.06	0.57	5.03	0.38	0.00	0.00	1.85
***Micronomus norfolkensis* +**	0.00	0.00	0.38	0.00	0.39	1.29	0.00	0.00	0.15
Miniopterus australis* #	0.00	0.00	0.25	0.29	0.74	3.29	0.00	0.00	1.06
Miniopterus orianae oceanensis* #	18.00	3.83	1.63	3.14	13.89	0.24	1.25	2.25	1.39
Myotis macropus* #	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
***Saccolaimus flaviventris*+**	1.75	7.00	0.13	2.71	0.55	0.33	0.25	0.00	0.76
***Scoteanax rueppellii*+**	0.00	0.00	1.91	0.43	6.53	1.71	0.00	0.00	1.85

Threatened species	MM1			MM2			MM3		
	2m	30m	60m	2m	30m	60m	2m	30m	60m
Vespadelus troughtoni* #	1.00	0.33	0.00	0.00	0.00	0.00	1.75	0.00	0.00

This above data suggests that whilst the majority of species present within the subject land will occur most frequently below canopy or at canopy height, there is also a high number of species, both threatened and non-threatened, that will on occasion fly higher and may be at risk of collision with turbine blades during the operational phase of the wind farm.

Assessment of potential roosting or foraging activity

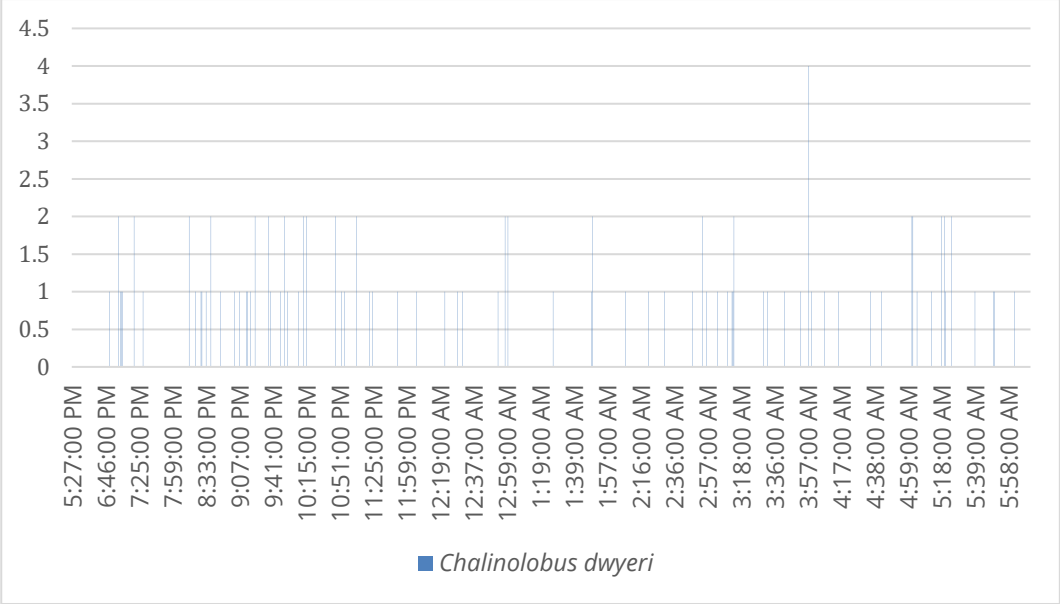
To further determine the nature of the microbat population recorded within the development footprint, analysis of the times calls were recorded has been undertaken. The aim of this analysis is to provide insight into the likelihood of the development footprint and the immediately surrounding landscape to support bat roosts, or whether the microbats recorded on site are travelling form roosts located away from the development to forage. It could be expected that if bats were roosting in close proximity to the development footprint, calls would be consistently clustered towards sunset and sunrise times, when bats are entering/exiting the roost for nocturnal forage activity. Furthermore, if the microbats present within the project area are roosting further from the site, and traveling some distance through the landscape to forage, calls would generally be clustered later into the night.

Table 45 provides times for sunset, end of twilight and sunrise as provided by https://www.timeanddate.com/ for Nundle in 2020.

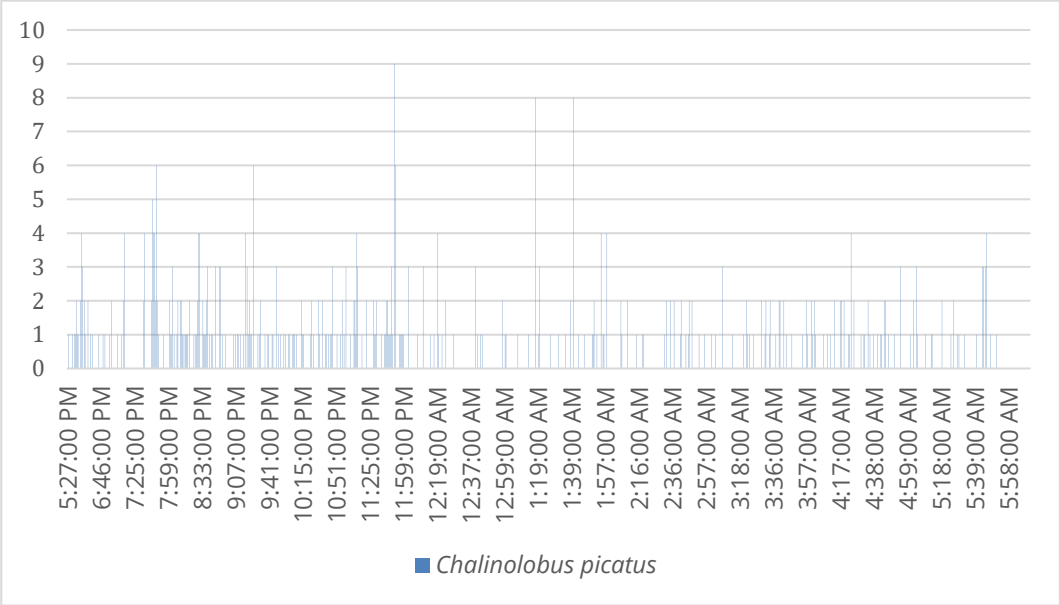
Table 45 Sunset, twilight and sunrise times for February to May 2020

Month	Sunset	End of twilight	Sunrise
February	7:55pm – 7:30pm	8:23pm – 7:55pm	6:20am – 6:44am
March	7:29pm – 6:52pm	7:54pm – 7:17pm	6:45am – 7:06am
April	6:51pm – 5:19pm	7:15pm – 5:44pm	7:06am – 6:25am
May	5:18pm – 5:00pm	5:43pm – 5:26pm	6:26am – 6:45am

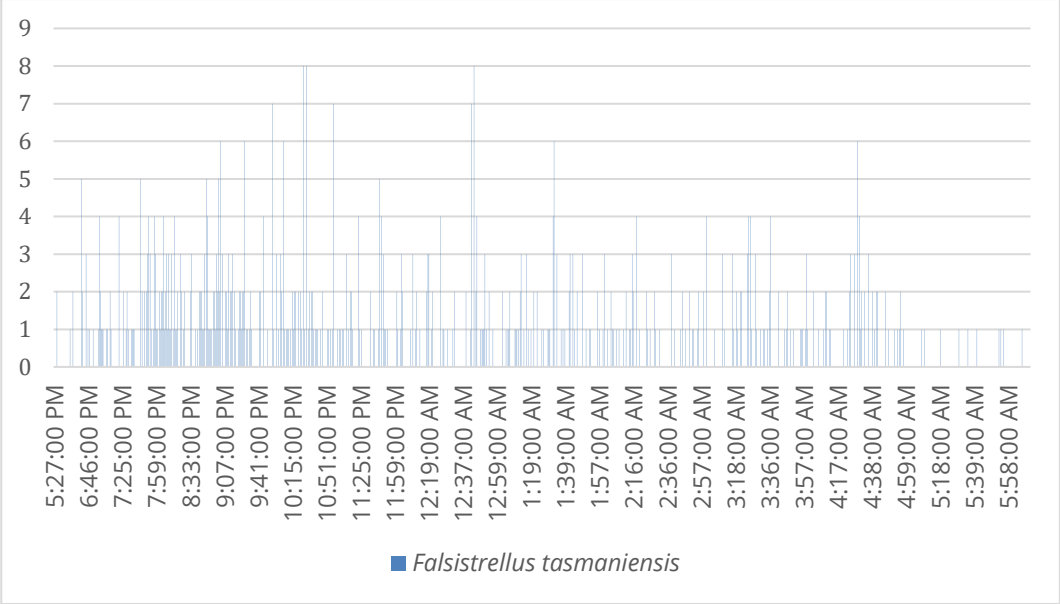
The following graphs have been prepared using the time-stamped call data collected between February and May 2020 and are provided to illustrate the time of night various species of microbats were found to be active within the project area. The first set of graphs relates to cave dependent/utilising species.



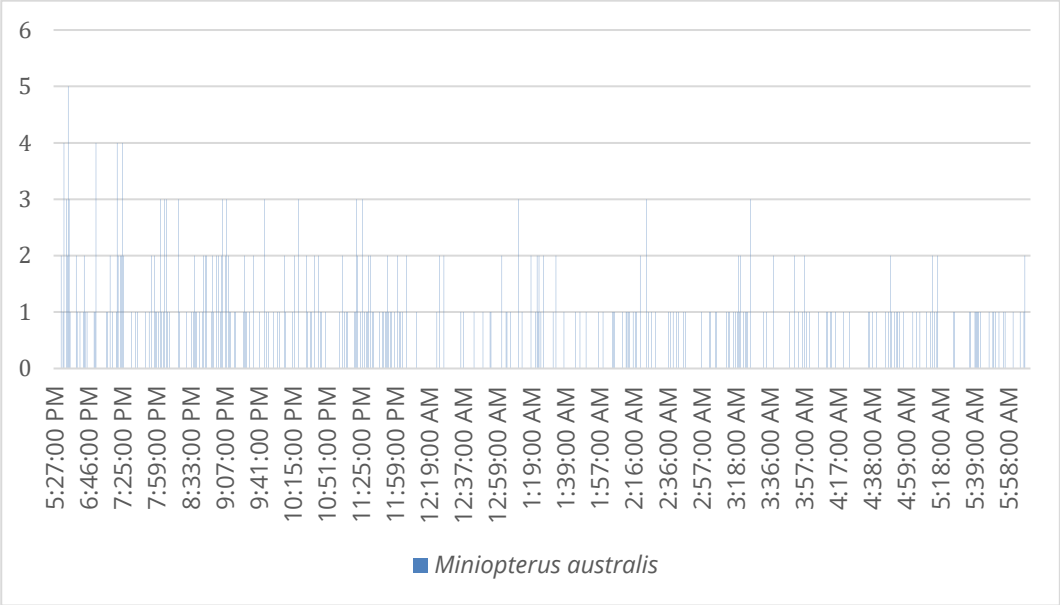
Graph 1 Time range and total number of calls recorded for Large-eared Pied Bat



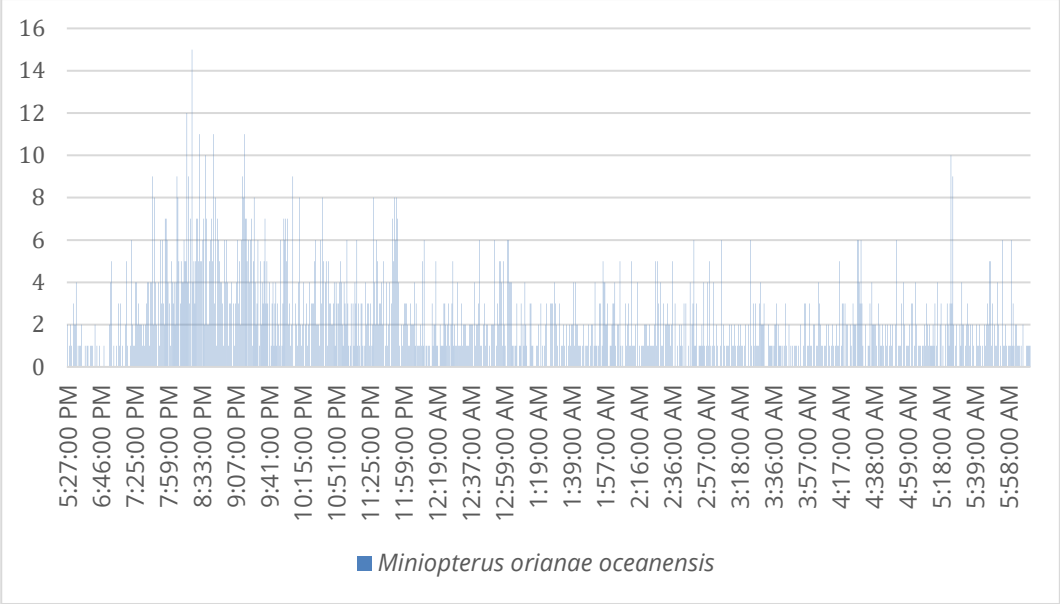
Graph 2 Time range and total number of calls recorded for Little Pied Bat



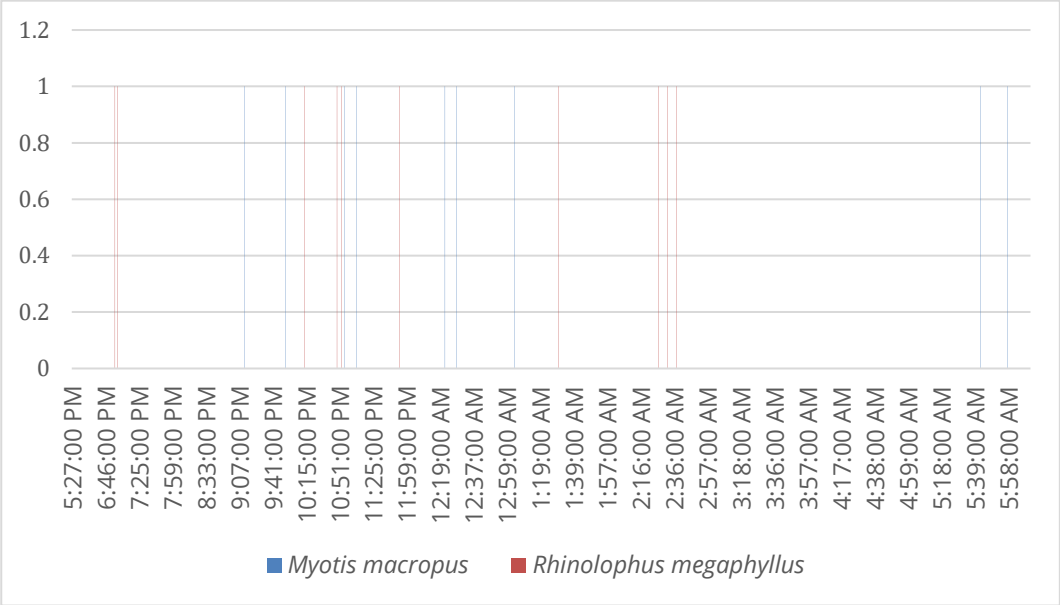
Graph 3 Time range and total number of calls recorded for Eastern False Pipistrelle



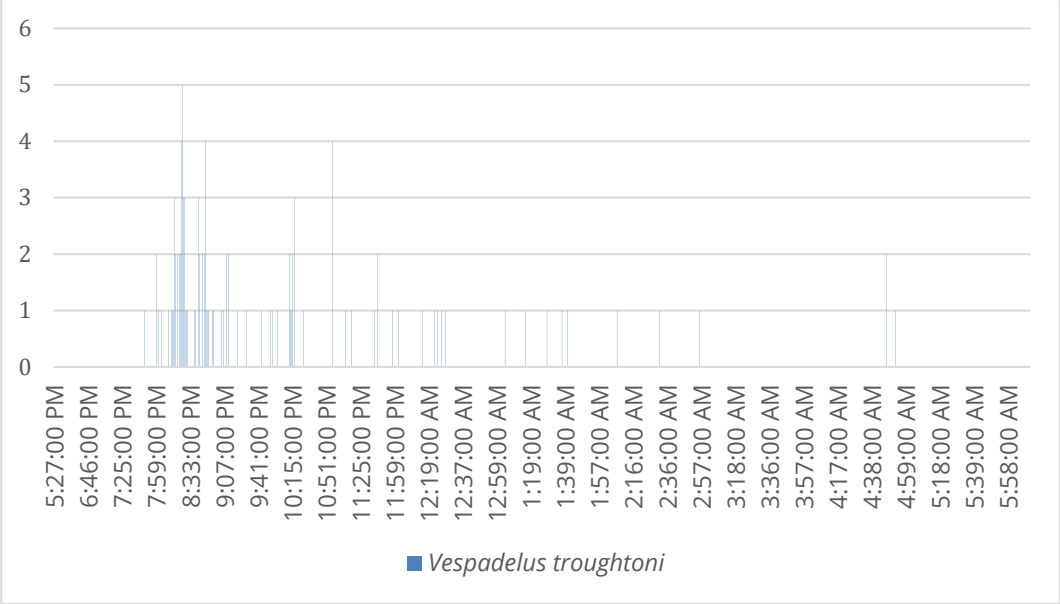
Graph 4 Time range and total number of calls recorded for Little Bent-winged Bat



Graph 5 Time range and total number of calls recorded for Large Bent-winged Bat



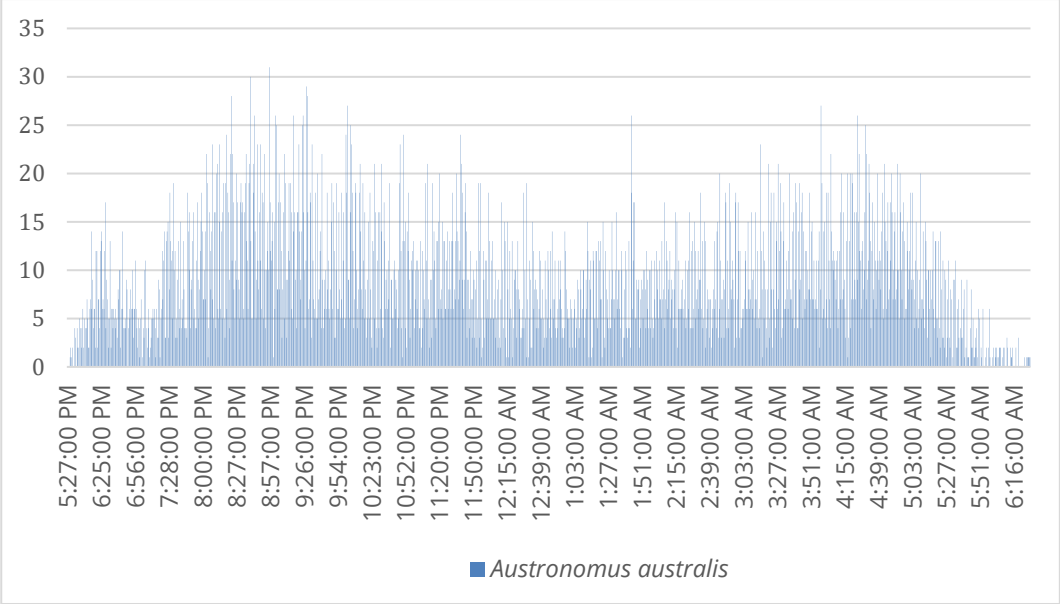
Graph 6 Time range and total number of calls recorded for Southern Myotis and Smaller Horseshoe Bat



