

APPENDIX

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Terrestrial and Aquatic Ecology Technical Report

Part 4 of 7

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

APPENDIX

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Terrestrial and Aquatic Ecology Technical Report

Appendix A Additional ecological investigations

CONTINUED

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT



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Fauna Survey Report

Targeted survey for Brigalow Woodland Snail *Adclarkia cameroni* within selected parts of the Inland Rail Project area, Queensland.

Compiled by BOOBOOK for ARTC

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Abbreviations

ARTC	Australian Rail Track Corporation
B2G	Border to Gowrie
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DES	Department of Environment and Science (State)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
GPS	Global Positioning System
GTRE	Ground-truthed Regional Ecosystem
km	kilometre (s)
L	Litre (s)
m	metre (s)
mm	millimetres
MNES	Matters of National Environmental Significance (EPBC Act)
MSES	Matters of State Environmental Significance (State legislation)
NC Act	<i>Nature Conservation Act 1992</i>
Qld	Queensland
RE	Regional Ecosystem (s)
REDD	Regional Ecosystem Description Database
SF	State Forest
TSSC	Threatened Species Scientific Committee

Conclusions drawn in this report are based on available information at the time of writing. Any additional information may alter such conclusions and the author reserves the right to do so if such information becomes available. This report has been made as at the date of the report and is not to be used after six (6) months and not if there are any material changes meanwhile. In either event it should be referred back for review. To the extent permitted by law BOOBOOK does not accept liability for any loss or damage which any person may suffer arising from any negligence or breach of contract on its part. This report was prepared for the benefit of the party to whom it is directed only and for the purpose identified within. BOOBOOK does not accept responsibility to any other person for the contents of the report.

Executive Summary

BOOBOOK Ecological Consulting (BOOBOOK) was commissioned by Australian Rail Track Corporation (ARTC) (the Client) to undertake a targeted survey for Brigalow Woodland Snail (*Adclarkia cameroni*) for the proposed Inland Rail Project (the Project). The survey focussed on a 100 km long Area of Interest (AOI) within the Border to Gowrie (B2G) section of the Project.

The Brigalow Woodland Snail is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and is so classed as a Matter of National Environmental Significance (MNES). It is also listed as vulnerable under the *State Nature Conservation Act 1992* and is therefore also a Matter of State Environmental Significance (MSES).

Brigalow Woodland Snail was predicted to occur within the Survey Area based on the EPBC Act Protected Matters Search Tool (PMST). No targeted surveys for Brigalow Woodland Snail are known to have previously been undertaken within the Survey Area by suitably qualified personnel.

The field survey had the following objectives:

- ✦ To confirm presence/absence of the Brigalow Woodland Snail within the Survey Area; and
- ✦ If detected, to obtain information relating to habitat use by Brigalow Woodland Snail within the Survey Area.

A field survey was conducted over a five-day period in August 2022 by BOOBOOK personnel. The survey was conducted at 20 sites between Wellcamp (near Toowoomba) and Canning Creek (between Millmerran and Inglewood).

Key findings of the survey are summarised as follows:

- ✦ Sixteen (16) species of land snail were recorded within the Survey Area.
- ✦ Brigalow Woodland Snail was detected at 11 of the 20 survey sites.
- ✦ The survey detected 22 live individuals and at least 39 dead shells of Brigalow Woodland Snail.
- ✦ Brigalow Woodland Snail was found within a 60 km stretch of the AOI between Brookstead and Canning Creek.
- ✦ Brigalow Woodland Snail was detected in the following remnant and/or regrowth regional ecosystem (RE) types in the Survey Area:
 - RE 11.3.2: *Eucalyptus populnea* woodland on alluvial plains.
 - RE 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
 - RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.
 - RE 11.9.5: *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.

Survey results confirmed the known general habitat preferences of Brigalow Woodland Snail outlined in TSSC (2016). Within the Survey Area, these can be summarised as follows:

- ✦ Fringing/riparian woodlands dominated by River Red Gum (*Eucalyptus camaldulensis*) on clay soils along watercourses and other streams.
- ✦ Woodlands dominated by Poplar Box (*E. populnea*) and/or Belah (*Casuarina cristata*) and/or Brigalow (*Acacia harpophylla*) on alluvial plains with clay soils.
- ✦ Woodlands dominated by Belah (*Casuarina cristata*) and/or Brigalow (*Acacia harpophylla*) on undulating low hills with clay soils.

Brigalow Woodland Snail was found in remnant and regrowth vegetation (irrespective of vegetation width and patch size) providing suitable shelter sites such as logs, dense leaf litter, low shrubs, flood debris piles and loose bark accumulations were present.

Brigalow Woodland Snail was not detected in woodlands dominated by Mountain Coolibah (*E. orgadophila*), Silver-leaved Ironbark (*E. melanophloia*) and/or Narrow-leaved Ironbark (*E. crebra*) on low basalt hills. These are represented by the following RE types within the Survey Area:

- ✎ RE 11.8.4: *Eucalyptus melanophloia* woodland to open woodland on Cainozoic igneous rocks - note that this RE may be dominated by *E. crebra* (DES 2021) which was the case at two of the sampled survey sites.
- ✎ RE 11.8.5: *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.

No estimates of the total population size of Brigalow Woodland Snail can be made within the Survey Area based on the current survey results as diurnal searches were undertaken only. Population studies would require further field work at night after rain when the species is most active and live individuals are readily detectable. Regardless, it is clear from the results of this survey that Brigalow Woodland Snail is distributed throughout a significant portion of the Survey Area (wherever potentially suitable RE and microhabitat is present), and that the Survey Area likely supports a significant population of the species.

1. Introduction

1.1 Purpose & Scope

BOOBOOK Ecological Consulting (BOOBOOK) was commissioned by Australian Rail Track Corporation (ARTC) (the Client) to undertake a targeted survey for Brigalow Woodland Snail (*Adclarkia cameroni*) for the proposed Inland Rail Project (the Project). The survey focussed on a 100 km Area of Interest (AOI) within the Border to Gowrie (B2G) section of the Project.

The Brigalow Woodland Snail is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and as Vulnerable under the State (Qld) *Nature Conservation Act 1992* (NC Act). Brigalow Woodland Snail has not previously been detected within the AOI, however no previous targeted searches by land snail specialists are known to have been undertaken. Potential presence of the species within B2G was predicted by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) (DCCEEW 2022a). ARTC requested information on presence/absence of Brigalow Woodland Snail within the B2G portion of the AOI.

1.2 Survey Area Description

The Survey Area extended for approximately 100 km between Wellcamp (west of Toowoomba) in the north and Canning Creek in the south (between Millmerran and Inglewood). The location of the Survey Area is shown within Appendix A.

The Survey Area is almost entirely located within the Toowoomba Regional Council apart from the southern extremity which is within Goondiwindi Regional Council. Land uses throughout the Survey Area include livestock grazing, cropping, mining and forestry. Major roads include the Toowoomba Cecil Plains Road, Gore Highway and Millmerran Inglewood Road.

North of the Condamine River the Survey Area lies within Subregion 31 (Eastern Darling Downs) of the Brigalow Belt South bioregion (Sattler and Williams 1999). South of the Condamine River the Survey Area is within Subregion 32 (Inglewood Sandstones). The majority of the Survey Area has been cleared of native vegetation. On the flat to gently undulating clay plains that were formerly dominated by native grassland, Poplar Box (*Eucalyptus populnea*) and/or Brigalow (*Acacia harpophylla*) communities the few vegetated areas that remain consist of shade lines, strips and clumps of remnant or regrowth vegetation. The main area of relatively intact vegetation is in the extreme southern end of the Survey Area (north of Inglewood) adjoining Bringalily State Forest (SF).

Elevation within the Survey Area ranges from about 330 m to 610 m. Between Wellcamp and Millmerran the geology is primarily Tertiary basalt and Quaternary alluvium. South of Millmerran are primarily Cretaceous sediments.

The northern two thirds of the Survey Area is drained by the Condamine River and its tributaries, forming part of the Balonne-Condamine catchment. South of Millmerran the remainder of the Survey Area drains into the Macintyre Brook via Canning Creek and its tributaries, part of the Border Rivers catchment. Both catchments are within the Murray Darling Basin.

1.3 Survey Team and Timing

The field survey was led by Craig Eddie (BOOBOOK, Principal Ecologist) over a five-day period from 22nd to 26th August 2022. Craig Eddie is an ecologist and land snail specialist with over 35 years of land snail survey experience.

1.4 Limitations

The field survey was conducted within or as close as possible to the AOI. Where land access limited access to sites within the AOI, the nearest accessible area with similar soils and vegetation was selected for survey (e.g. Condamine River). The survey focussed on areas with remnant vegetation and/or regrowth rather than cleared areas as highly modified sites do not provide suitable habitat for the target species.

Conditions during the survey were highly favourable for detection of Brigalow Woodland Snail. Available rainfall records for the central part of the Survey Area at Pittsworth (weather station 41082) showed that the region had received significant rainfall (total 635 mm) over multiple rain events between January and July 2022 (BOM 2022). A further 35 mm had fallen in the two weeks immediately prior to the survey hence ground conditions were very moist.

2. Species Profile

2.1 Taxonomy

The Brigalow Woodland Snail (*Adclarkia cameroni*) belongs to the family Camaenidae. It is one of three species within the genus *Adclarkia*. Although first collected in the mid-1980's (OZCAM 2022), Brigalow Woodland Snail was formally described in 2010 (Stanisic *et al.* 2010).

2.2 Legislative Status

The Brigalow Woodland Snail is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) and as Vulnerable under the Queensland *Nature Conservation Act 1992* (NC Act).

2.3 Description

The shell of Brigalow Woodland Snail is pale brown, thin and approximately 20mm in diameter when adult. The shells are depressedly globose with a low, domed spire (Stanisic *et al.* 2010). The reddish subsutural band on the shell described by Stanisic *et al.* (2010) is a variable feature and may be lacking in some specimens (C. Eddie pers. obs.). Like all species of *Adclarkia*, the teleoconch sculpture on the upper half of the shell is of fine, scaly pustules (Stanisic *et al.* 2010). The protoconch (i.e. the first whorl) sculpture is pustulose (Stanisic *et al.* 2010). The lower half of the shell is smooth and glossy with a narrowly open umbilicus. The lip is thin and barely reflected (Stanisic *et al.* 2010). The shell of the Dulacca Woodland Snail, which also occurs within the broader range of the Brigalow Woodland Snail, is thicker (including the lip), slightly smaller in diameter and much flatter. The Boggomoss Snail (*A. dawsonensis*) does not occur within the range of the Brigalow Woodland Snail (Stanisic 1996). It is slightly larger than the Brigalow Woodland Snail.

The living animal of Brigalow Woodland Snail is described as being “grey” (Stanisic *et al.* 2010). The mantle is pale orange and the black mottling on the lung roof of the animal is visible through the shell (C. Eddie pers. obs.).

2.4 Distribution

Publicly accessible records of Brigalow Woodland Snail (ALA 2022) show that it is found in a small area of southern inland Queensland between Bowenville in the east and Miles in the west. Most records are broadly associated with the Condamine River floodplain (ALA 2022).

The known distribution of the species is entirely within the Brigalow Belt bioregion. The majority of records lie within Subregion 31 (Eastern Darling Downs) with other occurrences in Subregion 26 (Southern Downs) and Subregion 32 (Inglewood Sandstones). Subregions 26 and 31 have extensive areas of fertile clay plains (Sattler and Williams 1999) that are substantially cleared of native vegetation. Consequently, the current distribution of Brigalow Woodland Snail is highly fragmented (ALA 2022) and largely restricted to retained patches and strips of habitat along riparian corridors (TSSC 2016).

2.5 Ecology

There are no studies of the ecology of Brigalow Woodland Snail. The species is known to live in a variety of woodland types where it shelters under logs, rocks, and other ground debris (Stanisic *et al.* 2010, TSSC 2016). Like other camaenid land snails the species is presumed to be active at night after rain. During periods of inactivity the Brigalow Woodland Snail will aestivate (i.e. enter a period of dormancy) at its chosen shelter site. In order to conserve moisture, live snails attach to the underside of logs, rocks, leaves or the ground surface and seal any gaps in the shell opening with mucus. Burrowing into shallow soil has been observed in captivity (C. Eddie pers. obs.).

2.6 Habitat

2.6.1 Vegetation Associations

At the time of the species description Stanisc *et al.* (2010) described the habitat of the Brigalow Woodland Snail as “Brigalow/eucalypt woodland”. Stanisc (in TSSC 2016) describes the Brigalow Woodland Snail as occurring in “remnant and scattered *Acacia harpophylla* (Brigalow) and woodland patches (such as road verges and riparian corridors) on the Condamine River floodplain, especially in the area around Dalby and Chinchilla”. Virtually no other habitat information has been published since the species description and subsequent Commonwealth listing (TSSC 2016). There are currently no documented RE associations or vegetation structural/floristic data available for known sites.

2.6.2 Microhabitat

The Brigalow Woodland Snail shelters beneath logs, under rocks, among leaf litter and in loose bark piles at the base of trees (Stanisc *et al.* 2010, C. Eddie pers. obs.). The species can occur in non-remnant habitats (e.g. regrowth and grassland) providing there are suitable shelter sites (TSSC 2016).

In summary, microhabitat features critical to the survival of the species include:

- ✎ logs;
- ✎ rocks;
- ✎ timber/vegetation piles;
- ✎ loose bark piles;
- ✎ loose bark at the base of trees; and
- ✎ dense leaf litter.

One or more of the above microhabitat features needs to be present for the species to be present at any given site. However, there is no data available concerning the abundance/density of microhabitat features required to support the species.

2.7 Movement Patterns

Nothing is known of the movements of Brigalow Woodland Snail; however, the species is considered to be of very limited mobility (Stanisc in TSSC 2016). Movement between suitable microhabitat sites (e.g. log piles) may be possible (Stanisc in TSSC 2016). Movement patterns of Australian land snails are poorly studied. Ridgeway *et al.* (2014) studied the behavioural ecology, including movement patterns, of several species of camaenid land snails in the Sydney region of New South Wales (NSW). These species were *Pommerhelix duralensis*, *Meridolum corneovirens* and *M. middense* which are comparable in size or a little larger (15-30mm in diameter) than Brigalow Woodland Snail. The study of Ridgeway *et al.* (2014) found that these snails moved only short distances during any one observation (often <1m) and that the longest recorded movement was 3.5 m out of 50 survey-animal nights. Ridgeway *et al.* (2014) also concluded that the very low dispersal rates recorded for two of the species suggested that they are highly susceptible to habitat fragmentation. Although not confirmed by field studies, it is probable that Brigalow Woodland Snails also move short distances and that they are equally as susceptible to habitat fragmentation through the creation of isolated populations.

2.8 Breeding Biology

Nothing is known of the breeding biology of Brigalow Woodland Snail (TSSC 2016). It is assumed, like other camaenid land snails, that it lays its eggs in depressions in soil under logs and other ground debris; multiple egg laying events per season are possible depending on the frequency and timing of weather events (Stanisc in TSSC 2016). Although not confirmed, the species is expected to reach sexual maturity during its second wet season (Stanisc in TSSC 2016).

Land snail eggs are prone to desiccation therefore an overstorey of trees and shrubs, in addition to ground shelter sites (e.g. logs and other debris), is considered critical to maintaining high levels of humidity at potential egg-laying sites (Stanisc in TSSC 2016).

2.9 Feeding Ecology

Nothing is known of the food or feeding ecology of Brigalow Woodland Snail. Like other camaenid land snails it is presumed to feed at night after rain upon hyphae and fruiting bodies of native fungi, lichen, algae and other detritus/biofilm among ground debris (Stanisic in TSSC 2016).

3. Methodology

3.1 Desktop & Literature Review

The following data and information sources were reviewed to inform this survey:

- ✎ PMST (DCCEEW 2022a);
- ✎ Species Profile and Threats Database (SPRAT) (DCCEEW 2022b);
- ✎ Atlas of Living Australia database (ALA 2022);
- ✎ Queensland Museum fauna specimen database (OZCAM 2022);
- ✎ State government pre-clear and remnant regional ecosystem (RE) mapping (DES 2022a);
- ✎ State government Wildlife Online database (DES 2022b);
- ✎ Client-supplied ground-truthed regional ecosystem (GTRE) mapping;
- ✎ Relevant published and other publicly available literature; and
- ✎ Satellite imagery for the Survey Area (Google Earth, Queensland Globe).

A series of potential field survey sites were selected during examination of relevant imagery for the Survey Area. Potential sites were chosen to in areas that were representative of all vegetation types/REs within the Survey Area, as well as all of the major watercourses. Suitability of potential field sites was assessed during the field survey.

3.2 Field Survey

3.2.1 Targeted Snail Searches

In the absence of species-specific survey guidelines for Brigalow Woodland Snail standard terrestrial land snail survey techniques (e.g. Stanisic *et al.* 2010, Cameron and Pokryszko 2005) and recommendations for survey of Brigalow Woodland Snail within the Conservation Advice (TSSC 2016) were followed. The Conservation Advice provides the following survey guidelines:

- ✎ The species “lives under forest debris and is best detected by turning logs and raking accumulated leaves”.
- ✎ “The best times for survey are during the months of summer storms and rain (generally October to March)”.
- ✎ “The snail is nocturnal, suggesting that night surveys would be preferable; however, given the difficulty with night observation of snails in their habitat, daylight searching can be equally effective”.
- ✎ “Survey effort for recording presence/absence should be at least two person hours targeting areas of preferred snail microhabitat”.

Surveys for the target species conformed to the survey guidelines in the following ways:

- ✎ The field survey was conducted outside of the preferred survey period of October – March, however survey conditions were highly favourable for detection of the species due to preceding wet conditions.
- ✎ Active searching of potential shelter sites within a range of vegetation types was the primary search method.
- ✎ Each site was searched for a minimum of two person hours (which included as much of each habitat in which the survey site was located) unless all microhabitat at the survey site was searched in less time.

Active searching included rolling logs and other ground debris, checking the inside of hollow logs, overturning rocks/rock piles, lifting fallen bark piles and raking through leaf litter and piles of fallen bark and flood debris. The undersides and hollows of logs were checked for aestivating live snails, while the top few centimetres of soil beneath logs was raked to detect whole shells or fragments of dead snails. Note that active searching was carefully undertaken to minimise microhabitat disturbance at all survey sites. The location (and number of shells) of Brigalow Woodland Snail (where detected) was captured by Global Positioning System (GPS) and recorded electronically for incorporation into relevant Geographic Information System (GIS) layers.

A sample of surface soil and leaf litter was collected from under logs/rocks or around the bases of trees from each survey site for post-field laboratory sorting. The amount of leaf litter/soil collected from each survey site varied from 0.1 to 3.5 L due to the amount available per site. For example, at sites adjoining the major watercourses most of the leaf litter had been washed away following recent floods. Leaf litter samples were dried and then sieved.

Shells of dead land snails were extracted from leaf litter using a stereo microscope under laboratory conditions. This additional search technique (e.g. Stanisic *et al.* 2010) was useful to detect juvenile snails and shell fragments where shells of the target species were not otherwise detected during active searches. Any land snails extracted from leaf litter samples were identified to species level using relevant field guides (e.g. Stanisic *et al.* 2010) and the BOOBOOK land snail reference collection.

Nocturnal searches were not undertaken as live snails were not necessary to confirm presence of the species within the Survey Area i.e. the species was readily detected by the presence of dead shells. As per the Conservation Advice (TSSC 2016), the presence of dead shells was assumed to be an indicator of living specimens.

Voucher specimens of land snails from each survey site were retained for identification confirmation. Shells of dead Brigalow Woodland Snails were collected under Scientific Purposes Permit WA0026174.

Land snail taxonomy within this report follows the MolluscaBase database (MolluscaBase 2022).

Brigalow Woodland Snail was readily distinguished from most other species of land snail present in the Survey Area by the shape and size of the shell. However, shape and size of the shell is variable and the Brigalow Woodland Snail is superficially similar to several undescribed species in the family Camaenidae which overlap with the broader range of the Brigalow Woodland Snail in the Brigalow Belt. As such size, colour and shape of the shell are not reliable identification characters on their own (C. Eddie pers. obs.). All specimens of *Adclarkia* were distinguished from other undescribed (and potentially confusing) species of Camaenidae by examining differences in microsculpture on the shell surface. This was undertaken by examining voucher specimens under a stereo microscope in the laboratory. All *Adclarkia* are sculptured with fine, elongate pustules each with a raised periostracal scale on the teleoconch (Stanisic *et al.* 2010). This feature is absent from shells of the undescribed Brigalow Belt camaenids, hence examination of shell microsculpture was the primary method of identification.

3.2.2 Microhabitat Assessments

As the focus of this survey was detecting the species (i.e. to determine presence/absence) detailed microhabitat assessments were not performed. However, a simplified microhabitat assessment was undertaken at each survey site. A range of microhabitat characteristics of potential importance to the species were assessed within a 50 m x 10 m plot including:

- ✦ abundance of small (<30cm diameter) and large logs (>30cm diameter);
- ✦ abundance of loose rocks/stones;
- ✦ abundance of trees with loose basal bark/basal bark piles;
- ✦ presence/absence of other bark piles (e.g. disassociated fallen bark);
- ✦ presence/absence of log piles (e.g. stick-raked piles resulting from previous clearing);
- ✦ density of leaf litter;
- ✦ density of ground layer;
- ✦ presence/absence of flood debris piles; and
- ✦ presence/absence of gilgais.

Notes about disturbances were recorded at each survey site such as clearing (including historical), thinning/selective logging, grazing, feral animal diggings/wallows, and fire, flood and storm damage.

4. Results

4.1 Desktop Searches

Previous land snail searches have been undertaken in or near the Survey Area as part of bioregion-wide surveys (e.g. Stanisic 1998) or as incidental activities during ecological assessments (BOOBOOK unpubl. data). These are not

considered to have been comprehensive. More importantly, no targeted surveys for Brigalow Woodland Snail are known to have been previously undertaken in the Survey Area.

Publicly accessible database records for Brigalow Woodland Snail within the Survey Area are shown within Appendix A. Specimen-backed records of Brigalow Woodland Snail were derived from searches of the Atlas of Living Australia (ALA 2022) and Queensland Museum (OZCAM 2022) databases. Records of Brigalow Woodland Snail from the Wildlife Online database (DES 2022b) were not used as several are not specimen-backed and the remainder are duplicates of ALA or OZCAM records.

The desktop search results (Appendix A) show that the Brigalow Woodland Snail has not previously been recorded from the Survey Area (ALA 2022, OZCAM 2022). The nearest publicly available records to the Survey Area are approximately 45-55 km to the northwest.

4.2 Targeted Searches

Existing desktop data was not adequate to address matters relating to Brigalow Woodland Snail within the Survey Area hence a targeted survey was performed as part of this study. Twenty (20) survey sites were sampled for Brigalow Woodland Snail. The location of each survey site is shown within Appendix A and descriptive notes for each are shown in Appendix B.

The field survey had the following objectives:

- ✎ To confirm presence/absence of the Brigalow Woodland Snail within the Survey Area; and
- ✎ If detected, to obtain information relating to habitat use by Brigalow Woodland Snail within the Survey Area.

The field survey was undertaken over a five-day period with weather conditions being mild and with nil precipitation.

At least sixteen (16) species of native land snail and two species of introduced slug were recorded within the Survey Area (Table 1). The total number of land snail species recorded may increase pending further examination of undescribed species within the families Camaenidae, Rhytididae and Charopidae.

Table 1: Terrestrial molluscs detected within the Survey Area.

Family	Scientific Name	Common Name	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Camaenidae	<i>Adclarkia cameroni</i>	Brigalow Woodland Snail	-	-	-	-	-	-	-	X	X	X	X	X	X	X	-	X	X	X	-	X
Camaenidae	Camaenidae sp. (undescribed – likely at least 2 spp.)	A Woodland Snail	-	-	X	-		X	X	-	-	-	-	-	X	-	-	-	-	-	-	X
Camaenidae	<i>Neveritis aridorum</i>	Nomadic Velvet Snail	-	X	X	X	X	X	-	-	X	-	X	-	X	-	-	-	-	-	-	-
Camaenidae	<i>Neveritis misella</i>	Mid-eastern Velvet Snail	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-
Charopidae	Charopidae sp. (undescribed)	A Pinwheel Snail	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charopidae	<i>Cineropa / Elsothera</i> sp. (undescribed)	A Pinwheel Snail	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Charopidae	<i>Discocharopa aperta</i>	Minuscule White Pinwheel Snail	-	-	X	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-
Punctidae	<i>Paralaoma servilis</i>	Mort's Pinhead Snail	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pupillidae	<i>Cylindrovertilla hedleyi</i>	Hedley's Amber Pupasnail	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Pupillidae	<i>Gastrocopta hedleyi</i>	Brigalow Pupasnail	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pupillidae	<i>Gastrocopta pediculus</i>	Weakly Toothed Pupasnail	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pupillidae	<i>Gastrocopta strangei</i>	Strange's Pupasnail	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Pupillidae	<i>Pumilicopta bifurcata</i>	Many-toothed Pupasnail	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-
Pupillidae	<i>Pupoides pacificus</i>	Single-toothed Pupasnail	-	X	X	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-
Rhytididae	Rhytididae sp.	a Carnivorous Snail	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-

Family	Scientific Name	Common Name	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Subulinidae	<i>Erelopeas tuckeri</i>	Tucker's Awlsnail	-	-	-	X	-	X	-	X	X	-	-	-	X	-	X	-	-	-	-	X
INTRODUCED SLUGS																						
Agriolimacidae	<i>Deroceras panormitanum</i>	Brown Field Slug	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Limacidae	<i>Letourneuxia nyctelia</i> (formerly <i>Lehmannia nyctelia</i>)	Striped Field Slug	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Brigalow Woodland Snail was detected at 11 of the 20 survey sites (Appendix C). Numbers of individuals recorded at each site and relevant microhabitat notes are summarised in Table 2.

Table 2: Summary of sites where Brigalow Woodland Snail was detected with RE and microhabitat notes.

Site No.	Brigalow Woodland Snail Detected	No. of live individuals	No of dead shells	RE	Microhabitat Notes
S01	No	-	-	Non-remnant	Microhabitat included dense grass and piles of flood debris.
S02	No	-	-	11.8.5	Microhabitat included logs, leaf litter accumulations and small rocks.
S03	No	-	-	Non-remnant	Microhabitat included small logs/log piles and fallen bark.
S04	No	-	-	11.8.4	Microhabitat included logs and small rocks.
S05	No	-	-	11.8.4	Microhabitat included logs, leaf litter accumulations and small rocks.
S06	No	-	-	11.8.5	Microhabitat included logs, small rocks, leaf litter accumulations and a boulder pile.
S07	No	-	-	11.9.5	Microhabitat included small logs and leaf litter accumulations.
S08	Yes	2	10	11.3.25	Brigalow Woodland Snail found under small logs, rubbish (discarded blanket) and piles of flood debris.
S09	Yes	2	4	11.3.25	Brigalow Woodland Snail found under logs, loose bark piles at base of trees, under ground plants (e.g. chenopods) and piles of flood debris.
S10	Yes	0	1	11.3.25	Brigalow Woodland Snail found under logs and piles of flood debris.
S11	Yes	2	2	11.3.2	Brigalow Woodland Snail found under small logs and leaf litter accumulations.
S12	Yes	1	1	11.3.2	Brigalow Woodland Snail found under small logs.
S13	Yes	2	4	11.3.17	Brigalow Woodland Snail found under logs.
S14	Yes	5	5	11.3.25 / 11.3.2	Brigalow Woodland Snail found under logs and piles of flood debris.
S15	No	-	-	11.9.5	Microhabitat included small logs and leaf litter accumulations.
S16	Yes	0	1	11.9.5	Brigalow Woodland Snail found under small logs and leaf litter accumulations.
S17	Yes	4	4	11.9.5	Brigalow Woodland Snail found under logs and leaf litter accumulations.
S18	Yes	1	1	11.3.17	Brigalow Woodland Snail found under small logs and leaf litter accumulations.
S19	No	-	-	11.3.18	Microhabitat included small logs and leaf litter accumulations.
S20	Yes	2	6	11.9.5	Brigalow Woodland Snail found under small logs and leaf litter accumulations.

Both live and dead Brigalow Woodland Snails were detected during the survey.

Although it was not the intention of the survey to detect live individuals, living Brigalow Woodland Snails were incidentally encountered during diurnal hand searches at nine sites. Approximately 39 dead Brigalow Woodland Snail shells were also found. The survey methodology was consistent with the TSSC (2016) guidelines.

Brigalow Woodland Snail was detected within the Survey Area between Brookstead and Canning Creek. The survey results extend the known distribution of the species eastwards and south-eastwards by up to 55-60 km.

4.3 Regional Ecosystem and Microhabitat Associations

4.3.1 Regional Ecosystem Associations

Brigalow Woodland Snail was detected within four of the seven sampled RE types these being:

- ✱ RE 11.3.2: *Eucalyptus populnea* woodland on alluvial plains.
- ✱ RE 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
- ✱ RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.
- ✱ RE 11.9.5: *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.

Survey results confirmed the known general habitat preferences outlined in TSSC (2016). Within the Survey Area, these can be summarised as follows:

- ✱ Fringing/riparian woodlands dominated by River Red Gum (*Eucalyptus camaldulensis*) on clay soils along watercourses and other streams.
- ✱ Woodlands dominated by Poplar Box (*E. populnea*) and/or Belah (*Casuarina cristata*) and/or Brigalow (*Acacia harpophylla*) on alluvial plains with clay soils.
- ✱ Woodlands dominated by Belah (*Casuarina cristata*) and/or Brigalow (*Acacia harpophylla*) on undulating low hills with clay soils.

Brigalow Woodland Snail was not detected in woodlands dominated by Mountain Coolibah (*E. orgadophila*), Silver-leaved Ironbark (*E. melanophloia*) and/or Narrow-leaved Ironbark (*E. crebra*) on low basalt hills. These are represented in the Survey Area by the following RE types:

- ✱ RE 11.8.4: *Eucalyptus melanophloia* woodland to open woodland on Cainozoic igneous rocks - note that this RE may be dominated by *E. crebra* (DES 2021) which was the case at two of the sampled survey sites.
- ✱ RE 11.8.5: *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.

Brigalow Woodland Snail was not detected at survey site S019 (Bringalily Creek). The site searched had loamy soils and the RE was attributed to 11.3.18: *Eucalyptus populnea*, *Callitris glaucophylla*, *Allocasuarina luehmannii* shrubby woodland on alluvium. This site had a limited amount of searchable microhabitat. It is likely that Brigalow Woodland Snail occurs in at least some of the riparian/alluvial vegetation communities on heavier soils associated with this stream, however further surveys would be required.

Pre-clearing regional ecosystem mapping (DES 2022a) indicates that three grassland REs are potentially present in the Survey Area these being:

- ✱ 11.3.21: *Dichanthium sericeum* and/or *Astrebla* spp. grassland on alluvial plains. Cracking clay soils.
- ✱ 11.3.24: *Themeda avenacea* grassland on alluvial plains. Basalt derived soils.
- ✱ 11.8.11: *Dichanthium sericeum* grassland on Cainozoic igneous rocks.

Survey Site S01 was located in an area pre-clear mapped as 11.3.21/11.3.24. This area was heavily infested by weeds and therefore was difficult to search. Although the substrate and landform was generally suitable for Brigalow Woodland Snail, the species was not recorded from the northern extremity of the Survey Area. The only terrestrial mollusc detected at this site was the introduced Brown Field Slug (*Deroceras panormitanum*).

Survey Site S03 was located in an area pre-clear mapped as RE 11.8.11. Searchable microhabitat at this site was similarly limited, however six species of terrestrial mollusc were detected. This included a medium-sized undescribed camaenid similar in general appearance to Brigalow Woodland Snail. The potential occurrence of Brigalow Woodland Snail in these grassland REs cannot be ruled out and may need further investigation. Brigalow Woodland Snail is known to occur within clearings (derived grassland) outside the Survey Area but only where there is suitable microhabitat (i.e. shelter sites) present (BOOBOOK unpubl. data). Grasslands are notoriously difficult to search for land snails as they typically have little microhabitat to search and are frequently overgrown with weeds.

Brigalow Woodland Snail was found in both remnant and mature regrowth RE types. It was also found in both patches and strips of vegetation (including roadside strips) of a variety of sizes and widths.

4.3.2 Microhabitat Associations

Although it was beyond the scope of this survey to undertake detailed assessments of microhabitat at each survey site, Table 3 summarises the results of the simplified microhabitat assessment undertaken.

Table 3: Summary of microhabitat features recorded at each survey site within 50m x 10m plot.

Site No.	Small Logs (<30cm dia.)	Large Logs (>30cm dia.)	Log Piles	Trees With Loose Basal Bark Piles	Other Bark Piles	Loose Rocks / Stones	Leaf Litter	Ground Layer (%)	Flood Debris Piles	Gilgais	BWS Detected?
S01	0	0	Absent	0	Absent	0	0	75-100	Present	Absent	No
S02	1-5	0	Present	0	Absent	1-5	<25	75-100	Absent	Absent	No
S03	0	0	Present	0	Absent	0	0	50-75	Present	Absent	No
S04	1-5	1-5	Absent	0	Absent	1-5	<25	75-100	Absent	Absent	No
S05	1-5	1-5	Absent	0	Absent	1-5	<25	75-100	Absent	Absent	No
S06	1-5	0	Absent	0	Absent	11-15	<25	50-75	Absent	Absent	No
S07	1-5	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	No
S08	1-5	0	Absent	0	Absent	0	<25	50-75	Present	Absent	Yes
S09	1-5	0	Absent	1-5	Absent	0	<25	50-75	Present	Absent	Yes
S10	1-5	0	Absent	0	Absent	0	<25	50-75	Present	Absent	Yes
S11	1-5	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	Yes
S12	1-5	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	Yes
S13	1-5	1-5	Absent	0	Absent	0	<25	50-75	Absent	Absent	Yes
S14	1-5	0	Absent	1	Absent	0	<25	50-75	Present	Absent	Yes
S15	0	0	Absent	0	Absent	0	<25	50-75	Absent	Absent	No
S16	1-5	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	Yes
S17	1-5	0	Absent	0	Absent	0	<25	50-75	Absent	Absent	Yes
S18	1-5	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	Yes
S19	0	0	Absent	0	Absent	0	<25	75-100	Absent	Absent	No
S20	1-5	1-5	Absent	0	Absent	0	<25	50-75	Absent	Absent	Yes

Brigalow Woodland Snail was detected alive under logs, among moist flood debris piles, under rubbish (e.g. a discarded blanket) and under bark piles at the base of trees. These findings are consistent with known microhabitat preferences. Dead shells were also detected among leaf litter accumulations and under low shrubs (e.g. chenopods).

4.4 Other Comments

No estimates of the total population size of Brigalow Woodland Snail can be made within the AOI based on the current survey results as diurnal searches were undertaken only. Population studies would require further field work at night after rain when the species is most active and live individuals are readily detectable. Regardless, it is clear from the results of this survey that Brigalow Woodland Snail is distributed throughout a significant portion of the AOI (wherever potentially suitable RE and microhabitat is present), and that the AOI likely supports a significant population of the species.