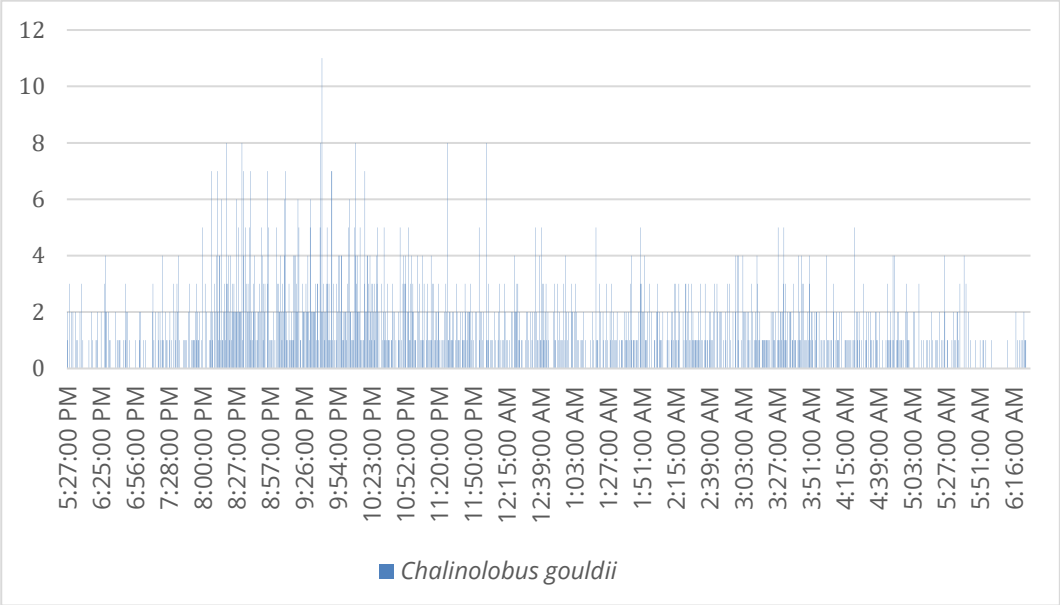
Graph 7 Time range and total number of calls recorded for Eastern Cave Bat

Based on the above graphs of time and number of calls recorded within the project area for cave dependent species, there appears to be a correlation for both Little Bent-winged Bat and Large Bent-winged Bat being commonly recorded on site between 5:30pm and 7:15pm for Little Bent-winged Bat, and 7:15pm and 9:25pm for Large Bent-winged Bat. Whilst this data suggests bats are arriving on site around sunset and end of twilight, the highest number of calls for Large Bent-winged Bat can be seen to be after 8:00pm, well after the end of twilight for the majority of the survey period. Furthermore, other than a total of five additional calls occurring before 7:30pm, call activity for Little Bent-winged Bat is relatively consistent through until 12:00am. Both species' high proportion of calls earlier in the night suggest they may be roosting close by, and only traveling a short distance to the site. This is supported by the presence of the known non-maternity roost for the species at Timor Caves, approximately 5 kilometres to the south of the project area. Both species are commonly recorded throughout the rest of the night, with Large Bent-winged Bat calls showing another minor increase closer to sunrise. Little Pied Bat, Eastern False Pipistrelle and Eastern Cave Bat calls also show some correlation towards the sunset / end of twilight time range however the trends are less apparent.

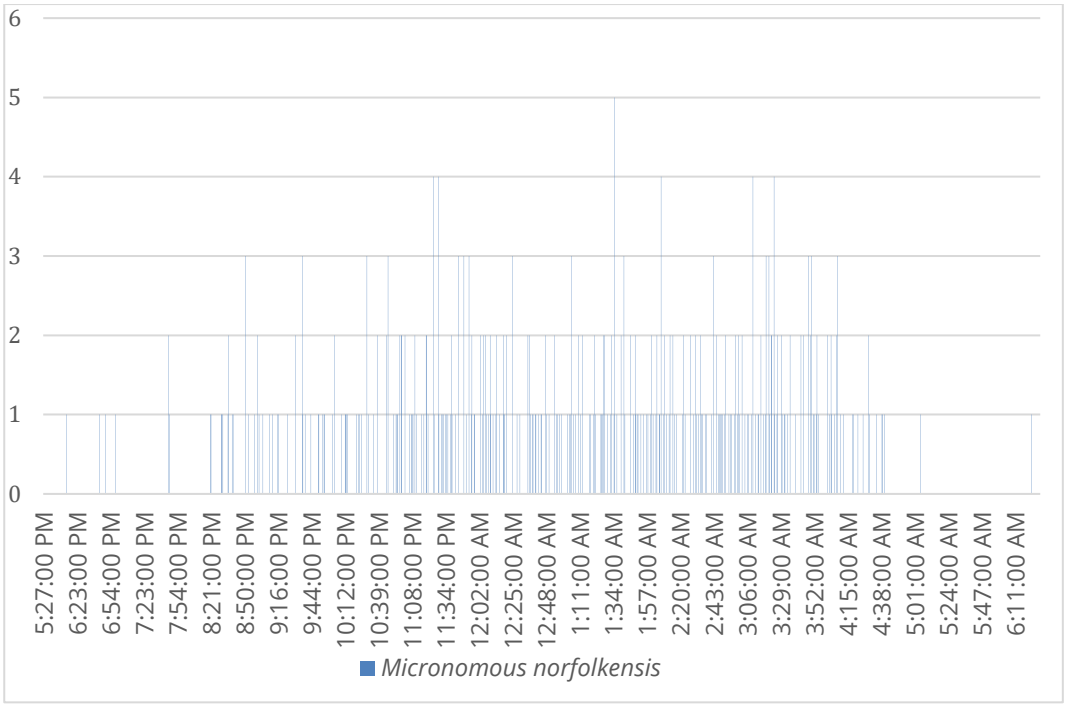
The following graphs provide comparable data for the three most common non-cave dependent microbat species and the remaining three threatened species (non-cave dependents) recorded within the project area.



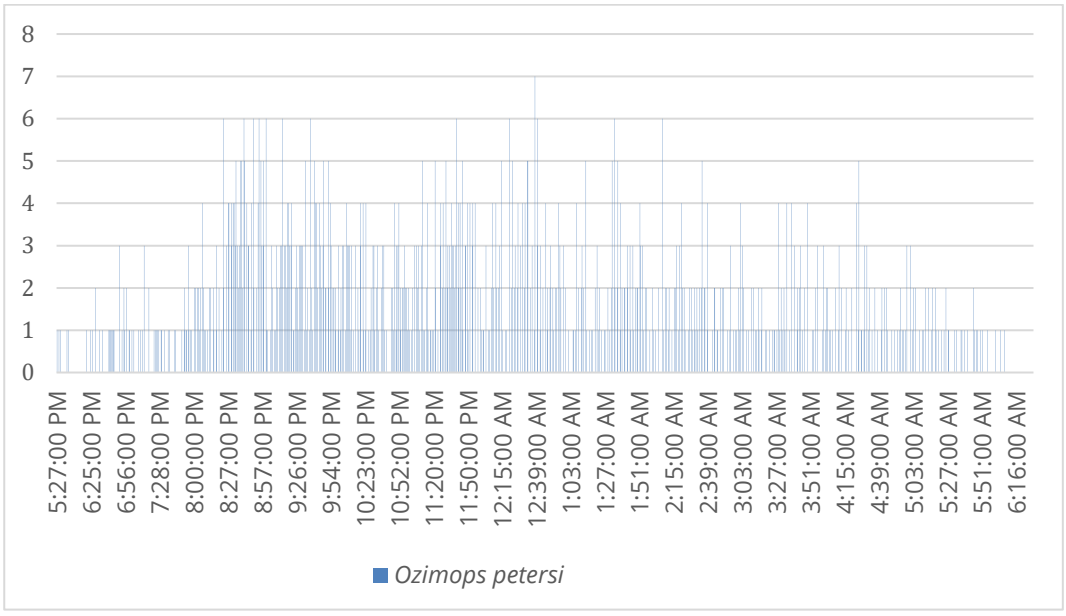
Graph 8 Time range and total number of calls recorded for White-striped free-tailed bat



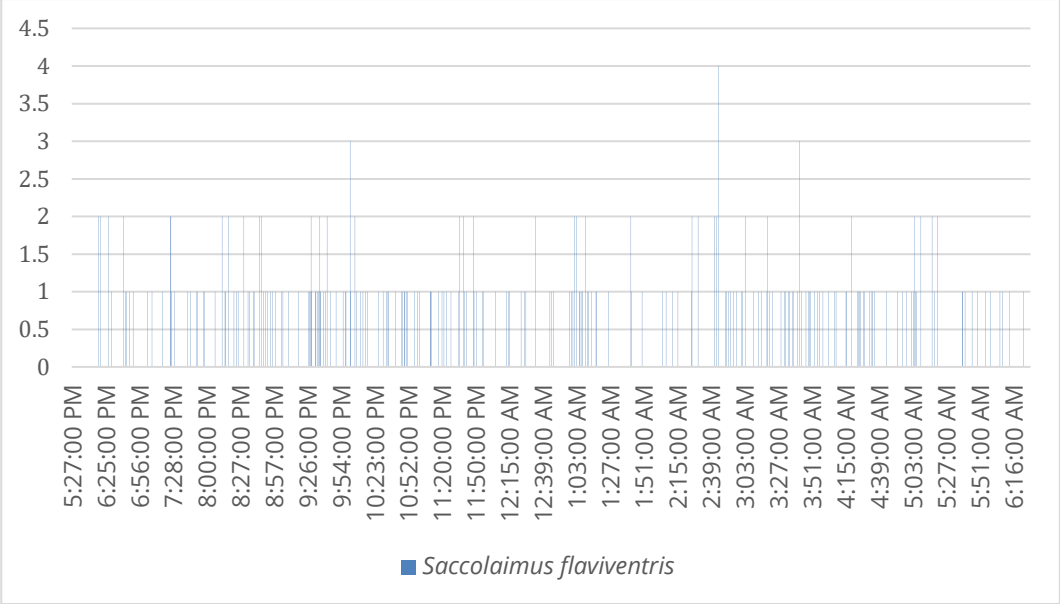
Graph 9 Time range and total number of calls recorded for Gould's Wattled Bat



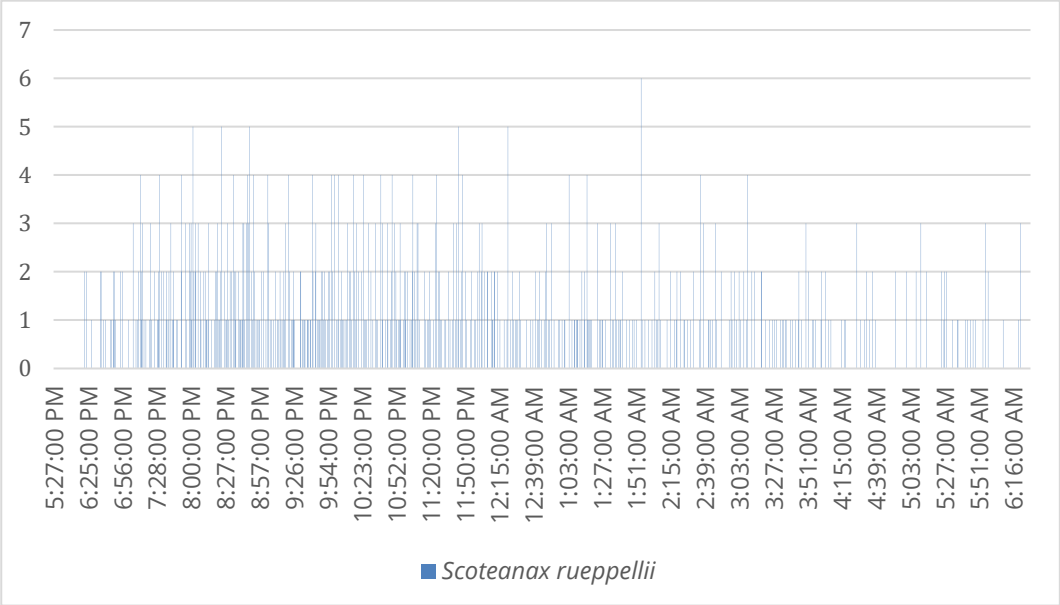
Graph 10 Time range and total number of calls recorded for Eastern Coastal Free-tailed Bat



Graph 11 Time range and total number of calls recorded for Inland Free-tailed Bat



Graph 12 Time range and total number of calls recorded for Yellow-bellied Sheath-tailed Bat



Graph 13 Time range and total number of calls recorded for Greater Broad-nosed Bat

Two of the non-cave dependent bats, the threatened Eastern Coastal Free-tailed Bat and non-threatened Inland Free-tailed Bat, are clearly more active within the project area during the later stages of the night suggesting roosting is occurring elsewhere. Timing of calls recorded for Gould's Wattled Bat and the threatened Great Broad-nosed Bat are somewhat clustered towards the start of the night with most activity found to be occurring between 8:00pm and 9:00pm, however there are also calls reasonably consistently recorded across the remainder of the night. Yellow-bellied Sheath-tailed Bat show no real trend in time of call, with numbers of calls recorded remaining consistent across the night.

The most common bat species recorded during the survey, White-striped Free-tailed Bat, shows a correlation for being recorded on site most commonly between 7:00pm and 10:30pm and again between 3:00am and 5:30am, which suggests roosting may be occurring in the vicinity of the site. However, calls are skewed somewhat away from both sunset / end of twilight and sunrise suggesting roosting may not be within the

immediate surrounds. The species is known to roost in tree hollows and an abundance of this habitat type is present within the development footprint and the landscape immediately surrounding, and further afield from, the project area.

Based on the analysis of the time ranges that species' calls were recorded, it is concluded that whilst some species, including Large Bent-winged Bat, Little Bent-winged Bat and White-striped Free-tailed Bat, are arriving on site during the early parts of the night, there is no clear evidence to suggest that regularly utilised roosts are present within the development footprint or immediate surrounds. The presence of potential cave roosts is discussed further below, and as outlined above the potential for tree roosts supporting White-striped Free-tailed Bat exists, however there is an abundance of potential tree roosting habitat throughout the broader landscape.

Assessment of potential breeding activity

Another limitation of acoustic surveys for microbats is the lack of ability to confirm the presence of breeding status of the bats present within the project area. To confirm the presence of breeding activity bats must be trapped and checked for signs of breeding such as attached juvenile bats or lactation. Largely due to the size and inaccessible nature of the development footprint, as well as the wide-spread potential for possible roost habitat, trapping surveys were not able to be undertaken as part of the current assessment.

To provide insight into the likelihood of habitats potentially present within and immediately surrounding the development footprint being used as maternity roosts, call data has been analysed based on mean nightly activity across the survey period on a temporal scale. Many bats are known to migrate to colonial maternity roots and as such, activity levels can be expected to change over time based largely on the presence of breeding females. Survey data was collected in November 2019 and March to May 2020, allowing for temporal comparison of activity around the known breeding periods of a number of bats.

Due to the high species diversity in microbat activity within the project area, the focus of this analysis has been on those bats considered at highest risk of substantial or significant impacts if breeding was found to occur and was impacted upon. Those species being the BAM species credit listed bats; Large-eared Pied Bat, Eastern Cave Bat, Large Bent-winged Bat and Little Bent-winged Bat.

Movement patterns relating to the reproductive strategies of these bats are outlined below, with information based on that provided in Churchill (2008), Parnabt et al. (2008), Hoye & Hall (2008), and Hoye & Schulz (2008).

Large-eared Pied Bat

- Births occur at maternity roosts in late November to early December, with juveniles suckled until late January.
- Young leave the roost in February, followed by females in late March.

Eastern Cave Bat

- Females congregate at maternity roosts in November, with births occurring in mid to late November.

Large Bent-winged Bat

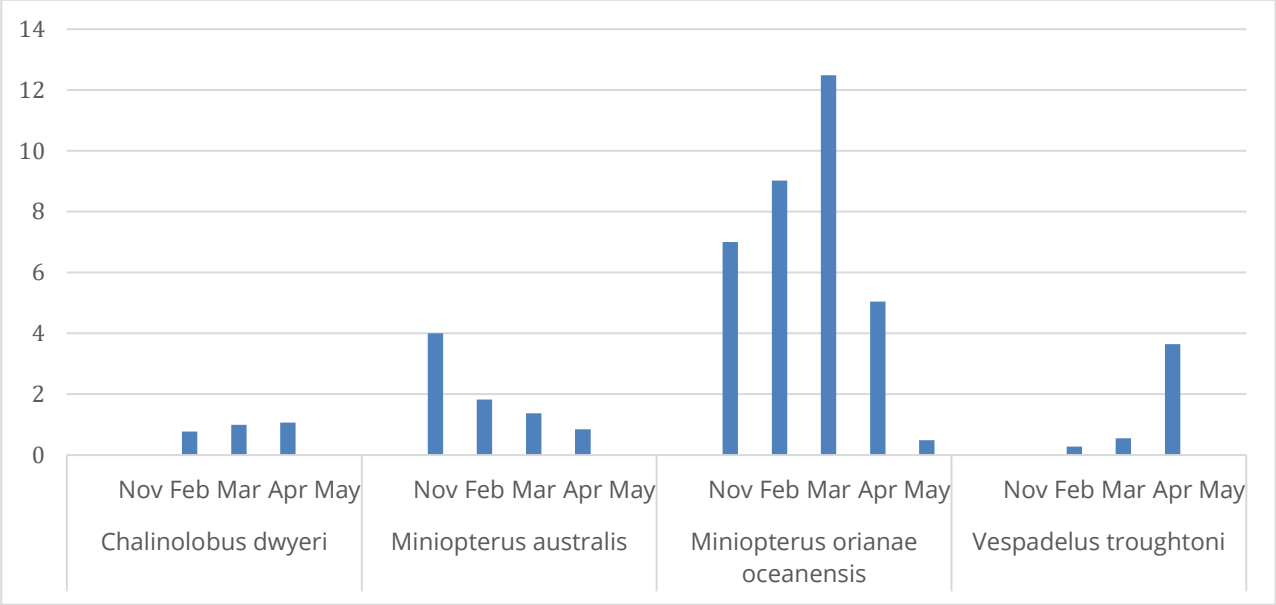
- Females congregate at maternity roosts in spring (from October), with births in December to January.
- Females leave maternity roost in February, with juveniles leaving around a month later. The colonies are deserted by April.

Little Bent-winged Bat

- Females congregate at maternity roosts in spring (recorded as early as August), males are also present but disperse from December.

- Young are born in December.

The graph below illustrates the mean nightly activity recorded for the four BAM species credit microbat species across the survey period to provide an indication of relative abundance within the project area over a temporal scale.



Graph 14 Mean nightly activity for Large-eared Pied Bat, Eastern Cave Bat, Large Bent-winged Bat and Little Bent-winged Bat during the microbat acoustic survey period

Relative abundance of Large-eared Pied Bat can be seen to be stable across late summer and into early autumn, with no activity recorded in either November or May. This indicates that breeding roosts are unlikely to be present within or immediately surrounding the development footprint as higher levels of activity would be expected in November, with activity levels dropping in late March.

Eastern Cave Bat can be seen to be most active within the project area in April, with low levels of activity recorded in February and March. Little is known about the breeding biology of this species; however, it could be expected that some activity would have been recorded in November if maternity roosts were present.

Large Bent-winged Bat activity peaks in March with higher activity levels also recorded in November and February. This suggests that individuals occurring within the project area are unlikely to be breeding females, who are known to leave maternity roosts in February, which would lead to a reduction in activity through March. Furthermore, as noted above, the species' maternity roosts are generally deserted by April and activity was recorded within the development footprint in both April and May, though at lower levels to those recorded in the warmer months. This could be expected for a species known to decrease activity during colder weather.