Most of the habitat available for Brigalow Woodland Snail is highly fragmented due to past clearing and there are limited opportunities for dispersal by the species between patches due to its low mobility and presence of potential barriers such as roads. Likewise, many small patches are susceptible to edge effects and other threats such as clearing, microhabitat loss, weed invasion and wildfire. Regardless, Brigalow Woodland Snail was found to persist in narrow strips of vegetation (<30 m wide). Note that such strips may not necessarily meet remnant vegetation mapping criteria (Neldner *et al.* 2022), however for the purposes of the snail they represent known or potential habitat.

5. Conclusions

Key findings of the survey are summarised as follows:

- ✎ At least sixteen (16) species of land snail were recorded within the AOI.
- ✎ Brigalow Woodland Snail was detected at 11 of the 20 survey sites.
- ✎ The survey detected 22 live individuals and at least 39 dead shells of Brigalow Woodland Snail.
- ✎ Brigalow Woodland Snail was found within a 60 km stretch of the AOI between Brookstead and Canning Creek.
- ✎ Brigalow Woodland Snail was detected in the following remnant and/or regrowth habitat types in the AOI:
 - RE 11.3.2: *Eucalyptus populnea* woodland on alluvial plains.
 - RE 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
 - RE 11.3.17: *Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.
 - RE 11.9.5: *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.
- ✎ Live Brigalow Woodland Snails were detected in the following microhabitat situations: under logs, among moist flood debris piles, under rubbish (e.g. a discarded blanket) and under bark piles at the base of trees.
- ✎ Although much of the habitat within the AOI has been cleared and fragmented the survey has demonstrated that a significant population of Brigalow Woodland snail occurs within the AOI.

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7. Figures



Figures 1a-b: Representative images of Brigalow Woodland Snail (*Adclarkia cameroni*) at survey site S08 - Condamine River North: bleached shell of a dead adult in flood debris (left) and live subadult on the underside of a discarded blanket within the river channel (right).



Figures 1c-d: Habitat at survey site S08 – Condamine River North: narrow fringe of River Red Gum (*Eucalyptus camaldulensis*), River Cooba (*Acacia stenophylla*) woodland RE 11.3.25 (left, right).



Figures 2a-b: Representative images of Brigalow Woodland Snail at survey site S09 - Condamine River: bleached shell of a dead adult under a saltbush (left) and live subadult found on the underside of loose bark at the base of a River Red Gum (right).



Figures 2c-d: Habitat at survey site S09 – Condamine River: River Red Gum open woodland RE 11.3.25 (left, right).



Figures 3a-b: Habitat at survey site S10 – Grass Tree Creek: fringe of River Red Gum, River Cooba woodland RE 11.3.25 (left, right).



Figures 4a-b: Habitat at survey site S11 – Lindenmayer Road: narrow roadside strip of alluvial Poplar Box (*E. populnea*) woodland RE 11.3.2 (left, right).



Figures 5a-b: Habitat at survey site S12 – Lovell Road: narrow strip of alluvial Poplar Box woodland RE 11.3.2 (left, right).



Figures 6a-b: Habitat at survey site S13 – Owens Scrub Road reserve: alluvial Poplar Box, Belah (*Casuarina cristata*) woodland RE 11.3.17 (left, right).



Figures 7a-b: Habitat at survey site S14 – water reserve: narrow fringe of River Red Gum open woodland along the bank of Back Creek RE 11.3.25 (left); alluvial Poplar Box woodland RE 11.3.2 on the adjoining floodplain (left, right).



Figures 8a-b: Habitat at survey site S16 – Millmerran Inglewood Road: narrow strip of Brigalow (*Acacia harpophylla*) woodland RE 11.9.5 (left, right).



Figures 9a-b: Habitat at survey site S17 – east of Millmerran Inglewood Road: retained shade line of Brigalow, Belah woodland RE 11.9.5 (left, right).



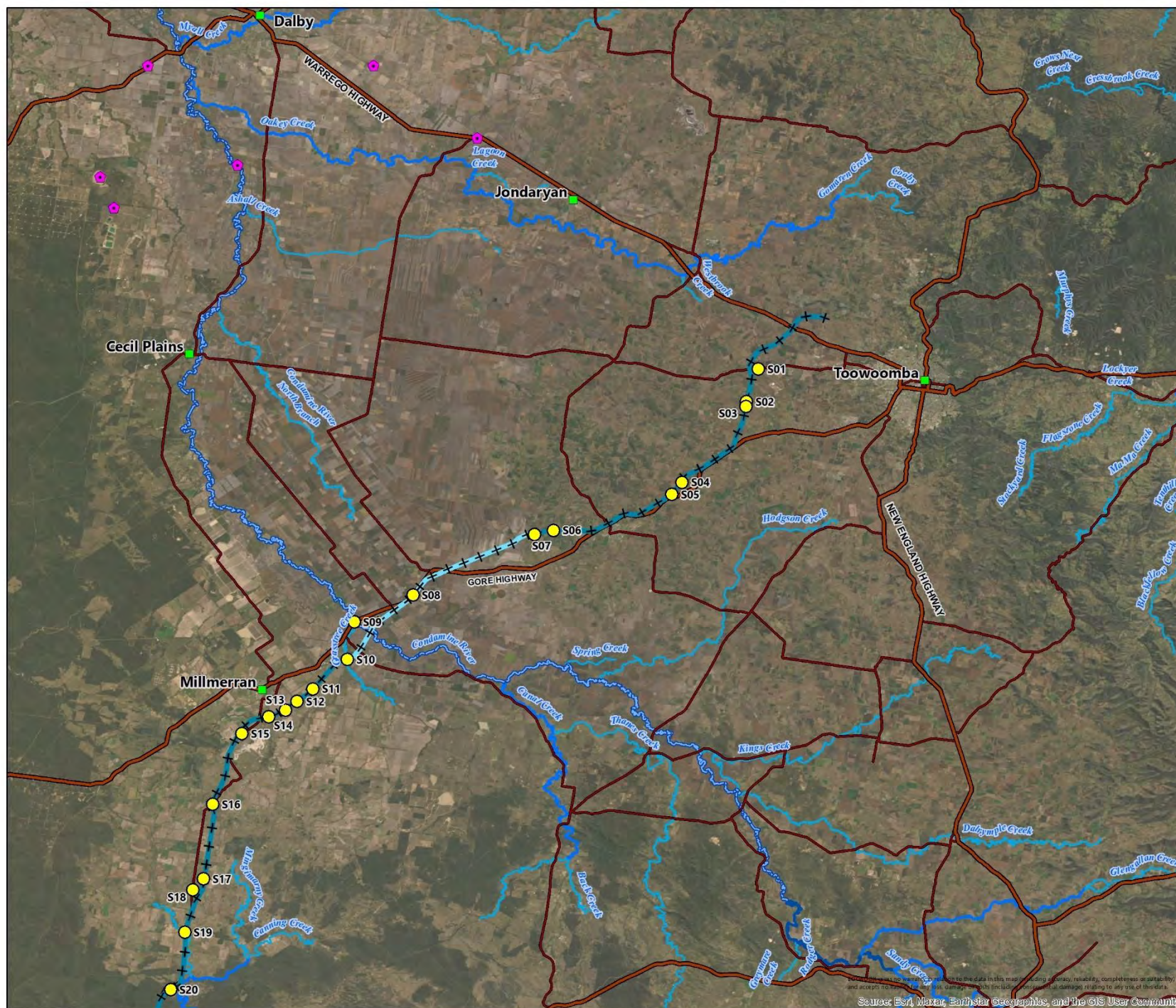
Figures 10a-b: Habitat at survey site S18 – Millmerran Inglewood Road: disturbed Poplar Box, Brigalow woodland RE 11.3.17 on the floodplain of Nicol Creek (left, right).



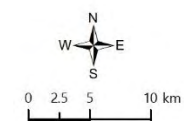
Figures 11a-b: Habitat at survey site S20 – southeast of Millmerran Inglewood Road: regrowth Brigalow, Belah woodland RE 11.9.5 (left, right).

Appendix A. Location of the Survey Area and field survey sites.

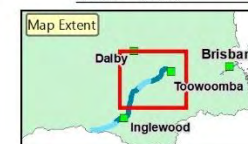
Appendix A: Location of the Study Area and Survey Sites



- Settlement
- Snail Survey Site
- ALA - Previous records
- ARTC Network**
- +— 0
- +— 1
- Major Roads**
- Highway
- Secondary Roads
- Ordered Streams**
- 5
- 6
- 7
- 8



Project: AIC
DWS Survey
Map No: PC892_AppA
Date: 30/08/2022
Drawn: L. Hardwick
Approved: C. Eddie
Scale: 1: 400,000 @ A3
Datum: GDA94



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Appendix B. Characteristics of Survey sites.

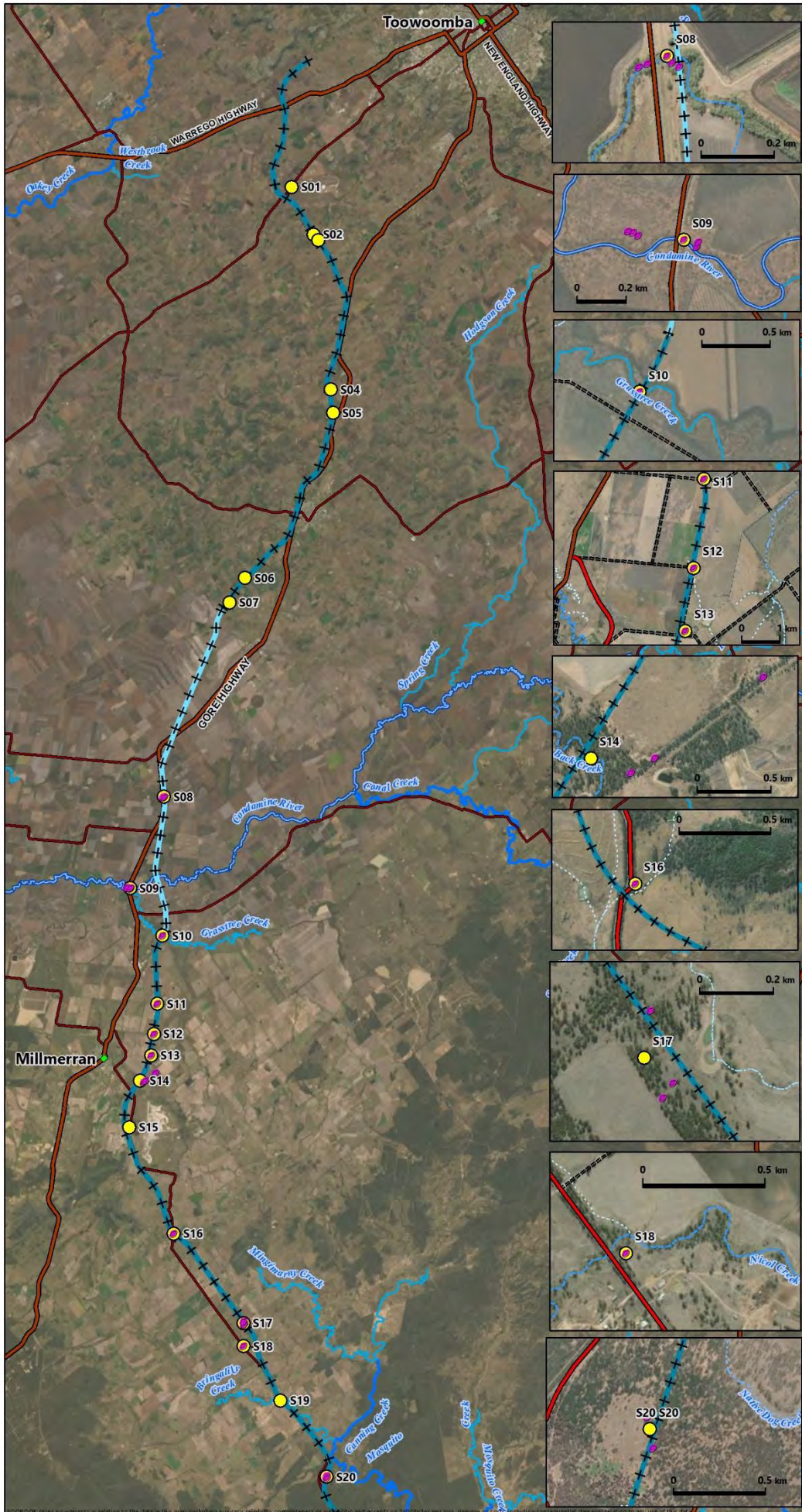
Site Code	Lot / Plan	General Location	Date Surveyed	Search Effort (mins)	RE Code	RE Condition	Landform	Substrate	Elevation (m)	Vegetation
S01	Road parcel	Toowoomba Cecil Plains Road: Westbrook Creek crossing	26/8/2022	60	N/A	Non-remnant	Floodplain beside watercourse	Brown clay.	444	Derived grassland dominated by introduced grasses and forbs. Occasional <i>Salix babylonica</i> along creek bank.
S02	12SP228312	East of Berghofer Road	26/8/2022	60	11.8.5	Remnant	Hill slope.	Brown clay.	576	<i>Eucalyptus orgadophila</i> open woodland with scattered <i>E. melanophloia</i> ; midlayer sparse <i>Acacia decora</i> ; ground layer composed of native and introduced grasses and forbs.
S03	12SP228312	East of Berghofer Road: One Mile Gully	26/8/2022	60	N/A	Non-remnant	Floodplain beside watercourse.	Brown clay.	520	Derived grassland dominated by introduced grasses and forbs; widely scattered <i>Angophora floribunda</i> .
S04	2RP110779	West of Linthorpe Valley Road	22/8/2022	120	11.8.4	Remnant	Hill slope (basalt).	Brown clay with scattered small rocks.	550	<i>Eucalyptus crebra</i> woodland; midlayer of canopy recruits & <i>Notelaea microcarpa</i> ; ground layer composed of native and introduced grasses and forbs.
S05	5RP841180	Corner of Geitz Road and Gore Highway	22/8/2022	60	11.8.4	Remnant	Hill slope (basalt).	Brown clay.	609	<i>Eucalyptus crebra</i> woodland; midlayer of canopy recruits, <i>Acacia</i> spp. & <i>Lycium ferocissimum</i> ; ground layer composed of native and introduced grasses and forbs.
S06	3RP7480	South of Glen Devon Road	22/8/2022	120	11.8.5	Remnant	Hill crest.	Brown clay with rock/boulder outcrop (basalt).	515	<i>Eucalyptus orgadophila</i> , <i>Callitris glaucophylla</i> woodland; midlayer of <i>Geijera salicifolia</i> , <i>Notelaea macrocarpa</i> , <i>Alphitonia excelsa</i> & <i>Carissa ovata</i> ; ground layer mix of native & introduced grasses & forbs.
S07	Road parcel	Roche Road	22/8/2022	30	11.9.5	Regrowth	Undulating plain.	Brown clay.	453	Narrow roadside strip of <i>Acacia harpophylla</i> woodland with scattered <i>Casuarina cristata</i> ; midlayer dominated by canopy recruits & <i>Geijera salicifolia</i> & <i>Eremophila mitchellii</i> ; ground layer dominated by <i>Megathyrsus maximus</i> & some forbs (chenopods).

Site Code	Lot / Plan	General Location	Date Surveyed	Search Effort (mins)	RE Code	RE Condition	Landform	Substrate	Elevation (m)	Vegetation
S08	Road parcel	Gore Highway: Condamine River North	23/8/2022	60	11.3.25	Regrowth	Watercourse.	Brown clay.	391	Narrow fringe of <i>Eucalyptus camaldulensis</i> with midlayer of <i>Acacia stenophylla</i> ; ground layer mix of native and introduced grasses and forbs.
S09	Road parcel	Gore Highway: Condamine River	23/8/2022	60	11.3.25	Remnant	Watercourse.	Brown clay.	407	<i>Eucalyptus camaldulensis</i> fringing woodland with midlayer of <i>Acacia stenophylla</i> ; ground layer mix of native and introduced grasses and forbs (particularly <i>Phyla canescens</i> and chenopods on floodplain).
S10	4RP16058	Millmerran Branch Railway: Grass Tree Creek	23/8/2022	60	11.3.25	Remnant	Watercourse.	Brown clay.	393	Narrow fringe of <i>Eucalyptus camaldulensis</i> with midlayer of <i>Acacia stenophylla</i> ; ground layer mix of native and introduced grasses and forbs.
S11	Road parcel	Lindenmayer Road	23/8/2022	60	11.3.2	Remnant (roadside strip)	Plain.	Brown clay.	406	<i>Eucalyptus populnea</i> woodland; sparse midlayer of <i>Notelaea microcarpa</i> ; ground layer dominated by <i>Megathyrsus maximus</i> & <i>Chloris gayana</i> .
S12	Road parcel	Lovells Road	23/8/2022	60	11.3.2	Remnant (roadside strip)	Plain.	Brown clay.	413	<i>Eucalyptus populnea</i> woodland; midlayer absent; ground layer dominated by <i>Cenchrus ciliaris</i> .
S13	2SP136970	Owens Scrub Road/Lovells Road junction	23/8/2022	120	11.3.17	Remnant	Plain.	Brown clay loam.	426	<i>Eucalyptus populnea</i> , <i>Casuarina cristata</i> woodland; midlayer dominated by <i>C. cristata</i> saplings ground layer mix of native and introduced grasses and forbs.
S14	140DER34129	Reserve via Foxwood Road	25/8/2022	60	11.3.25/1 1.3.2	Remnant	Watercourse (Back Creek) and adjoining plain	Brown clay.	378	<i>Eucalyptus camaldulensis</i> fringing open woodland with scattered <i>Angophora floribunda</i> along Back Creek. Adjoined by <i>Eucalyptus populnea</i> woodland on adjoining plain. Dense grassy ground layer + <i>Lomandra longifolia</i> & <i>Bryophyllum</i> spp.
S15	Road parcel	Millmerran Inglewood Road	24/8/2022	60	N/A (ex 11.9.5)	Regrowth (roadside strip)	Undulating low hills.	Brown clay.	436	Narrow roadside strip of <i>Acacia harpophylla</i> , <i>Casuarina cristata</i> woodland; midlayer dominated by canopy recruits & <i>Geijera parviflora</i> ; ground layer composed of introduced & native grasses & forbs including chenopods.

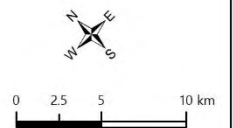
Site Code	Lot / Plan	General Location	Date Surveyed	Search Effort (mins)	RE Code	RE Condition	Landform	Substrate	Elevation (m)	Vegetation
S16	Road parcel	Millmerran Inglewood Road	24/8/2022	60	11.9.5	Regrowth (roadside strip)	Undulating low hills.	Brown clay.	466	Narrow roadside strip of <i>Acacia harpophylla</i> woodland; midlayer dominated by canopy recruits with some <i>Lycium ferocissimum</i> ; ground layer dominated by <i>Megathyrsus maximus</i> , <i>Cenchrus ciliaris</i> & forbs including chenopods.
S17	2RP145435	East of Millmerran Inglewood Road	25/8/2022	60	11.9.5	Regrowth	Undulating low hills.	Brown clay.	481	<i>Acacia harpophylla</i> , <i>Casuarina cristata</i> woodland (shade line); midlayer composed of <i>Geijera parviflora</i> & <i>Lycium ferocissimum</i> ; ground layer dominated by native grasses & chenopods.
S18	Road parcel	Millmerran Inglewood Road: Nicol Creek	24/8/2022	30	11.3.17	Remnant (disturbed)	Plain beside watercourse.	Brown clay.	363	<i>Eucalyptus populnea</i> , <i>Acacia harpophylla</i> woodland (disturbed); midlayer of <i>Geijera parviflora</i> ; ground layer dominated by introduced grasses & forbs.
S19	Road parcel	Millmerran Inglewood Road: Bringalily Creek	24/8/2022	60	11.3.18	Remnant	Plain beside watercourse.	Pale brown loam.	404	<i>Eucalyptus populnea</i> , <i>Callitris glaucophylla</i> woodland; midlayer of <i>Geijera parviflora</i> ; ground layer dominated by introduced grasses & forbs.
S20	10MH737	Southeast of Millmerran Inglewood Road	25/8/2022	60	11.9.5	Regrowth	Plain.	Brown clay.	330	<i>Acacia harpophylla</i> , <i>Casuarina cristata</i> woodland (with scattered <i>Melaleuca lanceolata</i>); midlayer composed of <i>Geijera parviflora</i> & <i>Lycium ferocissimum</i> ; ground layer dominated by native grasses & chenopods.

Appendix C. Location of Brigalow Woodland Snails detected during the
survey.

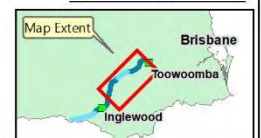
Appendix C: Location of Brigalow Woodland Snails detected during the survey



- Town
- Snail Survey Site
- Brigalow Woodland Snail
- ARTC Network**
 - 0
 - 1
- Major Roads**
 - Highway
 - Secondary Roads
- Ordered Streams**
 - 5
 - 6
 - 8



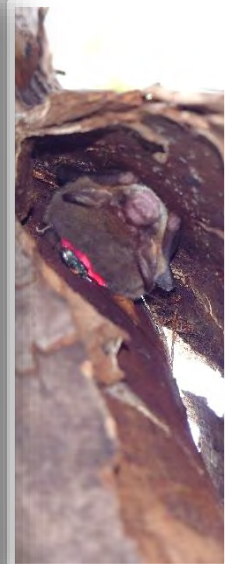
Project: ARTC
DWS Survey
Map No: PC892_AppB
Date: 21/09/2022
Drawn: L. Hardwick
Approved: C. Eddie
Scale: 1: 280,000 @ A3
Datum: GDA94



MICROBAT SURVEYS AND RESEARCH

INLAND RAIL: N2N AND B2G

Prepared for
ARTC



Biodiversity Assessment and Management Pty Ltd
PO Box 1376
CLEVELAND 4163

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Date:

Director

EXECUTIVE SUMMARY

BACKGROUND

Targeted microbat surveys and tracking research was undertaken for two threatened microbat species in large, forested areas of the B2G and N2N segments of the Inland Rail project. The target species included South-eastern Long-eared Bat *Nyctophilus corbeni* and Large-eared Pied Bat *Chalinolobus dwyeri*, both of which are listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Queensland *Nature Conservation Act 1992* and New South Wales *Biodiversity Conservation Act 2016*.

Whilst general microbat surveys have been undertaken in both study areas, these targeted surveys were conducted to extend on previous data to examine distribution of the target species. Tracking research was also undertaken to reveal local foraging and roosting requirements of the species, particularly in relation to the management and mitigation of impacts from the Inland Rail project.

METHODOLOGY

Field surveys were undertaken in the non-breeding season for both of the target species (February-March 2023 in the N2N study area and March-April 2023 in the B2G study area), and included harp trapping, bat call identification, GPS- and radio-tracking, and habitat assessments.

At the N2N study area, 24 *N. corbeni* were captured in harp traps, with four tagged with GPS tags (for foraging and roosting information) and a further nine tagged with radio tags (roosting only). Six unique roost trees were detected through tracking, including one in the N2N alignment. Further roosting and foraging areas were identified from GPS data both within and outside the impact footprint.

In the B2G study area, including the Canning Creek offset property, 10 *N. corbeni* were captured in harp traps. Three of these were used for GPS-tracking, with a further six individuals tagged with radio tags only. Tracking located eleven unique roost trees, with further roosting and foraging areas recorded through GPS data.

FINDINGS

Nyctophilus corbeni - Roosts

Nyctophilus corbeni were recorded roosting in a range of tree species, of various sizes (including saplings), although almost entirely in dead or dying trees. During the non-breeding season that this study was undertaken (February-April), roosts were primarily under bark. In contrast, studies undertaken during the breeding season (October-December) have found that tree trunk hollows and fissures are important roosting habitat, likely due to temperature stability. Hollows are also likely to be preferred during hibernation months (May-August). As such, standing trees with loose bark and/or trunk hollows are important roosting structures for *N. corbeni* to provide year-round roost habitat.

Several tracked individuals returned to the same areas, if not the same trees, on consecutive days to roost. This indicates that *N. corbeni* may have preferred roosting areas and likely has a memory for numerous roost trees within these preferred areas.

Nyctophilus corbeni – Foraging

GPS tracking revealed that *N. corbeni* foraged in areas up to 3,805 hectares per night per individual, within a linear span (nightly foraging diameter) up to 13 km. However, other studies have found this nightly foraging distance can be as great as 25 km.

Foraging was often targeted to areas with diverse vegetation structure (e.g., containing dense midstorey and/or understorey cover) and with diverse flora species, likely due to increased prey invertebrates in such areas.

Tracked bats were recorded foraging and/or moving in the landscape in the same areas frequented on preceding nights, including the Canning Creek offset property. Whilst this suggests that *N. corbeni* return to known foraging areas repeatedly, tracking was undertaken only for a short duration at each study area, whereas this pattern may change seasonally as food resources vary within the landscape.

N2N Study Area

Considering the vegetation composition of the impact alignment, the diversity of roost trees (species and size) used by *N. corbeni* during this study, the widespread distribution of *N. corbeni* in the Pilliga forests, and the large nightly foraging range of the species, it is likely that the majority of the N2N impact footprint is suitable roosting and/or foraging habitat for *N. corbeni*.

No *C. dwyeri* were trapped in the N2N study area, although calls of the species were detected at one location on one night in the west of the Pilliga forests, near where there are historical records of the species. As there is no suitable roosting habitat in the vicinity of the N2N study area, it is unlikely the disturbance footprint in the Pilliga forests impacts important foraging habitat of the species.

B2G Study Area, including Canning Creek Offset Property

The vegetation along the alignment in the B2G study area is comprised of various tree species that were found to be suitable for roosting or foraging of *N. corbeni*. Additionally, tracking data revealed the species crossed cleared land to forage in small or large patches of regrowth and remnant vegetation. This indicates the majority of the B2G impact footprint is suitable roosting, foraging or dispersal habitat for *N. corbeni*, taking into account the foraging range of the species, and the movement within the landscape revealed by tracking data.

No tracked individuals were found to be roosting on the Canning Creek offset property, although multiple tagged *N. corbeni* foraged there on several nights.

The forested areas on the two property lots in the west of the Canning Creek property were frequented by GPS tracked *N. corbeni* on multiple nights, indicating suitable foraging habitat for this species. While the forested areas were not surveyed specifically during this study, it is considered that these property lots are currently likely unsuitable for roosting due to the tendency for the species to avoid roosting near forest edges. However, revegetation of the adjacent cleared areas could result in parts of these remnant areas being suitable for roosting, particularly as the ground-truthed vegetation confirmed that tree species are present that *N. corbeni* was found to roost in within the adjacent Bringalily State Forest.

The central area of the Canning Creek offset property (adjacent on both sides to Millmerran-Inglewood Road and the B2G alignment) was the focus for survey effort. Three *N. corbeni* were trapped in this area and GPS tracking data revealed that several individuals were found to use the area over multiple nights. While the advanced and young regrowth in this part of the offset property is suitable foraging habitat, at the time of surveys, there was a general absence of dead or dying trees with the bark or trunk hollow features preferred for roosting. However, the maturing trees in the advanced regrowth areas have the potential to become suitable roosting habitat if surrounding areas continue to regenerate (reducing the proximity to forest edge) and natural or artificial senescence occurs (to provide suitable microhabitat of hollows or peeling bark).

Several individuals were also found to cross Millmerran-Inglewood Road (between blocks of Bringalily State Forest and/or Canning Creek), indicating this single major road is not a barrier to their movement in the landscape. The cumulative effect of multiple linear clearings is unknown for *N. corbeni*, however such infrastructure can pose other impacts than as a movement barrier.

The eastern portion of the offset property was visited only once due to unmaintained roads and/or wet weather, with no tagged microbats located. The absence of tagged bats in this area is not unexpected, considering tracking was focused closer to the alignment. However, the more mature vegetation, including senescing trees with buckling/peeling bark and trunk hollows, indicated suitable roosting habitat was widespread in the area.

No *C. dwyeri* were detected by trapping or acoustic calls within the B2G study area, with their key requirement of proximal roosting habitat absent in the general area.

MANAGEMENT AND MITIGATION RECOMMENDATIONS

Disturbance Footprint

The major threats and potential impacts from the Inland Rail project in the study areas relate to roost tree loss for *N. corbeni* through clearing activities, and the loss of roost microhabitat features (i.e., bark) from unsuitable fire management. Other potential impacts include foraging habitat loss, as well as habitat fragmentation, vegetation composition modification, vehicle strike and loss of usable habitat or behavioural disruptions due to noise, vibration and/or light.

Measures to minimise or manage these impacts for the various construction and operational phases are provided. Due to the particularly significant potential impact relating to *N. corbeni* roost loss, and the species' usage of a wide range of tree species and sizes, the removal of any native tree species should be reduced. Particular avoidance and/or care with dead or dying trees is also recommended, as these are preferred roosting habitat.

Mitigation of Residual Impacts

Direct loss of maternity and non-breeding tree roosts for *N. corbeni* is an impact with limited mitigation measures. Specifically, successful mitigation methods for *N. corbeni* roosts are unknown.

Standard artificial microbat roost boxes have been found to be unsuitable for *Nyctophilus* species. However, specially constructed roost boxes with increased chambers and ventilation have been found to be used more by non-threatened *Nyctophilus* species, and may be suitable for *N. corbeni*. Chainsaw cavities have also been found to mimic natural trunk cavities more than standard microbat roost boxes, and are currently being trialled for *N. corbeni* in NSW.

Artificial bark mimics have been successfully used overseas for threatened microbats that naturally roost under bark.

To mitigate the loss of both non-breeding (bark) roosts and breeding/hibernating (tree trunk hollow) roosts, it is recommended that a trial be undertaken using specially designed microbat boxes and artificial bark mimics. This could be conducted on the Canning Creek offset property, particularly since it is known to be used for foraging and dispersal of *N. corbeni* and currently has a lack of roosting microhabitat in certain parts of the property.

Offset Property Management

The primary recommendations for offset property management relate to the provision and/or retention of roosts for *N. corbeni*. In particular, this includes limiting the removal of standing dead or dying trees, suitable fire management to retain roost features (e.g. peeling/buckling

bark), and establishing suitable artificial roost structure (both breeding and non-breeding roosts) in areas with limited natural roosts.

Secondary land management activities are recommended that will further provide or retain foraging and/or roosting habitat for *N. corbeni* and *C. dwyeri*, as well as reducing risk of injury through entanglement on fences.

Microbat Surveys and Research

Inland Rail: N2N and B2G

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Appendix 2	Roost details and photos of tracked bats
Appendix 3	Routes of GPS tracked bats

Table of Terms and Abbreviations

ALA	Atlas of Living Australia
ARTC	Australian Rail Track Corporation
B2G	Border to Gowrie project
BoM	Bureau of Meteorology (Commonwealth)
Cd	<i>Chalinolobus dwyeri</i> Large-eared Pied Bat
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DEWHA	Department of the Environment, Heritage, Water and the Arts (Commonwealth; superseded)
N2N	Narromine to Narrabri project
Nc	<i>Nyctophilus corbeni</i> South-eastern Long-eared Bat
NSW	New South Wales
OEH	Office of Environment and Heritage (NSW Government)
PCT	Plant Community Type
Qld	Queensland
RE	Regional Ecosystem
TSSC	Threatened Species Scientific Committee

1.0 INTRODUCTION

1.1 OBJECTIVES

ARTC required specialist surveys and research to be undertaken for two threatened microbat species that occur in large, forested areas of the Border to Gowrie (B2G) and Narramine to Narrabri (N2N) segments of the Inland Rail project. The target species included South-eastern Long-eared Bat *Nyctophilus corbeni* and Large-eared Pied Bat *Chalinolobus dwyeri*, both of which are listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Queensland *Nature Conservation Act 1992* and New South Wales *Biodiversity Conservation Act 2016*.

The objectives of the surveys and research were to:

- Increase survey effort in suitable habitat of the B2G study area (including Canning Creek offset property) and N2N study area, to provide information on the species' presence and distribution within the study areas;
- Undertake tracking of the target species (if present/captured) to identify day roosting and foraging preferences in these localities;
- Evaluate the habitat along the Inland Rail alignment, based on the knowledge collected on distribution and habitat preferences; and
- Provide information on potential mitigation and management measures, for various ARTC documents, including the Species Management Plan and Construction Management Plan.

Whilst general microbat surveys have previously been undertaken in both study areas, this targeted survey will extend on previous data, include more concentrated effort of microbat surveys along the alignment and disturbance footprint, and include specialised tracking of captured target microbats to uncover new knowledge for threatened species management.

1.2 STUDY AREAS

1.2.1 N2N Study Area

The N2N study area (in New South Wales) includes the forested areas from south of Narrabri to north of Baradine, including Pilliga East, Euligal, Cumbil and Baradine State Forests (**Figure 1.1**). These forests are known to be a strong-hold for *N. corbeni*, with captures in the area higher than elsewhere in Australia (e.g., Turbill and Ellis, 2006). Additionally, records of *C. dwyeri* suggest a strong population of the species in Pilliga forests and surrounding National Parks, although typically away from the Inland Rail alignment.

1.2.2 B2G Study Area

The B2G study area (in Queensland) includes the forested areas north of Inglewood, primarily Bringalilly State Forest, but also encompassing Wondul Range National Park and Whetstone State Forest (**Figure 1.2**). *Nyctophilus corbeni* is known to occur throughout the study area and surrounding protected areas, whilst *C. dwyeri* is known to occur in the connected Western Creek State Forest to the north.

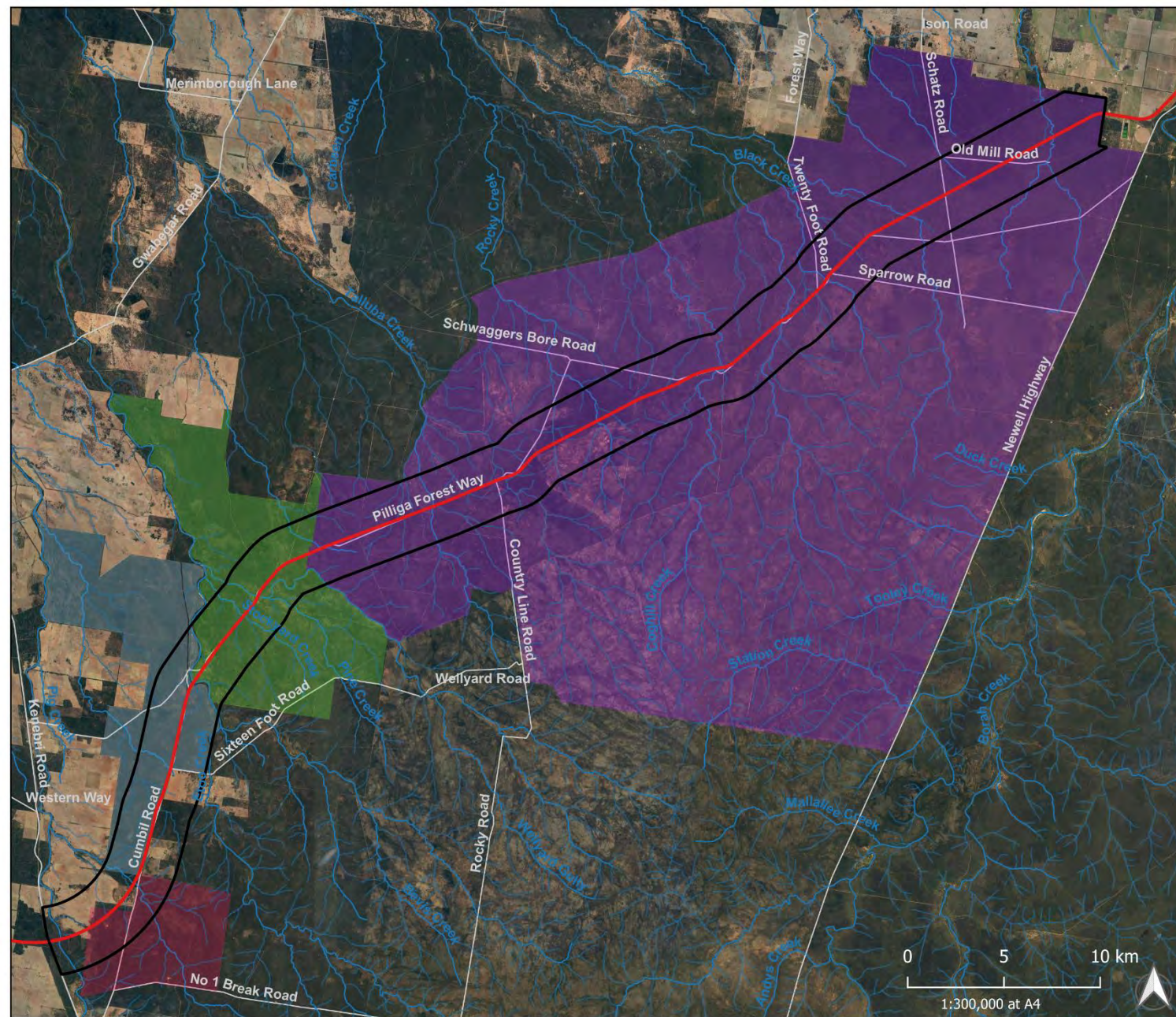


Figure: 1.1

Title: N2N study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 13/05/2023

LEGEND

— Watercourses

— Key roads

□ Target area

ARTC Data

■ N2N alignment

Protected Areas

■ Baradine State Forest

■ Cumbil State Forest

■ Euligal State Forest

■ Pilliga East State Forest

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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: 1.2

Title: B2G study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 13/06/2023

LEGEND

— Watercourses

— Key roads

□ Target area

ARTC Data

■ Inland Rail footprint

■ Canning Creek property

▨ Canning Creek - central lots

▨ Canning Creek - eastern lots

▨ Canning Creek - western lots

Protected Areas

■ Bringalilly State Forest

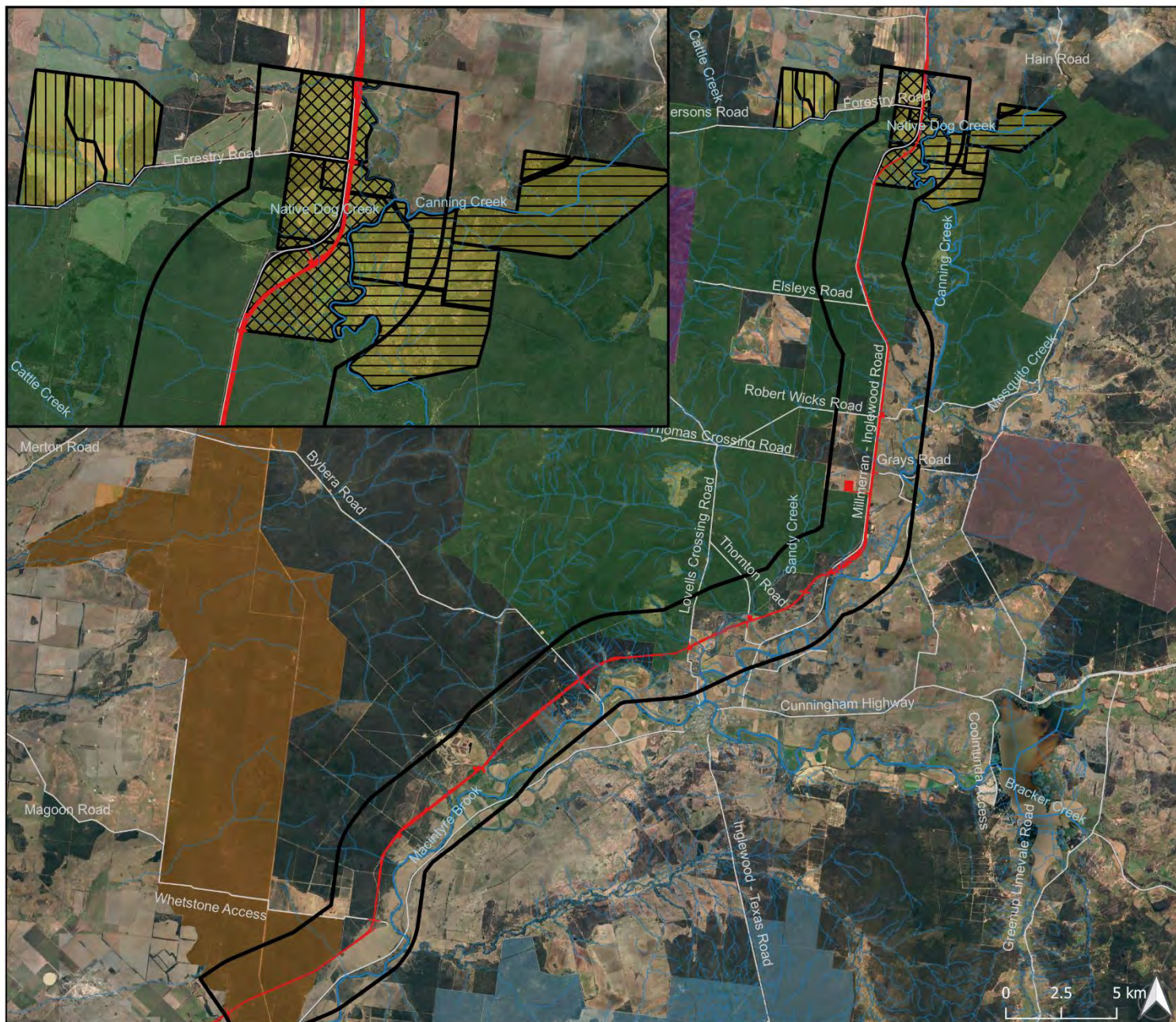
■ Devine State Forest

■ Whetstone State Forest

■ Wondul Range National Park

■ Yelarbon State Forest

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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

2.0 ECOLOGY OF THREATENED SPECIES

2.1 LARGE-EARED PIED BAT *CHALINOLOBUS DWYERI*

2.1.1 *Distribution*

Chalinolobus dwyeri is patchily distributed from central Queensland to southern New South Wales, typically within 500 km of the coast (e.g., see DCCEEW, 2023a; DCCEEW, 2023b). Occurrence within this area is highly dependent on the habitat requirements of the species, particularly relating to suitable roosting structure.

N2N study area

The species is known to occur in the Pilliga IBRA sub-region, associated with the following vegetation formations and Plant Community Types (PCTs) in the N2N study area (as per NSW OEH, 2023a and state mapping NSW DPE, 2023):

- Pilliga Outwash Dry sclerophyll forests
 - PCT 88: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion
- Western Slopes Dry Sclerophyll Forests
 - PCT 398: Narrow-leaved Ironbark - White Cypress Pine - Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion
 - PCT 399: Red gum - Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga - Goonoo sandstone forests, Brigalow Belt South Bioregion
 - PCT 404: Red Ironbark - White Bloodwood +/- Burrows Wattle heathy woodland on sandy soil in the Pilliga forests
 - PCT 405: White Bloodwood - Red Ironbark - Black Cypress Pine shrubby sandstone woodland of the Pilliga Scrub and surrounding regions

There are two ALA records of this species along the south-western part of the alignment in the N2N study area; one in Baradine State Forest in 2019 and the other in Cumbil State Forest in 2018.

B2G study area

State government species distribution mapping (Laidlaw and Butler, 2021) indicates potential *C. dwyeri* habitat exists in much of the State Forests that border the alignment in the Inglewood area, with high suitability habitat ~10 km to the north-west of the Canning Creek Offset Property.

There is one record of the species in ALA in Western Creek State Forest from 1997, which is within ~40 km of the B2G study area.

2.1.2 *Habitat*

Chalinolobus dwyeri requires a combination of suitable roosting and foraging habitat for continued occupancy (DCCEEW, 2023b).

Maternity roosts are typically in caves with a dome-shaped roof, with enough space for juveniles to learn to fly (DCCEEW, 2023b). Non-maternity roosts include cliffs, escarpments or rocky outcrops (typically sandstone or rhyolite; DCCEEW, 2023b), comprising not only caves, but also fissures and crevices in exposed rock (Williams and Thomson, 2018). The species has also been found roosting in abandoned Fairy Martin nests and abandoned mines (Schultz, 1998; Williams and Thomson, 2018).

Foraging habitat often includes fertile valleys and plains, along watercourses, upper slopes, crests and ridges (Williams and Thomson, 2018; DCCEEW, 2023b). Vegetation types in these areas include eucalypt woodland, dry and wet sclerophyll forest, grassy woodland, *Callitris* forest, subtropical rainforest, as well as small clearings and sandstone outcrop country adjacent to such areas (DCCEEW, 2023b). The species has also been observed foraging in open and fragmented pastoral landscapes near these vegetation types (Williams and Thomson, 2018).

2.1.3 Threats

Threats to *C. dwyeri* primarily relate to loss of suitable foraging and/or roosting habitat (DCCEEW, 2023b; NSW OEH, 2023a). In particular, this includes:

- Clearing and isolation of forest and woodland near cliffs, caves and abandoned mines;
- Unsuitable fire regimes (intensity, frequency, season and type), either from anthropogenic sources or wildfire;
- Loss of roosting habitat due to the construction of dams and other waterway management;
- Damage or disturbance to roosting and maternity sites from land operations (e.g., mining), recreational caving or pest animals such as goats; and
- Climate change and pesticide use impacts on invertebrate food sources (i.e., reduction in insects during drought conditions or in areas of high pesticide use).

2.1.4 Survey Guidelines

As per the *Survey Guidelines for Australia's Threatened Bats* (DEWHA, 2010), surveys for *C. dwyeri* are best undertaken between October and March. A combination of the following methods is recommended:

- Use of passive acoustic call recorders to identify the unique calls of *C. dwyeri*; these should be positioned in the vicinity of caves, mines, rocky outcrops and in foraging areas such as vegetation corridors, flyways, sandstone gorges, watercourses and water bodies. Active call recorders along transects can also be undertaken from dusk. The survey effort recommendation for acoustic recorders is a total of 16 passive detector nights for a minimum of 4 nights, and/or a total of 6 active detector hours over a minimum of 3 nights.
- Roost searches in suitable habitat, including in culverts, mines, caves, rock overhangs and crevices.
- Use of harp traps and/or mist nets to capture the species in forest flyways, near roosts, scarps, cliffs and riparian zones. The survey effort for harp traps and/or mist nets is 16 trap/net nights for a minimum of 4 nights.

2.2 SOUTH-EASTERN LONG-EARED BAT *NYCTOPHILUS CORBENI*

2.2.1 Distribution

Nyctophilus corbeni has a patchy distribution through southern central Queensland, central western New South Wales, north-western Victoria and eastern South Australia, typically inland of the Great Dividing Range (TSSC, 2015).

N2N study area

The species is known to occur in the Pilliga IBRA sub-region, associated with the following vegetation formations and PCTs in the study area (as per NSW OEH, 2023b and state mapping NSW DPE, 2023):

- Pilliga Outwash Dry Sclerophyll Forests
 - PCT 88: Pilliga Box - White Cypress Pine - Buloke shrubby woodland in the Brigalow Belt South Bioregion
- Inland Rocky Hill Semi-arid Woodlands
 - PCT 256: Green Mallee tall mallee woodland on rises in the Pilliga - Goonoo regions, southern Brigalow Belt South Bioregion
- Western Slopes Dry Sclerophyll Forests
 - PCT 398: Narrow-leaved Ironbark - White Cypress Pine - Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion
 - PCT 399: Red gum - Rough-barked Apple +/- tea tree sandy creek woodland (wetland) in the Pilliga - Goonoo sandstone forests, Brigalow Belt South Bioregion
 - PCT 404: Red Ironbark - White Bloodwood +/- Burrows Wattle heathy woodland on sandy soil in the Pilliga forests
 - PCT 405: White Bloodwood - Red Ironbark - Black Cypress Pine shrubby sandstone woodland of the Pilliga Scrub and surrounding regions

There are numerous ALA records of this species along the alignment in the N2N study area, particularly in Cumbil State Forest, Euligal State Forest and Pilliga East State Forest. The forests in the Pilliga area are known as a stronghold for the species.

B2G study area

State government species distribution mapping (Laidlaw and Butler, 2021) indicates the entire B2G study area is potential habitat for the species, with the majority of the area having high potential for suitable habitat.

There are four records in ALA within 10 km of the alignment in Bringalily State Forest, and two records from previous ARTC surveys in the area.

2.2.2 Habitat

Nyctophilus corbeni is found in a wide variety of woodland and forest types, including those dominated by box, ironbark, native cypress pine, Buloke (*Allocasuarina luehmannii*), Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*), smooth-barked apple (*Angophora costata*), river red gum (*Eucalyptus camaldulensis*) and various types of tree mallee (TSSC, 2015). It is typically found in large areas of forest (TSSC, 2015) that includes high tree stem density, especially those containing dead trees, as these provide key roosting habitat (Law et al., 2016). Specifically, the species roosts in tree hollows, crevices and under loose bark.

The species feeds on invertebrates by taking prey in flight, by gleaning them off foliage or foraging on the ground (TSSC, 2015).

2.2.3 Threats

Habitat loss and fragmentation are the predominant threats facing *N. corbeni*, particularly in relation to the reduction or fragmentation of the large, forested areas it requires (TSSC, 2015). The loss of suitable roosting habitat (tree hollows, loose bark) from clearing and fire is another major threat (SPRAT; NSW OEH, 2023b). Considering the variable height that the species forages, vehicle/train strike is another potential threat.

The loss of invertebrate food sources through pesticide use in or adjacent to foraging habitat, climate change (e.g. drought) and inappropriate fire regimes are further threats to the species. (NSW OEH, 2023b)

2.2.4 Survey Guidelines

As per the *Survey Guidelines for Australia's Threatened Bats* (DEWHA, 2010), surveys for *N. corbeni* are best conducted between October to April on warmer nights.

Passive acoustic call recorders can be used to identify areas where long-eared bats occur; however, *N. corbeni* cannot be distinguished from other long-eared bats by call alone. Hence, there are no survey recommendations of survey effort relating to call recorders for *N. corbeni*.

Mist nets and/or harp traps should be placed in flyways, dense vegetation and/or near water bodies and water courses for a total effort of 20 harp trap nights per project area <50 ha, for a minimum of 5 nights.

3.0 METHODOLOGY

3.1 FIELD SURVEY TIMING

Field surveys and research were undertaken between the following dates:

- N2N study area: 24 February – 10 March, 2023; and
- B2G study area: 16 March – 6 April, 2023.

During the N2N field survey, days were generally warm-hot (32.1-38.3°C daily maximum; Narrabri Airport AWS, BoM, 2023) with overnight temperatures variable (13.5-23.5°C daily minimum). Less than 2 mm of rain fell in the area on 27 and 28 February, which caused an increase in humidity in the following days.

Weather was more variable during the B2G field survey, with daily maximum between 22.9-37.0°C (Texas Post Office, BoM, 2023) and overnight temperatures dropping to 9.8-20.4°C. Storms and rain occurred in the area on 24-26 March (29.2 mm; Woodspring, BoM, 2023) and 29-30 March (60 mm), although it was highly patchy in the general area. This wet weather caused vehicle access issues to the Canning Creek offset property, which is only accessible through areas of Brigalow black soil.

3.2 HARP TRAPPING

Harp trapping was primarily undertaken to capture the target species; thus, traps were located in areas and habitats suitable for either *C. dwyeri* or *N. corbeni*. However, the species and number of all microbats collected during trapping were recorded, to provide further knowledge on the species that occur in the study areas.

Following capture overnight, microbats were either released prior to dawn or kept in canvas bags until release early the following evening.

N2N Study Area

Harp traps were located in eight locations in Pilliga East State Forest, Euligal State Forest and in Coolangla Creek between Cumbil and Baradine State Forests (**Figure 3.1**). Trapping was undertaken between 25 February – 5 March, 2023. A total of 56 trapping nights were undertaken, with harp traps in the same location for a maximum of 4 nights as per animal ethics requirements. This is greater than the minimum recommendation of 16 trapping nights per standard study area for both target microbat species, and greater than the N2N EIS surveys of 16 trapping nights total.

B2G Study Area

Harp traps were positioned in 15 locations in Bringalily State Forest and 10 locations in the south-west of the Canning Creek offset property between 17 March – 3 April, 2023 (**Figure 3.2**). A total of 95 traps nights were undertaken; in particular, this included 5 nights on the Canning Creek offset property and 9 nights in Bringalily State Forest. While further trapping was planned for the Canning Creek offset property, wet weather from the middle of the field survey period made access difficult and unsafe. These access issues also meant that some traps on the Canning Creek offset property were not opened on one night (see **Appendix 1** for details).

This trapping effort is greater than the minimum recommendation of 16 trapping nights per standard study area for both target microbat species.

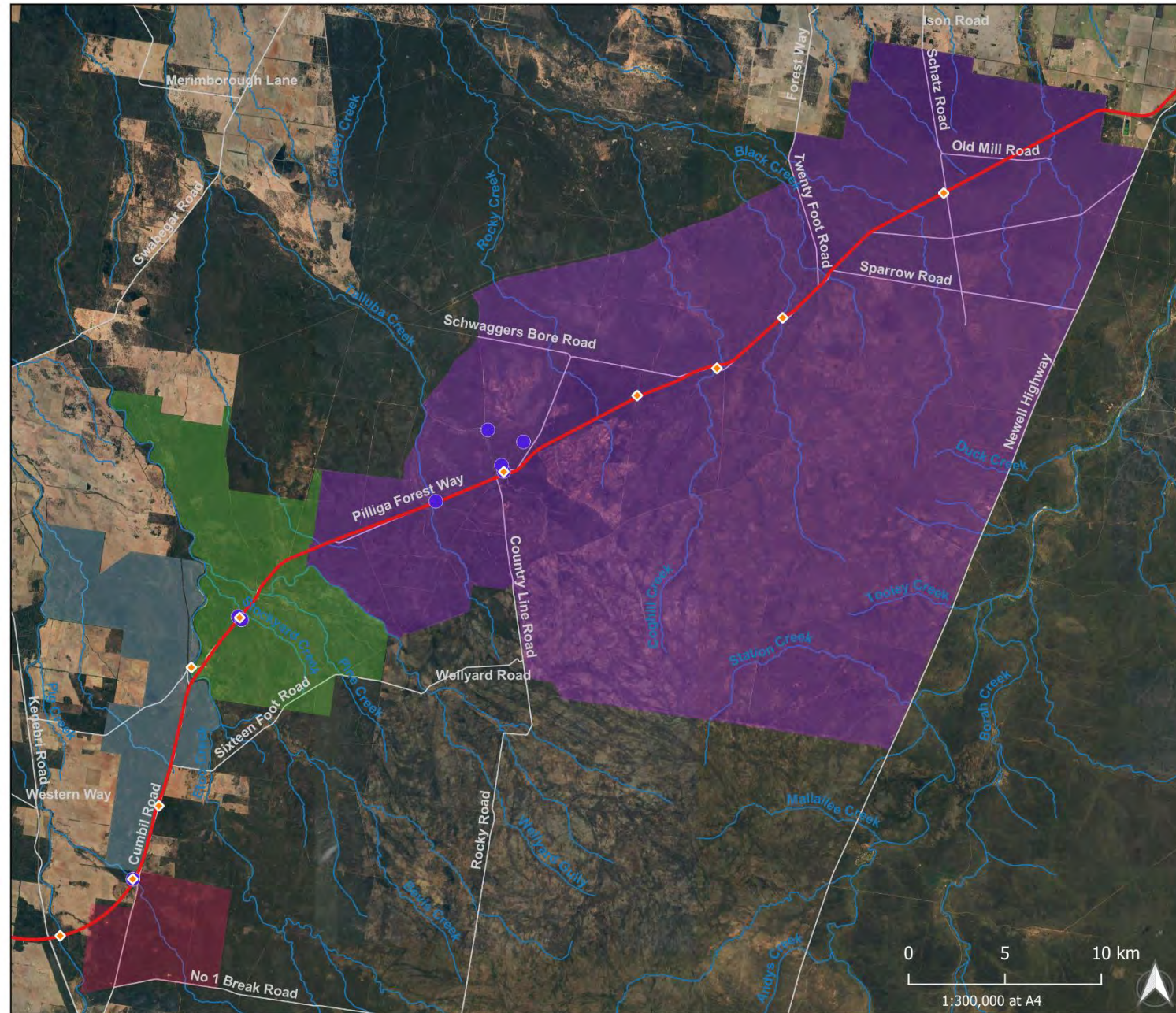


Figure: 3.1

Title: Harp trap and acoustic recorder locations in the N2N study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 10/05/2023

LEGEND

- Watercourses
- Key roads

Survey Methods

- ◆ Acoustic recorder
- Harp trap

ARTC Data

- N2N alignment

Protected Areas

- Baradine State Forest
- Cumbil State Forest
- Euligal State Forest
- Pilliga East State Forest

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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

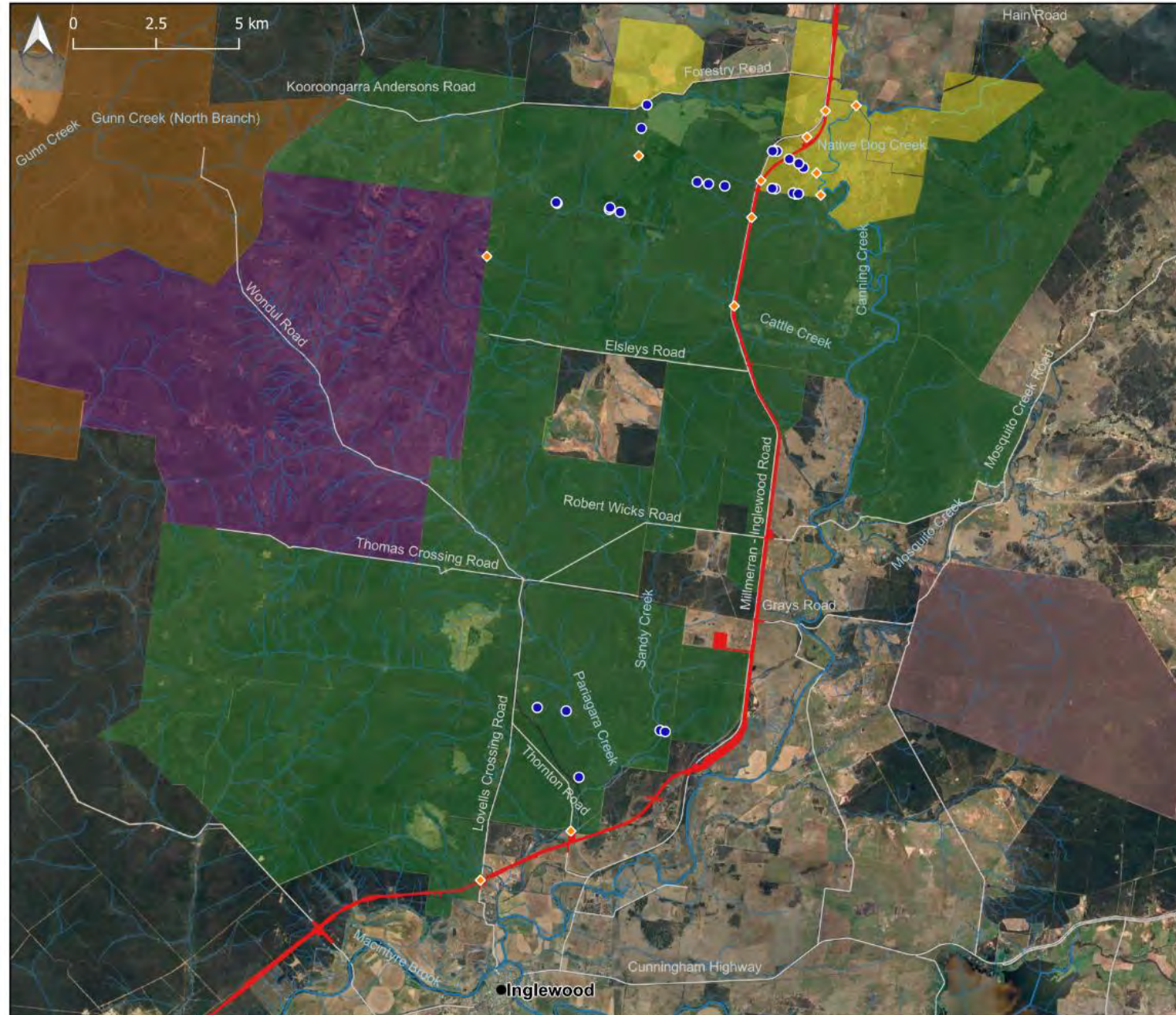


Figure: 3.2

Title: Harp trap and acoustic recorder locations in the B2G study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 18/04/2023

LEGEND

— Watercourses

— Key roads

Survey Methods

◆ Acoustic recorder

● Harp trap

ARTC Data

■ Inland Rail footprint

■ Canning Creek property

Protected Areas

■ Bringally State Forest

■ Devine State Forest

■ Whetstone State Forest

■ Wondul Range National Park

■ Yelarbon State Forest

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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

3.3 ACOUSTIC CALL ANALYSIS

Microbat calls were collected with AudioMoth recorders positioned for between 2-6 nights per location, depending on weather and other logistical constraints.

Data was analysed with Wildlife Acoustics Kaleidoscope software, with calls requiring a minimum of 3 pulses for identification. Due to the diversity of microbat calls for each species (i.e., social, search, feeding calls, etc.), only search phase calls were used for identification, as these are the most reliable.

As mentioned previously, *N. corbeni* cannot be identified by call analysis alone, and is therefore grouped with the other *Nyctophilus* species (long-eared bats) in call analysis. Several other microbat species have also been grouped together due similarity in call structure.

N2N Study Area

Acoustic recorders were located at 10 positions within 500 m of the alignment in locations anticipated to capture frequent microbat calls (see **Figure 3.1** above). All recorders were positioned for between 3-4 full nights at each location, with a total of 31 nights in total. This is greater than the minimum recommendation of 16 nights of passive call recording per standard study area for *C. dwyeri*.

B2G Study Area

Seven acoustic recorders were positioned on the Canning Creek offset property, with a further six acoustic recorders either located on the B2G alignment in the study area, or in Bringalily State Forest in areas where *C. dwyeri* may frequent, should it be present (see **Figure 3.2**). All recorders were positioned for between 2-6 full nights at each location, with a total of 50 nights in total (24 of which were on Canning Creek). This is greater than the minimum recommendation of 16 nights of passive call recording per standard study area for *C. dwyeri*.

3.4 RADIO- AND GPS-TRACKING

Radio- and GPS-tracking involves attaching small devices ('tags') to the back of captured individual microbats (**Photos 3.1** and **3.2**). Tagged microbats are then released, with follow-up involvement and the data collected depending on the type of tag used. Attached tags are either removed by the microbat (either tag type), left attached for natural detachment as the fur grows (radio tags), or require recapture to remove tags manually (GPS tags).

To ensure microbats are not encumbered by attached tags, our animal ethics permits stipulate that tags must not be more than 8% of the individual microbat's bodyweight. Due to the small weight of radio tags (Holohil LB-2X, 0.31 g), these were able to be used on any target microbat species. However, the larger GPS tags (Lotex Pinpoint 10 + Holohil LB-2X; 1.31 g) could only be used on female *N. corbeni* above 16.5 g bodyweight (note: *N. corbeni* show sexual dimorphism with females typically larger than males).

Tracking was primarily undertaken to collect information on:

- Roosting habitat (radio and GPS tags); and
- Foraging range and habitat (GPS tags only).

Tagged microbats (both radio and GPS tags) were attempted to be located during the day with tracking antennae and receivers to determine their diurnal roosting habitat. When a tagged microbat was located, variables recorded included:

1. Roost parameters

- Tree species, height, DBH, alive/dead/health status
- Roost height, cardinal direction, roost type and description (hollow, peeling bark, fissure)
- Photos of tree and roost (if visible)
- GPS coordinates taken.

2. Habitat parameters (25 x 25 m plot)

- Dominant vegetation species and density in upper, mid and ground layers
- Alive/dead status of all tree species
- Photos of each cardinal direction of the general habitat in the area
- Photo of tree cover directly above the roost tree.

GPS tags were programmed to collect a GPS point during night hours either every 30 minutes (fine-scale foraging; battery life 2-4 days) or every 2 hours (longer-term foraging data; 8-10 days). GPS tags were required to be retrieved to download the GPS data that is stored onboard. Note, there are no GPS tags currently small enough to allow for remote data download. GPS tags were therefore prioritised for retrieval following the estimated battery expiration, with GPS tags either removed from microbats or found on the ground having been shed/removed by the individual microbat.



Photo 3.1 South-eastern Long-eared Bat *Nyctophilus corbeni* with a radio tag attached



Photo 3.2 South-eastern Long-eared Bat *Nyctophilus corbeni* with GPS tag attached

3.5 HABITAT ASSESSMENT

Habitat assessments of the disturbance footprint within the N2N and B2G study areas were undertaken at the end of each field survey. This timing was to ensure that the knowledge on roosting and/or foraging habitat acquired during the field trip could be used to accurately evaluate the habitat values present.

The areas evaluated were inspected for potential roosting habitats similar to what was observed during tracking studies, as well as what has been published in scientific literature for the species. The diversity of vegetation, as well as vegetation structure, was also considered during assessment as a measure of foraging habitat quality.

Landscape attributes (specifically, distance to watercourses and forest edges) were also incorporated in habitat assessment following tracking data collection.

Consequently, assessment points (incorporating a 50 x 50 m representative plot) of the roosting and/or foraging habitat suitability for both threatened microbat species was undertaken:

- primarily:
 - along each alignment within the respective study area and the Canning Creek property, where access was possible,
 - at areas determined from satellite imagery, topographical/geological analysis or local knowledge, as potential habitat for cave-roosting *C. dwyeri*.
- secondarily:
 - where roosts were detected within the study areas,
 - at deployment locations of harp traps or acoustic recorders, or
 - during roost searches and meanders within the study area.

In areas where access was not possible (due to land access, vegetation density, weather/soil conditions), habitat assessment was undertaken by evaluating available mapping. Specifically, State mapping of regional ecosystems ('RE', Queensland) or plant community types ('PCT', NSW), or ground-truthed mapping (Canning Creek), were used to identify which areas had tree species considered to be suitable for roosting and/or foraging based on the findings from this study.

4.0 FINDINGS

4.1 MICROBAT COMMUNITY

4.1.1 Harp Trapping

N2N Study Area

Overall, 1,927 microbats from 12 species were captured over 56 harp trap nights (7 traps over 8 nights total). Of these trapped microbats, 24 *N. corbeni* were captured and no *C. dwyeri* were captured. Capture locations are depicted in **Figure 4.1**.

Of note, over 1,500 microbats were captured over a 3-night period following showers on preceding days; it is assumed the high humidity and temperature increased food resources and, consequently, microbat foraging activity, over these nights.

A full list of species and numbers captured at each location is provided in **Appendix 1**, with a summary of the species provided in **Table 4.1**.

B2G Study Area

In total, 347 microbats from 11 species were captured over 14 nights of trapping (total of 95 trap nights). Three *N. corbeni* were captured during the 5 days of trapping on the Canning Creek offset property, and a further 7 *N. corbeni* were trapped in Bringalily State Forest immediately adjacent to Canning Creek (**Figure 4.2**). No *C. dwyeri* were trapped in the B2G study area.

4.1.2 Acoustic survey

Acoustic surveys detected five additional microbat species that were not captured in harp traps (**Table 4.1**), including three likely calls of *C. dwyeri*. This species was recorded in a creek on one night in the western N2N study area, in the vicinity of previous ALA records. No other calls of *C. dwyeri* were found elsewhere in the N2N study area or on subsequent nights, or from the B2G study area and Canning Creek offset property.

Table 4.1 Microbat species recorded during harp trapping (H) and acoustic surveys (A) at the N2N and B2G study areas. Threatened (target) species are highlighted in pale green; species in blue text are unconfirmed detections from acoustic calls that could be multiple species.

Family	Species	Common Name	N2N	B2G	
				Bringalily SF	Canning Creek
Emballonuridae (Sheath-tailed Bats)	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	H, A	A	A
Molossidae (Free-tailed Bats)	<i>Austronomus australis</i>	White-striped Free-tailed Bat	A	A	A
	<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat	A	A	A
	<i>Ozimops planiceps</i>	Southern Free-tailed Bat	H, A ¹	-	-
	<i>Ozimops ridei</i>	Eastern Free-tailed Bat	A ¹	H, A ¹	-
	<i>Ozimops petersi</i>	Inland Free-tailed Bat	A ¹	A ¹	-
Vespertilionidae (Vesper Bats)	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	A	-	-
	<i>Chalinolobus gouldi</i>	Gould's Wattled Bat	H, A	H, A	H, A
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	H, A	H, A	A
	<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	-	A	A
	<i>Chalinolobus picatus</i>	Little Pied Bat	H, A	H, A	H, A
	<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	H(24), A ²	H(7), A ²	H(3), A ²
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	H, A ²	H, A ²	H, A ²
	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	H, A ²	H, A ²	A ²
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	H, A	H, A	H, A
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat	H, A ³	H, A ³	H, A
	<i>Scotorepens</i> sp. (Parnaby)	Central-eastern Broad-nosed Bat	H, A ³	H, A ³	H, A
	<i>Vespadelus regulus</i>	Southern Forest Bat	-	A ⁴	A ⁴
	<i>Vespadelus troughtoni</i>	Eastern Cave Bat	A	A	A
	<i>Vespadelus vulturnus</i>	Little Forest Bat	H, A	H, A ⁴	H, A ⁴

A¹ = species that have similar call spectrograms and cannot be distinguished from acoustic calls alone. Species with the same superscript number are grouped together.