Little Bent-winged Bat activity was highest within the project area in November and reduces from February through to April although the reduction relates to a mean of less than one call per night fewer being recorded between these months. Higher levels of activity in November are based on only two nights' data and as such higher activity may be more related to outlier nights than truly higher activity. There is little evidence from activity levels to suggest breeding behaviour in the immediately vicinity of the development footprint, and that overall activity for the species is comparatively low. Furthermore, Little Bent-winged Bat is known to co-occur in maternity roosts with Large Bent-winged Bat, especially in colder environment, and based on activity data for Large Bent-winged Bat, there is again little evidence to suggest either species is breeding in the area.

Whilst it is acknowledged that without trapping microbat breeding activity cannot be conclusively ruled out from occurring within and surrounding the project area, temporal activity patterns do not suggest that this is occurring.

Review of microbat forage space and flight behaviour

To inform the assessment of indirect impacts to microbat species recorded within the project area a review of flight behaviour, forage space, relationship to tree canopies and additional descriptive information has been undertaken. This information has been utilised and referenced in the impact assessments undertaken in Section 8.3 and is presented in Table 46 below. This information has been taken from Blakely et al (2017), Bullen and McKenzie (2001), Bullen and McKenzie (2008) and Churchill (2008).

Table 46 Review of microbat behaviour

Species	Foraging space	Flight characteristics	Canopy	Overview
White-striped free-tailed bat	Open	Fast, not designed for manoeuvrability	Above canopy	Fast-flying species intercepting their prey 50 m or more above the ground. (Churchill 2008).
Large-eared Pied Bat	Edge	Slow, direct, moderately manoeuvrable	Below	Insectivorous bat that flies relatively slowly with rapid but shallow wing beats (Churchill 2008). The relatively short, broad wing indicates manoeuvrability suggesting the species forages below the forest canopy (DPIE profile 2018).
Gould's Wattled Bat	Edge	Fast, agile	Just below, within the lower level of the tree canopy and along forest edges, creeklines and isolated paddock trees.	Feeds on a wide variety of prey, regularly foraging 5 - 10 km from their roost site. They fly just below or within the lower level of the tree canopy and along the forest edges, creeklines and around isolated paddock tree with fast, agile flight (Churchill 2008).
Chocolate Wattled Bat	Edge	Fast, agile, direct	Below canopy	In inland areas their distribution is associated with water courses that provide large trees for roosts. They prefer forests to small forest patches (Churchill 2008). They forage up to 5 km from their roost site, their flight is usually fast and direct with considerable agility (Churchill 2008). They mostly forage in the zone between the top of the understorey and the canopy, although sometimes fly low along forest trails.
Little Pied Bat	Edge	Fast, highly manoeuvrable	Below canopy	Greatest relative abundance in the mallee and mixed species woodlands of the Willandra Lakes area of NSW. They fly close to the vegetation, about 2-4 metres above the ground, and have been observed to glean prey from various substrates. Capable of commuting up to 17 km from roost sites (Churchill 2008).
Eastern False Pipistrelle	Open/ Edge	Swift, direct	Below canopy	Flight is swift, direct, within or just below the tree canopy. Can travel large distances between roost and foraging area (12 km). Absent from small forest patches preferring continuous forest to forage along tracks, creeks and rivers. Capable of moving through cleared landscapes and foraging over open areas.
Eastern Coastal Free-tailed Bat	Open/ Edge	Probably fast, direct	Above canopy	Preference for open spaces in woodland or forest, foraging in openings and gaps in the forest usually within a few kilometres of their roost (Churchill 2008). Fly quickly over the tops of trees in forests or along vegetation edges to hunt their prey.

Species	Foraging space	Flight characteristics	Canopy	Overview
Little Bent-winged Bat	Edge	Fast, manoeuvrable	Below	Fly rapidly with considerable manoeuvrability between shrub and canopy layers of densely wooded areas. Capable of flying large distances to congregate in maternity colonies.
Large Bent-winged Bat	Open/ Edge	Very fast, direct	Above canopy	Flies high, from just above the canopy to many times canopy height or above grasslands, flight may be just above the ground. Flight is very fast, and they can forage long distances from the roost site.
Southern Myotis	Closed / Edge	Probably slower, manoeuvrability	Water	Live in most habitat types as long as it is close to water where they forage for insects and small fish by flying back and forth low across the water.
Lesser Long-eared Bat	Closed	Slow, manoeuvrable	Below canopy	Species tend to fly close to vegetation and into the understorey as they feed on moths, crickets and grasshoppers
Northern Free-Tailed Bat	Open/ Edge	Fast to very fast, direct.	Above canopy	Forage in the unobstructed air-spaces from just above to well above the canopy as well as above the ground in grasslands and large clearings. Fast to very fast.
Inland Free-tailed Bat	Open/ Edge	Fast, direct	Above canopy	Forage in open unobstructed areas. They fly fast above the canopy. They are not very manoeuvrable in flight.
South-eastern Free-tailed Bat	Open/ Edge	Fast, direct	Above canopy	Forage at or above canopy height in the spaces between trees, and the outer edge of remnant vegetation and above the forest canopy.
Ride's Free-Tailed Bat	Open/ Edge	Fast, direct	Above canopy	Fly predominantly in the spaces between trees.
Golden-tipped Bat	closed	Slow, manoeuvrable	Below canopy	Typically forage within a 2 km radius inside rainforest gullies or cluttered habitat where orb-weaving spiders are present.
Smaller Horseshoe Bat	Closed	Slow, highly manoeuvrable	Below canopy	Short, broad wings and low wing loading. Adapted to cluttered habitats. Slow, but highly manoeuvrable flight. They often hover and manoeuvre successfully among the branches and foliage of dense shrubs. (Churchill 2008).
Yellow-bellied Sheath-tailed Bat	Open	Fast, direct, not manoeuvrable	Above canopy	Almost all habitats, migratory, probably fly high. Long, narrow wings.
Greater Broad-nosed Bat	Edge	Limited manoeuvrability and moderate speed	Below canopy	Forage about 5 m from the edge of isolated trees, forest remnants or along forest crowns with a slow, direct flight pattern.

Species	Foraging space	Flight characteristics	Canopy	Overview
Scotorepens balstoni	Edge	Moderately fast, agile	Below canopy	Flight is continuous with sudden rapid diversions. Forage mostly between trees but also at the edges of forests, and out in open areas. (Churchill 2008). They stay within 15 m of the ground and do not forage above the canopy.
Scotorepens greyii	Edge	Moderately fast, agile	Below canopy	Flight is continuous, moderately fast, agile. Search for insects close to the tree tops but not above them, flying in the open spaces along the contour of the vegetation within 2 m of the foliage. Forage over water, grasslands and other open habitat. (Churchill 2008).
Scotorepens orion	Edge			
Vespadelus darlingtoni	Edge	Fast, less manoeuvrable.	Below canopy	Fast-flying bat that is less manoeuvrable than most *Vespadelus*. Avoid cluttered regrowth and rainforest by foraging mainly within the spaces among trees and between the canopy and the understorey.
Vespadelus regulus	Edge	Fast, agile, manoeuvrable	Below canopy	Highly manoeuvrable, moderately fast insectivores. Fly with great agility very close to vegetation and readily enter gaps in the understorey, usually foraging at less than half the canopy height. Small foraging range of less than 10 ha.
***Vespadelus* sp.**	N/A			
Eastern Cave Bat	Edge			
Vespadelus vulturnus	Edge			

In general:
Open space / aerial = typically free-tail and sheath-tail bats. Fly fast. Long, narrow wings, not manoeuvrable.
Edge space = most bats (vespertilionids and Myotis). Fly fast to moderately slow. Moderately long and broad wings.
Closed = gleaning bats (*Phoniscus, Nyctophilus, Rhinolophus*) = slow, but able to manoeuvre and hover in cluttered places. Broad, shorter wings, rounded tip, large tail membrane.

Microbat cave roost assessments and results

To further define the nature and extent of the local microbat population within the project area, investigation of potential microbat roost and possible breeding habitat within and surrounding the development footprint was undertaken during the course of the development of the BDAR. Initial desktop investigation using GIS were undertaken to locate areas of potential for field investigation, the results of which were fed back into the project design to allow for avoidance of direct and indirect impacts. Follow-up desktop assessment and additional detailed field validation was then undertaken to further refine these areas of potential habitat.

The locations of steep topography with the potential to represent cliff-lines (and therefore potential bat roosts) on the edge of the escarpments in the project area were mapped. The GIS desktop analysis was undertaken as follows:

- A 5 m Digital Elevation Model (DEM) was created from a LiDAR point cloud.
- Focal statistics were run on the DEM to create a surface representing the range of elevation in a 2x2m cell neighbourhood around each input cell (roughly a 10m buffer).
- Focal range surface was reclassified to remove areas with a range less than 3m between highest and lowest points in the neighbourhood. This was undertaken to remove small topographic features less likely to provide suitable root habitat.
- The resulting 'clifflines' layer was symbolised to show areas of potential clifflines based on where the range was 4, 5, 6, 7 or >7 metres within the 2x2 neighbourhood.

These areas of steepest topography were used to identify potential areas where cave-dwelling microbats could establish roosts, and potentially breeding habitat.

Initial ground-truthing of these areas of potential habitat was undertaken in late-February 2020; however, rain and fog over the duration of the field event meant accessing down or near these areas of potential habitat, which comprise the steepest areas of the upper slopes surrounding the development footprint, was unable to undertaken, and views from the top were highly restricted. As illustrated in Photo 10 below.

The result of the inclement weather meant areas of potential habitat were mapped in a highly conservative manner and encompassed all areas of steep terrain potentially supporting cliff-lines, overhangs and any other such potential bat roost habitat. Ultrasonic recording devices were installed at many of the locations assessed as potential bat roost habitat to record the level of microbat activity at each location (with results as discussed above).

Photo 10 Wet and foggy weather conditions during February 2020 attempted ground-truthing survey

Follow-up assessment of the areas mapped as potential microbat roosting habitat was able to be undertaken in March 2021, and the two-staged process of desktop analysis followed by on-ground confirmation was repeated.

During the second round of desktop analysis of, the LiDAR data used to create the potential 'clifflines' layer was re-analysed using a slope analysis, with slope face classified into ranges, with the areas of steepest slope classified into between 65 to 75 degrees and 75 to 90 degrees. It was determined that whilst the potential clifflines layer provided information of the areas of greatest change in elevation, the approximately 10 metre buffer (created by the 2x2 pixel neighbourhood) meant that a change of 7 meters in elevation could occur over a 10 metre area, representing only a 35 degree slope. As the potential cliffline habitat being targeted by the desktop assessment is considered to comprise slopes of 75 degrees or greater, the aim of this second round of desktop analysis was to located areas supporting a combination of a large change in elevation (>3 metres) within a 10 metre neighbourhood, and a steep slope (>65 degrees).

In undertaking the desktop assessment in this manner, combined with a detailed review of high definition aerial imagery captured for the purposes of project design, a number of the areas previously assessed as potential microbat habitat could be discounted. It was found that in a number of locations the large change in elevation occurred either over a wide area, therefore representing steep slopes rather than cliffs or overhangs, or that where such changes occurred over more discrete areas they were often associated with breaks in canopy, rather than sharp changes in ground topography. All areas previously mapped as potential bat roost habitat were re-assessed and prioritised for follow-up ground confirmation.

On ground assessment of areas identified as potential microbat habitat was then undertaken between 29 March and 1 April 2021. All high priority areas that were identified as having a sudden decrease in elevation were able to be visually inspected from the nearest accessible point. The terrain within the project area was notably steep and rugged, and as a result some sections could only be accessed 50 to 100 metres away. This was not considered a significant limitation as the slopes or clifflines were visible from these distances when the location could not be directly accessed. Due to the large size of the site, not all areas previously mapped as potential habitat were able to be ground-truthed, and a sampling approach was undertaken. However, suitable conclusions were able to be reached for all areas not visited on ground based on the results of the

desktop assessment and extrapolation of ground observations across other areas of the development footprint.

Photographs were taken at each location and information regarding the type of slope, presence of outcropping, presence of clifflines, overhangs and fissures etc. was recorded. A significant portion of the sites identified during the desktop assessment as having sharp decreases in elevation were confirmed as very steep slopes and comprised of loose soils and unconsolidated material (Photo 11 to Photo 17) and were not considered to provide suitable habitat for microbats. This was in some cases observed to be the result of relatively recent landslides, less than 50 years old, as evident by the immature vegetation structure (images included) and eroded slopes. Two sites were identified as containing microbat habitat suitable to provide roosting and possibly breeding opportunities (Table 47 and Figure 15), one a small cliff line and another forming a large pillar like rocky outcrop. The majority of the rock forming these two habitats was deeply fissured, however the rock forming them was highly friable.

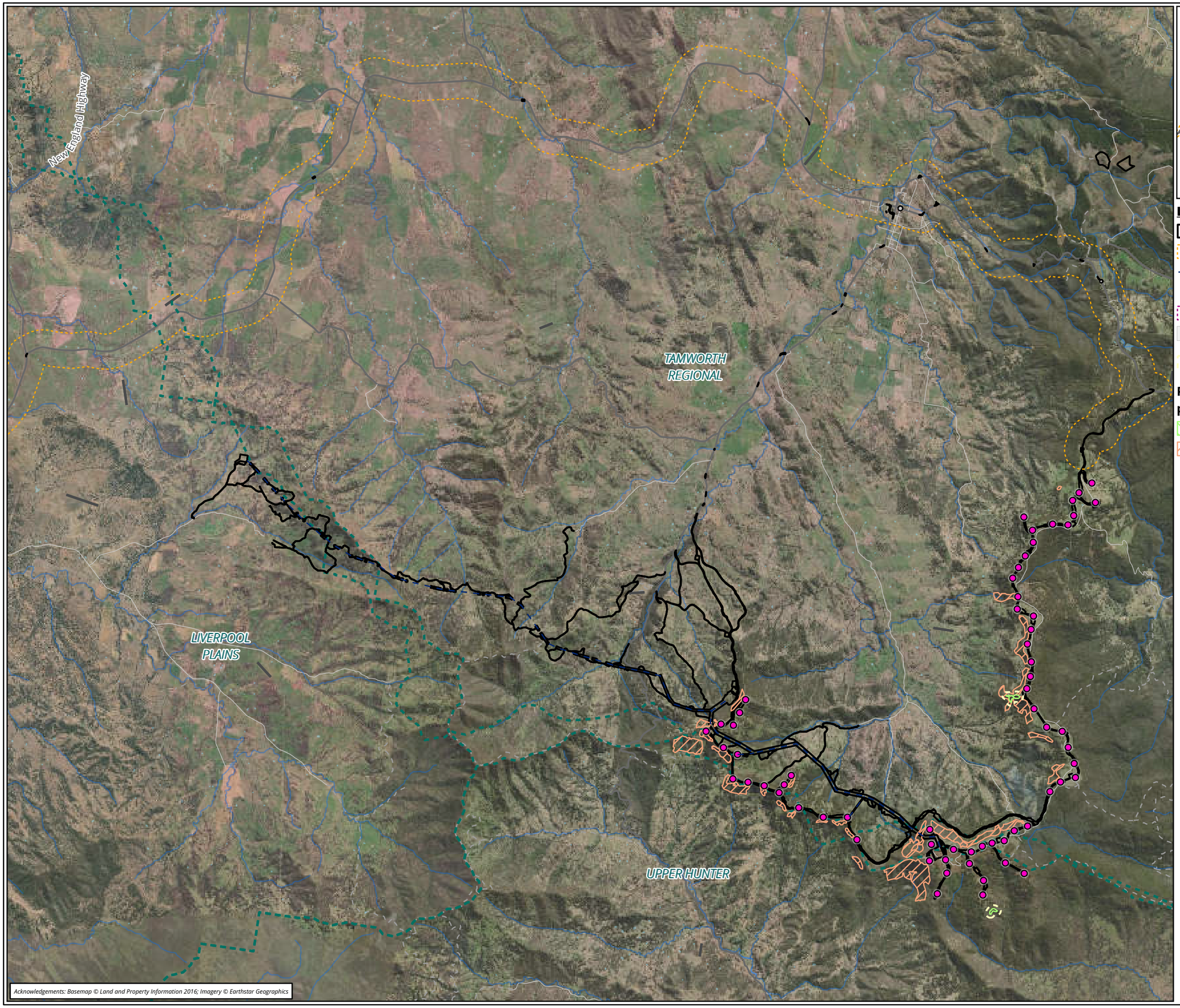
Table 47 provides details of the results of the desktop and/or ground assessment of all areas previously mapped as potential microbat roosts surrounding the development footprint. Area numbers are illustrated on Figure 15, and photos of a number of locations assessed on ground are provided below.

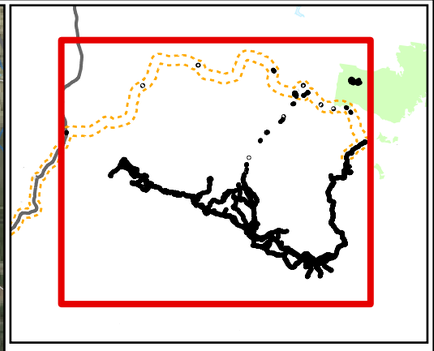
Table 47 Microbat habitat investigation results

Area No. (refer Figure 15)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
01	No	Steepness >65 degrees correlates to edges of canopy only. Larger areas of change associated with canopy breaks only	Moderate to steep slope with well vegetated grassy forest. No outcropping present.
02 & 03	No	Area of significant change, and linear steep slopes adjacent and continuing to the north	Steep slope, no cliff lines or notable outcropping.
04	No	Steepness >65 degrees correlates to edges of canopy only. No larger areas where change in elevation occur over a wider area (Ie lower potential cliffline values only)	Desktop assessment only.
05	No	Areas of significant change and steepness appear to relate to patchy canopy, however previous notes say rocky habitat abundant	Loose older landslip, no caves, crevices or fissures, unconsolidated and unstable.
06	No	Areas of significant change and steepness appear to relate to broken canopy edges, understory disturbed and cleared, lacks steep changes away from canopy	Desktop assessment only.
07	No	Areas of significant change and steepness appear to relate to patchy canopy, however previous notes say potential cave. Significant erosion in gully. Roost potential seems low	Loose older landslip, no depth to cavities, approx. 20 cm deep.
08	No	Areas of significant change and steepness mainly appear to relate to patchy canopy, however area of large change >7m should be targeted for ground-truthing	Very steep, almost vertical slope, well vegetated and boulders present, however no clifflines or fissures suitable for microbats were present.
09	No	Area appears steep from aerial, larger areas of change and steep slopes not well correlated (slope patchy not linear). will be able to extrapolate from other areas	Desktop assessment only.
10	No	Steepness >65 degrees correlates to edges of canopy only. No larger areas where change in elevation happens over a wider area (Ie lower potential cliffline values only)	Moderate to steep well vegetated slope. No clifflines or rock outcropping observed.
11	No	Large area of significant change, with more linear areas of steep slope	Moderate to steep well vegetated slope. No clifflines or rock outcropping observed.
12	No	Large area of significant change, with patchy areas of steep slope, sample approach	Moderate to steep well vegetated slope. Loose boulders present and no outcropping observed.
13	No	Area of large change and steep decent at western extent appears to be consistent slope	Desktop assessment only.

Area No. (refer Figure 15)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
14	No	Area appears steep from aerial, larger areas of change and steep slopes generally appear to be canopy edges, western end could be targeted for ground-truthing	Desktop assessment only.
15	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
16	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
17	No	Areas of significant change and steepness appear to relate to patchy canopy, understory less disturbed may represent breaks in slope, targeted ground-truthing likely to provide good clarity	Steep grassy slope, with very loose soils and no outcropping.
18	Yes	Large change steep descent, high priority for ground-truth	Cliffline extending for 70 metres, with both ends buried by landslide.
19	No	Areas of significant change and steepness appear to relate to patchy canopy	Steep and highly unstable slope. Many small clifflines and outcropping observed, however these contained only shallow cavities and depressions. Exposed material considered a result of relatively recent landslide.
20	No	Areas of significant change and steepness appear to relate to patchy canopy	Desktop assessment only.
21-23	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Loose steep slope, no large boulders mostly unconsolidated material.
24	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Densely vegetated steep slope, with no rock outcrops observed.
25	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Desktop assessment only.
26 (south)	No	Potential gully in centre of polygon high priority for ground-truth, remaining area is similar to other areas and data can be extrapolated	Steep and loose slope with some grassy groundcovers and unconsolidated rocks.
26 (north)	No	Potential gully in centre of polygon high priority for ground-truth, remaining area is similar to other areas and data can be extrapolated	Steep slope formed of unconsolidated cobble and boulders.

Area No. (refer Figure 15)	Microbat habitat presence	Desktop assessment conclusions	Rationale and field observations
27	Yes	Potential gully in centre of polygon high priority for ground-truth, remaining area is similar to other areas and data can be extrapolated	Pillar like outcrop with many deep and vertical fissures. No guano or odours identified.
28	No	Areas of significant change and steepness appear to relate to patchy canopy, but breaks in slope also possible, data can be extrapolated to/from other areas	Desktop assessment only.
29	No	Areas of significant change and steepness appear to relate to patchy canopy, data can be extrapolated form other areas	Heavily incised drainage line. No fissures observed and rock highly friable.
30	No	Areas of significant change and steepness appear to relate to patchy canopy, but breaks in slope also possible, data can be extrapolated to/from other areas	Desktop assessment only.





Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line
- Wind turbine locations
- Rotor swept area
- Zone of disturbance
- Potential microbat habitat 100m buffer

Potential microbat breeding habitat polygons

- Habitat
- Not habitat

Figure 15 Potential cave dwelling bat habitats with design and 100m buffer,
Page 1

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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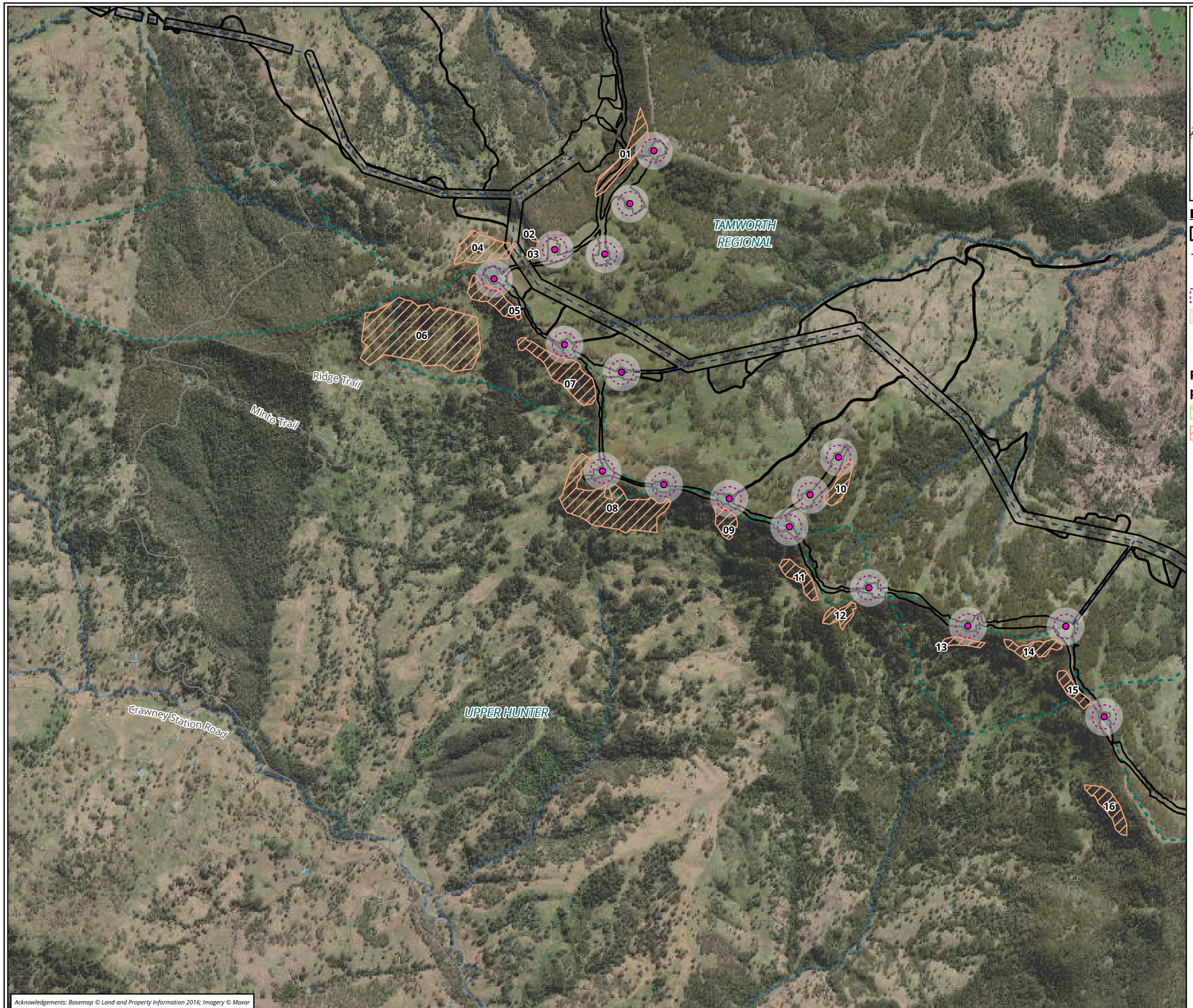
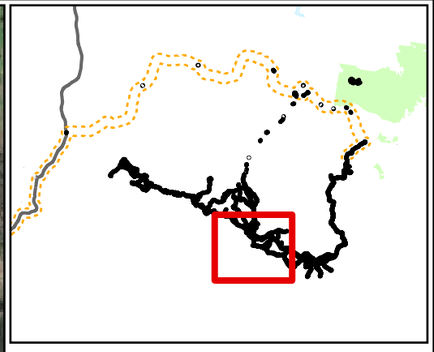
Matter: 34963,
Date: 25 October 2022 ,
Prepared for: CW, Prepared by: LH, Last edited by: amackegard
Layout: 34963_F15_PotentialBatHab
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_LH.aprx





Legend

- Infrastructure footprint
- Transmission line
- Wind turbine locations
- Rotor swept area
- Zone of disturbance
- Potential microbat habitat 100m buffer

Potential microbat breeding habitat polygons

- Habitat
- Not habitat

Figure 15 Potential cave dwelling bat habitats with design and 100m buffer,
Page 2

0 250 500 750 1,000

Meters

Scale: 1:25,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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biosis

Matter: 34963,
Date: 25 October 2022 ,
Prepared for: CW, Prepared by: LH, Last edited by: amackegard
Layout: 34963_F15_PotentialBatHab
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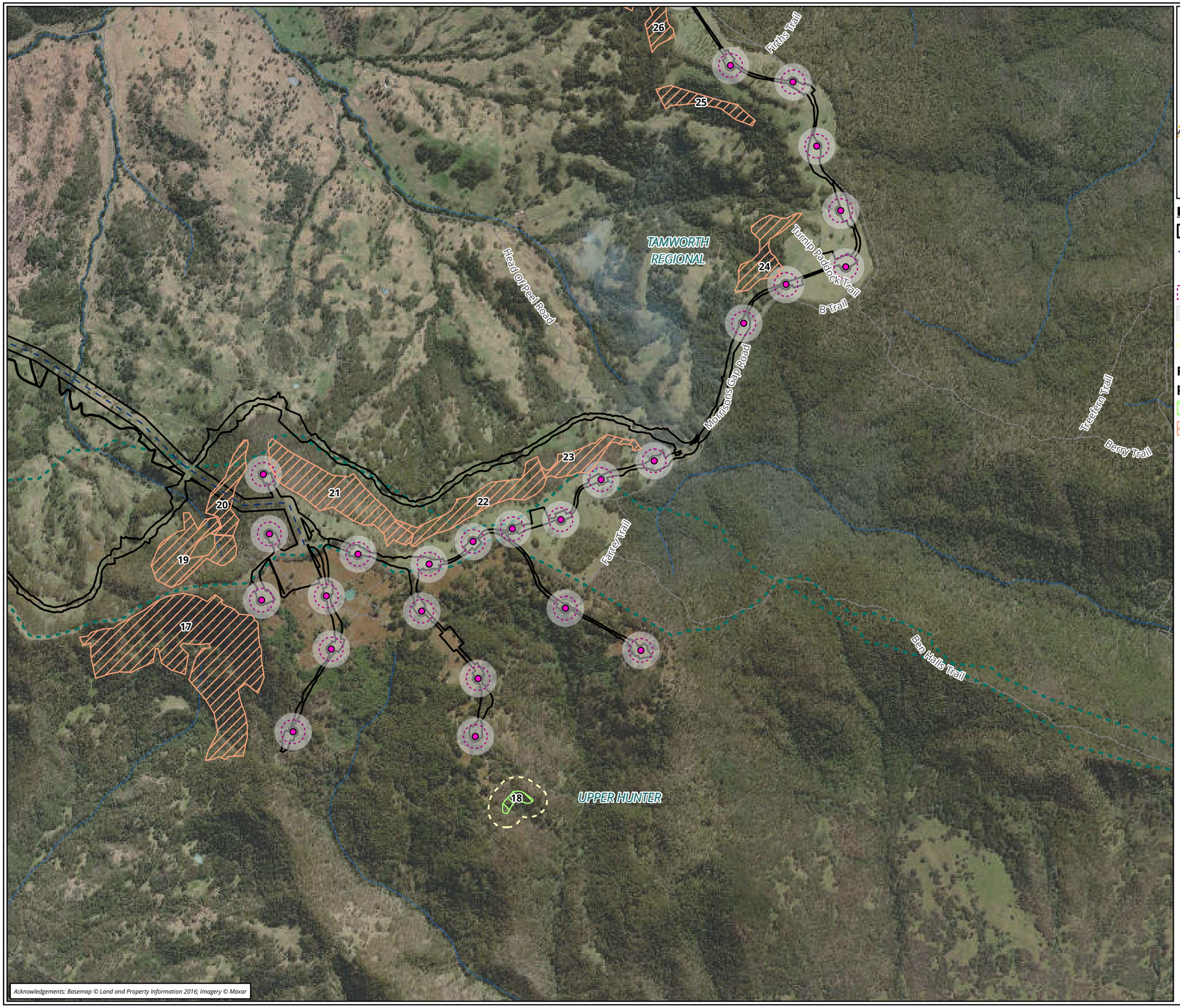

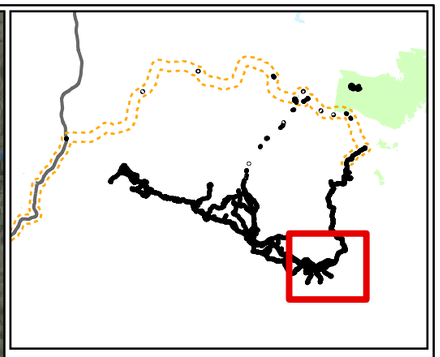

Legend

- Infrastructure footprint
- Transmission line
- Wind turbine locations
- Rotor swept area
- Zone of disturbance
- Potential microbat habitat 100m buffer

Potential microbat breeding habitat polygons

- Habitat
- Not habitat

Figure 15 Potential cave dwelling bat habitats with design and 100m buffer,
Page 3

0 250 500 750 1,000

Meters

Scale: 1:25,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Matter: 34963,
Date: 25 October 2022 ,
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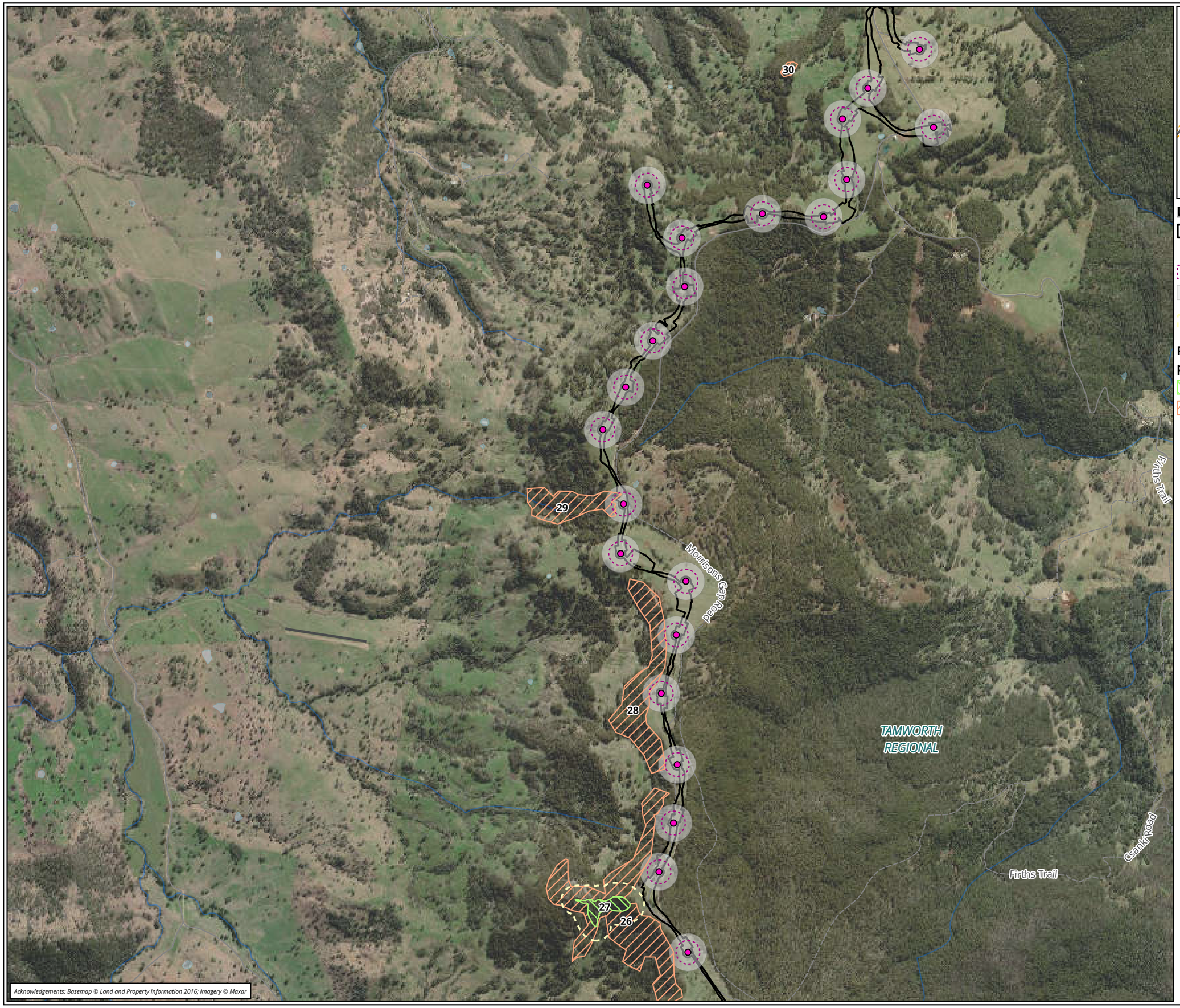
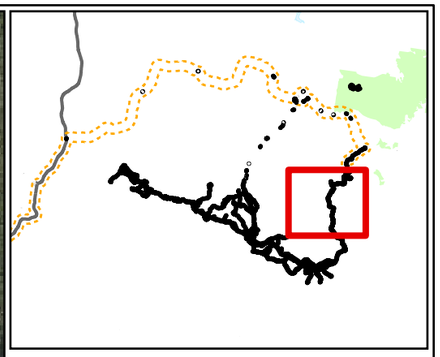
Layout: 34963_F15_PotentialBatHab
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_LH.aprx





Legend

- Infrastructure footprint
- Wind turbine locations
- Rotor swept area
- Zone of disturbance
- Potential microbat habitat 100m buffer

Potential microbat breeding habitat polygons

- Habitat
- Not habitat

Figure 15 Potential cave dwelling bat habitats with design and 100m buffer,
Page 4

0 250 500 750 1,000

Meters

Scale: 1:25,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Date: 25 October 2022 ,
Prepared for: CW, Prepared by: LH, Last edited by: amackegard
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Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_LH.aprx

Photo 11 Area 27 potential microbat roost habitat

Photo 12 Area 18 potential microbat roost habitat (over crest of slope)

Photo 13 Area 19 steep rocky slope not supporting microbat habitat

Photo 14 Area 01 steep slope not supporting microbat habitat

Photo 15 Example of recent landslide east slope, not supporting microbat habitat

Photo 16 Example of recent landslide west slope, not supporting microbat habitat

Photo 17 Area 26 (north) steep rocky slope not supporting microbat habitat

Geomorphology and Geology and Potential Microbat Roosting Habitat

To provide additional scientific advice on the likelihood of the project area and surrounding landscape to provide roosting and potential breeding habitat opportunities for microbats, a desktop geomorphological assessment was undertaken by Environmental Geosurveys Pty Ltd (Neville Rosengren, Geomorphologist and Honorary Associate La Trobe University). The full report (Environmental Geosurveys 2021) is attached as Appendix F of the BDAR.

The geomorphological assessment found the project area and surrounding landscape to comprise a diverse geological landscape formed in part by a range of volcanic activity resulting in the basalt lithology present at the development footprint. The occurrence of suitable microbat habitat was considered based on the potential presence and persistence of spaces in a coherent rock mass, or in accumulations of detached rock clasts. The extent to which either of these niches is present and suitable is a function initially of lithology and rock structure modified over time by geological and environmental processes that can increase or decrease the available space (Environmental Geosurveys 2021), with a diverse range of both inherent structures and secondary processes likely to occur in the broader landscape.

It was assessed that the likelihood for unreported caves within the vicinity of the development footprint, and specifically relating to previously mapped potential bat roost polygons, was low given the areas were not remote and there was generally good surface visibility, and that the potential roost sites in the wider area of basalt and other lithologies should be considered (Environmental Geosurveys 2021).

Within the surrounding basalt lithology, it was considered unlikely that large caverns such as those formed by dissolution of limestone at Timor and amygdaloidal basalt as at Coolah Tops have remained undetected. However, the extent of basalt exposure in valleys and at the margins of the several lava fields within flight range of microbats (conservative estimated as around 50-75 kilometres) means smaller cavities formed in this way may occur. Similarly, outcrops of fractured and weathered rock and downslope accumulations of blocky scree as potential habitat sites are also possibly widespread (Environmental Geosurveys 2021). This latter

form of potential habitat is considered of lower likelihood to support microbat roots due to it being low to the ground and unlikely to provide bats with opportunities to fly into the habitat. Furthermore, the wide range of lithology within the estimated microbat flight range, including carbonate and close-bedded sandstone-mudstone units, have the inherent and secondary (weathering) properties to develop potential habitat opportunities (Environmental Geosurveys 2021).