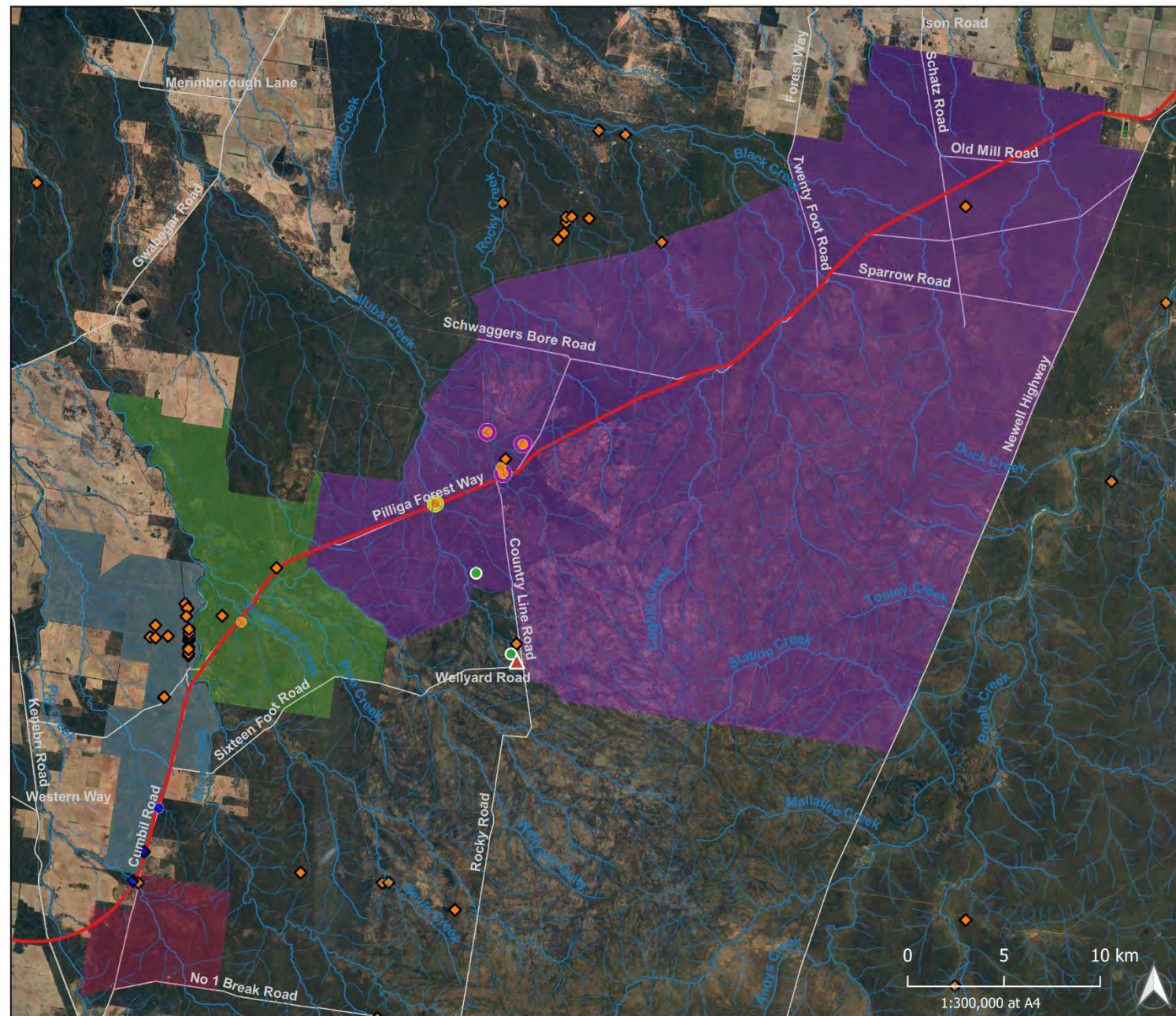


Figure: 4.1

Title: Threatened species in N2N study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 06/06/2023

LEGEND

- Nyctophilus corbeni captures
- ◆ ALA Nyctophilus corbeni
- Chalinolobus dwyeri call
- ◆ ALA Chalinolobus dwyeri
- ▲ Caves
- Watercourses
- Key roads
- Other MNES threatened species**
- White-throated Needletail
- Other MSES threatened species**
- Little Pied Bat
- Yellow-bellied Sheath-tailed Bat

ARTC Data

- N2N alignment

Protected Areas

- Baradine State Forest
- Cumby State Forest

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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

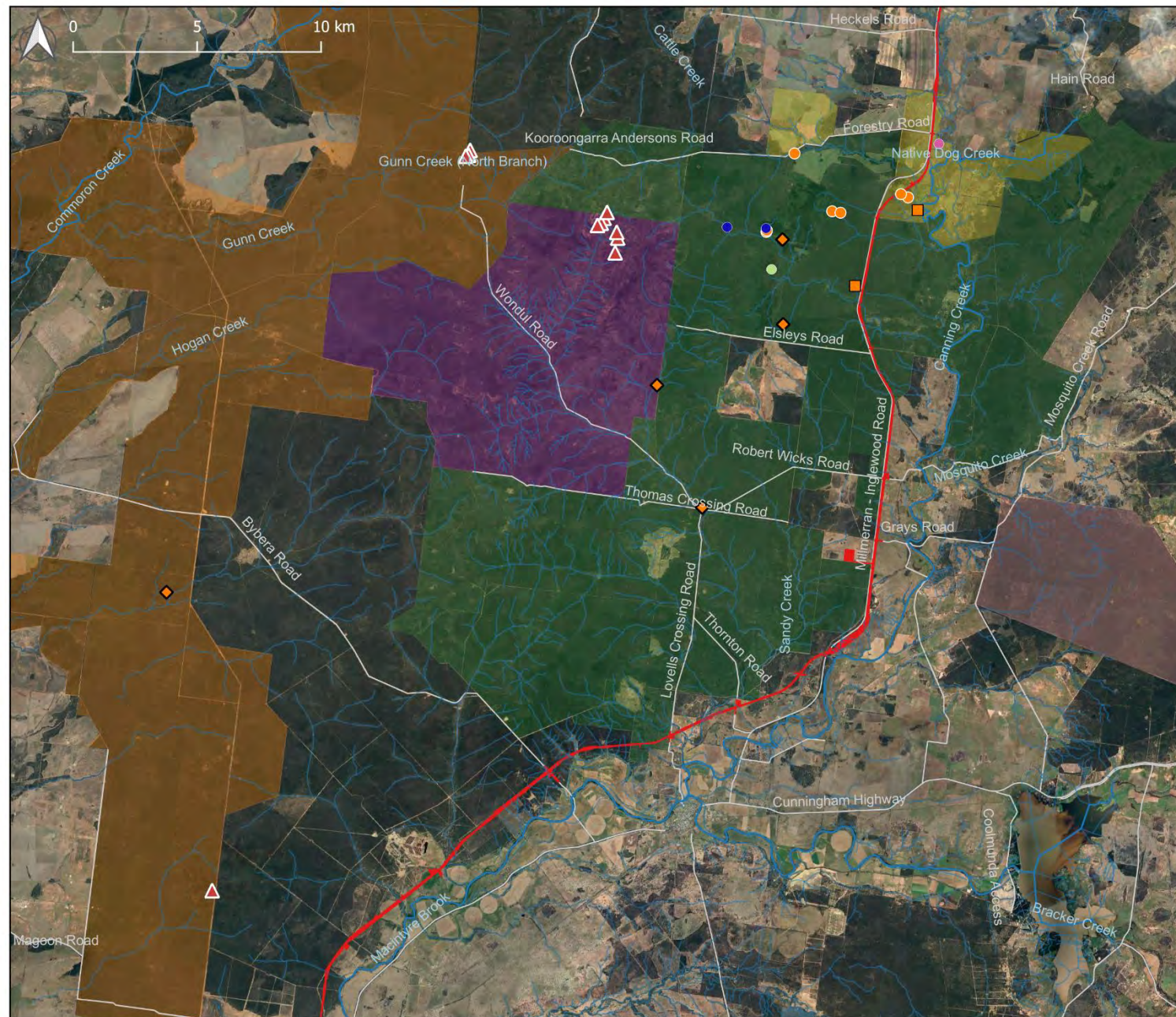


Figure: 4.2

Title: Threatened species in B2G study area

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 14/06/2023

LEGEND

● Nyctophilus corbeni captures

◆ ALA Nyctophilus corbeni

▲ Caves

— Watercourses

— Key roads

Other MNES threatened species

● Glossy Black-cockatoo

● Squatter Pigeon

Other MSES threatened species

● Powerful Owl

ARTC Data

■ ARTC Nyctophilus corbeni

■ Inland Rail footprint

■ Canning Creek property

Protected Areas

■ Bringallily State Forest

■ Whetstone State Forest

■ Wondul Range National Park

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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

4.2 LARGE-EARED PIED BAT *CHALINOLOBUS DWYERI*

4.2.1 Roosting habitat

No suitable roosting habitat for *C. dwyeri* was found within 5 km of either the N2N or B2G study area alignments. Whilst there is no precise information on the distance that this species will fly from roosting habitat, its morphology (i.e., short, broad wings) and the limited information available on home ranges suggests the species is likely to predominantly exist within a few kilometres of roosting habitat (DCCEEW, 2023b). However, this estimate should not be relied upon for management purposes (DCCEEW, 2023b).

No suitable breeding roost locations (larger caves with dome rooves or indentations) were located at either study area.

N2N Study Area

The closest located rock overhangs or caverns to the N2N alignment were the Salt Caves, approximately 9.2 km south of the alignment on Country Line Road (see **Figure 4.1** above). This rocky area and shallow caverns were likely suitable for occasional, non-breeding roosting only, and are unlikely to contribute to significant roosting habitat for the species.

B2G Study Area

Small rocky escarps, rock overhangs and caverns up to 12 m deep were found in Wondul Range National Park, approximately 9.9 km west of the alignment and 10.2 km west of the Canning Creek offset property (**Photos 4.1 and 4.2; Figure 4.2**). Inspection of a number of these caverns found occasional microbat faeces (**Photo 4.3**) and moth wings (food remnants), with an unidentified grey microbat also disrupted from one cavern.

In general, the rocky areas that were visited were of marginal *C. dwyeri* roosting habitat, due to the low escarpments (typically 2-3 m high) and shallow nature of most of the caverns. Additionally, these roosts were generally infrequently clustered and isolated in the landscape. The evidence of occasional microbat habitation in these caverns is more likely to be of another, non-threatened, cave-dwelling species.

Additionally, Queensland National Parks and Wildlife Service and Queensland Forestry staff commented that caves and rock overhangs also exist in Whetstone State Forest, approximately 5.9 km north-west of the alignment (**Figure 4.2**); however, these were not visited due to time constraints.



Photo 4.1 Example of the caverns inspected in Wondul Range National Park



Photo 4.2 Example of the inside of caverns inspected in Wondul Range National Park



Photo 4.3 Microbat faeces were detected in several of the caverns examined

4.2.2 Foraging habitat

The vegetation and general landscape (containing riparian and fertile valleys/plains) of both the N2N and B2G study areas would be suitable foraging habitat for *C. dwyeri*. However, a key requirement for this species is proximity to roost habitat, which, as described above, is lacking to both study areas. The detection of infrequent *C. dwyeri* calls in the west of the N2N study area indicates very occasional use of the area, while there is very limited evidence that the species exists in the vicinity of the B2G study area.

While occasional foraging of *C. dwyeri* may occur at the N2N study area, when individuals travel from the surrounding area where caves/escarpments and records of the species have been confirmed, it is unlikely that the disturbance footprint is an important foraging area.

4.3 SOUTH-EASTERN LONG-EARED BAT *NYCTOPHILUS CORBENI*

At N2N, of the 24 captured *N. corbeni*, four were tagged with GPS tags (three of which were retrieved), and a further nine with radio tags only. Of the ten *N. corbeni* trapped at B2G, three were tagged with GPS tags (all retrieved; one damaged without data) and a further six with radio tags. GPS data tracks are provided in Appendix 3. Note, GPS tags require retrieval from the tagged microbat to download the data.

In terms of landscape attributes, foraging points were generally within 1.1 km of moderate waterways (those with permanent water pools, e.g., Canning Creek) and 300 m of minor watercourses and drains (**Table 4.2**). Similar distances were observed with roosts. While concentrated foraging areas were recorded up to the edge of forested areas, roosts were only observed in remnant forest interiors. Dispersal data and potential individual foraging points were recorded throughout the landscape, including in cleared areas, up to 5.1 km from contiguous forest (see Appendix 3).

Table 4.2 Distance to landscape attributes for foraging and roosting data. Note, for N2N, there were five foraging clusters and ten roost points; for B2G, there was three foraging clusters and nine roost points.

Data type	N2N			B2G		
	Mean	Min	Max	Mean	Min	Max
Foraging cluster						
Distance to watercourse	1,047 m	85 m	1,805 m	1,115 m	701 m	1,495 m
Distance to minor watercourse	245 m	30 m	760 m	296 m	0 m	652 m
Distance to forest edge	>10 km	-	-	781 m	98 m	1,675 m
Roosts						
Distance to watercourse	1,340 m	131 m	1,910 m	957 m	536 m	1,888 m
Distance to minor watercourse	280 m	24 m	1,331 m	362 m	5 m	833 m
Distance to forest edge	>10 km	-	-	3,275 m	598 m	4,484 m

4.3.1 Roosting

Radio-tracking undertaken in this study indicates that, during the non-breeding season, *N. corbeni* roosted in a range of tree species, including:

- Brigalow (*Acacia harpophylla*) – five unique roost trees in the B2G study area (four of these were by the same tagged microbat)
- Narrow-leaved ironbark (*Eucalyptus crebra*) – three roosts (N2N)
- Native cypress (*Callitris* sp.) – two roosts (N2N)
- Acacia sp. (likely *Acacia burrowii*) – two roosts (B2G)
- Rusty gum (*Angophora leiocarpa*) – two roosts (B2G)
- Buloke (*Allocasuarina luehmannii*) – one roost (N2N)
- Baradine gum (*Eucalyptus chloroclada*) – one roost (B2G)
- Red Ash (*Alphitonia excelsa*) – one roost (B2G)

Tree age/size was highly variable, from DBH 3.5 cm (small sapling Acacia) to 32 cm (mature Brigalow/ironbarks). Roosts were typically in dead trees, or live trees with dead stems/large branches. Fourteen of the recorded roosts were beneath bark; specifically, either bark that had detached from the hardwood and 'buckled' outwards (see **Photos 4.4** and **4.5**), beneath a 'plate' of outer bark that remained on an otherwise smooth hardwood core (**Photo 4.6**), or that was peeling from the hardwood (**Photo 4.7**). Two hollows were also used (**Photos 4.7** and **4.8**). Photos and details of all roost features and roost trees are provided in **Appendix 2**.



Photos 4.4 and 4.5 Examples of known roosts under the 'buckled' bark of dead trees



Photos 4.6 and 4.7 Examples of known roosts under a bark 'plate' (left) and peeling bark (right)



Photos 4.8 and 4.9 Examples of known roosts in tree trunk fissures and trunk hollows

The tracking undertaken in this study found some differences in roost preferences to other published studies (e.g., Law et al., 2016, 2018 and Gonsalves, 2022). Specifically, the roosts located during this study in non-breeding season were predominantly under bark, whereas the previous studies, mainly undertaken during the breeding season (October to December), found that roosts were often in the hollows and fissures of dead tree trunks, particularly *Allocasuarina luehmannii*. One potential explanation is that, during the breeding season, tree trunk hollows provide a more stable temperature for growing young or conserving energy for lactation; whereas, during the non-breeding season, roost temperature is less imperative. This has been found in other Australian bat species (Lumsden et al., 2002; Goldingay and Stevens, 2009) and is the reason this report recommends the retainment of trees with hollows for breeding and/or hibernation.

Roost fidelity (returning to the same roost) was variable at both study locations; that is, roosts were either changed daily or revisited in consecutive days. For example, one female tagged bat used the same tree on four out of five consecutive nights that she was tracked at B2G. In contrast, other tagged individuals were not located in the same roosts on subsequent days. However, in general, for several of the microbats tracked, roosts were in different trees, but in the same area/s throughout the study period. This indicates that *N. corbeni* may have preferred roosting areas and likely has a memory for numerous roost trees within these preferred areas. This latter point is supported by the direct flight of one tagged *N. corbeni* from one roost to another during GPS retrieval. This information indicates the retainment of known or possible tree roosts is important for the longevity of individuals. However, if an occupied roost does need to be removed, delaying disturbance to the roost for one day is likely to result in the natural dispersal of the individual to another roost in the landscape.

N2N

Six unique roost trees were identified through radiotracking, one of which was within the alignment footprint (**Figure 4.3**). Tagged microbats were found to both change roosts daily, or return to the same roost as previous night/s.

GPS tracking data detected a further nine roost locations, although the individual trees cannot be determined with the GPS tag accuracy (<30 m). Two of these roosts were in an area not visited during field survey; however, satellite imagery and State fire and vegetation mapping indicate it is a scorched eucalypt forest, similar to other located roosts.

Considering the diversity of roost tree species and size, and their widespread distribution in the Pilliga forests, it is likely that the majority of the N2N impact footprint is suitable roosting habitat for *N. corbeni*.

B2G

Eleven unique roost trees were identified through radiotracking, with none of these in the alignment or on the Canning Creek offset property (**Figure 4.4**). However, both harp trapping and GPS tracking data confirms the use of the Canning Creek offset property by *N. corbeni*.

Treed areas on the two western property lots of the Canning Creek offset property were visited by one GPS tracked *N. corbeni* on two nights (see Appendix 3), including a significant foraging effort in one area for over four hours. These western property lots were not surveyed specifically during this study, although previous ground-truthed vegetation surveys indicate that tree species are present that *N. corbeni* is known to roost in within Bringalily State Forest. In the current condition, the treed areas of the western lots are likely suitable foraging habitat only, due to the propensity of *N. corbeni* to avoid roosting in forest edges. However, revegetation of the surrounding cleared areas may mean these remnant forest patches become more suitable for roosting.

The central area of the Canning Creek offset property (adjacent to Millmerran-Inglewood Road and the B2G alignment) was the focus for survey effort. Three *N. corbeni* were trapped in the area and GPS tracking indicated that a fourth individual captured in Bringalily State Forest moved through the central part of the property over two nights (Appendix 3). Searches over eight consecutive days for tagged microbats found no roosts at the Canning Creek offset property. This may be due to a general lack of suitable roosting structures in this area; in particular, the mature regrowth vegetation had limited dead or dying standing trees with suitable bark or hollows at the time of the study. However, the maturing trees in the advanced regrowth areas have the potential to become suitable roosting habitat if surrounding areas continue to regenerate (thus reduce the proximity to forest edges) and natural or artificial senescence occurs (to provide suitable microhabitat of hollows or peeling bark).

The eastern portion of the offset property was visited only once due to wet weather and/or unmaintained road access issues, with no tagged microbats located. However, the more mature vegetation, including senescing trees, indicated suitable roosting habitat was available in the area.

4.3.2 Foraging

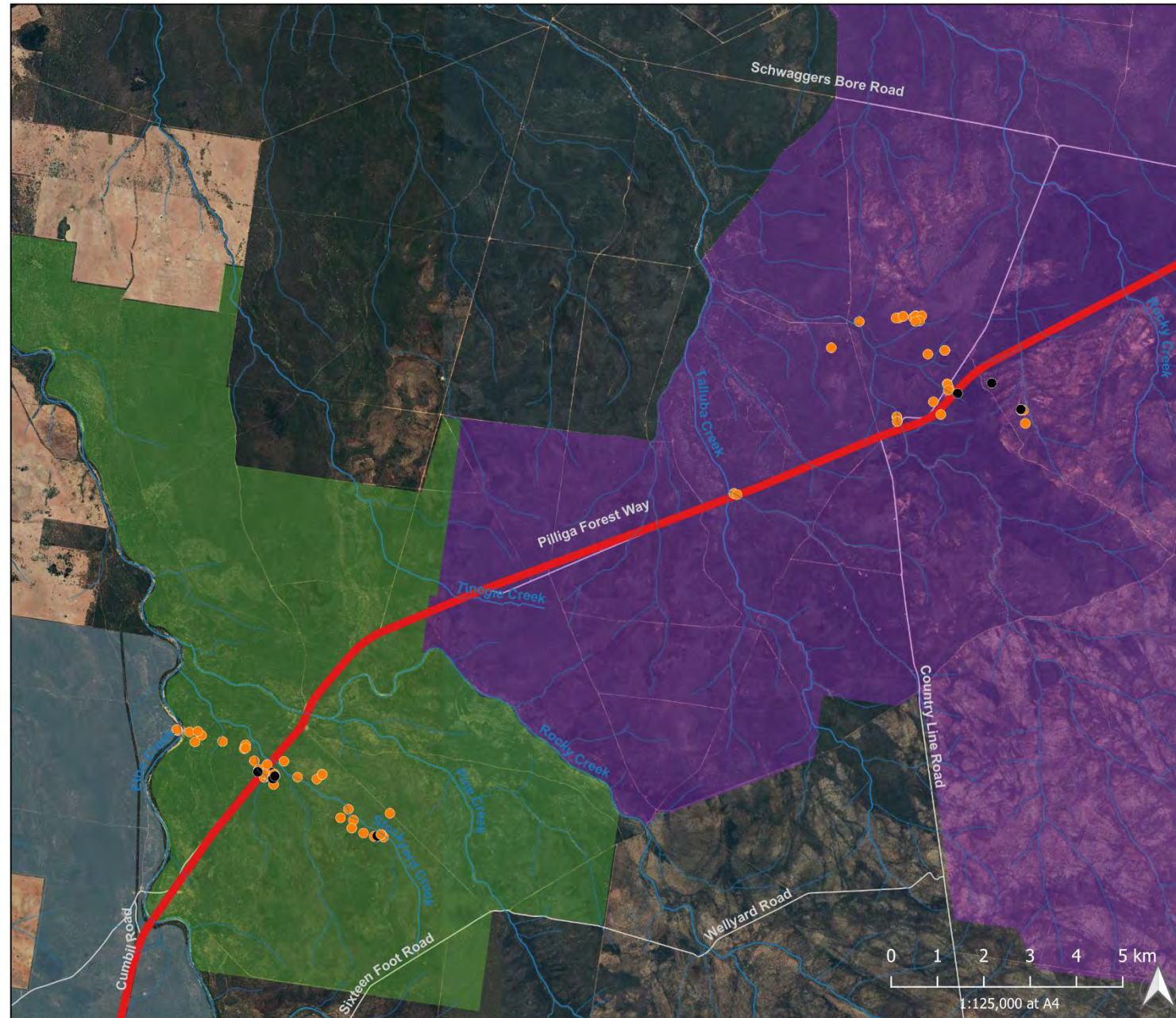
The GPS tracking data revealed that *N. corbeni* foraged in areas up to 3,805 ha per night, with up to 13 km between the most distant foraging points per night (i.e., nightly foraging diameter). Other tracking studies on *N. corbeni* in the Pilliga have found this nightly foraging diameter to be as large as 25 km (personal comm., NSW DPI). Foraging range and distance were greater at B2G than N2N, likely due to inherent differences in resources between the two study areas at the time of tracking.

Several areas were visited for habitat assessment where GPS tagged microbats showed concentrated foraging efforts (i.e., ≥ 3 consecutive GPS foraging points), with vegetation typically more diverse in structure (e.g., distinct ground and midstorey layers) and flora species than surrounding areas. Areas within the vicinity of riparian vegetation or ephemeral creeks and drains were also highly visited. Riparian and other diverse vegetation are likely to contain a higher abundance of invertebrate prey for microbat species.

Tracked bats were recorded foraging and/or moving in the landscape in the same areas frequented on preceding nights, including the Canning Creek offset property. Whilst this suggests that *N. corbeni* return to known foraging areas repeatedly, it is also likely that this pattern may change seasonally as food resources vary within the landscape.

The Canning Creek offset property was used by at least four of the ten captured *N. corbeni* during the study, three of which were trapped on the property. The fourth individual was captured in Bringalily State Forest to the west; however, GPS data showed her flying to/on Canning Creek on both nights that data was recorded. In total, four of the ten tagged *N. corbeni* moved across Millmerran-Inglewood Road (between blocks of Bringalily State Forest or to the Canning Creek offset property; see Appendix 3), indicating this single major road is not a barrier to their movement in the landscape. The cumulative effect of multiple linear transport corridors for *N. corbeni* is unknown due to the paucity of knowledge for the species. However, considering the species avoids roosting in areas of considerable disturbance (e.g., commercial thinning; Law et al., 2016), it is possible that the species may display avoidance and/or barrier effects with multiple cleared transport lines. Additionally, linear transport infrastructure is typically considered to cause reduced activity of microbats in Australia (e.g., Bhardwaj, 2017) likely due to habitat loss, fragmentation and degradation, as well as adverse impacts from vehicle strike, light and pollution, with cumulative impacts likely (Altringham and Kerth, 2015).

GPS data from the B2G study area, and information from other research on *N. corbeni* (personal comm., NSW DPI), indicates that the species will travel across cleared land to forage in remnant or regrowth woodland and forest patches.



Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: 4.3

Title: Nyctophilus corbeni
roosting and foraging
points at N2N study area

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 10/05/2023

LEGEND

- Detected roosts
- Foraging/dispersal points
- Watercourses
- Key roads

ARTC Data

■ N2N alignment

Protected Areas

- Cumbil State Forest
- Euligal State Forest
- Pilliga East State Forest

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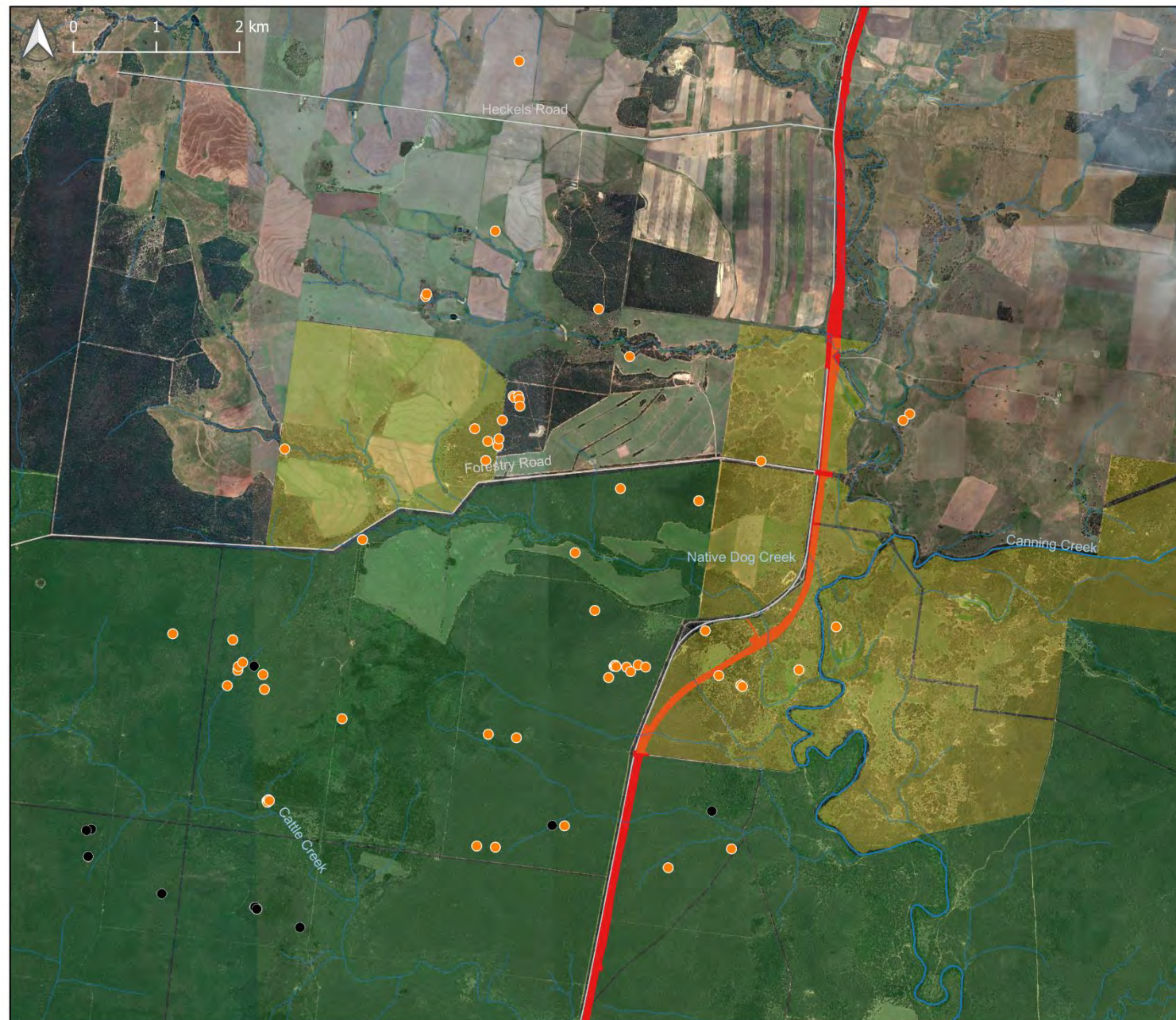


Figure: 4.4

Title: Nyctophilus corbeni
roosting and foraging
points at B2G study
area

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 10/05/2023

LEGEND

- Detected roosts
- Foraging/dispersal points
- Watercourses
- Key roads

ARTC Data

- Inland Rail footprint
- Canning Creek property

Protected Areas

- Bringalily State Forest

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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

4.4 OTHER THREATENED TAXA

Three other nationally threatened fauna species were detected during the microbat surveys and research in the study areas (see locations on **Figures 4.1** and **4.2**), including:

- Squatter Pigeon (southern) *Geophaps scripta scripta*
 - two individuals sighted together on the Canning Creek offset property on 18 March, 2023;
- White-throated Needletail *Hirundapus caudacutus*
 - five individuals observed on multiple days between 4-8 March, 2023, foraging around the fire tower and surrounding forests near the Salt Caves in Pilliga East State Forest, and towards the N2N alignment; and
- Glossy Black-cockatoo (south-eastern) *Calyptorhynchus lathami lathami*
 - three young male birds recorded on multiple days in Bringalily State Forest between 20 March – 5 April, either feeding in *Allocasuarina* species or coming to a waterbody to drink.

For the N2N study area, NSW listed threatened species recorded during the field survey included:

- Little Pied Bat *Chalinolobus picatus* (Vulnerable)
 - captured in harp traps on numerous occasions (see Appendix 1 for dates and locations, also Figure 4.1),
 - calls for this species were also recorded in the N2N alignment;
- Northern Free-tailed Bat *Ozimops lumsdenae* (Vulnerable)
 - calls for this species were recorded in the N2N alignment;
- Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris* (Vulnerable)
 - captured in a harp trap on 27 February, 2023 (see Figure 4.1),
 - calls for this species were also recorded in the N2N alignment;
- Eastern Cave Bat *Vespadelus troughtoni* (Vulnerable)
 - calls for this species were also recorded in the N2N alignment;

For the B2G study area, one Qld listed threatened species included one probable sighting of Powerful Owl *Ninox strenua* in Bringalily State Forest west of the B2G alignment (Figure 4.2) on 25 March, 2023.

5.0 HABITAT ASSESSMENTS

A summary of the approximate habitat for both threatened species is provided in **Table 5.1**. These estimates were calculated following habitat assessment based on either known information on *C. dwyeri* biology, or after *N. corbeni* tracking data collection. Specifically, habitat was assessed based on this biological knowledge and the landscape context (either point visits along the alignment and/or examination of ground-truthed REs, where available) for *N. corbeni*. The criteria developed to assess *N. corbeni* habitat is provided in **Table 5.2**, which is based on four main parameters derived from the findings from **Section 4.3** and other published information on the species.

Note, the hectares provided should be used as a guide only, as precise boundaries were not mapped during the field survey, and roads/tracks have not been omitted when these are within the disturbance footprint.

Table 5.1 Estimated hectares of habitat impacted in the study areas. Note, the study areas are not the full length of the Inland Rail project segment (e.g., not the full length of B2G segment).

Microbat species	Habitat type	N2N study area (ha)	B2G alignment in study area (ha)	Canning Creek property
<i>Nyctophilus corbeni</i>	Likely roosting	962	56	241
	Suitable roosting	61	109	205
	Potential roosting	215	162	737
	Suitable foraging	218	348	746
	Marginal foraging/ dispersal only	95	238	805
<i>Chalinolobus dwyeri</i>	Marginal foraging	340	0	0

Table 5.2 Criteria used to assess habitat suitability for *Nyctophilus corbeni*

Parameters:	Roost trees	Vegetation diversity	Water proximity	Forest proximity
Description, summary of knowledge	For roosting habitat; Certain tree species are known to contain roosts, or shed bark and form trunk hollows suitable for roosting	Foraging habitat; Vegetation present/ RE/PCT with structural (i.e. upper, mid, ground storey) and/or species diversity	Roosting and foraging Typically roost and/or forage within 1 km of water	Roosting and foraging Typically roost/forage within 1 km of large forest areas
Likely roosting habitat	>500 m to forest edge; AND Onsite habitat assessment recorded many suitable roosting microhabitat and trees OR Remnant RE/PCT predominantly comprised of suitable roost tree species (3)	Present (1)	Distance to minor watercourse is <1 km (1)	1 = Distance to large areas of woodland or forest is <1 km (1)
Suitable roosting habitat	>500 m from forest edge; AND Onsite habitat assessment recorded many suitable roosting microhabitat and trees OR RE/PCT contains suitable roost tree species as co-dominant (2)	Present (1)		
Potential roosting habitat	RE/PCT contains suitable roost tree species, but has some disturbance (e.g., selective logging) or is maturing regrowth, or is within 500 m of forest edge (1)	Present (1)		
Suitable foraging	Limited trees for roosting present (either standing trees or roost-forming species) (0)	Present (1)		
Marginal foraging	Limited trees for roosting present (either standing trees or roost-forming species) (0)	Absent/limited (0); E.g., cleared pastoral areas with isolated trees and other vegetation	>1 km to minor watercourse	>1 km from large areas of woodland or forest (0)
Non habitat	Limited trees for roosting present (either standing trees or roost-forming species) (0)	Absent/limited (0)		

Figure: 5.1

Title: Nyctophilus corbeni
habitat assessment
along N2N study area
alignment

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 10/05/2023

LEGEND

— Watercourses

— Key roads

Habitat Assessment Points

• Primary

• Secondary

Habitat Assessment

■ Likely roosting

■ Suitable roosting

■ Potential roosting

■ Suitable foraging

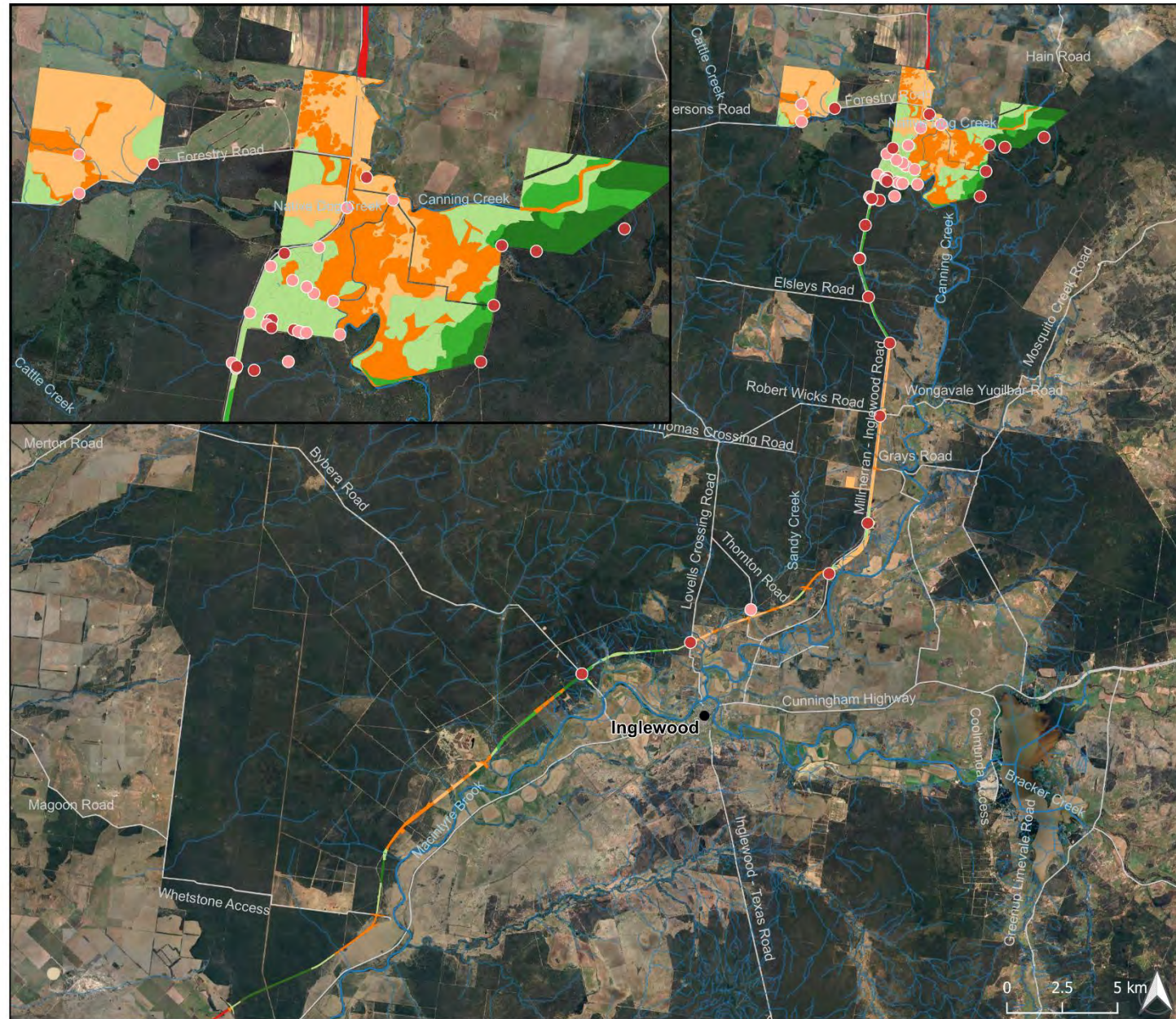
■ Marginal foraging



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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: WGS 84



Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: 5.2

Title: Nyctophilus corbeni
habitat assessment at
B2G study area

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 05/05/2023

LEGEND

Habitat Assessment Points

- Primary
- Secondary

Habitat Assessment

- Likely roosting
- Suitable roosting
- Potential roosting
- Suitable foraging
- Marginal foraging/dispersal only

Protected Areas

- Bringalily State Forest
- Whetstone State Forest
- Wondul Range National Park

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6.0 MANAGEMENT AND MITIGATION OF IMPACTS

6.1 NATURE OF IMPACT

Key points on the ecology for the two threatened microbat species relevant to impact identification and management are described below. These key points were elucidated from the current study, as well as relevant published scientific articles (notably Law et al., 2016; Law et al., 2018; Williams and Thomson, 2018; Gonsalves et al., 2022; see **Section 4.0** for further details).