It was found that the diverse terrain and lithology across the broader landscape, combined with dynamic geomorphology result in a high potential for microbat roosting sites to occur at all elevations within the expected flight range of mircobats potentially present within the project area. However, the undulating plateau and ridge terrain of the project area has no extended rock escarpments and limited outcropping of fractured basalt as vertical or inclined columnar structures. Detailed ground survey would be needed to define the extent of such outcropping, but the evidence from the available data lead to the conclusion that there is discontinuous and limited bat roost habitat in the immediate vicinity. Furthermore, no data was found to suggest that the development footprint and immediate surrounds geomorphologically standout from the surrounding landscape in any way. (Environmental Geosurveys 2021).

The assessment found that in the immediate vicinity of the project area, outcrops of fractured basalt may provide localised habitat, However, the terrain and geology of this precinct provide limited opportunity for extensive habitat. While several large solution caverns in limestone and basalt occur in surrounding terrain, these are localised and there is a low probability that similar unreported large roost habitat sites occur. It is extremely unlikely there are basalt caverns of the dimension to accommodate a large bat colony. There is also a low possibility that unknown caves occur in the Devonian crystalline limestone, as these outcrops have been searched on several occasions (Allen et al. 1986, Environmental Geosurveys 2021).

The geomorphological assessment is considered to support the findings of the re-assessment of potential microbat roosting habitat within and immediately surrounding the development footprint. A diverse range of rocky outcropping was recorded during on-ground assessments, however few sites were of a size and structure suitable to support roosting bats. The broader landscape is considered highly likely to support a large range of bat roosting opportunities for the local bat populations, hence the high levels of microbat activity recorded as part of the current assessment. Due to this expected high availability of habitat in the landscape, there is no reason to suggest that bats are favouring the project area for roosting, and/or doing so in large numbers, and may well be present foraging over the higher ground, and intact vegetation on the slopes surrounding the project area.

This conclusion is supported by Biosis' senior microbat ecologist Mark Venosta (refer Section 1.9.2 for credentials). It is considered more likely that the bats utilising the habitats within and surrounding the development footprint are coming from a range of larger roosts elsewhere in the landscape, rather than a disproportionally large number of smaller roosts in the immediate vicinity of the project site. Based on this expectation, it is considered highly unlikely that the project would result in direct impacts to rocky roosting habitats, of a scale substantial enough to result in impacts to the local populations of microbat species. This is also supported by the detailed field assessment (referred to above) by Biosis ecologists undertaken in March-April 2021, which confirmed the presence of suitable rocky habitat features for roosting bats within just two of the thirty areas initially considered to provide potential roosting habitat. The total area assessed in the immediate vicinity of the development footprint comprised over 330 hectares of land considered of the highest likelihood for supporting potential cave roosting microbat habitat features (refer Figure 15).

Further supporting the assessment of high levels of available habitat in the broader landscape surrounding the project area, is in Table 48 provided by Environmental Geosurveys from local speleological groups (specifically academic and expert speleologist—Dr Susan White of La Trobe University), illustrating 14 known caves with microbats known to be present, in the Tamworth area.

Table 48 Known bat caves in the Tamworth area

Cave Area	District	Cave Number	Cave Name	Significant number of bats	Occasional roosting
Kunderang Brook	East of Kempsey	2KB-1	Youdales Cave, Hut Cave	Yes	
-	-	2KB2	-		Yes
Timor (Incl. Isaacs Ck; Isis R; Allston)	Timor	2TR-2	Belfry Cave		Yes
-	-	2TR-4	Helictite Cave		Yes
Stockyard Creek	West of Kempsey	2SC-5	Carrai Bat Cave	Yes	
-	-	2SC-7		Yes	
-	-	2SC-9			Yes
Moparabah	West of Kempsey	2MP-1	Moparabah Cave; Main Cave	Yes	
Yessabah	WSW of Kempsey	2YE-1	Yessabah Bat Cave	Yes	
Willi	West of Kempsey	2WW-1	Willi Willi Bat Cave	Yes	
-	-	2WW-4	Possum Cave	Yes	
Moore Creek	North of Tamworth	2MC-1	Moore Creek		Yes
Sulcor	North of Tamworth	2S-4	Bullock Hole		Yes

Note. Many of the locations of the above caves were not provided due to the regarded sensitivity of caves to the speleological groups who provided the information.

Whilst the presence of these caves in the broader Tamworth area illustrates the availability of habitat across the landscape, not all of the locations in the table above will be relevant to the subject land, and the local populations of microbat species. In the provided (Appendix F) advice Dr Susan White notes *pers. comm.* advice from Emmi van Harten regarding the need to assess the foraging range of microbats from major roosts to be 'at least' 75 kilometres, which has informed the list of caves provided. Whilst this may be true for some species, particularly the Southern Bent-wing Bat *Miniopterus orianae bassanii*, on which Emmi van Harten is a recognised expert, this is not the case for all cave roosting bats. Eastern Cave Bat, for example, is known to forage only over small areas over consecutive nights, and are noted as being capable of flying 500 m over cleared land (Churchill 2008).

Based on the above, the occurrence of high potential cave dependent microbat habitat within and/or immediately surrounding the development footprint, additional to that confirmed as present during the recent field investigation, is considered low, and that this habitat is likely to be present throughout the broader landscape. As such direct impacts to a significant or substantial portion of the local populations of microbat species as a result of the project is considered unlikely. Indirect impacts associated with potential turbine strike and barriers to movement and habitat accessibility are discussed further in Section 8.3 and Section 8.5.

Greater Glider

The Greater Glider is listed as Vulnerable under the EPBC Act and is not a listed species under the BC Act. It is the largest gliding possum in Australia, with a head and body length of 35 – 46 centimetres, and a tail measuring 45 – 60 centimetres (Menkhorst & Knight 2011). The species is arboreal and nocturnal and is mostly restricted to eucalypt forests and woodlands. It is typically found in highest abundance in tall, montane and moist eucalypt forests with old trees and abundant hollows. The species favours forests with a diversity of eucalypt species, due to the seasonal variation in its preferred tree species. During the day Greater Glider shelters in tree hollows, particularly those that are in large, old trees (McKay 2008).

The Greater Glider occurs in eastern Australia, from the Windsor Tableland in north Queensland through to central Victoria. The broad extent of occurrence is unlikely to have changed substantially since European settlement, however the area of occupancy has decreased substantially, mostly due to land clearing (Threatened Species Scientific Committee 2016). This decline is most likely continuing due to further land clearing, fragmentation, fire and forestry activities. The species is considered to be particularly sensitive to forest clearance, logging and fire, and is slow to recover following major disturbance. The species is also considered to be sensitive to fragmentation due to a low dispersal ability, previously showing low persistence in small forest fragments (Threatened Species Scientific Committee 2016).

Twenty-five Greater Gliders were recorded within the development footprint during targeted surveys in the current assessment (Biosis 2019). Previous records of the species are also scattered throughout the adjacent Ben Halls Gap Nature Reserve (EES 2020). As Greater Glider tend to have relatively small home ranges (1 – 4 ha), for the purposes of this assessment, these records throughout the development footprint and adjacent reserve make up the 'local population'. Nationally, there are no officially recognised 'important populations' of Greater Glider. However, in NSW there are three specific populations listed as Endangered under the BC Act (EES 2020). These are the populations of the Eurobodalla LGA, Mount Gibraltar Reserve, and Seven Mile Beach National Park which are remote from the Project. It is not considered that the local population addressed in this assessment makes up an important population of the species. Further assessment of impacts to Greater Glider are provided in Section 8.8.5.

Approximately 36.28 hectares of Greater Glider habitat is proposed to be removed from the development footprint as a part of the current project. This encompasses eucalypt woodland, and the associated hollow-bearing trees throughout. The impacts to Greater Glider habitat are also predominantly to smaller patches of fragmented suitable habitat on the wind farm infrastructure sections of the development footprint, and no large contiguous patches of habitat will be impacted.

Koala

Koala is listed as Endangered under the Commonwealth EPBC Act and Vulnerable under the NSW BC Act. It occurs from north-east Queensland to South Australia, including parts of NSW. A rapid decline in the number of individuals has been seen since European settlement, primarily due to a reduction in available good quality vegetation with appropriate canopy species suitable for supporting the species (DECC 2008).

The development footprint is located within the Northern Tablelands Koala Management Area (KMA), and the proposed works include the removal of a total of 190.54 hectares of native vegetation, composed of various forms of eucalypt forest. Of this, approximately 46.28 hectares is considered to be Koala habitat as defined using the BAM method for mapping species polygons, encompassing multiple PCTs.

Within 10 kilometres of the development footprint, the species has been recorded seven times (EES 2020), with an additional three individuals recorded within the development footprint during the current field assessment (consisting of a mother and joey during spotlighting surveys, and a mature individual on camera trap). The closest previous records of Koala occur within Ben Halls Gap Nature Reserve, which is east of, and contiguous with, the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla

State Forest and Nature Reserve all lie within 20 kilometres of the development footprint and contain scattered Koala records throughout (EES 2020). For the purposes of this assessment the definition of "the population" encapsulates all contiguous areas of Koala habitat into a singular spatial unit.

Photo 18 Koala recorded on arboreal camera trap

The results of the Koala SAT survey indicate that there is a low level of Koala activity across the site. Eight of the eleven SAT surveys had no scats recorded around the 30 surveyed trees, two SATs recorded scats around two trees and one SAT recorded 6 scats. This level of koala activity is consistent with the known population dynamics of Koalas in central NSW, with lower levels in drier areas. The escarpment where the wind farm is located is likely to support higher koala numbers than the transmission line corridor due to the higher soil nutrients and preferred koala food trees.

Phillips and Callaghan (2011) note that low levels of Koala activity assessed using the SAT method can also indicate that Koala use of the site may be transitory or a result of a naturally low density population.

As Koala is listed under the EPBC Act and, as the proposed works include potential impacts to this species, an assessment against the Significant Impact Criteria detailed in the Matters of National Environmental Significance: Significant impact guidelines version 1.1 (Commonwealth of Australia 2013) has been undertaken in this BDAR.

Spotted-tailed Quoll

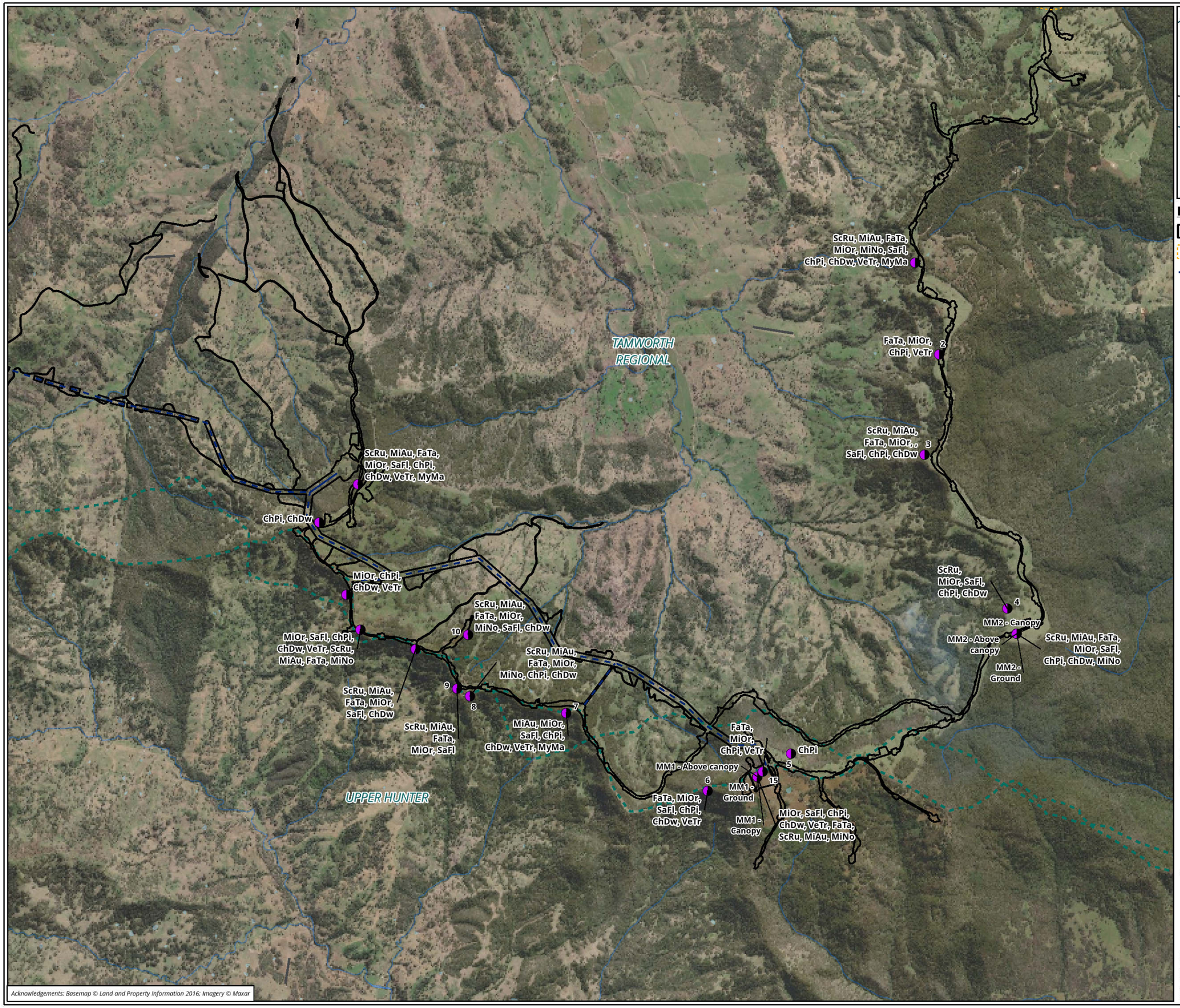
Spotted-tailed Quoll is listed as Endangered under the Commonwealth EPBC Act and Vulnerable under the NSW BC Act. It occurs across south-east Queensland, eastern NSW, Victoria, south-east South Australia and Tasmania (Jones 2001). The subspecies' mainland range is now considered to have reduced by 50–90% (Jones 2001). However, detailed distribution records and abundance estimates are generally lacking due to the scale and intensity of surveying that is required to detect the species across its entire range (DAWE 2016).

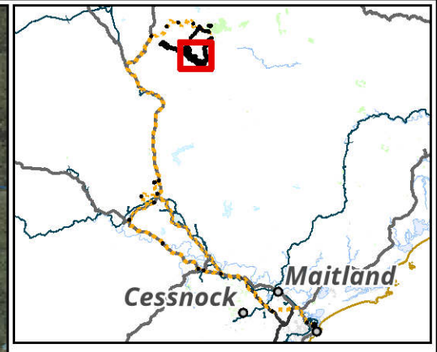
The Spotted-tailed Quoll has previously been recorded within and adjacent to the development footprint. In 2019, a roadkill individual was located within the Ben Halls Gap State Forest adjacent the development footprint, and another individual was recorded on a camera trap within the development footprint. Hanging Rock State Forest, Nundle State Forest, and Tomalla State Forest and Nature Reserve all lie within 20

kilometres of the development footprint and contain scattered previous Spotted-tailed Quoll records throughout (EES 2020).

Potential Spotted-tailed Quoll habitat occurs throughout the development footprint in the form of eucalypt woodland, rocky outcrops, caves, logs and tree hollows. Spotted-tailed Quoll was recorded twice during targeted remote camera surveys as part of the current assessment. As such approximately 45.62 hectares of Spotted-tailed Quoll habitat has been identified within the development footprint which will be removed as part of the proposed works. This habitat is comprised of the PCTs identified in BioNet, assessed as having high and moderate condition levels.

As Spotted-tailed Quoll is listed as Endangered under the EPBC Act and, as the proposed works include potential impacts to this species, an assessment against the Significant Impact Criteria detailed in the Matters of National Environmental Significance: Significant impact guidelines version 1.1 (Commonwealth of Australia 2013) has been undertaken in this BDAR.





Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line
- Microbat passive detector

Figure 16 Threatened fauna and raptors recorded during field survey

0 500 1,000 1,500 2,000

Meters

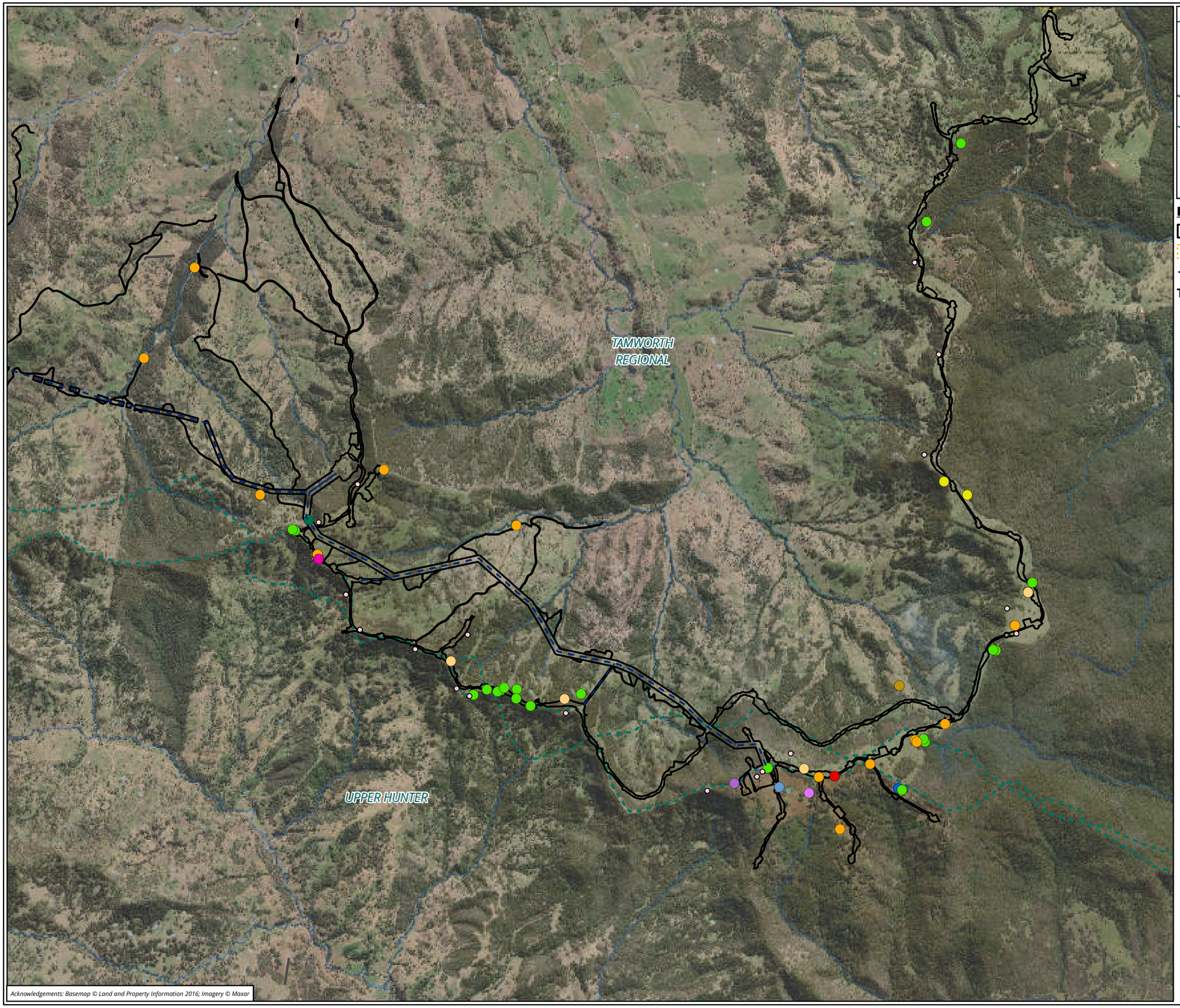
Scale: 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 21 October 2022 ,
Prepared for: CW, Prepared by: LH, Last edited by: amackegard
Layout: 34963_F16_ThrFaunaRecorded
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_LH.aprx



Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line

Threatened fauna and raptors

- Australian Hobby
- Black Kite
- Flame Robin
- Greater Glider
- Grey-headed Flying-fox
- Koala
- Large-eared Pied Bat
- Southern Myotis
- Spotted-tailed Quoll
- Wedge-tailed Eagle
- Yellow-bellied Sheathtail-bat
- Masked owl

Figure 16 Threatened fauna and raptors recorded during field survey

0 500 1,000 1,500 2,000

Meters

Scale: 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
Date: 26 October 2022 ,
Prepared for: CW, Prepared by: LH, Last edited by: amackegard
Layout: 34963_F16_ThrFaunaRecorded
Project: P:\34900s\34963\Mapping\34963_ArcGISPro\34963_BDAR\34963_HoG_BDAR_LH.aprx

Acknowledgements: Basemap © Land and Property Information 2016; Imagery © Maxar

5.5 Threatened fauna habitat polygons

According to the BAM, impacts to threatened fauna species must be calculated according to the area of suitable habitat identified by the species polygon. For dual credit species, only the breeding habitat for the species is to be mapped. For full credit species, both foraging and breeding habitats need to be included in any species polygons.

A detailed assessment of the mapped fauna habitat for threatened species listed under the BC Act is provided in Table 49 and mapped in Figure 17 to Figure 21.

Habitat polygons have been developed based on a combination of targeted field surveys, ground-validated habitat assessments, and species' habitat requirements based on published literature and the TBDC. Preparing species polygons in this manner was undertaken to ensure the use information available for each species; such as PCT associations, habitat parameters where they can be justified based on BioNet or published, peer-reviewed literature, habitat assessments, and targeted surveys; was adequately included to ensure species polygons that are as accurate and meaningful as possible. The approach was undertaken considering Section 6.1.1.2 of the BAM, which specifies that:

'An assessor may use additional information about a threatened species, in BioNet (e.g. the profile of a threatened species) or published, peer reviewed literature, when assessing the habitat suitability of a site'

Koala, Eastern Pygmy Possum, and Squirrel Glider species polygons, were developed based on a combination of on-ground fauna habitat assessments undertaken across the entire wind farm corridor, and the results of targeted surveys undertaken for all three of these species. Whilst Koala was confirmed as present within the project area, Eastern Pygmy-possum and Squirrel Glider were not recorded despite 11 nights of nocturnal surveys over five separate events and up to 1009 trap nights from arboreal camera traps.

Due to the large size and linear nature of the project area, areas of potential habitat for these species occur adjacent to the development footprint. As such the presence of Eastern Pygmy-possum and Squirrel Glider was not considered to be conclusively excluded, despite the high level of survey undertaken, and the species not being recorded. The species' presence was instead conservatively assumed, with this assumption of presence relating to the areas of optimal habitats only, justified by the lack of detection of the species during the targeted survey effort. In order to determine areas of optimal habitat for each species the data collected during on-ground habitat assessments was used to refine the species' habitat polygons, this data related to the presence (or lack thereof) of habitat features such as high condition vegetation, characteristic feed trees, abundant tree hollows, and levels of human disturbances.

Habitat polygons for Koala were also refined on the basis of these on-ground habitat assessments, with areas considered as less suitable habitat excluded. Such areas comprised substantially rocky areas less likely to be traversed by the species, and areas of significant human disturbance.

Owl species habitat polygons were initially developed on the basis of the breeding habitat information provided in the Large Forest Owl Recovery Plan (DEC 2006) that states Powerful Owl and Sooty Owl optimal breeding habitat occurs in unlogged, unburnt gullies and lower slopes. BioNet also makes this point for Masked Owl, and notes that the species breeds in moist eucalypt forested gullies. Barking Owl has an affinity for roosting near watercourses, which in the context of the project area are again associated with forested gullies. However feedback received from BCS determined that additional potential breeding habitat, as defined by the TBDC, was required to be mapped for Barking Owl, Masked Owl and Powerful Owl, and included in the species polygons if the species' presence was to be assumed, and that an upper quantum of impact was to be determined.

In order to calculate this upper quantum of impact targeted habitat surveys were undertaken in May / June 2022 to map areas of potential habitat, comprising living or dead trees with hollows greater than 20

centimetre diameter (and greater than 4 metres above the ground for Barking Owl only). Subsequent to this habitat mapping (detailed in Section 5.3.2) and further consultation with BCS, it was deemed necessary to refine these areas of potential habitat, and thus potential impact, through further targeted nocturnal survey (detailed in Section 5.4.2). The aim of the nocturnal survey work was to determine the use of the hollows mapped as potential habitat, and the results of this work have been used to refine the impacts to the three large forest owl species.

It should be noted that a commitment has been made to undertake further surveys for relevant owls with a hollow bearing tree inventory prior to construction. If breeding owls are located on site during these surveys, or >20cm hollows determined to be impacted, then compensatory measures in accordance with the BAM would be determined and retired, as per the an unexpected finds procedure incorporated into the Biodiversity Management Plan. Further details are provided in Section 8.10.1.

Table 49 Approach to calculating impacts for species credit species

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
Large-eared Pied Bat	Recorded	The species is a full species credit because it cannot be reliably predicted to occur on a site based on vegetation and other landscape features (either foraging or breeding). Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat. Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc.). Polygon must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be identified. All habitat on the subject land should also be mapped if present. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.	Species polygons for 'Forage habitat' include PCTs associated with the species in the BioNet database, in moderate and high condition states, where they occur within 2km of confirmed potential microbat breeding habitat, and/or within 2km of Mount Royal Tops soil landscape (Mitchell 2002). All impacted native vegetation in the development footprint within the buffer areas is captured. Cave bat habitat polygons are mapped in Figure 17.
Eastern Cave Bat	Recorded	The species is a full species credit because it cannot be reliably predicted to occur on a site based on vegetation and other landscape features (breeding or foraging). Potential breeding habitat is PCTs associated with the species within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat. All breeding habitat on or within 100m of the subject land and the area immediately surrounding the feature must be	Species polygons for 'Forage habitat' include PCTs associated with the species in the BioNet database, in moderate and high condition states, where they occur within 2km of confirmed potential microbat breeding habitat, and/or within 2km of Mount Royal Tops soil landscape (Mitchell 2002). All impacted native vegetation in the development footprint within the buffer areas is captured. Cave bat habitat polygons are mapped in Figure 17.

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
		mapped. Artificial structures should be inspected and included on the map if the species is using these features for breeding. All habitat for this species should also be mapped if present. Species mapping polygon for breeding habitat must use high resolution aerial imagery and topographic maps to identify features on the subject land (caves, scarps, cliffs etc). Polygon boundaries must be at least 100m wide (or 50m radius for point locations such as caves) with the breeding habitat features (may be multiple) as the centroid (see Threatened Bat Survey Guide). When the species is present on the subject land and the proposed impact is not a potential SAII, standard species credits will be generated. All habitat on the subject land where the subject land is within 2km of caves, scarps, cliffs, rock overhangs and disused mines must be mapped. Use high resolution aerial imagery and topographic maps to identify potential roost habitat features on the subject land within 2km caves, scarps, cliffs etc. Species polygon boundary should align with PCTs on the subject land to which the species is associated that are within 2km of identified potential roost habitat features.	
Southern Myotis	Recorded	The species was allocated to species credit because it is dependent on waterways with pools of 3m wide or greater for foraging (which will be protected under legislation), habitat surrounding waterways is used for breeding and roosting. All habitat on the subject land where the subject land is within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land must be mapped. Use aerial imagery to map waterbodies with pools/ stretches 3m or wider on or within 200m of the subject land. Species polygon boundaries should align with PCTs on the subject land to which the species is associated that are within 200m of waterbodies mapped.	Dams more than 3m wide were mapped and a 200m buffer applied. All PCTs within the development footprint forming habitat associations for the species, as listed in the BioNet database, were included within the habitat polygons where they were located with 200m of the dams. No waterways >3m wide were identified. Habitat polygons for Southern Myotis are mapped in Figure 18.

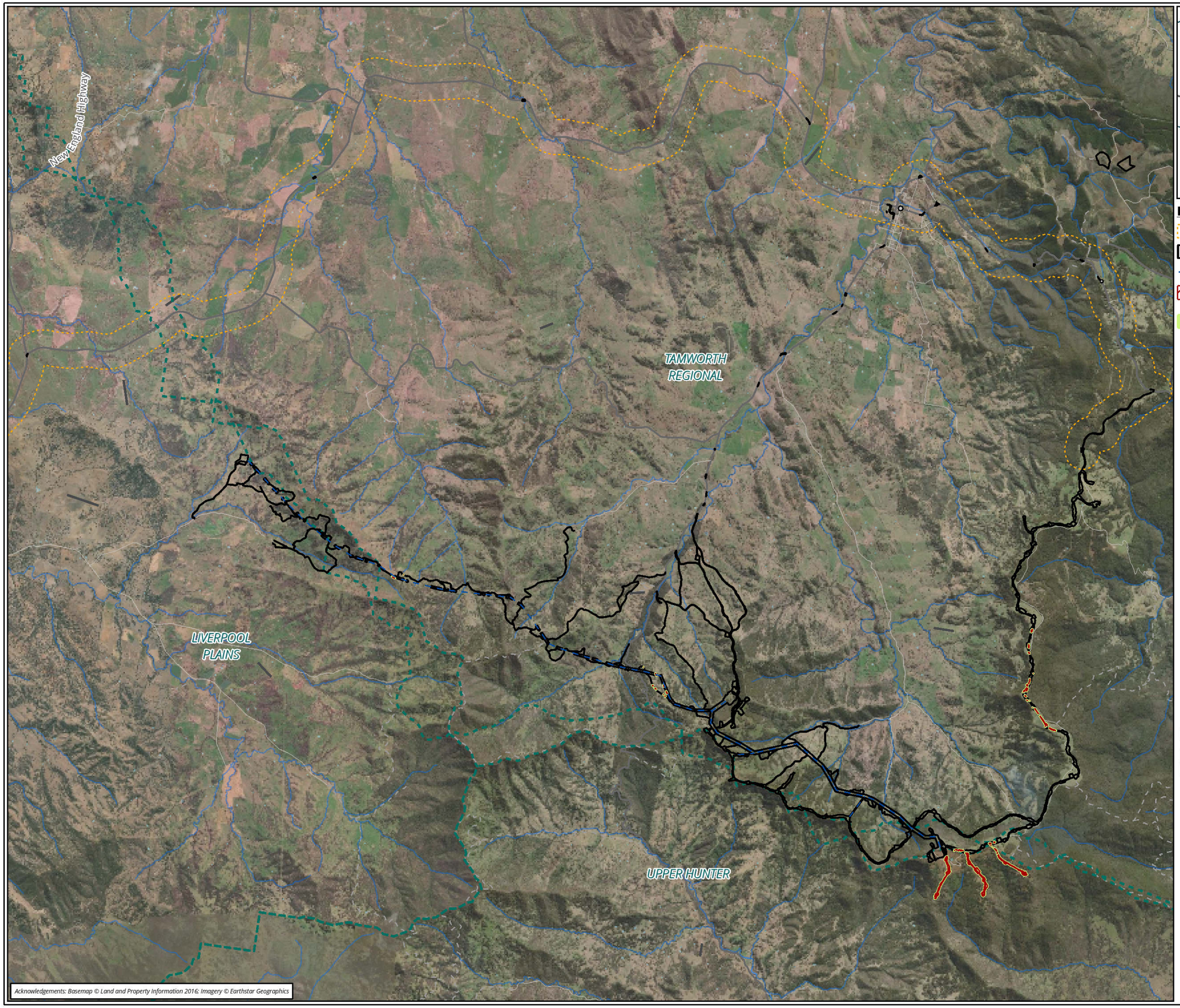
Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
Koala	Recorded	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include impacted areas of the species' associated PCTs within the development footprint, as listed in BioNet, and mapped in moderate and high condition states. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting >50% rock outcropping Areas mapped as being subject to high severity clearing of the tree canopy Habitat polygons for Koala are mapped in Figure 19.
Eastern Pygmy-possum	Assumed present	Based on BioNet, there are no habitat constraints for these species other known PCT habitat associations.	Habitat polygons include impacted areas of the species' associated PCTs within the development footprint as listed in BioNet and mapped as in 'High" condition. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting <5% characteristic understorey feed species Areas mapped as not supporting any tree hollows Areas mapped as being subject to high severity clearing of the tree canopy Areas mapped as being subject to highly or moderately severe agriculture impacts such as cropping, grazing, exotic pasture, soil disturbance. Habitat polygons for Eastern Pygmy Possum are mapped in Figure 19.
Squirrel Glider	Assumed present	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include impacted areas of the species' associated PCTs, as listed in BioNet, and mapped in Moderate and High condition within the development footprint. Field captured habitat assessments were used to refine the polygons, with the following characteristics excluded: Areas supporting <5% characteristic understorey feed species Areas mapped as not supporting any tree hollows Areas mapped as being subject to high severity clearing of the tree canopy Areas mapped as being subject to high severity agriculture impacts such as cropping, grazing, exotic pasture, soil disturbance. Furthermore, areas where sufficient survey in the form of arboreal

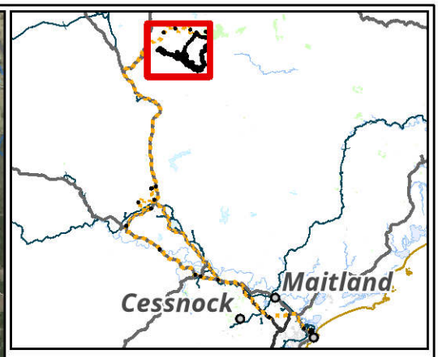
Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
			camera trapping has been undertaken for the species have been removed from the habitat polygons (as the species was not recorded). Areas retained are considered to have undergone less intensive survey and include the central-southern portion of the wind farm corridor, due to camera traps being burnt in bushfire in this area, and along the transmission line corridor, where nocturnal surveys did not occur. Habitat polygons for Squirrel Glider are mapped in Figure 19.
Border Thick-tailed Gecko	Assumed present	Based on BioNet, there are no habitat constraints for this species other known PCT habitat associations.	Habitat polygons include impacted areas of the species' associated PCTs as listed in BioNet, and mapped in Moderate and High condition states, where they are associated rocky areas mapped in the development footprint as potentially suitable to support the species, and within the species' known elevation range of 500 - 1000m altitude. Habitat polygons for Border Thick-tailed Gecko are mapped in Figure 20.
Booroolong Frog	Assumed present	No specific guidance is provided on how to derive habitat polygons for the species.	Habitat polygons include areas within the development footprint of native vegetation in High and Moderate condition where they occurred within a 40m riparian buffer from Wombramurra Creek (centreline/hydroline). PCTs not listed in the BioNet database as associated with the species were also included in the habitat polygons due to the presence of a high density of records in the area and the known SOS population along the creekline. A 40m buffer was selected as it represents the BAM riparian buffer for a 5th order watercourse, which Wombramurra exists as in this location. Habitat polygons for Booroolong Frog are mapped in Figure 20.
Barking Owl	Assumed present	Where any known nest trees occur on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest trees. Additional breeding habitat notes: • The species typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NPWS 2006).	Updated species polygons based on the following parameters. • Upper quantum of potential habitat developed based on: – Associated PCTs: 433, 486, 490, 492, 526, 540, 541, 599, 934, 954, 1194 – All native vegetation within 100 m of a potential nest tree is considered potential habitat. – All native vegetation within the areas surveyed for potential habitat, confirmed not to support potential nest trees, and

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
		• The species seems most abundant in the largest remnants but also occurs at low density in fragmented habitat, where it uses healthy riparian woodland or gallery forest amid extensive, diverse woodland supporting a diversity of native prey. (Debus 2001). • Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. (BioNet 2021b). • It was also noted that Barking Owl habitat has a strong spatial association with hydrological features such as rivers and wetlands (Taylor & Kirsten 1999).	not within 100m of a potential nest tree is excluded from potential habitat. – All remaining un-surveyed vegetation is considered potential habitat, except for the following vegetation zones that have been confirmed as not supporting hollow-bearing trees through field survey data collection: ▪ All DNG condition zones ▪ PCT 492 Low ▪ PCT 541 Low ▪ PCT 931 Low • Species polygon (i.e. impacts) developed based on: – Areas within 500m buffer of call play-back locations excluded from species polygon. – Areas within 50m buffer of stag-watching, listening, hollow observations, and spotlighting excluded from species polygon. – All remaining un-surveyed potential habitat included in species polygon. Species polygons for Barking Owl are mapped in Figure 21.
Powerful Owl	Assumed present	Where any known nest trees occur on site (e.g. known from existing data, studies or other documented evidence), a species polygon providing a circular buffer with a 100 m radius should be drawn around the known nest trees. Additional breeding habitat notes: • Species known to breed in old hollow eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC 2006).	Updated species polygons based on the following parameters. • Upper quantum of potential habitat developed based on: – Associated PCTs: 526, 931, 934, 954, 1194 – All native vegetation within 100 m of a potential nest tree is considered potential habitat. – All native vegetation within the areas surveyed for potential habitat, confirmed not to support potential nest trees, and not within 100m of a potential nest tree is excluded from potential habitat. – All remaining un-surveyed vegetation is considered potential habitat, except for the following vegetation zones that have been confirmed as not supporting hollow-bearing trees through field survey data collection: ▪ All DNG condition zones

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
			▪ PCT 492 Low ▪ PCT 541 Low ▪ PCT 931 Low • Species polygon (i.e. impacts) developed based on: – Areas within 500m buffer of call play-back locations excluded from species polygon. – Areas within 50m buffer of stag-watching, listening, hollow observations, and spotlighting excluded from species polygon. – All remaining un-surveyed potential habitat included in species polygon. Species polygons for Powerful Owl are mapped in Figure 21.
Masked Owl	Recorded – September 2022	Where a breeding site has been identified in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. Additional breeding habitat notes: • Species known to breed in old hollow eucalypts, live or dead but commonly live, in a variety of topographic positions from gully to upper slope, with hollows greater than 40 cm wide and greater than 100 cm deep; there is no relationship with distance to streams. (DEC 2006). • Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. (BioNet 2021a).	Updated species polygons based on the following parameters. • Upper quantum of potential habitat developed based on: – Associated PCTs: 507, 526, 599, 931, 934, 954, 1194 – All native vegetation within 100 m (at less than 1200 m elevation) of a potential nest tree is considered potential habitat. – All native vegetation within the areas surveyed for potential habitat, confirmed not to support potential nest trees, and not within 100m of a potential nest tree is excluded from potential habitat. – All remaining un-surveyed vegetation (at less than 1200 m elevation) is considered potential habitat, except for the following vegetation zones that have been confirmed as not supporting hollow-bearing trees through field survey data collection: ▪ All DNG condition zones ▪ PCT 492 Low ▪ PCT 541 Low ▪ PCT 931 Low

Species credit species	Survey status	BioNet and OEH (2018) guidance on species polygon extent, other relevant habitat notes	Approach to assessment of impacts (species polygons)
			• Species polygon (i.e. impacts) developed based on: – Areas within 500m buffer of call play-back locations excluded from species polygon. – Areas within 50m buffer of stag-watching, listening, hollow observations, and spotlighting excluded from species polygon. – All remaining un-surveyed potential habitat included in species polygon. Habitat polygons for Masked Owl are mapped in Figure 21.
Sooty Owl	Assumed present	Where a hollow bearing tree has been identified as a breeding site in accordance with the BAM the species polygon should be established by providing a circular buffer with a 100m radius around the nest tree. Old hollow trees, eucalypt or rainforest species usually live but stags are occasionally used, in unlogged, unburnt gullies and lower slopes within 100 m of streams, with hollows greater than 40 cm wide and greater than 100 cm deep; surrounded by canopy trees. (DEC 2006) Also nests in caves.	Timbered watercourses in deep gullies within and surrounding (within 100m) the development footprint was manually reviewed using high-definition aerial imagery, LiDAR data, and topographical contour lines, to selected potential locations for breeding habitat. Mapped hydroline features present within potential gully habitat were used to create a 100m buffer, within which all native vegetation was selected, and included within the species polygon. Habitat polygons for Sooty Owl are mapped in Figure 21.