- *Nyctophilus corbeni*
 - roosts in trees of varying species and sizes (from as little as 3.5 cm DBH), typically under peeling or buckling bark, in small hollows or fissures in trunks;
 - roosts are most commonly in dead or dying trees, but do occur in live trees;
 - typically changes roosts daily (both maternity and non-breeding roosts), although can occupy a roost on consecutive days;
 - maternity roosts are more likely to be tree trunk hollows, whereas non-breeding roosts can be highly variable, including under thin, peeling bark;
 - considered a clutter-specialist species, preferring to forage and/or roost in areas of dense trees, and in or adjacent to large areas of forest;
 - often in close proximity to ephemeral drains and watercourses.
- *Chalinolobus dwyeri*
 - roosts in rocky escarps, overhangs and caves or caverns in a variety of rock types;
 - requires large caverns/caves with a domed roof for breeding;
 - forages around and above the canopy of forests and (less frequently) individual trees, often in or near riparian or highly fertile areas;
- Both species:
 - feed on a variety of insects and invertebrates, with the highest abundance of these prey often in areas of diverse vegetation (species and/or structure) and waterways;
 - moves in the landscape along typical microbat flyways (e.g., along watercourses, tracks and roads);
 - forages several kilometres from roosts, including traveling many kilometres per night.

Considering these key ecological parameters, the key threats to *C. dwyeri* and *N. corbeni* associated with the Inland Rail project at the two study areas are described in **Table 6.1**. Estimated areas of foraging and roosting habitat loss are provided in **Table 5.1** in **Section 5.0**.

Table 6.1 Threats and potential impacts in the study areas associated with the Inland Rail project

Threat	Potential impact associated with Inland Rail project	Project phase
Direct roost loss (<i>N. corbeni</i>)	Tree removal (clearing, fire) and unsuitable fire management will reduce roost trees and roost microhabitats (e.g., peeling/buckling bark, hollows, fissures) for breeding and non-breeding microbats	• Construction • Operation
Vegetation clearing	Direct loss of foraging habitat	• Construction • Operation
Habitat fragmentation	Forest-dwelling microbats, particularly <i>N. corbeni</i> , are sensitive to forest fragmentation; fragmentation can be due to clearing and/or disturbance from noise, light or vibration causing avoidance of otherwise suitable habitat	• Construction • Operation
Introduction of weeds	Weed proliferation may modify the current/preferred habitat for microbats, particularly tree-roosting species like <i>N. corbeni</i>	• Construction • Operation
Inappropriate fire regimes or fire management/controls	Low intensity, patchy and infrequent fire is required to maintain <i>N. corbeni</i> roosts, as well as maintain suitable habitat composition for both threatened microbat species	• Construction • Operation
Vehicle strike	Injury or mortality of individuals through interaction with vehicles, machinery or trains	• Construction • Operation
Noise, vibration and light	Loss of useable habitat and behavioural disruptions due to noise, vibration and/or light	• Construction • Operation

6.2 MEASURES TO AVOID, MINIMISE AND MANAGE IMPACTS

Considering the threats and species ecology outlined in **Section 6.1**, measures to minimise and manage impacts are provided in **Table 6.2** below. Note, this is not an exhaustive list of mitigation measures for the target species, which should be developed with close consultation with engineers and planners.

Table 6.2 Mitigation measures suitable for *Chalinolobus dwyeri* (Cd) and *Nyctophilus corbeni* (Nc) in relation to the Inland Rail project at the N2N and B2G study areas.

Activity	Mitigation Measure	Cd	Nc
Pre-construction Phase			
Site Preparation	Works that could cause disturbance to roosts (e.g., tree clearing, ground vibration) should be scheduled to primarily avoid breeding season (October-December) and, where possible, the hibernation period (June-August)	✓	✓
	The extent of disturbance of suitable habitat should be delineated and clearly marked to avoid unnecessary habitat loss	✓	✓
	Dead trees, or those with peeling/buckling bark, hollows or fissures, should be avoided to minimise loss of suitable roosts		✓
	The removal of standing dead and live trees should be minimised to minimise the loss of suitable roosts		✓
	The width of clearing/disturbance areas should be kept as narrow as possible to minimise habitat fragmentation	✓	✓
	Disturbance at and near cave structures should be avoided to minimise habitat disturbance	✓	
	A spotter-catcher or other suitably qualified specialist should identify all potential maternity roosts in the disturbance area	✓	✓
	Exclusion zones should be established around active breeding places and monitored until the site has been vacated	✓	✓
	Along the length of the alignment, suitable undisturbed 'recipient' sites should be identified to release microbats captured during clearing activities	✓	✓
Site Work Instruction	All site personnel, including contractors, should be made aware of the extent of any unauthorised access areas, as well as specific limitations related to construction works being conducted in or within proximity to microbat roosts	✓	✓
Construction Phase			
Access	Access to and from the project footprint should occur along designated access tracks only, to avoid unnecessary habitat disturbance and fragmentation	✓	✓
	To avoid entanglement, the use of barbed wire should be avoided, particularly on the top strand of required fencing	✓	✓
	Exclusion or restricted zones should be established around breeding roosts that have been located/initiated after the commencement of construction	✓	✓

Activity	Mitigation Measure	Cd	Nc
Clearing	Areas to be cleared will remain clearly demarcated for the duration of clearing activities	✓	✓
	Clearing will occur, and be monitored to comply, only within the approved areas	✓	✓
	Clearing activities should be supervised by a suitable qualified and experience Environmental Officer, with a spotter-catcher on hand at all times to relocate and/or manage disturbed microbats	✓	✓
	All vegetation clearing within identified threatened microbat habitat should comply with clearing related approvals	✓	✓
	Clearing should be undertaken in a sequential manner to allow microbats to escape clearing activities into nearby, undisturbed areas	✓	✓
	Dead or dying standing trees should be thoroughly inspected for potential or occupied <i>N. corbeni</i> roosts, with particular attention to features similar to the known roosts provided in photos in Appendix 2		✓
	Identified roosts that are currently occupied by microbats, plus a 20 m radius buffer, should be marked and left uncleared until the roost is re-checked the following day. Ground disturbance, or other spreading disturbances (light, noise, vibration) should be avoided for up to 100 m, depending on the nature of the disturbance. As <i>Nyctophilus corbeni</i> typically change roosts daily, even during the breeding season, it is possible that clearing activities only need to be suspended for one day to allow for self relocation.		✓
	Where potential roost trees (with peeling/buckling bark, hollows or fissures) need to be removed: • trees should be inspected by a spotter-catcher to determine occupancy and, where microbats are present, these should be captured (rather than flushed from the roost) to prevent predation from birds such as currawongs, kookaburras, butcherbirds, corvids, etc.; • trees should be felled gently/lowered to the ground and inspected immediately by a spotter-catcher, before being left for a short period (approximately 10 minutes) to allow microbats to escape that were not identified previously, prior to the tree being processed; • during the hibernation period (June-August), microbats may be less inclined or slower to depart from disturbed roost trees, and spotter-catchers should be more vigilant for potential roosts and occupancy; • displaced, uninjured microbats should be relocated to the recipient site during night hours and within 24 hours of capture; and • injured microbats should receive veterinary attention immediately and, when recovered, should be released into the recipient site.		✓
Weed Management	Weed management strategies should be implemented to minimise the introduction and/or proliferation of weed species	✓	✓
	Vehicle, equipment and personnel access should be restricted in areas known or suspected to contain weed infestations, with weed control measures undertaken early where required	✓	✓
	All vehicles/equipment should possess current weed hygiene declarations	✓	✓

Activity	Mitigation Measure	Cd	Nc
	Vehicles/equipment should have current and updated risk assessments to determine the level of inspection, washdown and certification when travelling to, within and between project areas	✓	✓
Light, Noise and Vibration Management	Equipment, vehicles and activities that emit light, noise and/or vibration should be regularly maintained to optimal working order to minimise these emissions	✓	✓
	Equipment types, as well as activity methods and sequence, should be considered to reduce all light, noise and vibration disturbance to microbat habitat during construction, during both daylight and night hours	✓	✓
	Equipment parts and add-ons that reduce light, noise and vibration should be implemented and maintained (e.g., light shields/hoods to prevent light spill into adjacent areas, quietening guards, etc.)	✓	✓
Progressive Rehabilitation	Excluding ongoing operational or maintenance tracks and areas, rehabilitation of areas should be planned, commenced, monitored and managed as soon as possible to initiate habitat restoration	✓	✓
Operational Phase			
Clearing	As per Construction Phase	✓	✓
Light, Noise and Vibration management	Equipment, vehicles and activities that emit light, noise and/or vibration should be regularly maintained to optimal working order to minimise these emissions	✓	✓
	Modelling should be undertaken to determine the lowest possible levels of ongoing light, noise and vibration disturbances near any potential roost or foraging habitat	✓	✓
Fire Management	Measures to minimise the risk of wildfire in surrounding areas is required, particularly those methods that do not include further habitat disturbance (i.e., local prevention around hot work, rather than the construction of fire breaks)	✓	✓
	At offset properties: - planned burns should be undertaken at a frequency suitable to the vegetation community type and level of resilience, to maintain diversity of age and structure; - planned burns should be undertaken in a manner to ensure a patchy mosaic of low intensity fire and unburnt areas results; - already cleared fire breaks should be maintained to reduce the risk of wildfire from neighbouring areas; and - current access tracks should be maintained where possible to allow fire control and management.		✓
Entanglement	All temporary or permanent fencing should avoid the use of barbed wire wherever possible, particularly as the top strand, to minimise microbat entanglement	✓	✓
Weed Management	As per Construction Phase	✓	✓
Progressive Rehabilitation	As per Construction Phase	✓	✓

Activity	Mitigation Measure	Cd	Nc
Rehabilitation Phase			
Revegetation	Revegetation should include flora species and densities as per the relevant RE or PCT that existed prior to disturbance, with areas close to the train line omitting common roost tree species such as ironbarks, Brigalow, native cypress and Buloke.		✓
Weed Management	As per Construction Phase	✓	✓
Fire Management	As per Construction Phase		

6.3 MITIGATION OF RESIDUAL IMPACTS

6.3.1 Artificial roosts for *Nyctophilus corbeni* roost loss

Apart from measures to minimise tree loss (from clearing or fire) described in **Table 6.2**, direct loss of maternity and non-breeding tree roosts for *N. corbeni* is an impact with limited mitigation options. In particular, roosts of this species are typically under peeling/buckling bark, in trunk hollows or fissures in dead trees, which can be difficult to replicate.

Microbat roost boxes

Artificial microbat roost boxes are often suggested as a mitigation method for tree-roosting species; however, there is limited evidence that they provide valuable roosting structures for many Australian species of microbats. Several research studies have found that uptake of microbat roost boxes is species-specific, with *Nyctophilus* species rarely occupying them. For example, a study spanning 22 years, with four sites and over 100 microbat roost boxes of various designs, found only one least concern microbat species used the artificial roosts with any degree of regularity (Griffiths et al., 2017). Whilst the study was conducted outside the distribution of *N. corbeni*, one comparable species (e.g., *Nyctophilus geoffroyi*) was a common inhabitant of the study area, but did not use the artificial roost boxes.

In another study, where *N. geoffroyi* and *N. gouldi* (both with similar roosting preferences to *N. corbeni*) were common in the landscape, less than 5% occupancy rate of any microbat species were found to occupy artificial roost boxes, with no *Nyctophilus* maternity roosts detected (Rueegger et al., 2019). Of interest, artificial roost boxes that were designed and implemented during the study with increased chambers and ventilation were found to contain more *Nyctophilus* species than standard roost boxes. Considering the non-breeding roosts recorded at both the N2N and B2G study areas were often in exposed locations under bark and with high levels of ventilation, it is possible this design could be more suitable to *N. corbeni*; however, further examination and monitoring is required to confirm this.

Chainsaw cavities

Nyctophilus species (other than *N. corbeni*) have been found to occupy cavities carved into live trees with a chainsaw (which does not kill the tree if undertaken correctly), with a front plate subsequently attached with an entrance hole (Rueegger, 2017). One artificial cavity was also considered to be a *Nyctophilus* maternity roost. Chainsaw cavities have also been found to have more comparable microclimate (e.g., stable roost temperatures) to microbat tree hollows, compared to artificial bat boxes, which have highly fluctuating temperatures (Griffiths et al., 2018). As the maternity roosts of *N. corbeni* are typically located in tree trunk hollows (e.g., see Law et al., 2016, 2018 and Gonsalves et al., 2022), likely due to a greater stability in microclimate providing energy efficiency whilst microbats are at rest, chainsaw cavities may provide suitable maternity roosting opportunities for *N. corbeni*.

The NSW DPI has recently started examining whether chainsaw cavities, as well as ring-barking trees to create suitable bark roosts, are used by *N. corbeni*; however, no details are yet available.

Bark mimics

Overseas, several types of bark mimics have been successfully developed for microbat species that roost under bark. 'Bat Bark' is made from a synthetic mould (typically polyurethane, fibreglass or polyresin) to replicate typical roosts of target species (see Noteman, 1998; Taylor et al., 2020). 'BrandenBark' is another example of a bark mimic that has been successfully occupied by various

microbat species in several areas of the United States, including as maternity roosts (e.g., Gumbert et al., 2013; Adams et al., 2015).

While bark mimics require consideration of the target species roost preferences (shape, attachment location, microclimate, etc.), their increased development, research and successful implementation provides an opportunity for extension in Australia.

6.3.2 Offset Property

Considering the Inland Rail project will result in residual impacts to threatened microbat species through loss of maternity and non-breeding roosting sites (for *N. corbeni*), as well as reduced foraging habitat for both *N. corbeni* and *C. dwyeri*, adequate offset property management will be important to mitigate such impacts. Offset property management recommendations relevant to the two threatened microbat species are provided in **Section 7.0**.

6.4 MONITORING OF IMPACTS

A monitoring plan, including detailed measurable targets and thresholds, for each of the mitigation methods detailed in **Table 6.2**, should be developed to ensure compliance and allow adaptive management actions.

As train strike for microbat species is a specific threat in these forested areas, with limited information on practical mitigation measures in Australia or overseas. Specifically, as *N. corbeni* (and various other microbat species) fly and forage at a range of heights, including picking invertebrates from the ground, to above the canopy foliage (TSSC, 2015), it is recommended that adequate monitoring is undertaken to determine the extent of this ongoing threat. Specifically, this could involve regular surveys for microbat carcasses along high biodiversity areas of the alignment/s.

7.0 OFFSET PROPERTY MANAGEMENT RECOMMENDATIONS

The primary recommendations for offset property management relate to the provision and/or retention of roosts for *N. corbeni*. In particular, this includes limiting the removal of standing dead or dying trees, suitable fire management to retain roost features (e.g., peeling/buckling bark), and establishing suitable artificial roost structure in areas with limited natural roosts.

Secondary land management activities are also recommended that will further provide foraging and/or roosting habitat for *N. corbeni* and *C. dwyeri*, as well as reducing risk of injury through entanglement on fences.

7.1 LIMIT REMOVAL OF STANDING DEAD OR DYING TREES

The removal or disturbance of any standing, native, dead trees, or trees with dead branches or sections, should be minimised, regardless of species or size. In particular, *N. corbeni* is known to roost in a range of native tree species of various ages, including small (dead) saplings that may have been outcompeted during natural thinning processes.

Furthermore, all dead or dying native tree species should be retained as *N. corbeni* roost preferences vary throughout the year. Specifically, hollows are likely to be favoured during breeding season and hibernation, whilst under ventilated bark is more commonly used as a roost during warmer, non-breeding months. Additionally, *N. corbeni* is known to prefer dense stands of trees, thus clearing, thinning or disturbance of any trees may restrict roosting in the area.

If any clearing work does need to be undertaken, it is important to avoid the months during hibernation (June-August) to minimise mortality from energetic stress, as well as the breeding season (October-December), to minimise risk of young abortion or displacement.

7.2 FIRE MANAGEMENT

Suitable fire management is required to protect current roost features of trees for *N. corbeni*. In particular, peeling or loose bark and the edges/internal structure of trunk hollows can be consumed by moderate to high intensity fire, and these should be avoided.

Research has indicated that, in the Pilliga, *N. corbeni* preferred either unburnt or areas of patchy, lightly burnt forest due to the creation of suitable roosts (i.e., dead trees, curling thick bark; Gonsalves et al., 2022). However, areas with moderate to high intensity fires were avoided for both roosting and foraging (see also Law et al., 2016).

Fire can also alter the vegetation composition, especially in recovering habitats such as the young Brigalow, cypress and Buloke regrowth in the south-western property lots of the Canning Creek offset property. In addition to the patchy, low intensity burn recommendation above, consultation with an appropriate expert on fire frequency suitability for such vegetation and habitats, should fuel management require control burns.

7.3 ARTIFICIAL ROOSTS

Offset properties, with agreements to offset *N. corbeni* residual impacts, should be surveyed to determine the current existence of natural roosts. It is likely that, in areas of regrowth or young forest, limited natural roosting opportunities may exist. As such, artificial roosts are required to encourage usage of the offset properties.

Artificial roosts for *N. corbeni* have not been investigated in Australia, although similar-roosting congeneric microbats (i.e., other *Nyctophilus* species) rarely occupy standard microbat roost boxes. Therefore, it is recommended that a study be undertaken following determination of suitable roosting habitat areas, on whether microbat roost boxes adapted for *N. corbeni* roost preferences (i.e., increased ventilation for non-breeding season and suitably insulated for breeding season) or chainsaw cavities (for breeding roosts), and an artificial bark prototype (for non-breeding roosts) may be suitable roost substitutes.

7.4 HABITAT MANAGEMENT

7.4.1 Grazing

While grazing should pose limited disturbance to roosts of *N. corbeni*, monitoring of the effects of cattle grazing should be implemented to ensure no distinct change in composition or density of vegetation, or direct impacts to roost trees and their features (i.e., pushing over dead trees).

7.4.2 Weed Management

As for grazing, weed incursion and/or proliferation can result in a change to the composition or density of suitable vegetation and microbat habitat. As such, suitable methods should be undertaken to control existing weeds, as well as prevent the introduction of new weed species.

Weed control measures need to minimise indirect impacts on microbats, such as the reduction of insect food resources (chemical application) or damage to potential roost trees (mechanical removal).

7.4.3 Erosion Management

The monitoring and stabilisation of current or additional erosion is also important. In particular, erosion can result in the direct loss of roost trees or the modification of suitable foraging and roosting habitat.

7.5 ENTANGLEMENT

To reduce the risk of entanglement on barbed-wire, the top strand of fences should be plain steel wire. As microbats primarily use echolocation to navigate the landscape, fencing wire is difficult to 'see' and is a common cause of injury and death.

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APPENDIX 1

Microbat species and numbers captured in harp traps

APPENDIX 1 – MICROBAT SPECIES AND NUMBERS CAPTURED IN HARP TRAPS

Species initialisms included in harp trap capture tables. Conservation status is as per Commonwealth (EPBC Act) or State legislation, and includes V = Vulnerable or LC = Least Concern.

Initialism	Species Name	Common Name	Conservation Status	
			EPBC	State
Cg	<i>Chalinolobus gouldi</i>	Gould's Wattled Bat	LC	LC
Cm	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	LC	LC
Cp	<i>Chalinolobus picatus</i>	Little Pied Bat	LC	V (NSW)
Nc	<i>Nyctophilus corbeni</i>	South-eastern Long-eared Bat	V	V (NSW, Qld)
Nge	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	LC	LC
Ngo	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	LC	LC
Op	<i>Ozimops planiceps</i>	Inland Free-tailed Bat	LC	LC
Or	<i>Ozimops ridei</i>	Eastern Free-tailed Bat	LC	LC
Sf	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	LC	V (NSW)
Ss	<i>Scotorepens</i> species*	Broad-nosed Bat	LC	LC
Vv	<i>Vespadelus vulturnus</i>	Little Forest Bat	LC	LC

*Broad-nosed Bats (*Scotorepens* spp.) were not always identified to species in the field before release due to the need to undertake various measurements (e.g. finger bones) for accurate identification.

Site coordinates for harp trapping in the N2N study area

Site Name	Latitude	Longitude
Coolangla Creek (dbl)	-30.84792	149.08037
Nr Stockyard Creek #1	-30.72604	149.13833
Nr Stockyard Creek #2	-30.72615	149.13880
Ned's Creek Rd (dbl)	-30.67177	149.24479
Cubbo Creek #1	-30.65800	149.28167
Cubbo Creek #2	-30.65777	149.28160
Cubbo Creek Rd East	-30.64399	149.29234
Cubbo Creek Rd West	-30.63840	149.27303

(dbl = double, where two traps are set up side-by-side)

Harp trap captures in the N2N study area

Date	Site	Cg	Cm	Cp	Nc	Nge	Ngo	Op	Sf	Ss	Vv
25/02/2023	Coolangla Creek (dbl)					3				1	
	Nr Stockyard Creek #1					1					2
	Ned's Creek Rd (dbl)	1			1	9	2	1		2	5
	Cubbo Creek #1	13	1		1	28	2			15	5
	Cubbo Creek #2					0					
26/02/2023	Coolangla Creek (dbl)	1									
	Nr Stockyard Creek #1				1						2
	Ned's Creek Rd (dbl)					7					2
	Cubbo Creek #1	5				7	2	2		9	5
	Cubbo Creek #2					0					
27/02/2023	Coolangla Creek (dbl)	2				2				4	
	Nr Stockyard Creek #1					1					
	Ned's Creek Rd (dbl)	7				9		7	1	27	9
	Cubbo Creek #1	17				19		3		78	14
	Cubbo Creek #2										
28/02/2023	Coolangla Creek (dbl)									1	2
	Nr Stockyard Creek #1										1
	Ned's Creek Rd (dbl)	60	1		3	15	3			78	16
	Cubbo Creek #1	89	2	1	3	9	2			255	77
	Cubbo Creek #2	18			2	8	4			67	14
2/03/2023	Nr Stockyard Creek #2					4				1	1
	Ned's Creek Rd (dbl)	4				3	1	1		18	6
	Cubbo Creek #1	52			4	10	2	1		148	15
	Cubbo Creek #2					10				3	3
	Cubbo Creek Rd East	34			2	5	1	4		36	25
	Cubbo Creek Rd West	62		1	1	4		8		91	39
3/03/2023	Nr Stockyard Creek #2									5	
	Ned's Creek Rd (dbl)					1				12	2
	Cubbo Creek #1 and #2	1				2				6	4
	Cubbo Creek Rd East	6			2			4		15	5
	Cubbo Creek Rd West	1				2				8	12
4/03/2023	Nr Stockyard Creek #2										3
	Ned's Creek Rd (dbl)	3				3				26	15
	Cubbo Creek #1	1				2				8	2
	Cubbo Creek #2					0					
	Cubbo Creek Rd East	5		3	1	5		1		5	17
	Cubbo Creek Rd West					1		1			3
5/03/2023	Nr Stockyard Creek #2										1
	Ned's Creek Rd (dbl)					1				2	5
	Cubbo Creek #1	7			1	1				7	1
	Cubbo Creek #2					0					
	Cubbo Creek Rd East	7		1	2					14	13
	Cubbo Creek Rd West				1	1					2

Site coordinates for harp trapping in the B2G study area

Site Name	Latitude	Longitude
Scorched habitat track	-28.33906	151.09245
Pariagara Creek (dbl)	-28.34011	151.10133
Sandy Creek (dbl)	-28.34582	151.13012
Corner creek	-28.34617	151.13170
Southern dam	-28.35824	151.10492
Northern dam (dbl)	-28.17518	151.12907
Northern fire tower track	-28.18155	151.12723
Southern fire tower track (dbl)	-28.20431	151.12031
Fire tower dam #1	-28.20357	151.11689
Fire tower dam #2	-28.20432	151.11723
Offset property Trap #1 (east)	-28.19298	151.17691
Offset property Trap #2 (mid)	-28.19179	151.17543
Offset property Trap #3 (west)	-28.19056	151.17255
Offset property south #1 (dbl)	-28.20013	151.17438
Offset property regrowth #1	-28.19861	151.16809
Offset property regrowth #2	-28.19850	151.16718
Offset property south #2	-28.20006	151.17464
Offset property south #3	-28.20000	151.17416
Bringalily SF Trap Rd #1 (east)	-28.19764	151.15261
Bringalily SF Trap Rd #2 (central)	-28.19699	151.14760
Bringalily SF Trap Rd #3 (west)	-28.19642	151.14415
Cattle Creek #1	-28.20164	151.10097
Cattle Creek #2	-28.20159	151.10094

(dbl = double, where two traps are set up side by side)

Harp trap captures in the B2G study area

Date	Site	Cg	Cm	Cp	Nc	Nge	Ngo	Or	Ss	Vv
17/03/2023	Scorched habitat track	0	0	0	0	0	0	0	0	0
17/03/2023	Pariagara Creek (dbl)	3	0	0	0	3	0	0	2	2
17/03/2023	Sandy Creek (dbl)	0	0	0	0	4	0	0	2	2
17/03/2023	Corner creek	0	0	0	0	3	1	0	2	0
17/03/2023	Southern dam	4	1	0	0	4	0	0	8	3
18/03/2023	Scorched habitat track	0	0	0	0	0	0	0	0	0
18/03/2023	Pariagara Creek (dbl)	0	0	0	0	0	0	0	0	0
18/03/2023	Sandy Creek (dbl)	0	0	0	0	1	0	0	1	0
18/03/2023	Corner creek	0	0	0	0	0	0	0	1	0
18/03/2023	Southern dam	0	0	0	0	1	0	0	1	0
19/03/2023	Northern dam (dbl)	0	0	0	0	0	0	0	1	1
19/03/2023	Northern fire tower track	0	0	0	0	0	0	0	0	0
19/03/2023	Southern fire tower track (dbl)	0	0	1	0	1	0	0	3	0
19/03/2023	Fire tower dam #1 and #2	11	1	2	2	9	0	2	10	3
20/03/2023	Northern dam (dbl)	0	0	0	1	5	0	1	7	2
20/03/2023	Northern fire tower track	0	0	0	0	0	0	0	0	0
20/03/2023	Southern fire tower track (dbl)	0	0	0	0	2	0	0	14	0
20/03/2023	Fire tower dam #1	3	1	1	1	11	0	2	26	1
20/03/2023	Fire tower dam #2	0	0	0	0	28	0	0	2	0
21/03/2023	Northern dam (dbl)	0	0	0	0	1	0	0	5	1
21/03/2023	Northern fire tower track	0	0	0	0	0	0	0	1	0
21/03/2023	Southern fire tower track (dbl)	0	0	0	0	2	0	0	2	1
21/03/2023	Fire tower dam #1 and #2	0	0	0	1	10	0	0	2	1
22/03/2023	Northern dam (dbl)	0	0	0	0	2	0	0	0	0
22/03/2023	Northern fire tower track	0	0	0	0	1	0	0	1	1
22/03/2023	Southern fire tower track (dbl)	0	0	1	0	0	0	0	1	0
22/03/2023	Fire tower dam #1	0	0	0	0	3	0	0	2	0
22/03/2023	Fire tower dam #2	0	0	0	0	7	0	0	0	0
No trapping – no spare tyre plus storms										
26/03/2023	Offset property Trap #1 (east)	0	0	0	0	0	0	0	0	0
26/03/2023	Offset property Trap #2 (mid)	0	0	0	0	1	0	0	2	2
26/03/2023	Offset property Trap #3 (west)	0	0	0	1	0	0	0	0	1
26/03/2023	Offset property south #1 (dbl)	1	0	0	0	0	0	0	1	0
26/03/2023	Offset property regrowth #1 and #2	0	0	0	0	1	0	0	1	0
27/03/2023	Offset property Trap #1 (east)	0	0	0	0	0	0	0	0	0
27/03/2023	Offset property Trap #2 (mid)	0	0	0	1	0	0	0	0	5
27/03/2023	Offset property Trap #3 (west)	0	0	0	0	2	0	0	1	0
27/03/2023	Offset property south #1 (dbl)	0	0	0	0	0	0	0	0	1
27/03/2023	Offset property regrowth #1	0	0	0	0	3	0	0	0	0
27/03/2023	Offset property regrowth #2	0	0	0	0	1	0	0	0	1
28/03/2023	Offset property Trap #1 (east)	0	0	0	0	1	0	0	1	0
28/03/2023	Offset property Trap #2 (mid)	0	0	0	1	1	0	0	1	1
28/03/2023	Offset property Trap #3 (west)	0	0	0	0	1	0	0	0	0

Date	Site	Cg	Cm	Cp	Nc	Nge	Ngo	Or	Ss	Vv
28/03/2023	Offset property south #1 (dbl)	0	0	0	0	1	0	0	0	0
28/03/2023	Offset property regrowth #1	0	0	1	0	3	0	0	0	0
28/03/2023	Offset property regrowth #2	0	0	0	0	4	0	0	0	0
29/03/2023	No trapping – storms and poor access									
30/03/2023	Offset property Trap #1 (east)	Not opened due to access issues from rain								
30/03/2023	Offset property Trap #2 (mid)	Not opened due to access issues from rain								
30/03/2023	Offset property Trap #3 (west)	Not opened due to access issues from rain								
30/03/2023	Offset property dam west	0	0	0	0	0	0	0	0	0
30/03/2023	Offset property dam east	1	0	1	0	3	0	0	1	4
30/03/2023	Offset property south #2 and #3	0	0	0	0	0	0	0	0	2
31/03/2023	Offset property Trap #1 (east)	0	0	0	0	0	0	0	0	0
31/03/2023	Offset property Trap #2 (mid)	0	0	1	0	0	0	0	1	1
31/03/2023	Offset property Trap #3 (west)	0	0	0	0	0	0	0	0	1
31/03/2023	Offset property dam west	0	0	0	0	3	0	0	0	1
31/03/2023	Offset property dam east	0	0	0	0	0	0	0	0	0
31/03/2023	Offset property south #2	0	0	0	0	0	0	0	0	0
31/03/2023	Offset property south #3	0	0	0	0	2	0	0	0	1
1/04/2023	Bringalily SF Trap Rd #1 (east)	0	0	0	0	0	0	0	0	2
1/04/2023	Bringalily SF Trap Rd #2 (central)	0	0	0	0	0	0	0	0	2
1/04/2023	Bringalily SF Trap Rd #3 (west)	0	0	0	0	0	0	0	0	0
1/04/2023	Fire tower dam #1 (dbl)	0	0	0	0	0	0	0	0	0
1/04/2023	Cattle Creek #1	0	0	1	0	0	0	0	0	0
1/04/2023	Cattle Creek #2	0	0	0	0	2	0	0	0	0
2/04/2023	Bringalily SF Trap Rd #1 (east)	0	1	0	0	0	0	0	0	1
2/04/2023	Bringalily SF Trap Rd #2 (central)	0	0	0	1	1	0	0	0	1
2/04/2023	Bringalily SF Trap Rd #3 (west)	0	0	0	1	0	0	0	1	0
2/04/2023	Fire tower dam #1 (dbl)	0	0	1	0	2	0	0	0	0
2/04/2023	Cattle Creek #1 and #2	0	0	1	0	1	0	0	0	0
3/04/2023	Bringalily SF Trap Rd #1 (east)	0	0	0	0	1	0	0	0	1
3/04/2023	Bringalily SF Trap Rd #2 (central)	0	0	1	0	0	0	0	1	0
3/04/2023	Bringalily SF Trap Rd #3 (west)	0	0	0	0	0	0	0	1	4
3/04/2023	Fire tower dam #1 (dbl)	0	0	1	0	2	0	0	0	0
3/04/2023	Cattle Creek #1 and #2	0	0	0	0	0	0	0	0	1

APPENDIX 2

Roost details and photos of tracked bats

APPENDIX 2 – ROOST DETAILS AND PHOTOS OF TRACKED BATS

Study Area	Vegetation Summary	Roost Tree Species				Height (m)	Roost Location	Microbat (tag)	Notes
		Species	Health	DBH (cm)	Height* (m)				
N2N	Callitris, Allocasuarina and eucalypt woodland; Fire evidence	<i>Callitris</i> spp.	Dead	19	7	4	Under buckled bark	Female (230-28)	Watched emerge at dusk to confirm tree
	Callitris, Allocasuarina and eucalypt woodland; Fire evidence	<i>Eucalyptus crebra</i>	Dead	26	8	3.5	Under buckled bark; visible	Female (230-09a)	
	Callitris, Allocasuarina and eucalypt woodland; Fire evidence	<i>Allocasuarina luehmannii</i>	Live	18	6	2.5	Hollow; visible	Female (230-09b)	Not natural diurnal roost; escaped to here from <i>E. crebra</i> roost on GPS retrieval, but likely a known roost
	Callitris, Allocasuarina and eucalypt woodland; Fire evidence	<i>Callitris</i> sp. (suspected)	Dead	22	16	Unknown	Unknown	Female (791-05)	Signal not clear on precise roost location but likely large dead Callitris
	Scorched <i>Eucalyptus crebra</i> woodland	<i>Eucalyptus crebra</i>	Dead	32	11	6	Under buckled bark	Female (445-06)	Detached GPS tag located under bark
	Scorched <i>Eucalyptus crebra</i> woodland	<i>Eucalyptus crebra</i>	Live	30	13	8	Under buckled bark	Male (437-06)	Location based on strongest signal
B2G	Callitris, Allocasuarina and Eucalyptus/Angophora woodland	<i>Eucalyptus chloroclada</i>	Partially dead	17 (roost in dead trunk)	8	3.75	Hollow	Male (165-04)	Detached tag found in hollow; initial tree stem was ringbarked, but mature resprouted stems also present
	Acacia dominated patch in Callitris, Allocasuarina and eucalypt woodland	<i>Acacia</i> sp. (likely <i>A. burrowii</i>)	Dead	3.5	6	2	Under buckled bark; visible	Male (472-22)	
	Angophora, Callitris and Acacia woodland	<i>Acacia</i> sp. (likely <i>A. burrowii</i>)	Dead	13	5	1.7	Under buckled bark; visible	Male (472-24)	

Study Area	Vegetation Summary	Roost Tree Species				Height (m)	Roost Location	Microbat (tag)	Notes
		Species	Health	DBH (cm)	Height* (m)				
	Brigalow/Wilga woodland; unburnt	<i>Acacia harpophylla</i>	Dead	16	11	6	Under buckled bark	Male (633a-22)	Location based on strongest signal
	Brigalow/Wilga woodland; unburnt	<i>Acacia harpophylla</i>	Dead	18	11	5	Under buckled bark	Male (633a-23)	Location based on strongest signal
	Brigalow/Wilga woodland; unburnt	<i>Acacia harpophylla</i>	Live, dead limbs	26	13	4	Under buckled bark	Male (633a-24)	Location based on strongest signal;
	Brigalow/Wilga woodland; unburnt	<i>Acacia harpophylla</i>	Dead	32	11	3.5	Under buckled bark	Male (633a-25)	Location based on strongest signal
	Allocasuarina, Callitris and eucalypt woodland	<i>Angophora leiocarpa</i>	Dead	9	9	4.75	Under bark plate; visible	Male (633b-04)	
	Eucalypt, Allocasuarina, Callitris and Acacia woodland	<i>Angophora leiocarpa</i>	Dead	12 (roost), 15	8	3	Under bark plate; visible	Female (847-22)	Observed roosting in this tree on 4 occasions
	Ironbark, Callitris woodland; unburnt	<i>Alphitonia excelsa</i>	Dead	18	5.5	3	Under bark; visible	Female (847-23)	
	Brigalow/Wilga woodland; unburnt	<i>Acacia harpophylla</i>	Dead	25	11	6	Under buckled bark	Male (913b-04)	Location based on strongest signal

*Dead trees were often snapped off/burnt and likely were taller when alive

N2N – Female, 230-28 (under bark, dead *Callitris* sp.)