Legend

- Transport haul routes
- Infrastructure footprint
- Transmission line
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons, Page 1

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963.
Date: 21 October 2022 .
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Layout: 34963_F17_BatHabitat
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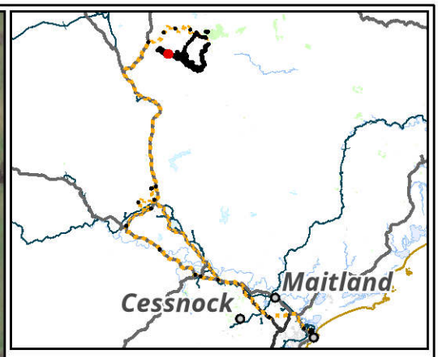

Legend

- Transport haul routes
- Infrastructure footprint
- Transmission line
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons, Page 2

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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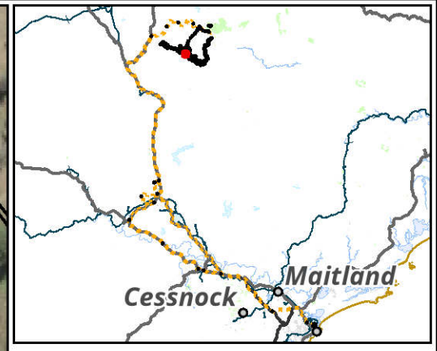

Legend

- Transport haul routes
- Infrastructure footprint
- Transmission line
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons, Page 3

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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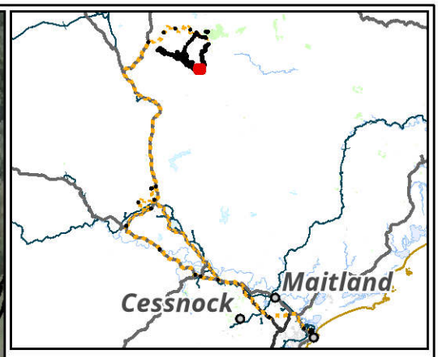

Legend

- Transport haul routes
- Infrastructure footprint
- Transmission line
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons, Page 4

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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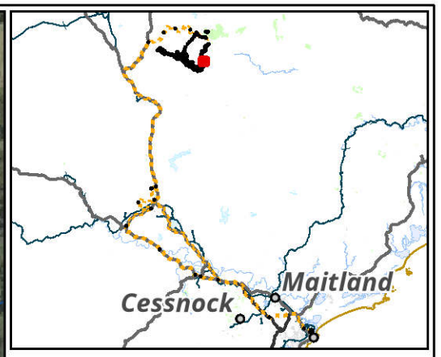

Legend

- Transport haul routes
- Infrastructure footprint
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons, Page 5

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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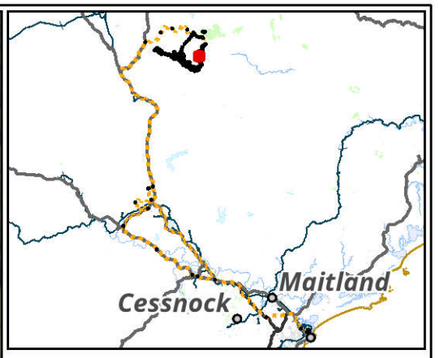

Legend

- Transport haul routes
- Infrastructure footprint
- Eastern Cave Bat (forage habitat)
- Large-eared Pied Bat (forage habitat)

Figure 17 Cave bat habitat polygons,
Page 6

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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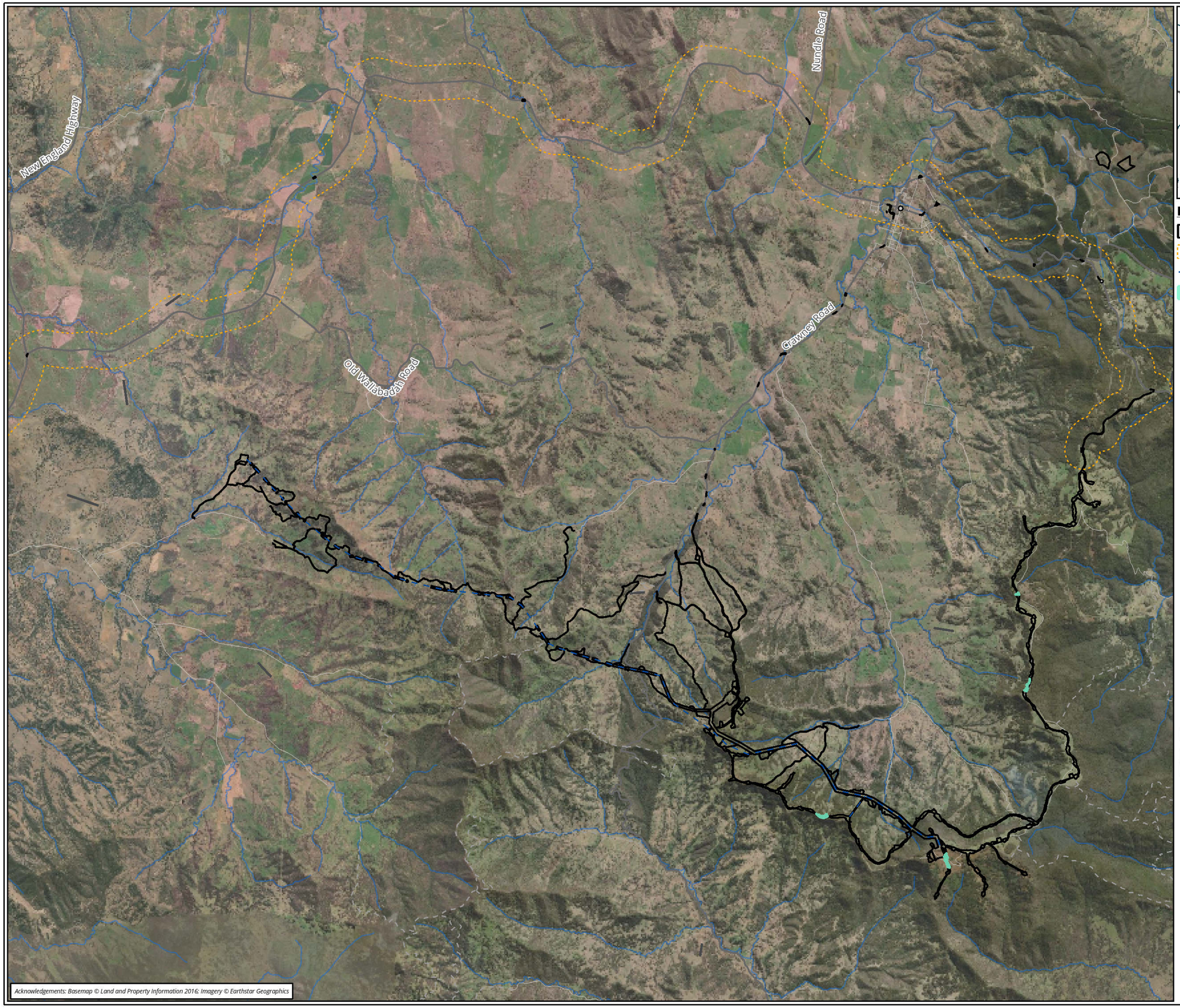

Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line
- Southern Myotis

Figure 18 Southern Myotis habitat polygons, Page 1

0 1,000 2,000 3,000 4,000

Meters

Scale: 1:100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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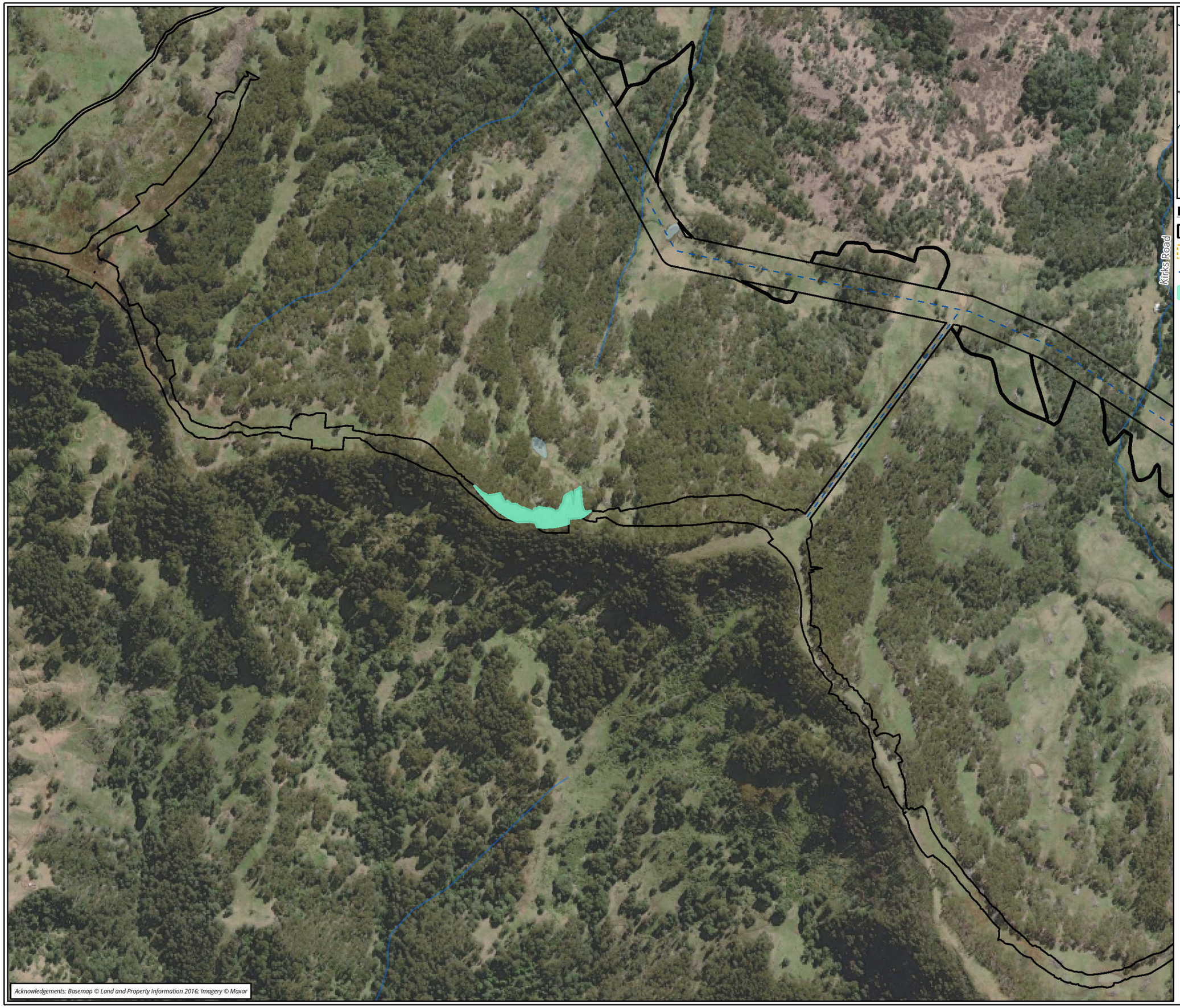

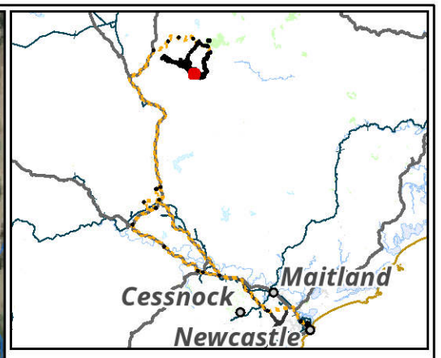

Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line
- Southern Myotis

Figure 18 Southern Myotis habitat polygons, Page 2

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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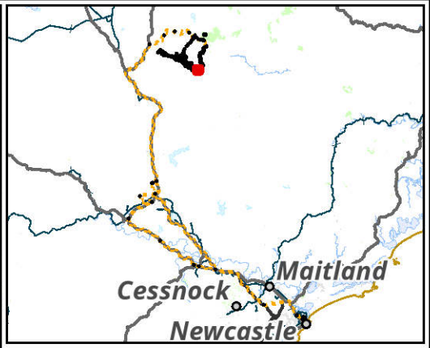

Legend

- Infrastructure footprint
- Transport haul routes
- Transmission line
- Southern Myotis

Figure 18 Southern Myotis habitat polygons, Page 3

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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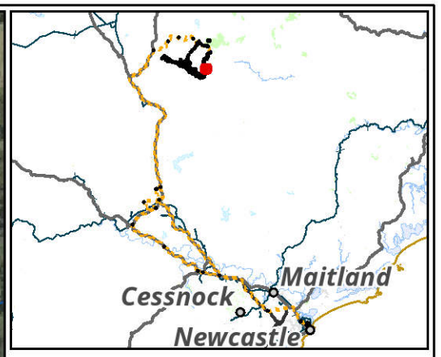

Legend

- Infrastructure footprint
- Transport haul routes
- Southern Myotis

Figure 18 Southern Myotis habitat polygons,
Page 4

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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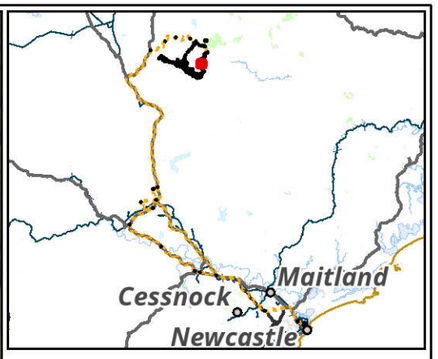

Legend

- Infrastructure footprint
- Transport haul routes
- Southern Myotis

Figure 18 Southern Myotis habitat polygons,
Page 5

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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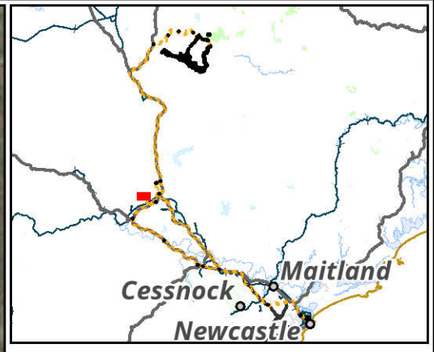

Legend

- Infrastructure footprint
- Transport haul routes
- Southern Myotis

Figure 18 Southern Myotis habitat polygons,
Page 6

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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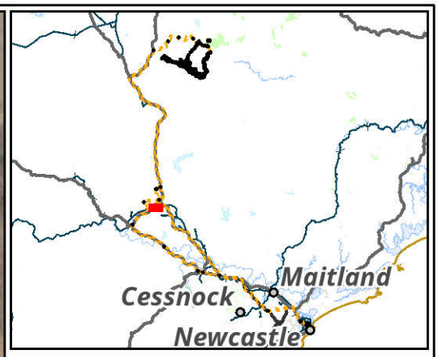

Legend

- Infrastructure footprint
- Transport haul routes
- Southern Myotis

Figure 18 Southern Myotis habitat polygons,
Page 7

0 20 40 60 80

Meters

N

Scale: 1:2,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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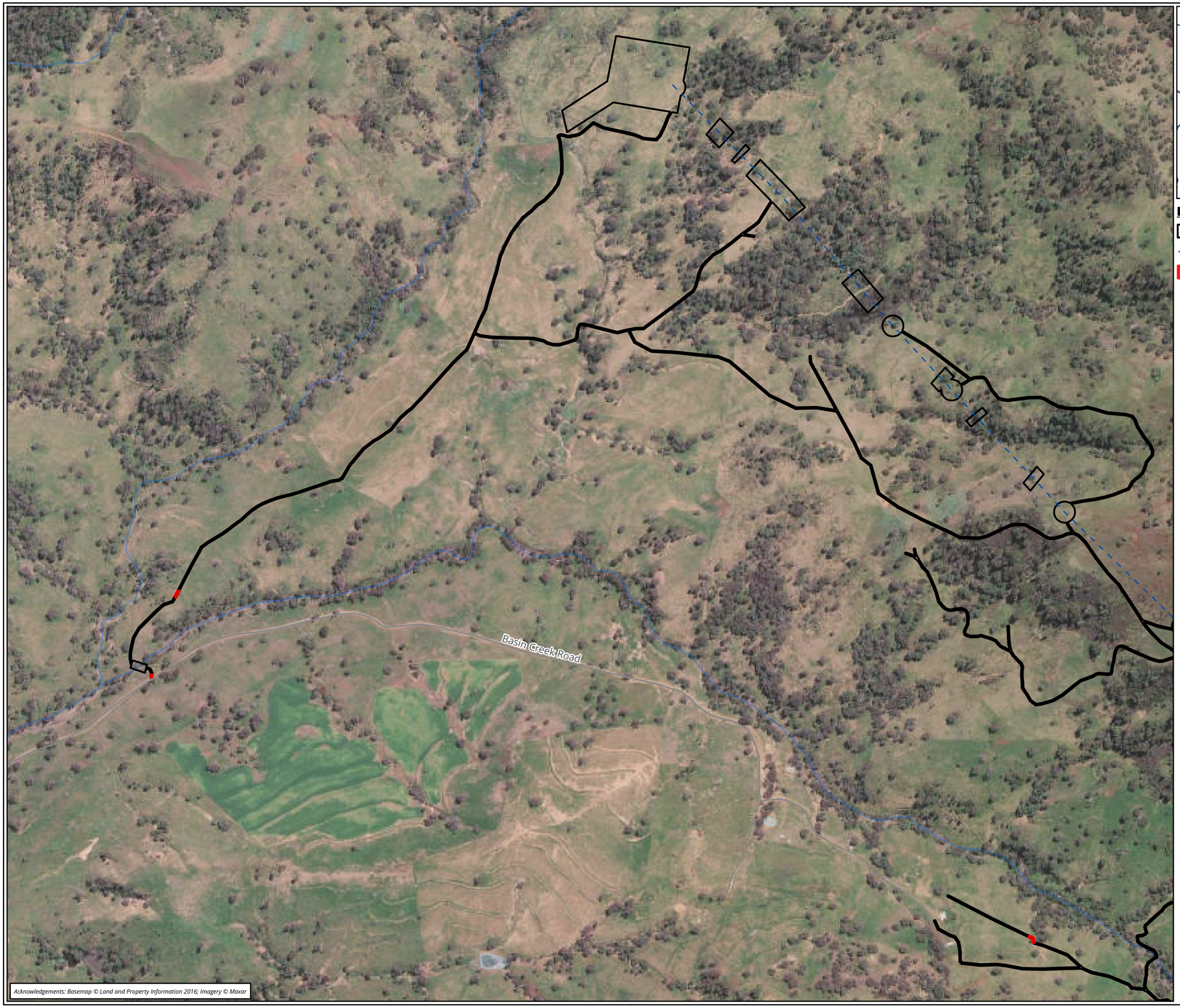