N2N – Female, 230-09a (under bark, dead *Eucalyptus crebra*)



N2N – Female, 230-09b (trunk fissure, live *Allocasuarina luehmannii*)



N2N – Male, 437-06 (under bark, live *Eucalyptus crebra*)



N2N – Female, 445-06 (under bark, dead *Eucalyptus crebra*)



N2N – Female, 791-05 (precise location unknown, likely dead *Callitris* sp.)



B2G – Male, 165-04 (tag in trunk hollow, dead stem of live *Eucalyptus chloroclada*)



B2G – Male, 472-22 (under bark, *Acacia* sp. likely *burrowii*)



B2G – Male, 472-24 (under bark, *Acacia* sp. likely *burrowii*)



B2G – Male, 633a-22 (under bark, dead *Acacia harpophylla*)



B2G – Male, 633a-23 (suspected under bark, dead *Acacia harpophylla*)



B2G – Male, 633a-24 (suspected under bark, live *Acacia harpophylla*)



B2G – Male, 633a-25 (suspected under bark, dead *Acacia harpophylla*)



B2G – Male, 633b-04 (under bark, dead *Angophora leiocarpa*)



B2G – Female, 847-22 (under bark, dead *Angophora leiocarpa*)



B2G – Female, 847-23 (under bark, dead *Alphitonia excelsa*)



B2G – Male, 913b-04 (suspected under bark, dead *Acacia harpophylla*)



APPENDIX 3

Routes of GPS tracked bats

APPENDIX 3 – ROUTES OF TRACKED BATS

N2N (Figures 3.1)

- Fig. A3.1a - GPS tagged bat 230, with 10 nights of data at 2 hr GPS point intervals
- Fig. A3.1b - GPS tagged bat 445, with 1.5 nights of data at 2 hr GPS point intervals
- Fig. A3.1c - GPS tagged bat 791, with one night of data at 30-minute GPS point intervals

B2G (Figures 3.2)

- Fig. A3.2a - GPS tagged bat 071, with one night of data at 30-minute GPS point intervals
- Fig. A3.2b - GPS tagged bat 284, with two nights of data at 30-minute GPS point intervals
- Fig. A3.2c – Radiotagged bats data points

Note, foraging routes with a solid line depict consecutive GPS data points, while dashed lines are the route between two points where an intermediate point or points are missing due to invalid geometry (i.e., not enough satellites were picked up at the time programmed to take a GPS point).

Numbers are provided to assist in understanding the chronological order of tracking, with each bat's route beginning at a 'Start', then 1, 2, etc., until the bat finds a roost at daybreak. Bats with more than one night of data, will have numbers 11, then 12, etc., for the second night, and the third night with 21, 22, etc. When a GPS tag was found on the ground or removed from the bat, the coordinate is labelled with 'End'.

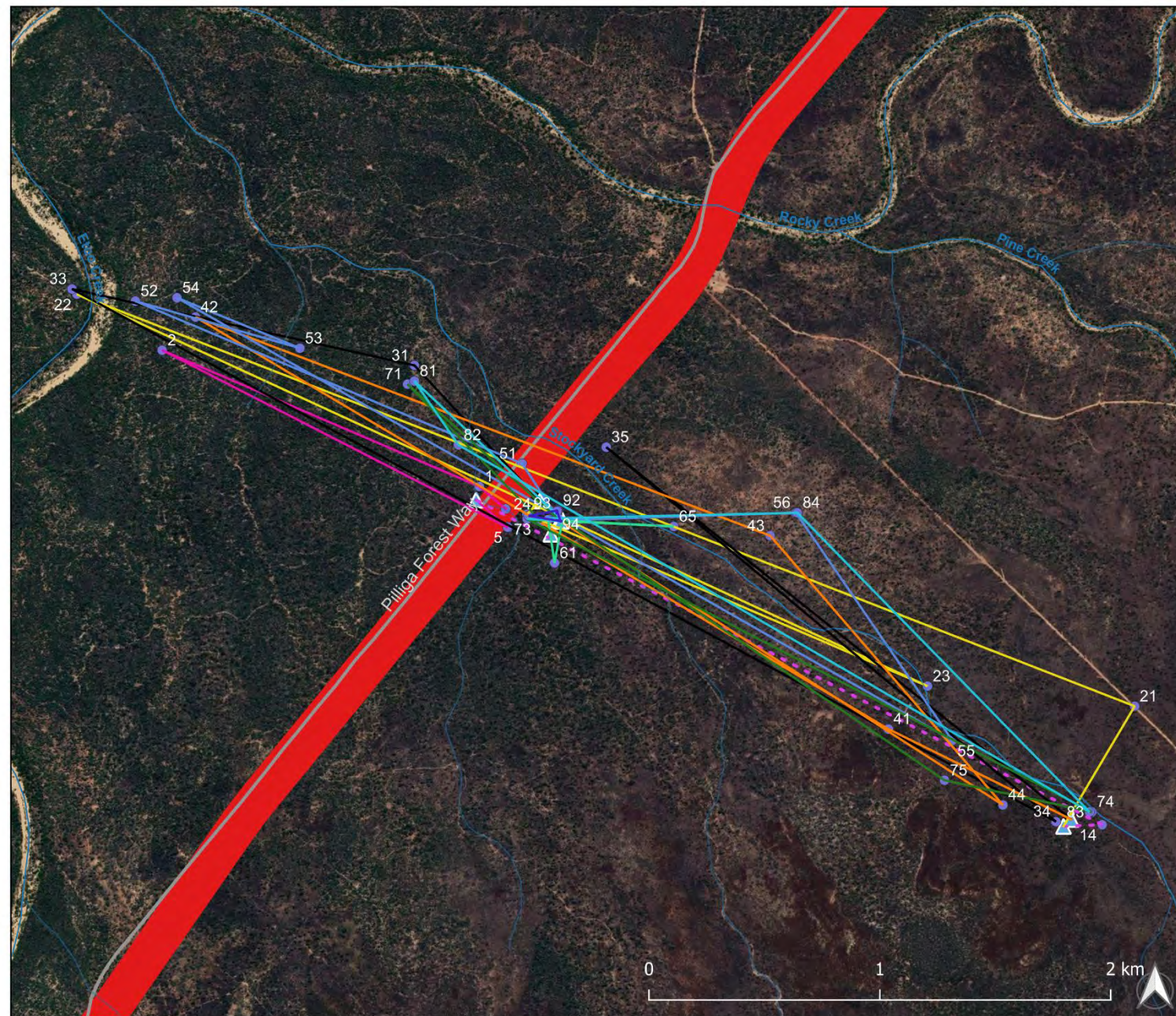


Figure: A3.1a

Title: GPS tagged bat 230 -
10 nights 2 hr data

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 13/06/2023

LEGEND

— Watercourses

— Key roads

▲ Roost

● GPS point

Foraging Routes

— Night 1

— Night 2

— Night 3

— Night 4

— Night 5

— Night 6

— Night 7

— Night 8

— Night 9

— Night 10

ARTC Data

■ N2N alignment

(c) BAAM Ecology
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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: A3.1b

Title: GPS tagged bat 445 -
2 nights patchy 2 hr data

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 13/06/2023

LEGEND

— Watercourses

— Key roads

▲ Roost

● GPS points

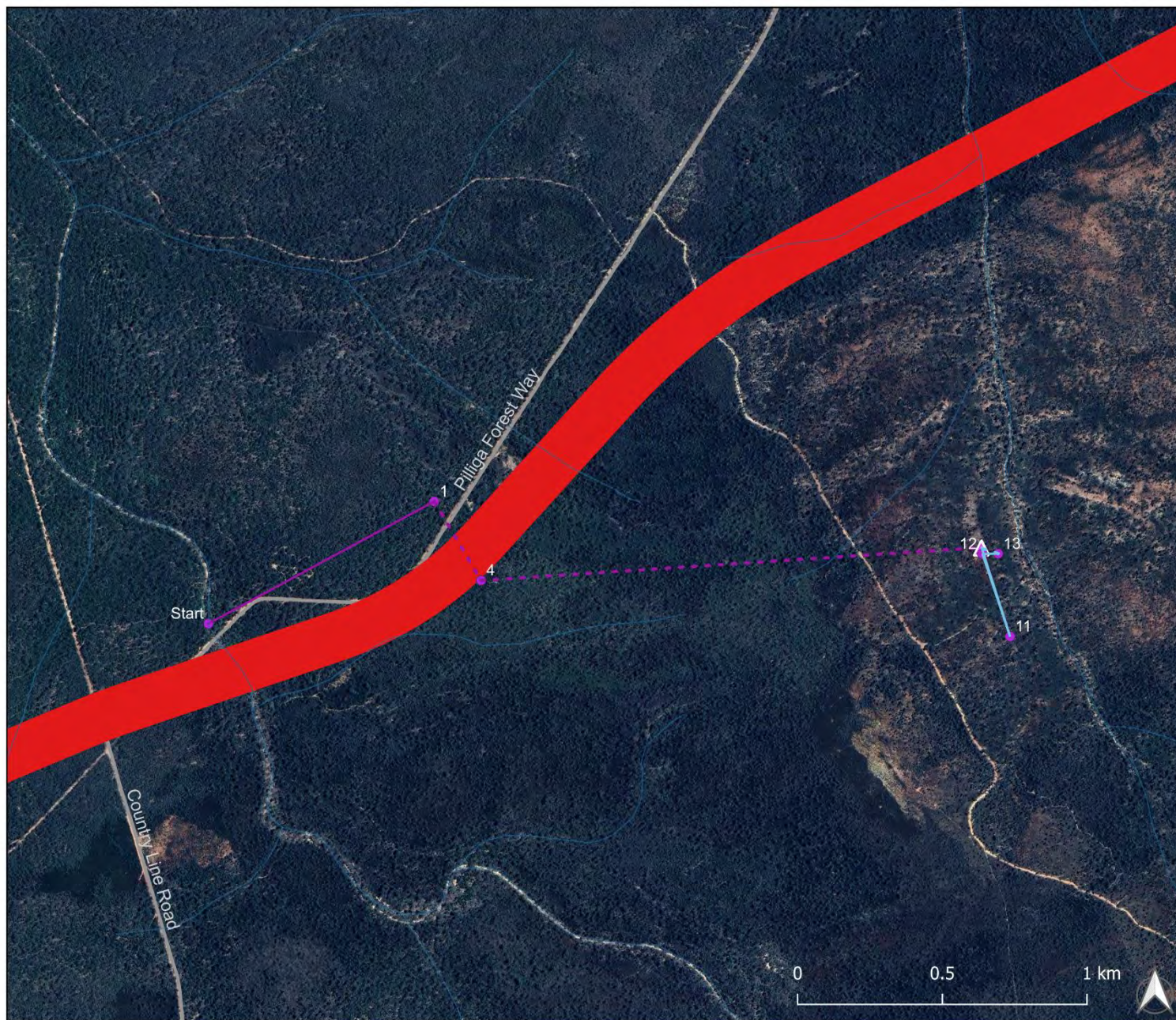
Foraging Routes

— Night 1

— Night 2

ARTC Data

■ N2N alignment



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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: A3.1c

Title: GPS tagged bat 791 -
1 night 30 min data

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

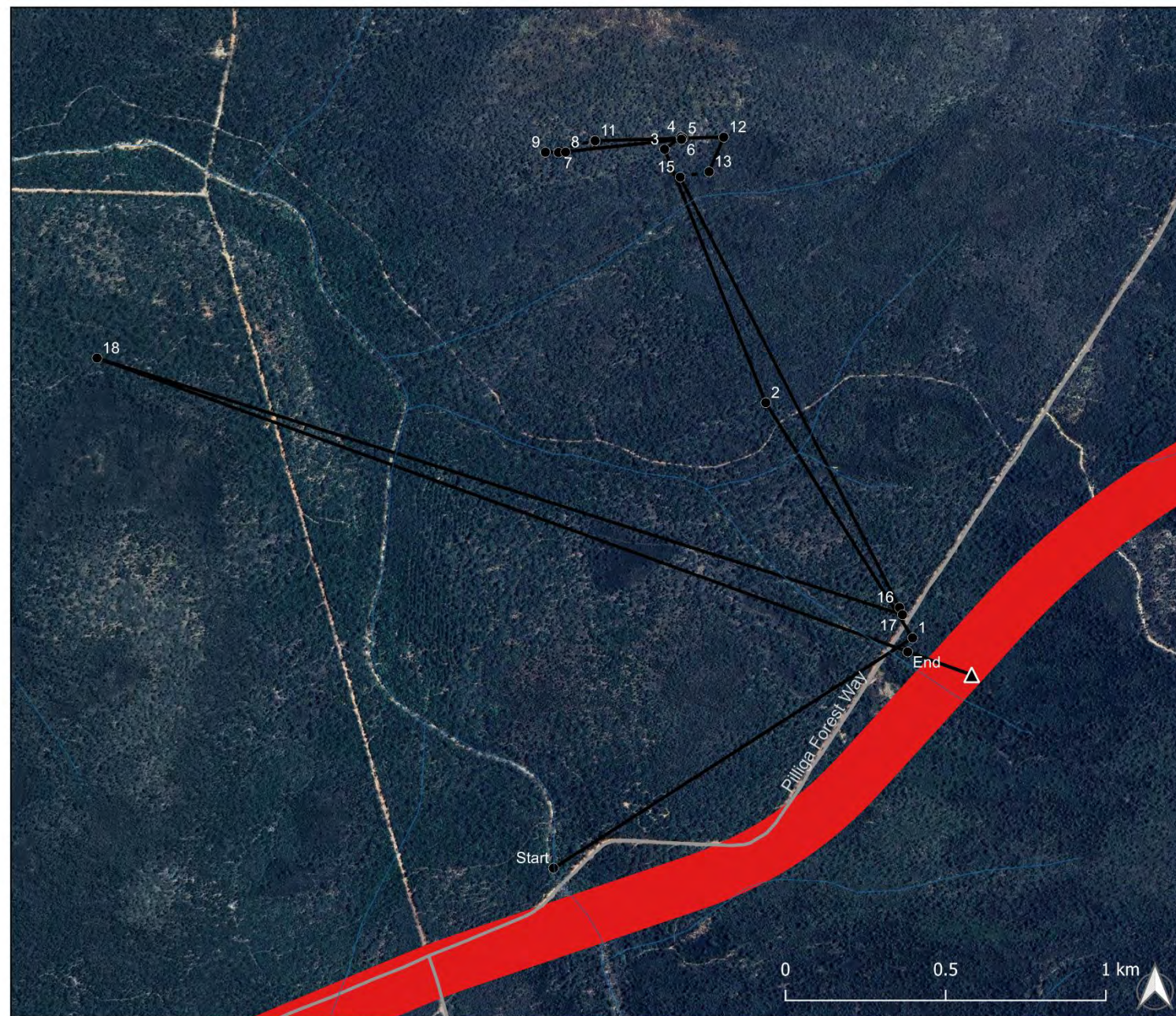
Drawn: EW 13/06/2023

LEGEND

- Key roads
- Watercourses
- ▲ Roost
- GPS point
- Foraging route

ARTC Data

- N2N alignment



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Data sources: ARTC Inland Rail alignment April 2023; NSW Gov DCS Road Segment Data; NSW Gov DFS Named Watercourses; NSW Gov Dedicated State Forests / Forestry Corp NSW; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: A3.2a

Title: GPS tagged bat 071 -
1 night GPS data only

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 120/06/2023

LEGEND

Watercourses

Key roads

GPS data points

071

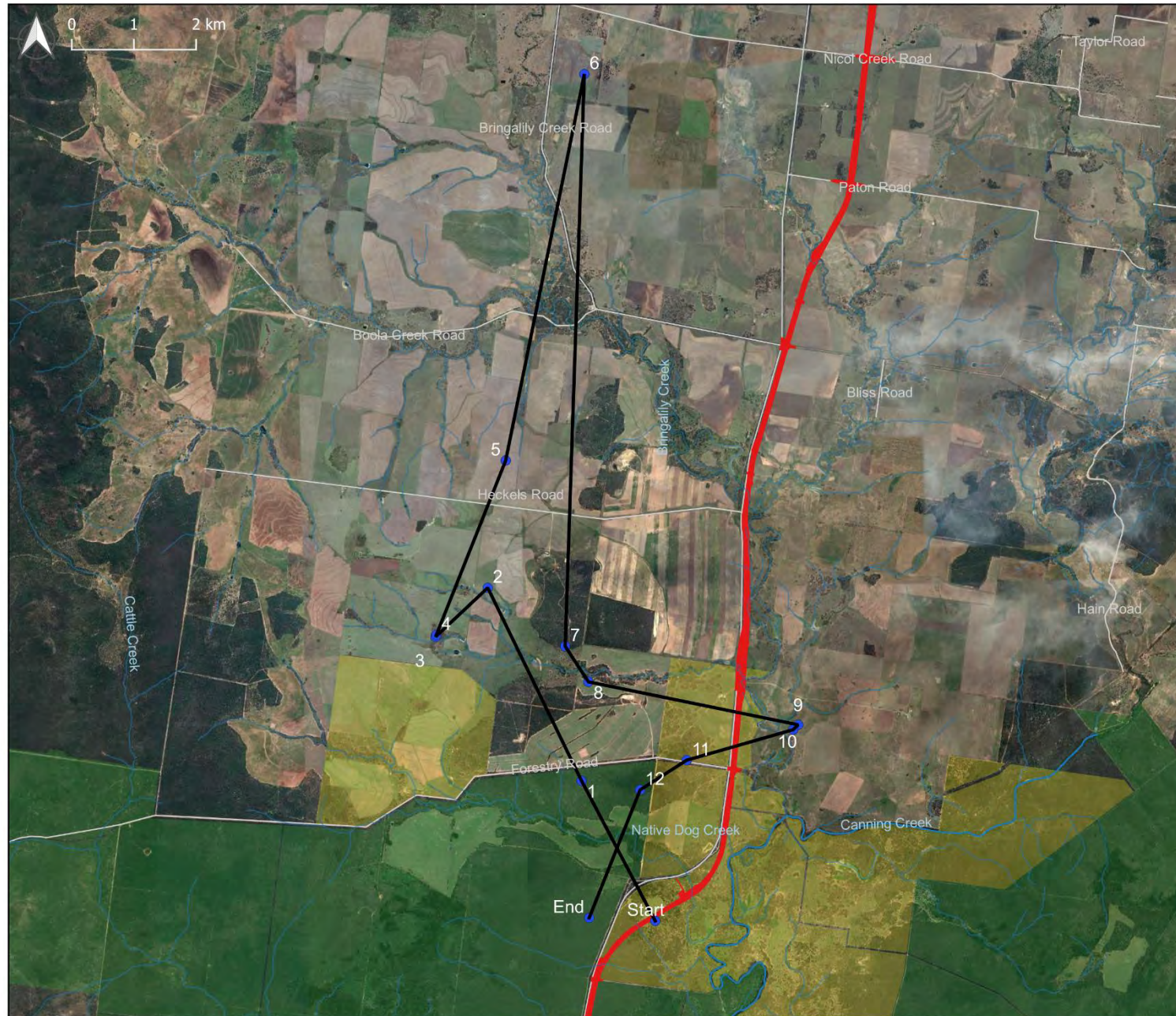
ARTC Data

Inland Rail footprint

Canning Creek property

Protected Areas

Bringalily State Forest



(c) BAAM Ecology
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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

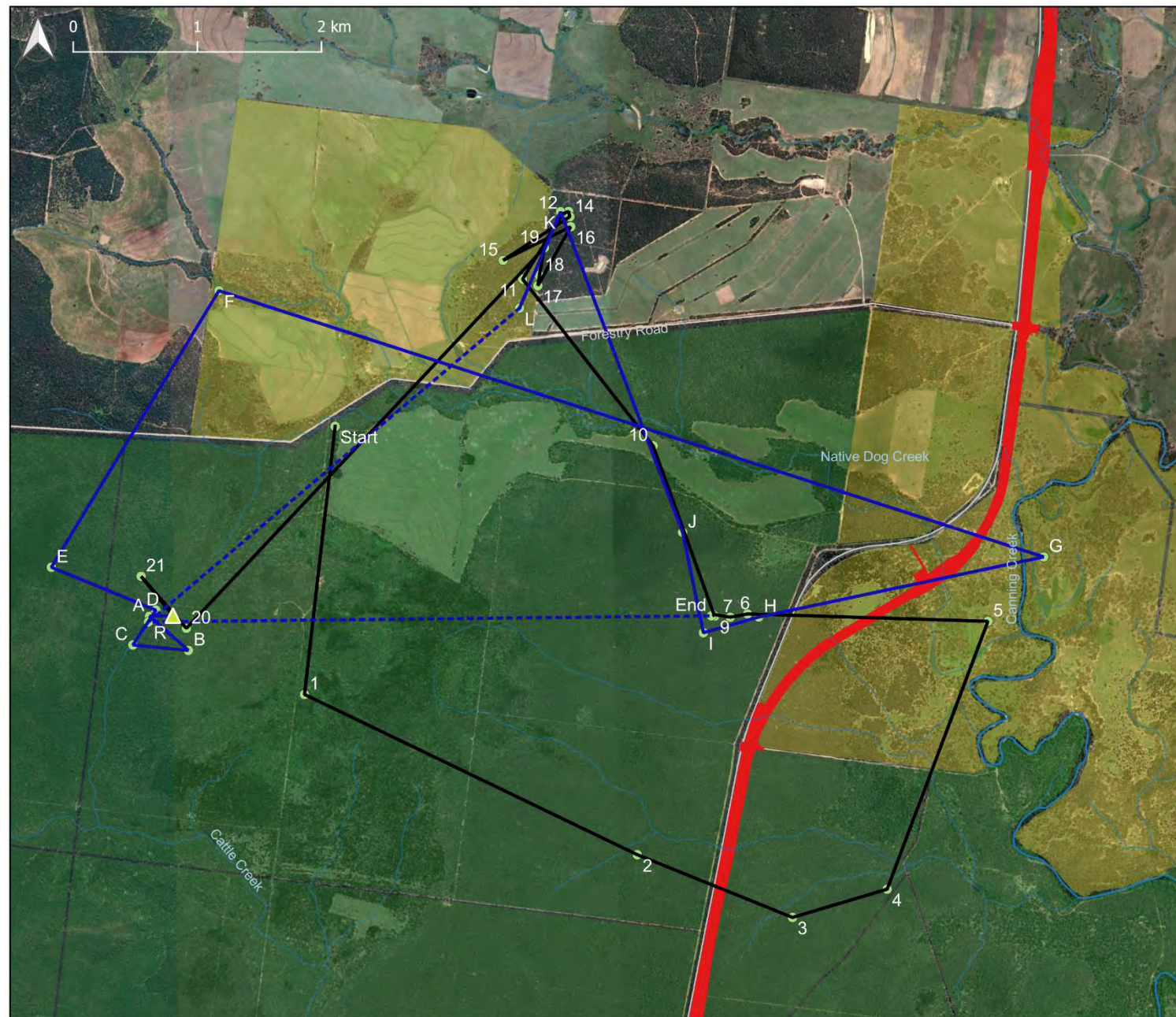


Figure: A3.2b

Title: GPS tagged bat 284 -
2 nights GPS data

Project: Microbat Surveys and
Research, Inland Rail

Client: ARTC

Drawn: EW 12/06/2023

LEGEND

Watercourses

Key roads

284 GPS foraging points

284 Roosts

Foraging routes

Night 1 foraging

Night 2 foraging

Night 2 foraging - incomplete

ARTC Data

Inland Rail footprint

Canning Creek property

Protected Areas

Bringalily State Forest

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incomplete in any way and for any reason.



Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56

Figure: A3.2c

Title: B2G Radiotagged bat data points

Project: Microbat Surveys and Research, Inland Rail

Client: ARTC

Drawn: EW 12/06/2023

LEGEND

Watercourses	
Key roads	
Release point	
Roosts	
Tags removed	
Incomplete route	

Tagged bats

165	
427	
633a	
633b	
845	
913a	
913b	

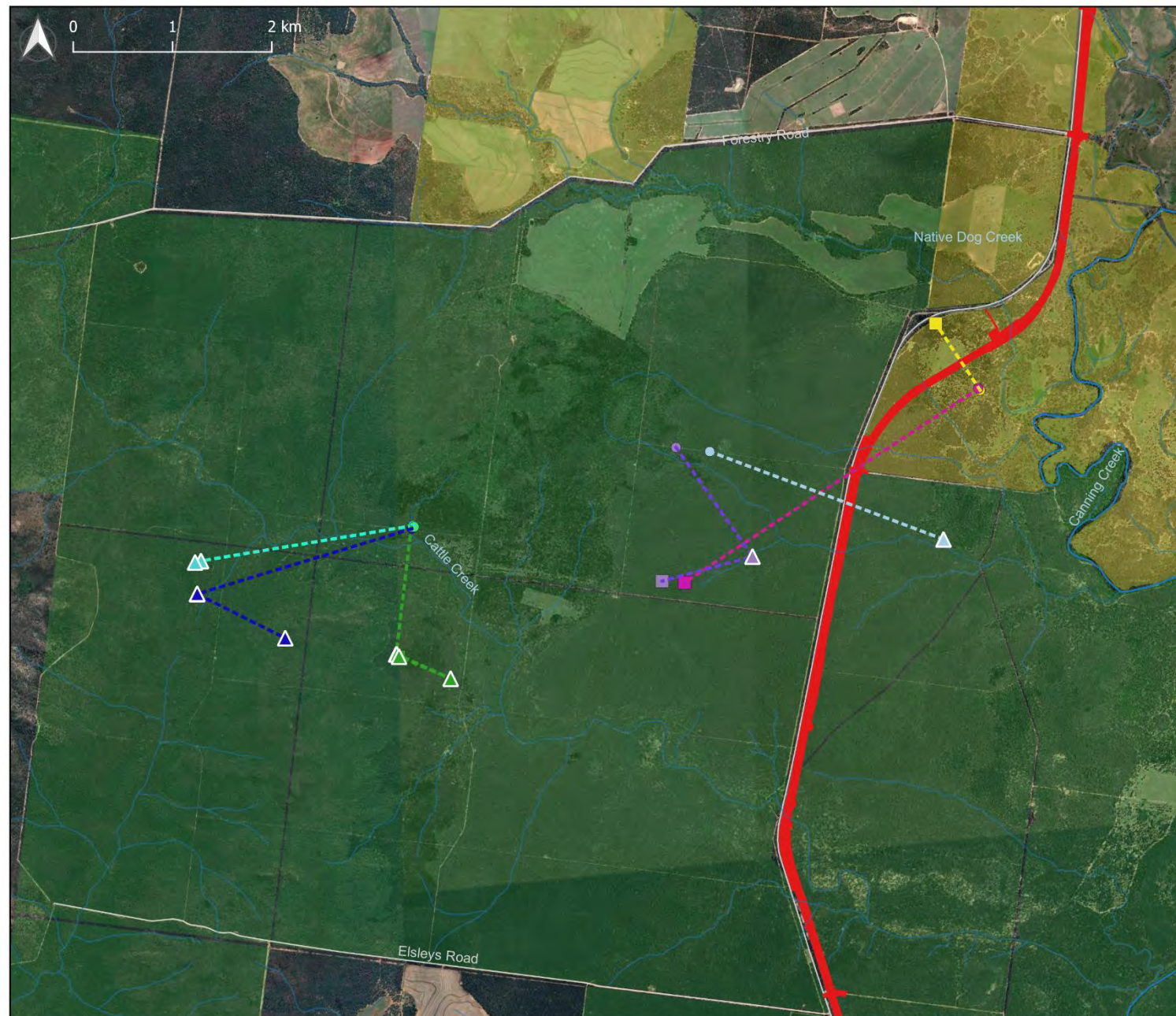
ARTC Data

Inland Rail footprint	
Canning Creek property	

Protected Areas

Bringalily State Forest	
-------------------------	---

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Data sources: ARTC Inland Rail alignment and offset property April 2023; Qld Gov Populated Places; Qld Gov Watercourse Lines; Qld Gov Protected Areas; Qld Gov Roads and Tracks; ; WMS Ausmaps / Google; Coordinate System: GDA2020 Zone 56



Koala Genetics Study Project

Inland Rail Program

12 March 2024

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Signature Page

12 March 2024

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Acronyms and Abbreviations

Name	Description
AEP	Annual Exceedance Probability
ALA	Atlas of Living Australia
ARTC	Australian Rail Track Corporation
N2N	Narromine to Narrabri
N2NS	Narrabri to North Star
NS2B	North Star to Border
B2G	Border to Gowrie
ELA	Eco Logical Australia
G2H	Gowrie to Helidon
H2C	Helidon to Calvert
C2K	Calvert to Kagaru
K2AB	Kagaru to Acacia Ridge/Bromelton
DAWE	Department of Agriculture, Water and Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water (formerly Department of Agriculture, Water and Environment)
DES	Department of Environment and Science
DOEMP	Draft Outline Environmental Management Plan
DTMR	Department of Transport and Main Roads
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
FFJV	Future Freight Joint Venture
GHD	GHD Group Pty Ltd
IRP	Inland Rail Program
KMP	Koala Management Plan
MNES	Matters of National Significance
OCG	Office of the Coordinator-General
RFI	Request for Information
SAT	Spot Assessment Technique
SEQ	Southeast Queensland
ul	micro litre
UniSC	University of Sunshine Coast
WSP	Williams Sale Partnership

EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Australian Rail Track Corporation (ARTC) to conduct studies into koala genetics, habitat, occurrence, and utilisation across sections of the Inland Rail Program (IRP) from Narromine to Acacia Ridge/Bromelton (note: Kagaru to Acacia Ridge/Bromelton section (K2ARB) is no longer a part of the IRP) (the project area). The study was conducted along these sections of the IRP as per the scope outlined by ARTC. A collaboration has been undertaken with the University of the Sunshine Coast (UniSC) Detection Dogs for Conservation (DDC) Team to obtain genetic information from koalas across the project area. This report presents the findings and recommendations of this collaborative study project to support koala management throughout the design, construction, and operation of the IRP.

The project area for this study included properties with existing land access agreements (LAA) in place with ARTC and other publicly accessible land (road reserves, state forests and travelling stock reserves) within the IRP alignment and is situated across central-north New South Wales (NSW), from the township of Narromine north to the border, and south-east Queensland, from the border north to Toowoomba and then east to the Brisbane suburbs of Acacia Ridge and Bromelton. The final section of the rail from Kagaru to Acacia Ridge and Bromelton (K2ARB) has since been removed from the IRP, however, remains included in this study in order to provide a more robust analysis of koala genetics. The IRP involves the construction of 500km of new tracks in northern New South Wales and south-east Queensland and the upgrade of existing tracks along an additional 1600km throughout the existing inter-state line.

The IRP was separated into 13 sections at the time of the study (now reduced to 12 in response to IR review), being delivered through the planning and approvals stages as distinct projects. The genetics study focuses on eight (8) sections between the town of Narromine and Brisbane and here after these eight sections will be referred to as the IRP for the purpose of this report. Land use histories vary considerably across the eight sections of the IRP with extensive clearing for agriculture present, particularly west of the Great Dividing Range, while large areas of state forests also remain. The IRP also extends through heavily urbanised areas including the regional cities and townships of Toowoomba, Narrabri, Moree and Narromine. ARTC has identified the need to provide appropriate identification, assessment, and management of key environmental issues associated with the IRP. One such environmental issue is the presence of koalas and key areas of habitat and connectivity within the IRP and the need for innovative approaches for baseline assessment and ongoing monitoring. This forms the rationale for undertaking this koala genetic study, focusing on understanding koala occurrence and habitats, and important connectivity across the landscape, to assist in identifying key opportunities for koala management at the local and landscape scale.