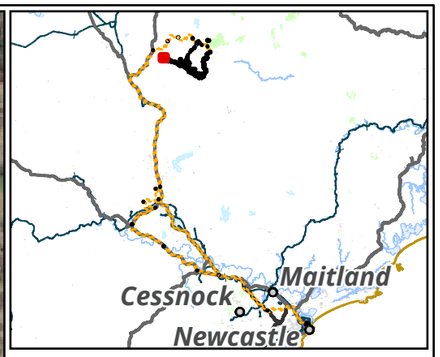

Legend

- Infrastructure footprint
- Transmission line
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 2

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

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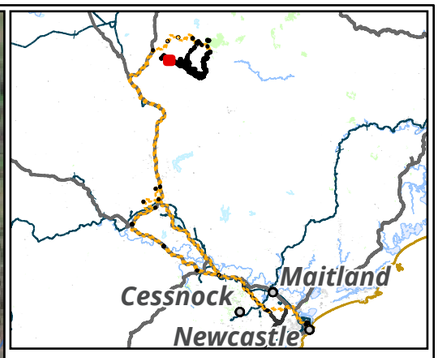

Legend

- Infrastructure footprint
- Transmission line
- Squirrel Glider
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 3

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

Matter: 34963,
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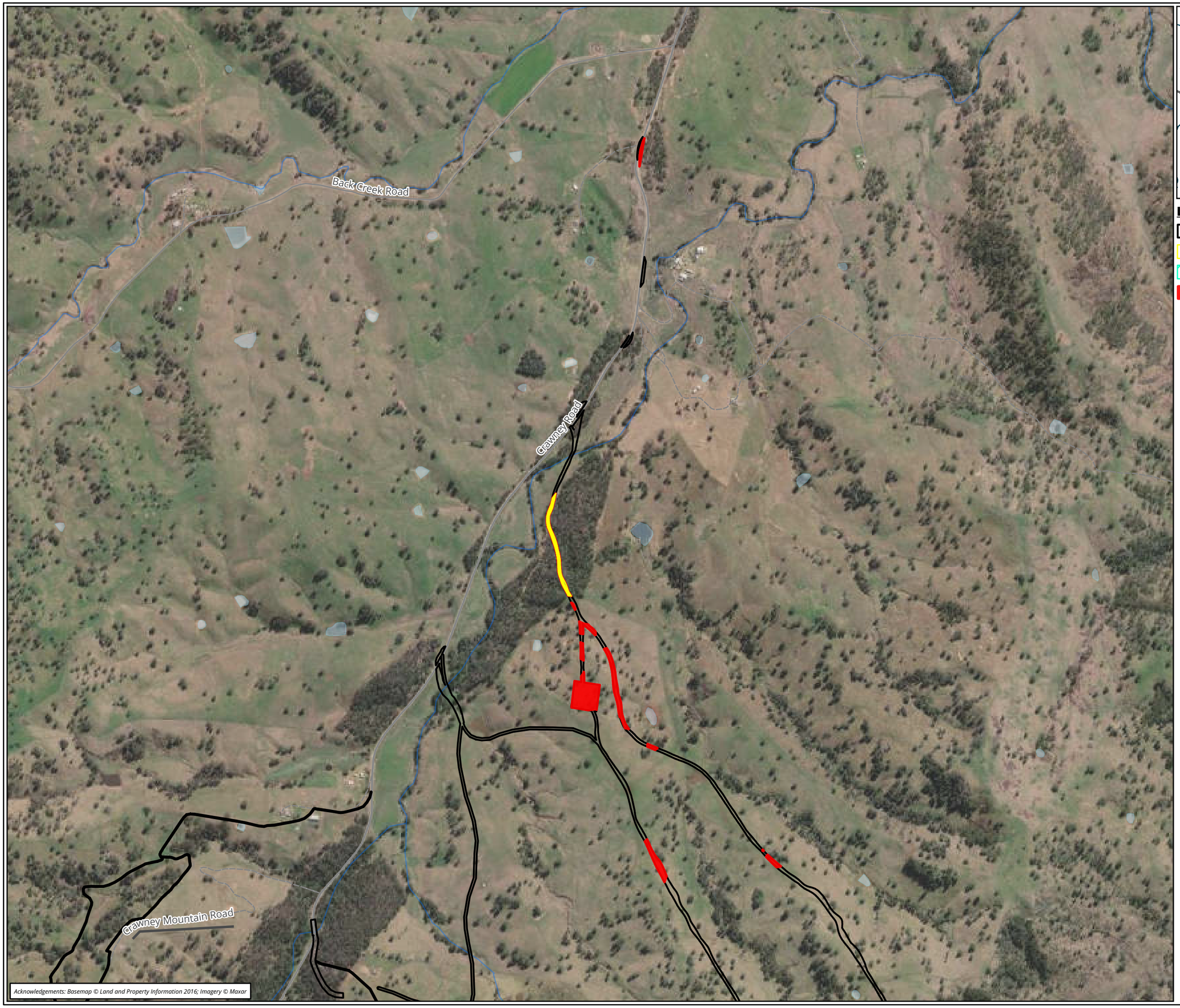

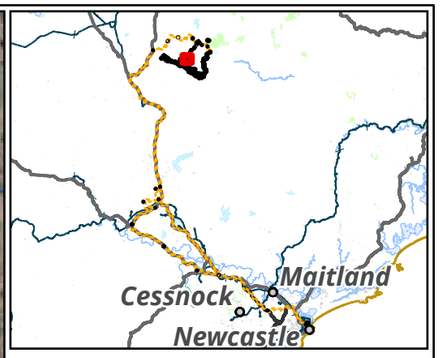

Legend

- Infrastructure footprint
- Eastern Pygmy Possum
- Squirrel Glider
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 4

0 150 300 450 600

Meters

Scale: 1:15,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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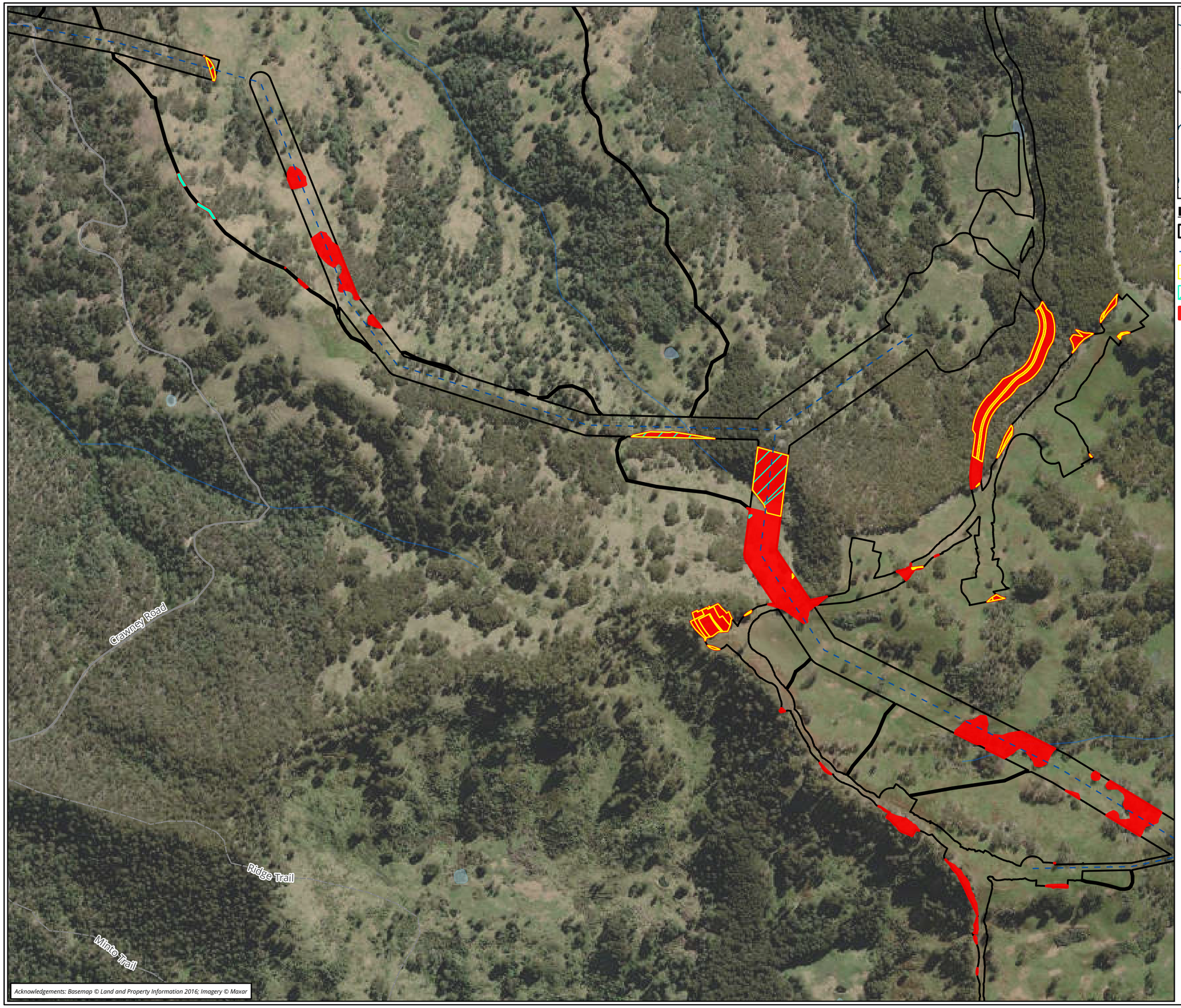

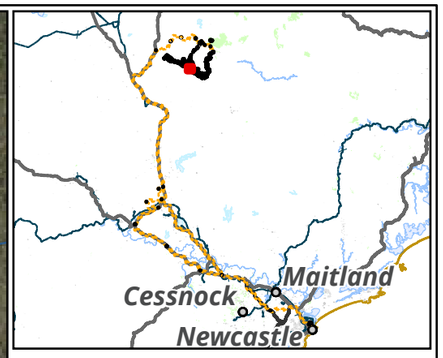

Legend

- Infrastructure footprint
- Transmission line
- Eastern Pygmy Possum
- Squirrel Glider
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 4

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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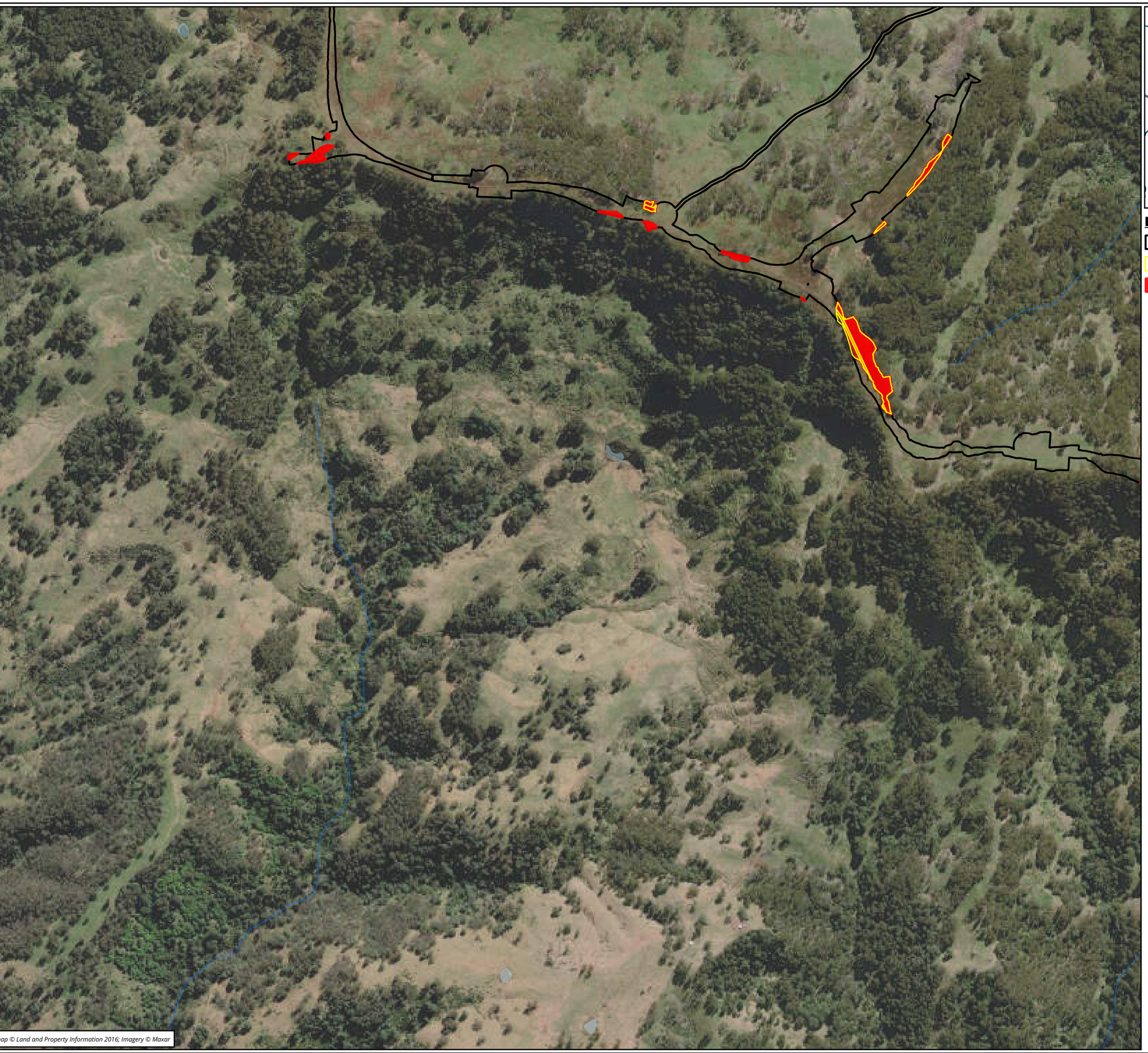

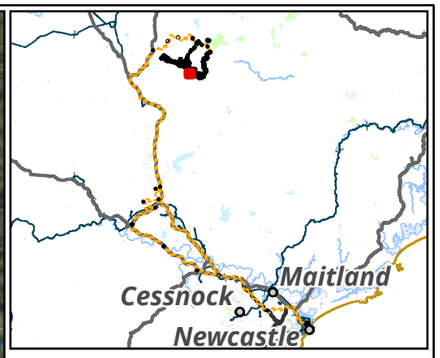

Legend

- Infrastructure footprint
- Eastern Pygmy Possum
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 5

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

biosis

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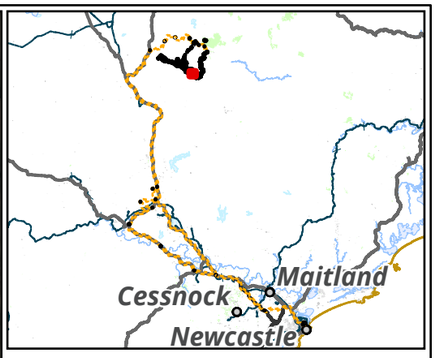

Legend

- Infrastructure footprint
- Transmission line
- Eastern Pygmy Possum
- Squirrel Glider
- Koala

Figure 19 Arboreal mammals habitat polygons, Page 6

0 100 200 300 400

Meters

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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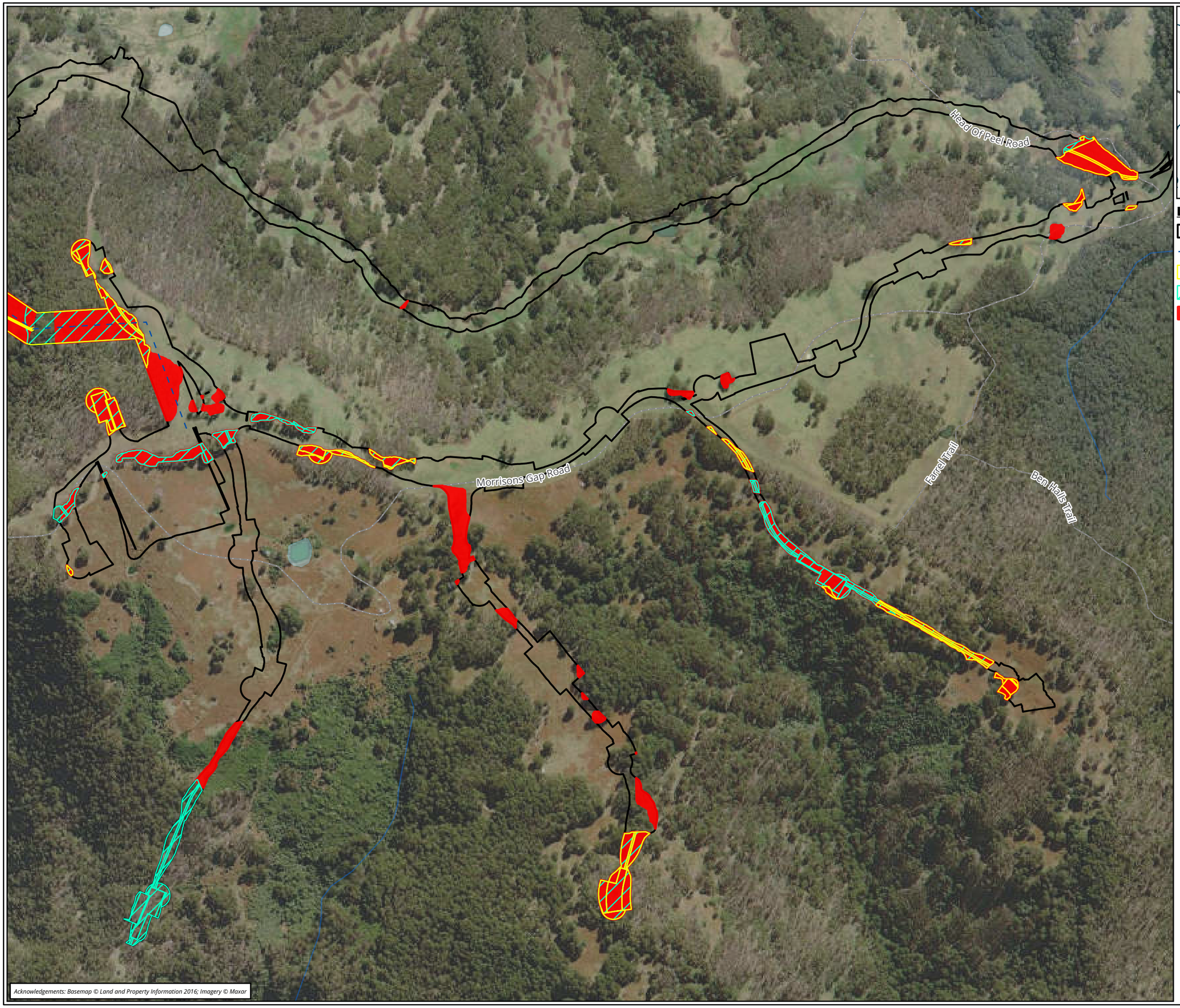

Figure 19 Arboreal mammals habitat polygons, Page 7

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