Using desktop reviews and learnings from previous surveys throughout the IRP, key threats have been identified to koala populations within the IRP. These include:

- Habitat loss and degradation (including habitat fragmentation, edge effects and barrier effects);
- Injury or mortality from vehicle strike;
- Injury or mortality from train strike;
- Injury or mortality from predators, including domestic dogs, foxes and dingoes;
- Prevalence of disease (as well as increased susceptibility); and
- Extreme weather events (drought, flood, heat stress).

To more effectively identify important areas of koala habitat within the IRP, hotspots of potential koala activity were established using a combination of existing koala presence data, sourced from the Atlas of Living Australia, community groups and previous IRP surveys, and mapped areas of known koala habitat. Field verification of koala hotspots was undertaken by a range of specialists for ARTC.

Koala detection dogs provide reliable, efficient, and accurate methods for surveying large areas of the alignment. Survey locations for this study were informed by pre-fieldwork 'hotspots' of known koala activity to maximise detection of fresh koala scats.

A total of 120 detection dog surveys were undertaken throughout the IRP at 118 locations. Of these, fresh scats and individual koalas were found at forty-one (41) sites with detections made in northern NSW and southeast Queensland. Across these sites, seventy-three (73) fresh koala scats were detected and thirty-six (36) unique individuals identified. Samples were separated into two distinct groups: coastal (those samples located east of the Great Dividing Range - Toowoomba) and inland (those samples located west of the Great Dividing Range). Twenty samples were categorised as coastal while the remaining 13 as inland.

The most common habitat type that was sampled in the study area consisted of poor to moderate quality eucalypt open forest and woodland dominated by *Eucalyptus camaldulensis* and/or *E. tereticornis* with a mixture of other notable canopy species were identified but with less consistency across sites. Other prominent habitat types were dominated by *Allocasuarina luehmanni*, *Casuarina cunninghami*, *Casuarina cristata* and *Callitris glaucophylla*. Based on a review of koala habitat assessment criteria and methods undertaken by the Australian National University (2021), many of the dominant species identified throughout the IRP are also identified as locally important koala trees within the koala management bioregions relevant to the various stages of the IRP. Important ancillary habitat trees were also present. The type of habitats that surveys were completed in were consistent with DCCEEW (previously known as DAWE) classifications of koala habitat (forests or woodlands, higher proportion of feed trees, remnant or non-remnant vegetation, and roadside or railway vegetation) (DAWE, 2022). In low koala density areas, obtaining adequate samples for analysis can be challenging. For this study, noting the limited access to land parcels for sampling, comparisons have been made with other genetic data from other studies across Queensland and New South Wales, using data held in UniSC databases. Some samples were pooled with IRP samples to form three groups along the Inland Rail alignment, while other groups were included to help contextualise the population status along the IRP alignment.

Overall, the three groups from which samples were collected in this study, compared to other groups in the larger landscape had:

- High levels of heterozygosity: Higher levels of heterozygosity equate to larger genetic diversity within a population(s), which is positive as genetic diversity is linked to both individual health and at population level, evolutionary potential; with Group 3 (B2G + G2H) higher than the other groups;
- Low levels of inbreeding and of relatedness between individuals: this suggests gene flow is currently occurring within the groups and the potential for negative impacts due to excessive inbreeding is minimal;
- Relatively small population size, with Group 3 (B2G + G2H) having a larger population size relative to other groups. This results in overall lower densities of koalas across the landscape;
- No concerns regarding sex ratio, but high chlamydia prevalence, except Group 3 which is medium prevalence (however the sample size remain very low). The ratio of males to females is not of concern for genetic health although chlamydia prevalence is high. Caution should be taken when interpreting these findings as the sample size is small; and
- Diet analysis results indicate that the diet of koalas varies between individuals and varies alongside geographic location. With a key consistency being that tree species with a higher relative abundance within a geographic location was reflected in the results of scat collected within that geographic location.

There appears to be reasonable connectedness of koala populations within the landscape, and so it is imperative that ongoing design and management measures support the ability for koalas to traverse the landscape through the maintenance of habitat connectivity. Although scat detections throughout the IRP were made across broad geographic areas with notable gaps in sample locations, further investigation of koala genetics at a broader landscape scale will be beneficial for overcoming these limitations. This approach will also enable a greater understanding of koala genetics at a broader scale and inform effective koala management and impact mitigation measures within the IRP.

1. INTRODUCTION AND PURPOSE

1.1 Background

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Australian Rail Track Corporation (ARTC) to conduct a study into koala occurrence and genetics for the Inland Rail Program (IRP) to better manage this species during delivery of the IRP. In doing so, a collaboration has been undertaken with the University of the Sunshine Coast (UniSC) Detection Dogs for Conservation (DDC) Team to obtain genetic information from these koala populations across the IRP.

This Report provides a description of survey effort and discussion of results from the field survey effort, including the results of the genetic analysis of sampled scats and a summary of habitats sampled. The results of the field surveys have been assessed to identify areas of koala hotspots and locations where the IRP traverses landscapes where connectivity for koala should be focused to maintained connectivity for the species.

1.2 Objectives

This study aims to provide an understanding of, and contribute new knowledge to, the current status of inland koala populations. Doing so will provide valuable contributions to scientific knowledge while also aligning with the objectives of state and federal koala recovery plans to identify priority areas for threat reduction, opportunities for collaborative studying and identifying priority areas of koala habitat for protection and restoration. Following previous field assessments throughout the IRP, this study aims to extend what is currently known about koalas in the project area and results will contribute to the design and application of koala management strategies that are tailored to the local regions of the IRP. To achieve this, two primary objectives have been identified to guide study efforts:

- Provide an assessment of koala genetics for populations present along the IRP alignment, identifying genetic diversity, gene flow and population structure along the alignment; and
- Identify health characteristics such as the presence of disease, particularly Chlamydia (*Chlamydia pecorum*), in populations of koala along the IRP alignment. Although the prevalence of koala retrovirus is also an important population characteristic that informs conservation management, sampling for koala retrovirus was deemed to be beyond the scope of this genetics research as sampling fresh scat material for koala retrovirus was not thought to have provided robust and meaningful results that could positively inform koala management within the IRP.

1.3 Ecology and Existing Knowledge of the Koala

The koala, *Phascolarctos cinereus*, is a tree dwelling marsupial and is known as one of Australia's most iconic and recognisable animals. Identifiable by their stocky bodies, residual tails, and muscular limbs with sharp climbing claw, koalas will typically weigh between 4 and 15 kilograms, with males weighing up to 50% more than females (Nowak, 2005). Body weight is known to fluctuate throughout their range, with individuals in more southern extents typically weighing up to twice that of those in the north (DCCEEW 2022).

Populations are distributed across eastern and southern mainland Australia, particularly in forests on more fertile soils or with easily accessible water sources. Predominantly solitary, koalas will maintain home ranges of highly variable sizes depending on the quality of habitat available. Known estimates range from 135 ha (Ellis et al. 2002), to as little as 1 ha (Davies, et al., 2013). In the agricultural landscapes of SEQ, home ranges are known to vary between 5.3 ha and 91.4 ha (Davies, et al., 2013). Although generally considered sedentary, males are known to disperse over longer distances than females (DES 2022).

Koalas occupy a range of forest and woodland habitats however their presence is dependent on the availability of appropriate food trees. Koalas possess a highly specialised diet with only a small number of species proving appropriate food resources. These trees belong almost exclusively to the genus *Eucalyptus*, however some *Corymbia*, *Angophora* and *Lophostemon* species are also known (Youngentob, Marsh, & Skewes, 2021). While not important as food resources, ancillary tree species provide important structural habitat features that are used for thermoregulation, resting, movement and protection (Youngentob, Marsh, & Skewes, 2021). Due to the low caloric content of their diet, koalas will typically rest up to 22 hours a day (Johnson 2018), with the majority of activity being crepuscular or nocturnal. The toxicity found in eucalypt leaves is not palatable to most herbivores and so koalas maintain little to no competition for food resources (Johnson 2018).

Koalas are capable of breeding annually when conditions are favourable but is heavily influenced by seasonality, population density, food quality and availability, and climate. Reproduction will fail or not occur when conditions are unsuitable or when individuals exhibit poor physical condition (DCCEEW 2022). Like most marsupials, gestation is relatively short in koalas at approximately 30 – 36 days. Joeys are dependent on their mothers for the first 12 months of life and will remain with them until sexual maturity at 2 years old. The life expectancy for a koala is between 13 and 18 years although males may have a slightly lower survival rate than females (DCCEEW 2022).

1.3.1 Key Threatening Processes

The Southeast Queensland bioregion supports some of the largest populations of koalas in the state and habitat identified as important koala habitat extends over 6 million hectares (ha) (Fowler, Houlden, Hoebe, & Timms, 2001). On a similar note, the Northern Tablelands Koala Management Area (KMA 4) and NSW North-Coast Koala Management Area (KMA 1) are additionally important areas for koala populations. These areas contain small koala populations that are fragmented throughout, however still provide important habitat for the species. The importance of habitat is acknowledged by the Southeast Queensland Koala Conservation Strategy 2020-2025 (DES 2020), which outlined the top two actions as Habitat Protection and Habitat Restoration, followed by threat management, improved mapping, monitoring, studying and reporting, community engagement, and partnerships and strategic co-ordination. The Conservation Advice for the koala combined populations of Queensland, New South Wales and the Australian Capital Territory (12 February 2022), references a study by Adams-Hosking et al. in 2016 reflecting that the population in the Southeast Queensland region to be 15,821. This study provides an estimation of a 53% decline over three preceding generations (15-21 years).

A number of key threats to koala populations within the proposed IRP are present and have the potential to be exacerbated by its development and operation. These are:

- Habitat loss and degradation (including habitat fragmentation, edge effects and barrier effects);
- Injury or mortality from vehicle strike;
- Injury or mortality from train strike;
- Injury or mortality from predators, including domestic dogs, foxes, and dingoes;
- Prevalence of disease (as well as increased susceptibility); and
- Extreme weather events (drought, flood, heat stress).

Stressors to the environment, including heatwaves, droughts, bushfires, and floods are known to cause high mortality in koalas, as well as this, post extreme event recovery can be impaired by other threatening processes (DCCEEW 2022). The 2019-2020 “Black Summer” bushfires effected koala populations from south-east Queensland down to eastern Victoria. Literature estimates that the catastrophic event had immense impacts to koala populations along the east coast of Australia (Dunstan et al., 2021, Cristescu et al., 2021, Phillips et al., 2021).

Although the black summer fires had devastating effects to koala populations, recent studies have shown in some areas within three months of the fire event koalas are able to live wholly within a burnt habitat, being able to disperse through a previously burnt area that was severely impacted from fire (Matthews et al., 2007, M. Lane and K. Marsh). This information was recorded from GPS trackers and observations of fresh scat in burnt habitat. Overall, scientific literature suggest that scale and severity of fire has a large influence of the effects to both koala individuals / populations and their respective habitat, however, even high severity fire does not necessarily render a landscape as unusable habitat to a koala (Law et al., 2022b).

Koala populations have experienced significant declines in recent decades following wide scale deforestation and habitat fragmentation. (Seabrook, McAlpine, Phinn, Callaghan, & Mitchell, 2003). Agriculture, mining and urbanisation are significant drivers of this change in land use and in the Southeast Queensland bioregion large areas of remnant forests have been removed since 2000 (de Oliveira, Murray, de Villiers, & Baxter, 2014). Within the area covered by the IRP, historic land clearing, largely for agricultural purposes has been undertaken. Within the IRP, the vegetation quality varies considerably between remnant forests to low-lying cleared flood plains.

Vehicle related mortality and domestic and wild dog attacks pose significant impact to koala populations (de Oliveira, Murray, de Villiers, & Baxter, 2014). Mortality from these occurrences typically remove healthy breeding individuals, posing a threat to juvenile koala dispersal post-weaning (occurring in both males and females). Mature males are at higher risk due to larger home ranges and increased activity during the breeding season, with males typically dispersing more frequently and over larger distances than females. Although males have a higher risk of mortality and will disperse more frequently, losses of any individual to this trauma have the potential to negatively affect or even disrupt gene flow (DCCEEW 2022).

Disease can be a major contributor to population decline and population viability, with wild populations carrying disease pathogens (DCCEEW 2022). Quigley and Timms (2020) identifies the two major pathogens affecting koalas as *Chlamydia pecorum*, leading to chlamydial disease and koala retrovirus (KoRV). The significant impact of disease, particularly from Chlamydia and KoRV, is routinely highlighted in koala literature (Grogan, et al., 2017; McCallum, Kerlin, Ellis, & Carrick, 2017; Polkinghorne, Hanger, & Timms, 2013) therefore presenting a need to include it as a threat that needs to be mitigated for the IRP. Narayan (2019) reflects on the presence of population instability in the face of human-induced environmental changes, which may lead to reduced genetic variability of wild koalas and increases in population vulnerability to diseases. While it is not known to what extent these diseases currently impact the koala population within the IRP, it can be assumed that the risks associated with disease transmission remain high for the population.

1.4 Assessing Koala Genetics to Inform Management

Current understanding of koala abundance at local scales is limited across their distribution and the differentiation of distinct populations of koalas is difficult due to limited genetic data. A lack of consistent monitoring methodologies has also led to a high level of uncertainty at a bioregional scale that limits opportunities to implement effective management strategies (Adams-Hoskins, et al., 2016). Understanding population genetics at the local scale provides valuable insight into population health, patterns of dispersal and gene flow, and population stability in the face of current and future threatening processes. While it is beyond the scope of this study to identify distinct populations of koalas along the IRP alignment, this study will provide a locally specific investigation of genetic diversity that is important for informing future management for koalas along the IRP.

2. PROJECT AREA DESCRIPTION

The IRP will provide a service for the interstate freight market that is reliable and competitive in price and availability relative to road transport. The Australian Government has engaged ARTC to deliver the 1600 km long IRP through enhancements and upgrades of the existing inter-state line, and 500 km of new track in northern New South Wales and south-east Queensland.

The focus of this Report is on the sections of IRP from Narromine, New South Wales to Acacia Ridge/Bromelton, Queensland. This portion of the IRP is broken up into eight sections: Narromine to Narrabri, Narrabri to North Star, North Star to Border, Border to Gowrie, Gowrie to Helidon, Helidon to Calvert, Calvert to Kagaru, Kagaru to Acacia Ridge and Bromelton. Each of these sections of the IRP crosses varying landscape and as such can be elaborated on below and shown in Figure 2-1.

2.1 QLD Inland Rail Project Sections

Kagaru to Acacia Ridge and Bromelton (K2ARB)

The K2ARB was the last section of the IRP, however the planned 49 kilometres of existing track upgrades through Kagaru to Acacia Ridge and Bromelton is no longer a part of the IRP. The former K2ARB section of the IRP is still able to provide meaningful insights into koala genetics and critical habitat and so data collected from this section has been included in this koala genetics study. It is the section of the previous IRP most urbanised with pockets of vegetation consisting of nature/wildlife refuges, and road parcels having wildlife crossings or bridges to uphold connectivity for koala activity. To note it is in proximity to the Greenbank Military Reserve.

Calvert to Kagaru (C2K)

Calvert to Kagaru covers 53-kilometres of the IRP and it possesses more koala hotspots across the Teviot Range, Peak Crossing and Ebenezer localities. Outside of these biodiversity corridors the IRP passes through more highly fragmented agricultural land, dominated by pasture grasses with isolated trees or woody regrowth.

Calvert to Kagaru (C2K)

Calvert to Kagaru covers 53-kilometres of the IRP and it possesses more koala hotspots across the Teviot Range, Peak Crossing and Ebenezer localities. Outside of these biodiversity corridors the IRP passes through more highly fragmented agricultural land, dominated by pasture grasses with isolated trees or woody regrowth.

Gowrie to Helidon (G2H)

Gowrie to Helidon is the shortest section of the IRP being of 28 kilometres long yet holds significance to the IRP, being intersected by the Toowoomba Range, a known koala hotspot and biodiversity corridor. Outside of this mountain range native viable habitat is highly fragmented and compromised by grazing lands.

Border to Gowrie (B2G)

Border to Gowrie, a 217-kilometre section (including 9 km of North Star to Border (NS2B)) of the IRP moving through South-East Queensland and reflecting a continuation of the detriment of agricultural practises and urbanised land, with extensive grazing areas intersected by State Forests. Riparian zones, notably the Condamine River, are of high value for koala activity.

2.2 NSW Inland Rail Project Sections

North Star to Border (NS2B)

North Star to Border, a 39-kilometre stretch (30 km in NSW and 9 km in QLD) reaching the border of NSW and Queensland. This section of the IRP also is suffering the harsh effects from land modified for agricultural practises with large tracts of remnant vegetation rare and most native vegetation in isolated woodland re-growth pockets and in a degraded state. Koala activity is linked to riparian habitat of drainage lines and on the banks of the Macintyre River.

Narrabri to North Star (N2NS) (Phase 2)

Narrabri to North Star section is 187 kilometre long, however, this study is only concerned with Phase 2 upgrading 13-kilometres of existing railway between Moree and Camurra, then building upon 2-kilometres of new track across the Mehi-Gwydir floodplain. The rail corridor and surrounding area has been heavily affected by agricultural activities with 'patches' of native woodland vegetation existing sporadically. Koala sightings have especially been associated with riparian corridors including the Mehi River and Gwydir River, Traveling Stock Reserves (TSRs) and isolated road parcel trees.

Narromine to Narrabri (N2N)

Narromine to Narrabri is a 306 km stretch of the IRP in Northern NSW. Much of this portion of the IRP is fragmented woodland habitat altered for agricultural purposes like running livestock or growing crops. The most northern section is dominated with state forests of The Pilliga, with historic records indicating koala presence by Etoo Creek.



Legend

Inland Rail Alignment

B2G - NSW/QLD Border to Gowrie

C2K - Calvert to Kagaru

G2H - Gowrie to Helidon

H2C - Helidon to Calvert

K2AB - Kagaru to Acacia Ridge/Bromelton

N2N - Narramine to Narrabri

N2NS - Narrabri to North Star

NS2B - North Star to Border

LGA Boundary

Data Source:

ESRI World Topographic Map

ARTC Koala Genetics Study IRP Area

Drawing No: 0628339_N2AB_TM_G001_R2.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

0102030Km

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

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3. SURVEY LOCATIONS

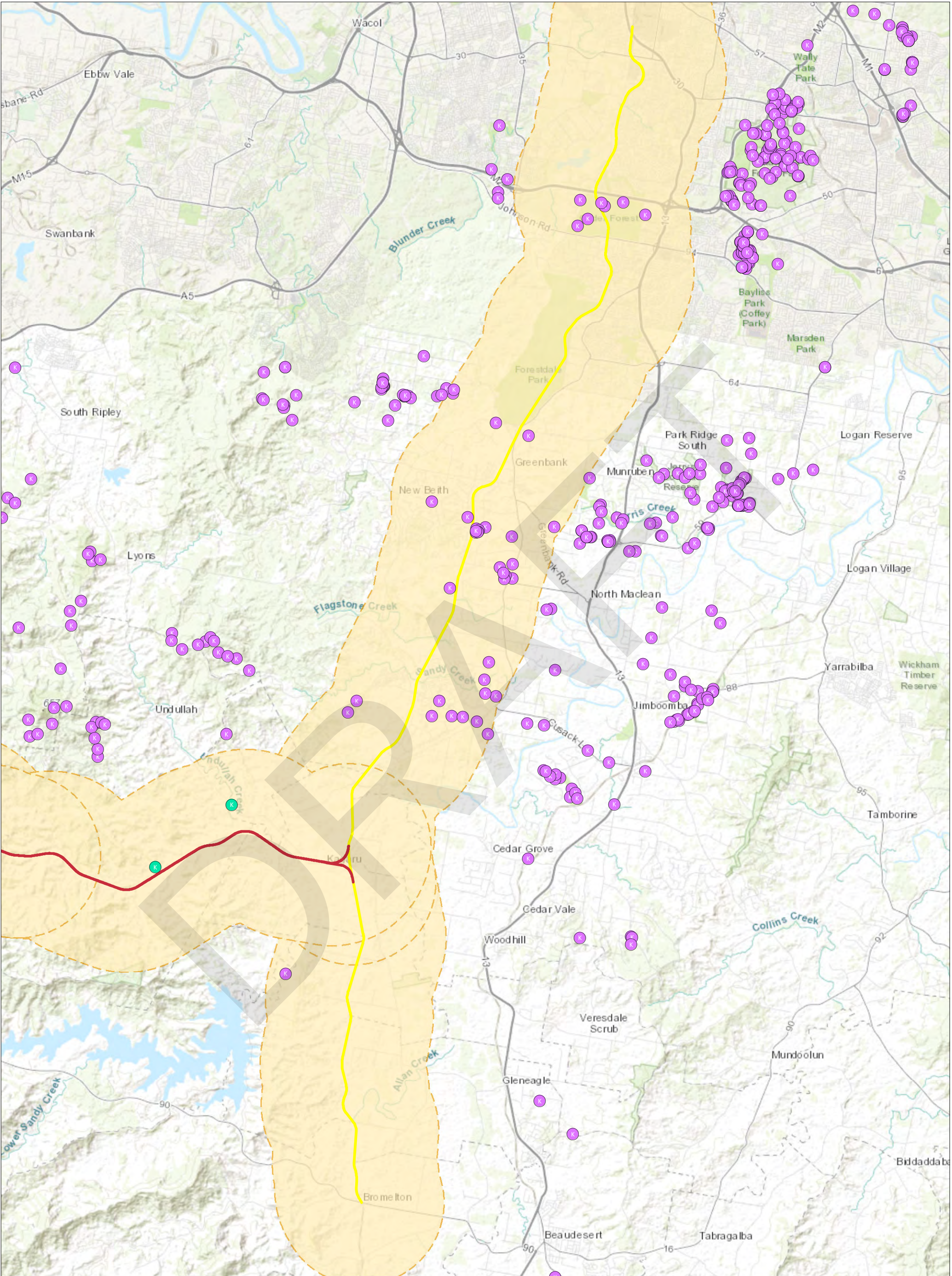
As the ARTC IRP operates across a wide geographic area, koala 'hotspots' were selected throughout the alignment and searching for scat was undertaken at each location. This provides suitable coverage across the entire IRP, while maximising the time spent in the field to collect samples.

Using Queensland and NSW state koala habitat mapping and historic koala presence data from ALA, BioNet and WildNet and previous surveys for the IRP (Figure 3-1), potential koala hotspots were identified. Hotspots were defined as those areas containing both a high abundance of historic presence records and potentially suitable habitat for either koala foraging or dispersal. These hotspots were used to identify potentially important locations to be ground-truthed through this genetics study. Only areas within the IRP where land access agreements could be obtained were included in desktop and field-based surveys.

Identifying these pre-fieldwork 'hotspots' of activity, based on koala observations, rather than only sampling habitat types, was chosen to maximise detectability while also providing adequate coverage of IRP. The delineation of koala hotspots is based on triangulating; known areas of high koala activity, previous data acquired from Environmental Impact Statements across the IRP and quality of habitat at each site. The table below outlines pre-fieldwork 'hotspot' locations for each section of the IRP and thus survey effort required. The location of these survey points is shown across the entire IRP in Figure 3-1.

Table 3-1 Pre-fieldwork koala hotspot locations and number per project

Project and length	Number of Pre-fieldwork hotspot locations per Inland Rail Project
Narromine to Narrabri (306km)	7
Narrabri to North Star (187km)	9
North Star to Border (39km)	4
Border to Gowrie (207km)	10
Gowrie to Helidon (28km)	3
Helidon to Calvert (47km)	2
Calvert to Kagaru (53km)	4
Kagaru to Acacia Ridge and Bromelton (49km)	3
Program-wide combined Narromine to ARB	42



Legend

3km Buffer Along The IRP Alignment

Koala Records (Australian Living Atlas)

C2K Koala Observations (FFJV)

Inland Rail Alignment

C2K - Calvert to Kagaru

K2AB - Kagaru to Acacia Ridge/Bromelton

Data Source:

ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

024km

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

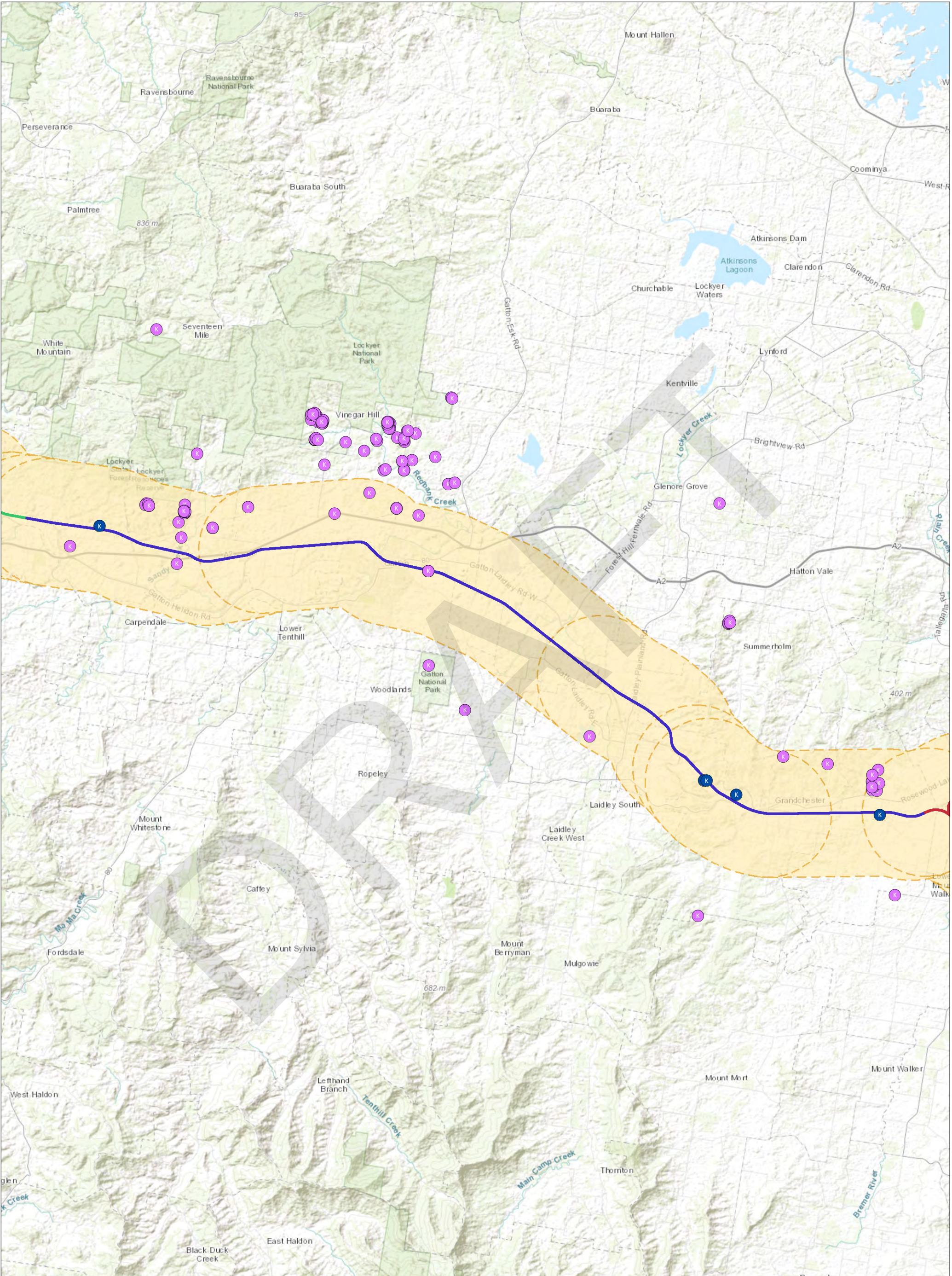
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Legend

3km Buffer Along The IRP Alignment

Koala Records (Australian Living Atlas)

H2C Koala Observations (FFJV)

Inland Rail Alignment

C2K - Calvert to Kagaru

G2H - Gowrie to Helidon

H2C - Helidon to Calvert

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

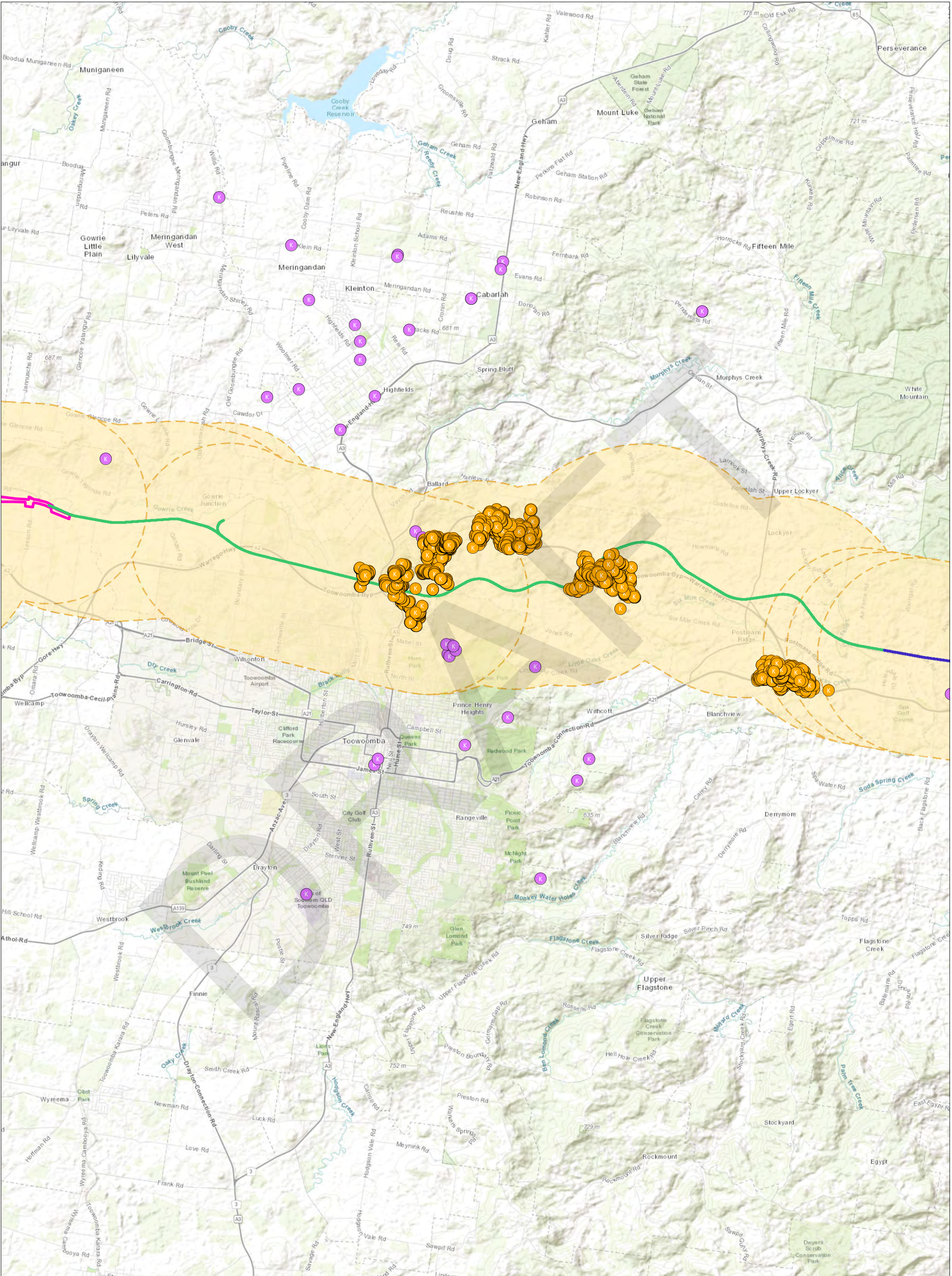
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Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

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F3-1c



Legend

3km Buffer Along The IRP Alignment

Koala Records (Australian Living Atlas)

G2H TSRC Koala Tracking (DTMR)

Inland Rail Alignment

B2G - NSW/QLD Border to Gowrie

G2H - Gowrie to Helidon

H2C - Helidon to Calvert

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

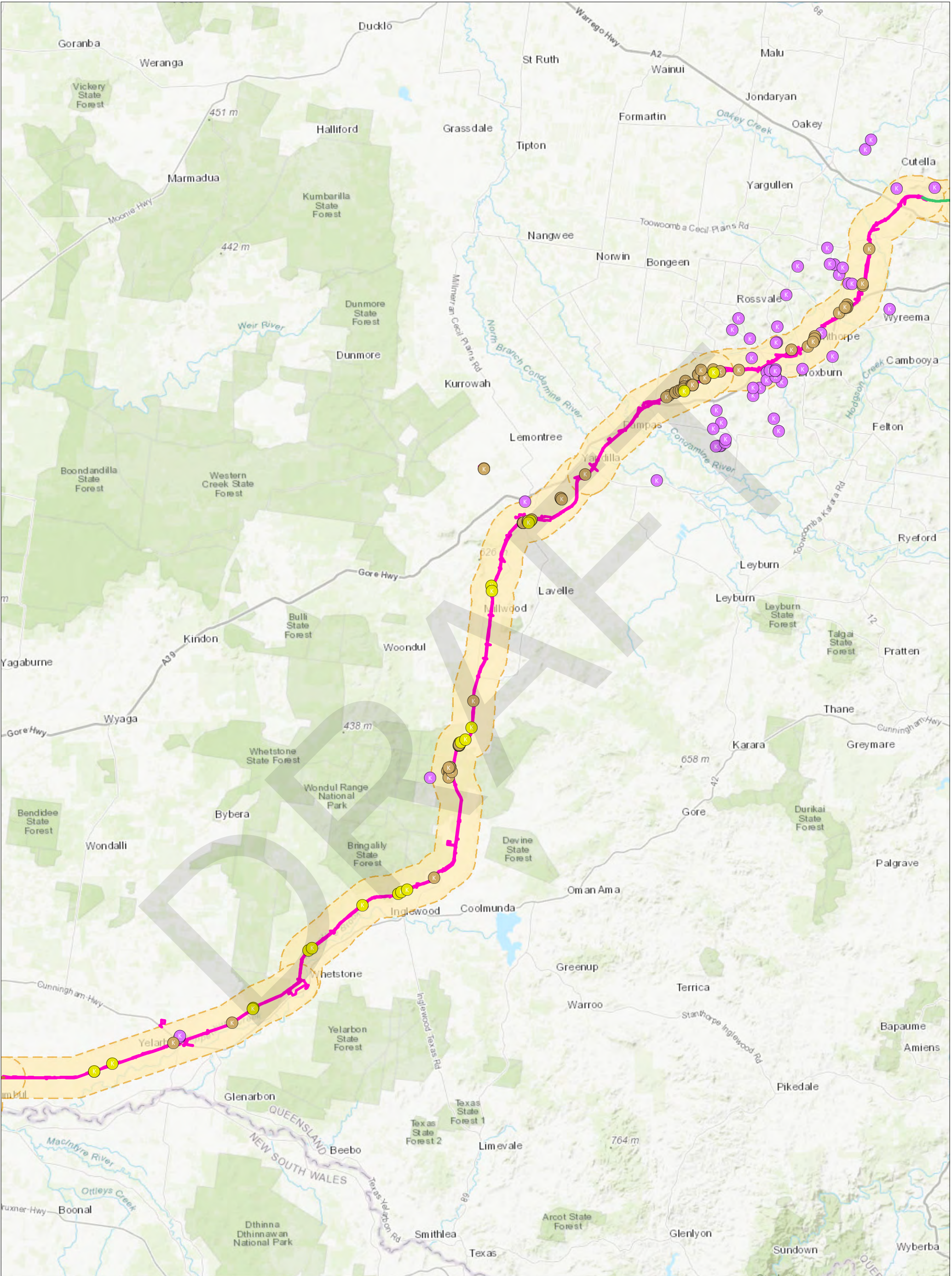
Coordinate System: GDA2020 MGA Zone 56

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

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F3-1d



Legend

3km Buffer Along The IRP Alignment

Koala Records (Australian Living Atlas)

B2G Koala Observations (Ausecology)

B2G Koala Observations (Cardno)

Inland Rail Alignment

B2G - NSW/QLD Border to Gowrie

G2H - Gowrie to Helidon

NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

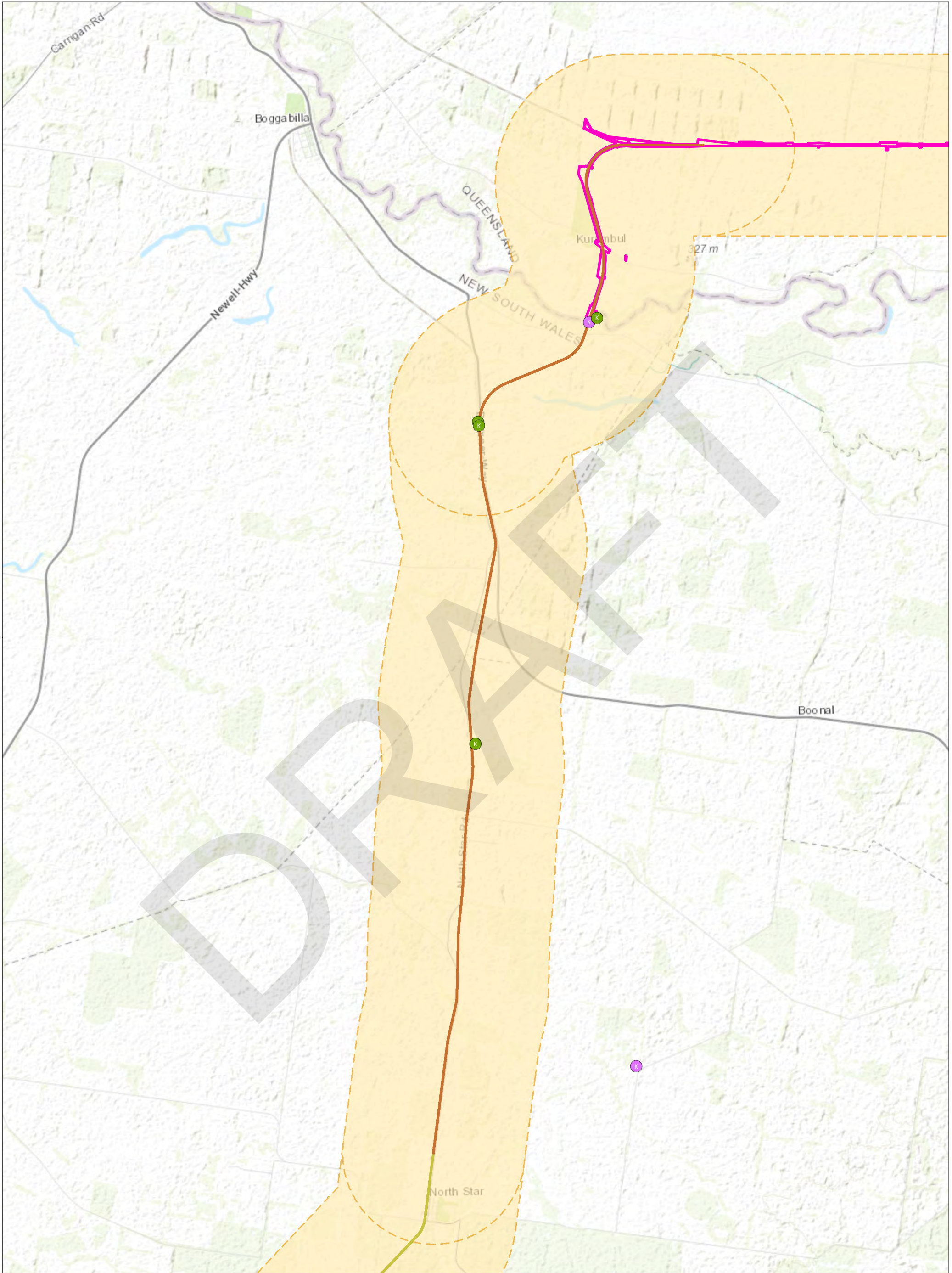
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N

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F3-1e

ERM



Legend

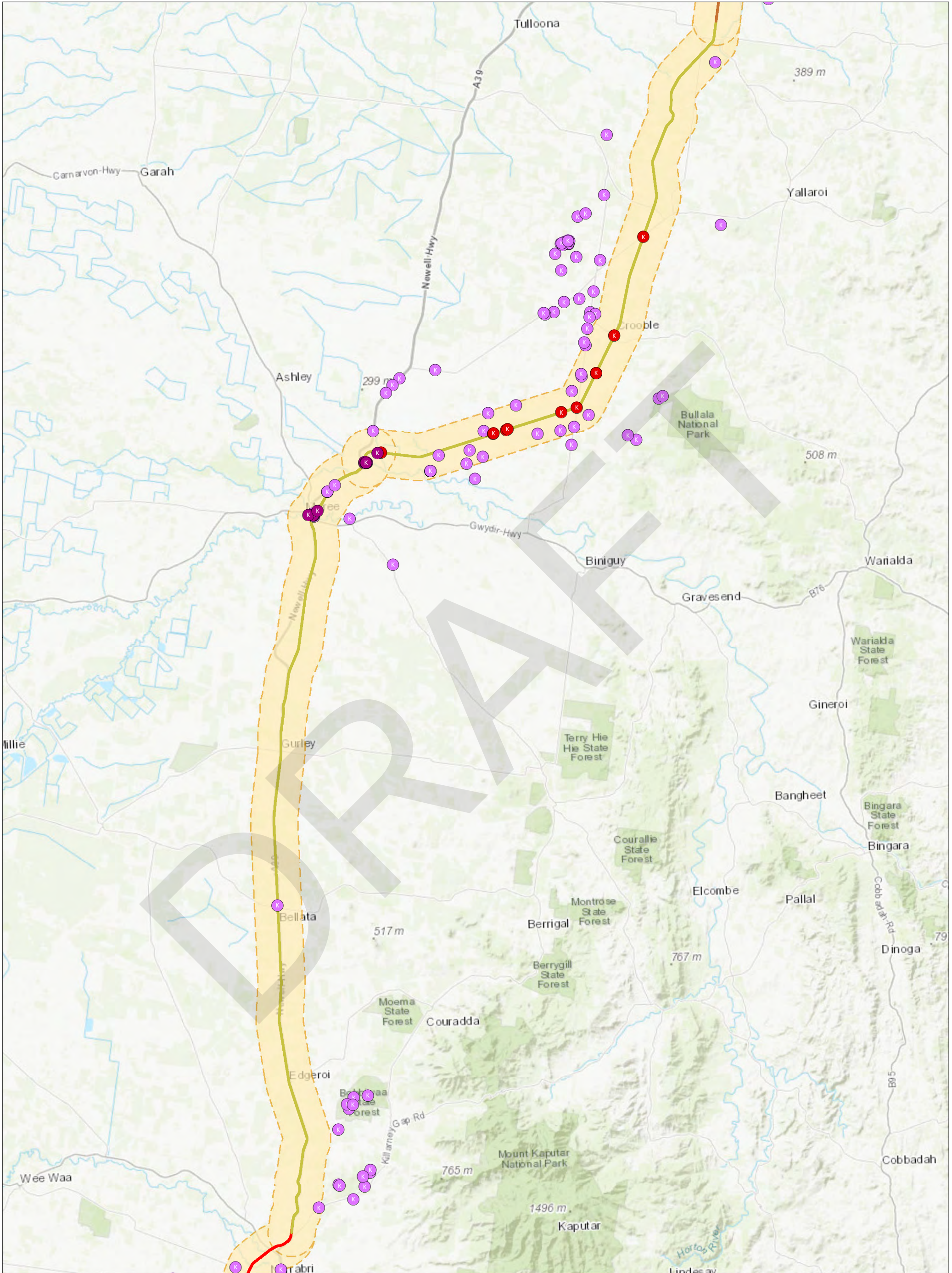
- 3km Buffer Along The IRP Alignment
- Koala Records (Australian Living Atlas)
- NS2B Koala Observations (FFJV)
- Inland Rail Alignment**
- B2G - NSW/QLD Border to Gowrie
- N2NS - Narrabri to North Star
- NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

F3-1f

Drawing No: 0628339_N2AB_TM_G002_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD) Client: ARTC
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	
Coordinate System: GDA2020 MGA Zone 56		
024Km This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.		



- Legend**

 - 3km Buffer Along The IRP Alignment
 - Koala Records (Australian Living Atlas)
 - N2NS SP2 Observed Koala Sightings (BDAR)
 - N2NS Koala Records (Umwelt/GHD)
- Inland Rail Alignment**

 - N2N - Narramine to Narrabri
 - N2NS - Narrabri to North Star
 - NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd
Date: 14/02/2024
Drawn By: VN/CB
Reviewed By: MD

Coordinate System: GDA2020 MGA Zone 56

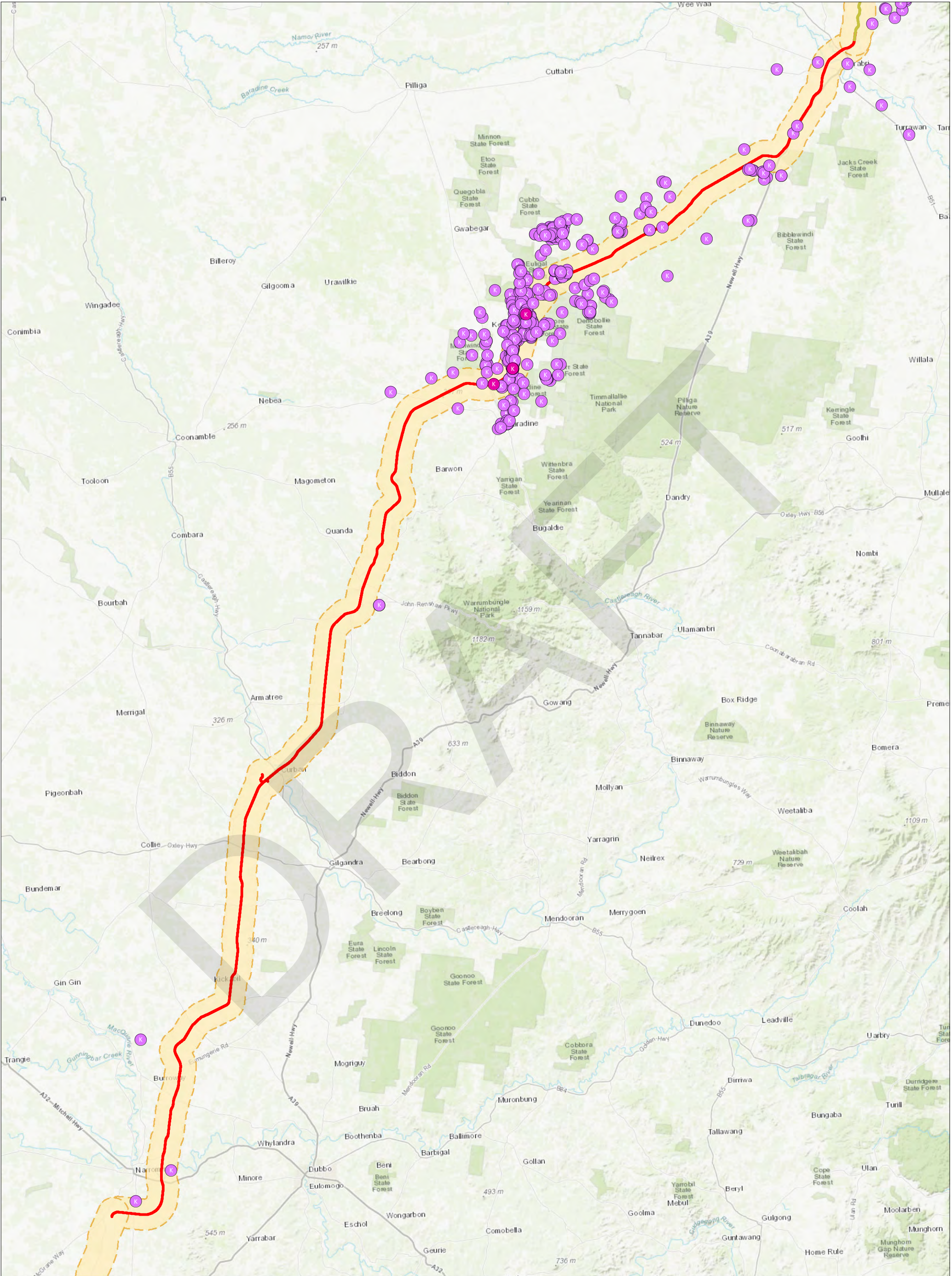
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Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

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F3-1g



Legend

3km Buffer Along The IRP Alignment

Koala Records (Australian Living Atlas)

N2N Koala Observations (GHD)

Inland Rail Alignment

N2N - Narramine to Narrabri

N2NS - Narrabri to North Star

Data Source:
ESRI World Topographic Map

Location of Koala Records across IRP Area

Drawing No: 0628339_N2AB_TM_G002_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

0 2 4km

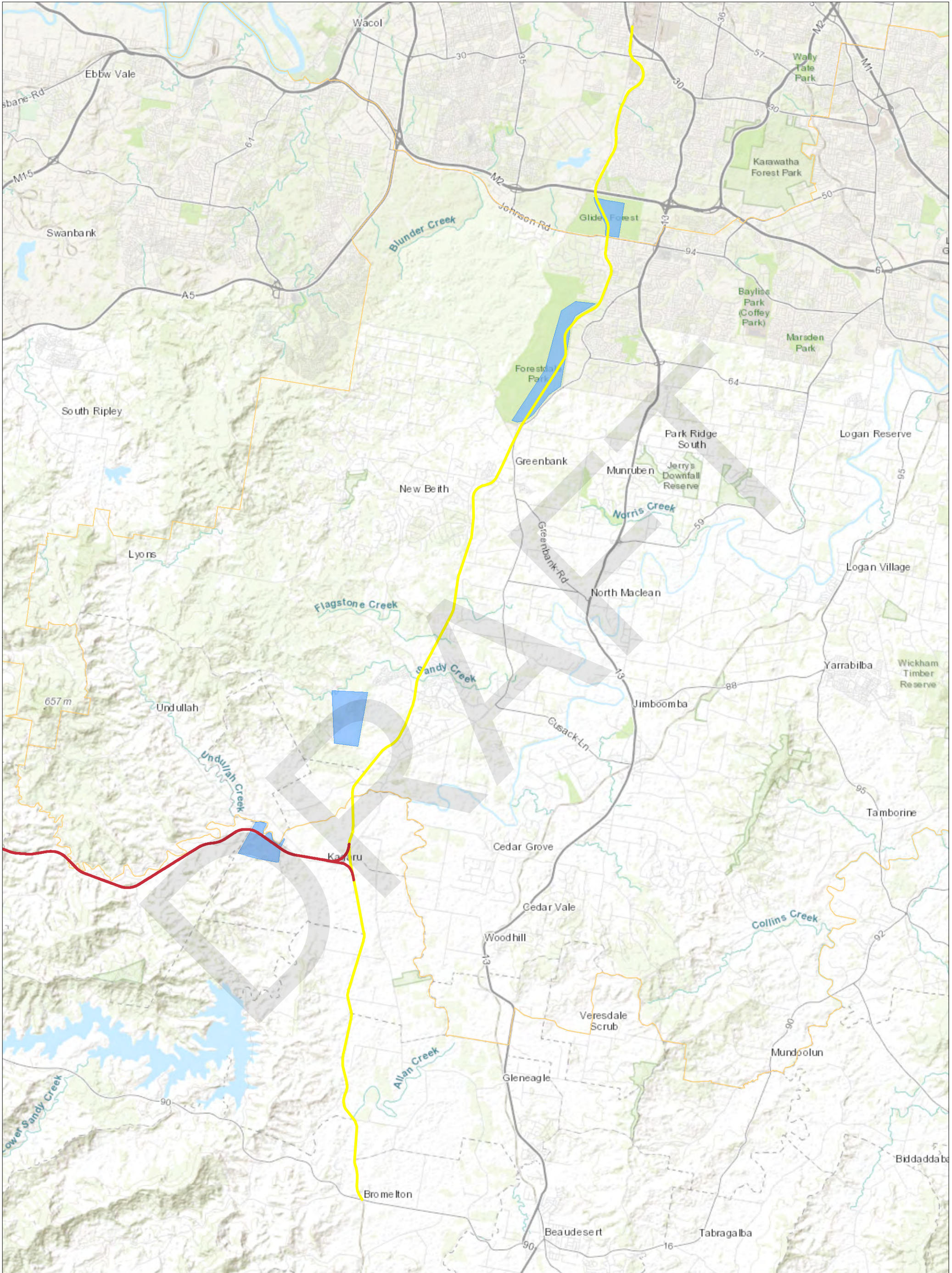
Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Reviewed By: MD

Client: ARTC

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F3-1h



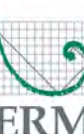
- Legend**
- Pre-fieldwork Hotspots
 - Inland Rail Alignment**
 - C2K - Calvert to Kagaru
 - K2AB - Kagaru to Acacia Ridge/Bromelton
 - LGA Boundary

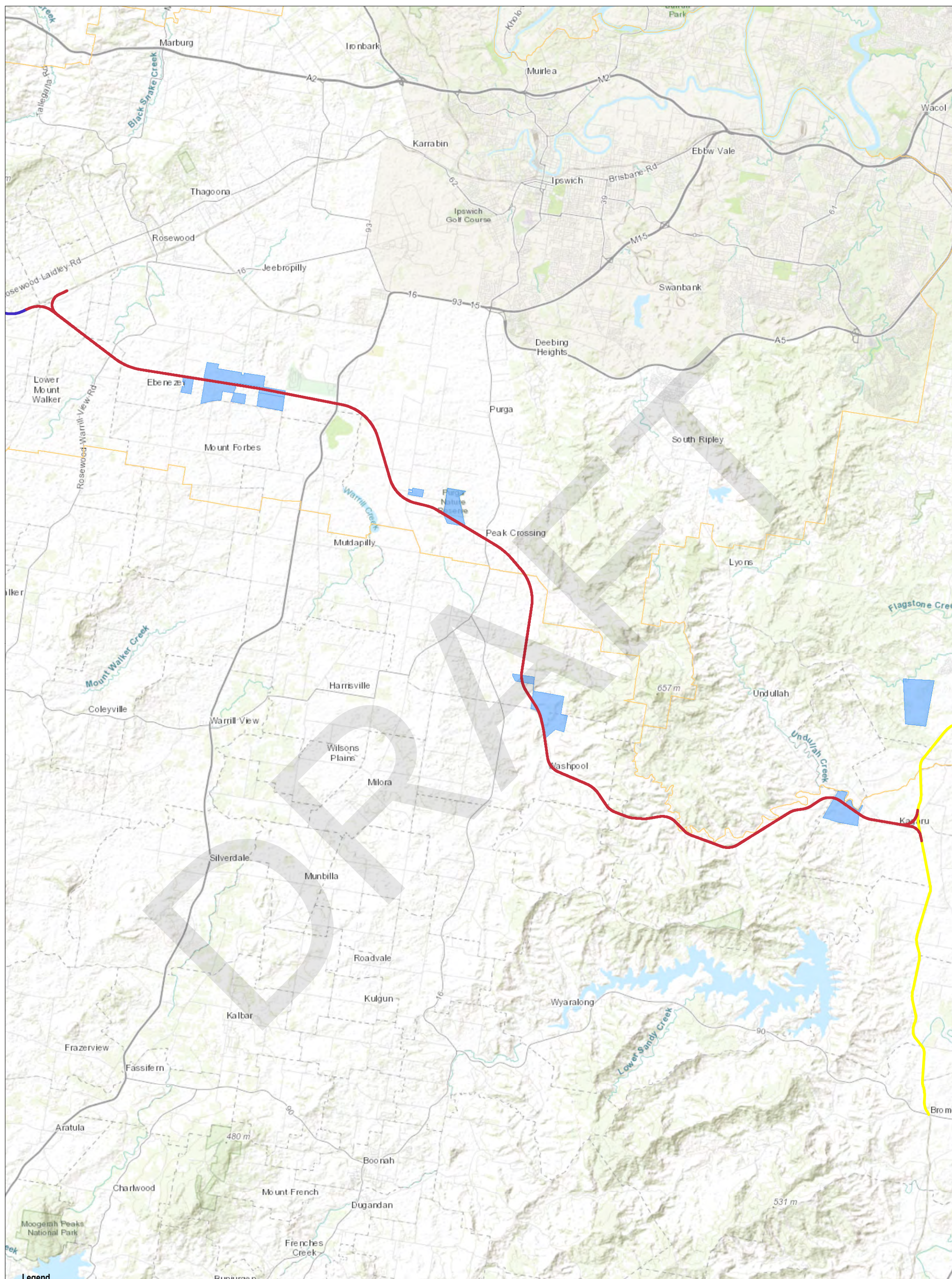
Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

F3-2a

Drawing No: 0628339_N2AB_TM_G003_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN/CB	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56		N  This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy. 	
0 2 4Km 			





Legend

-  Pre-fieldwork Hotspots
Inland Rail Alignment
 C2K - Calvert to Kagaru
 H2C - Helidon to Calvert
 K2AB - Kagaru to Acacia Ridge/Bromelton
 LGA Boundary

Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

Drawing No: 0628339_N2AB_TM_G003_R3.mxd

Date: 14/02/2020

Drawn By: VN/CB

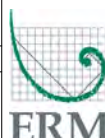
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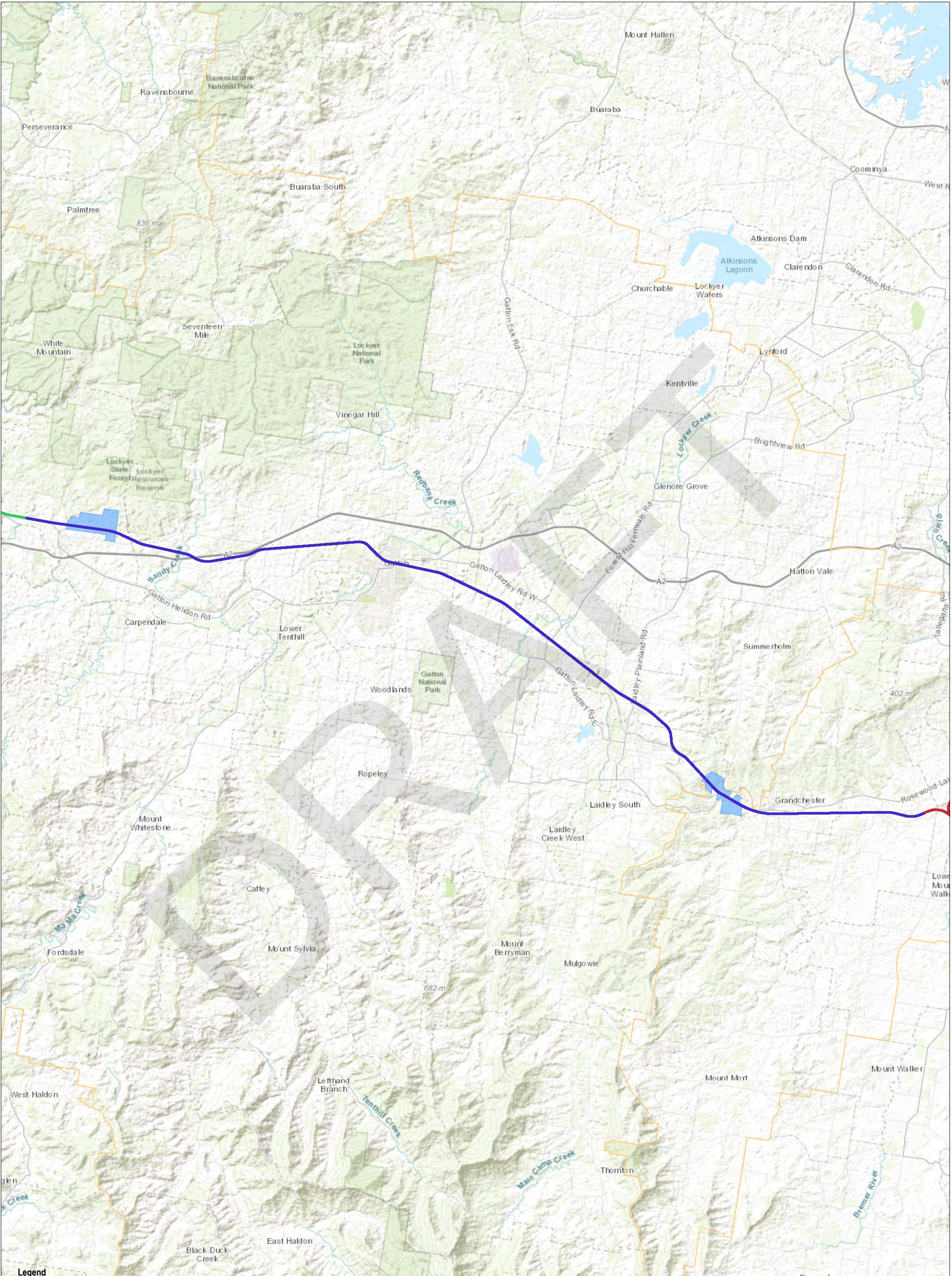
Koala Genetics Study Project – Inland Rail Program
(NSW and QLD)

Client: ARTC

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F3-2b





Legend

- Pre-fieldwork Hotspots
- Inland Rail Alignment**
- C2K - Calvert to Kagaru
- G2H - Gowrie to Helidon
- H2C - Helidon to Calvert
- LGA Boundary

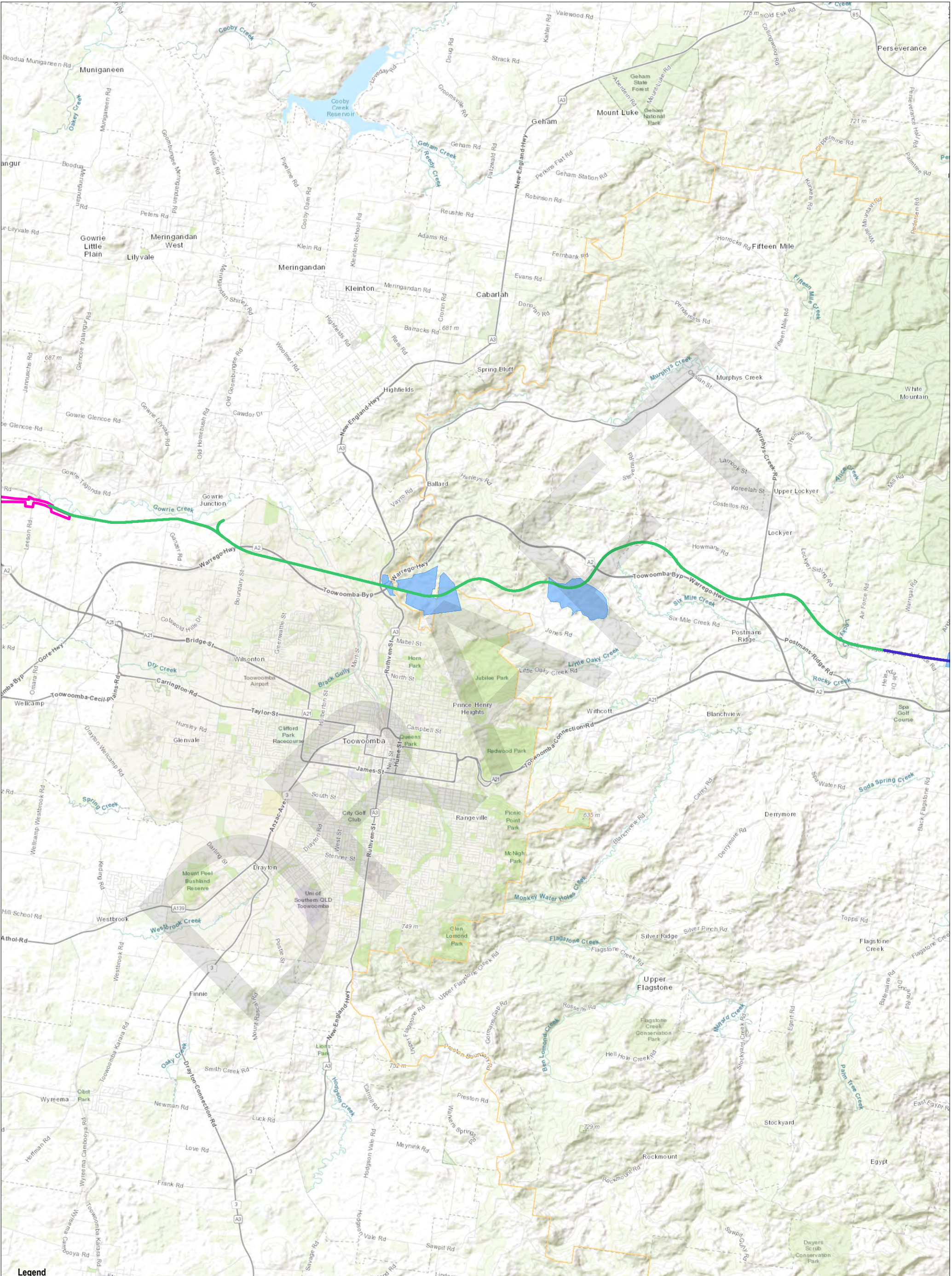
Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

Drawing No: 0628339_N2AB_TM_G003_R3.mxd	Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC
Drawn By: VN/CB	Reviewed By: MD	
Coordinate System: GDA2020 MGA Zone 56		
024Km N ↑		

F3-2c

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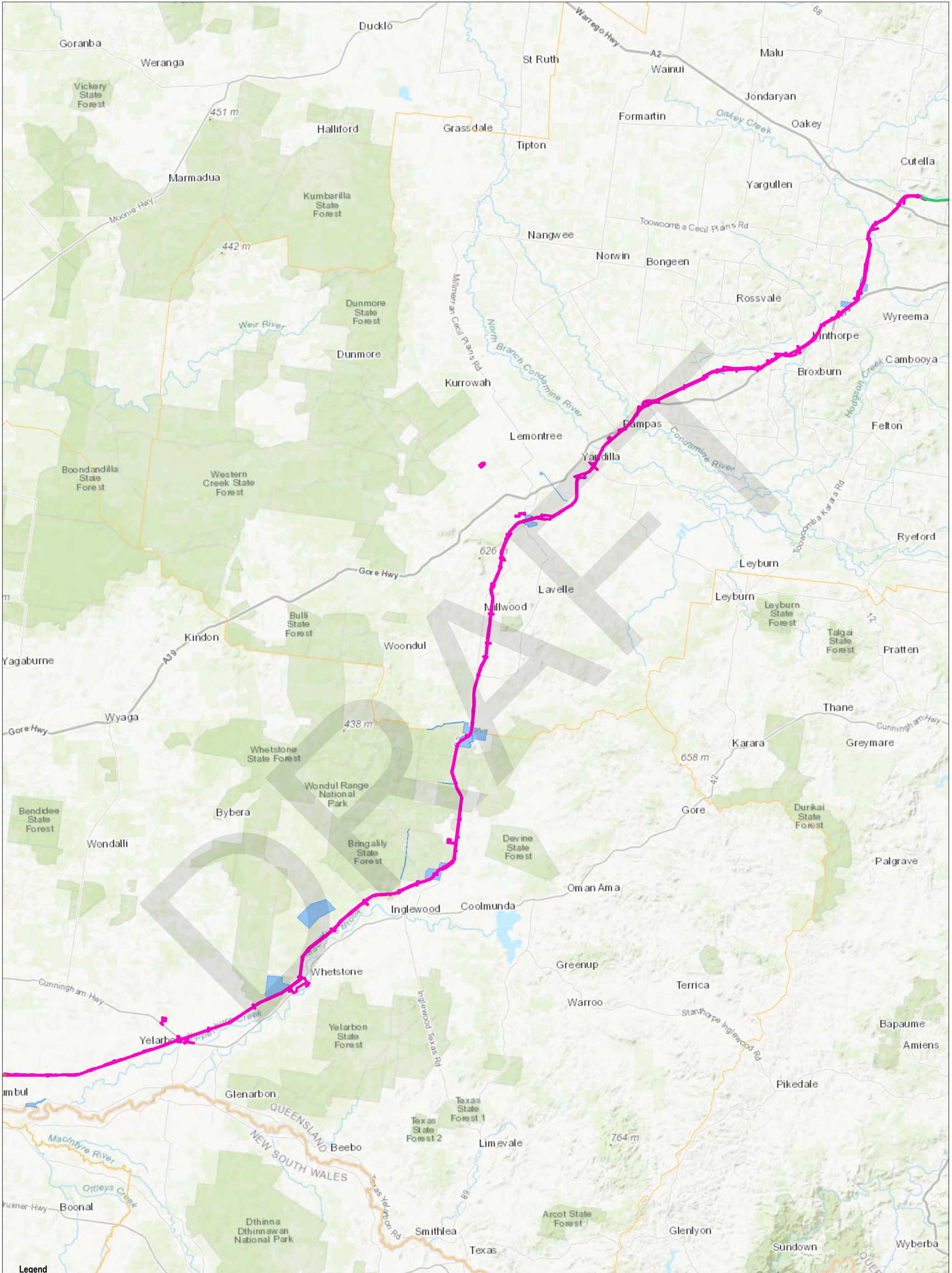


- Legend**
- Pre-fieldwork Hotspots
 - Inland Rail Alignment**
 - B2G - NSW/QLD Border to Gowrie
 - G2H - Gowrie to Helidon
 - H2C - Helidon to Calvert
 - LGA Boundary

Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area			F3-2d
Drawing No: 0628339_N2AB_TM_G003_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024		Drawing Size: A4	
Drawn By: VN/CB		Reviewed By: MD	
Client: ARTC			
Coordinate System: GDA2020 MGA Zone 56			
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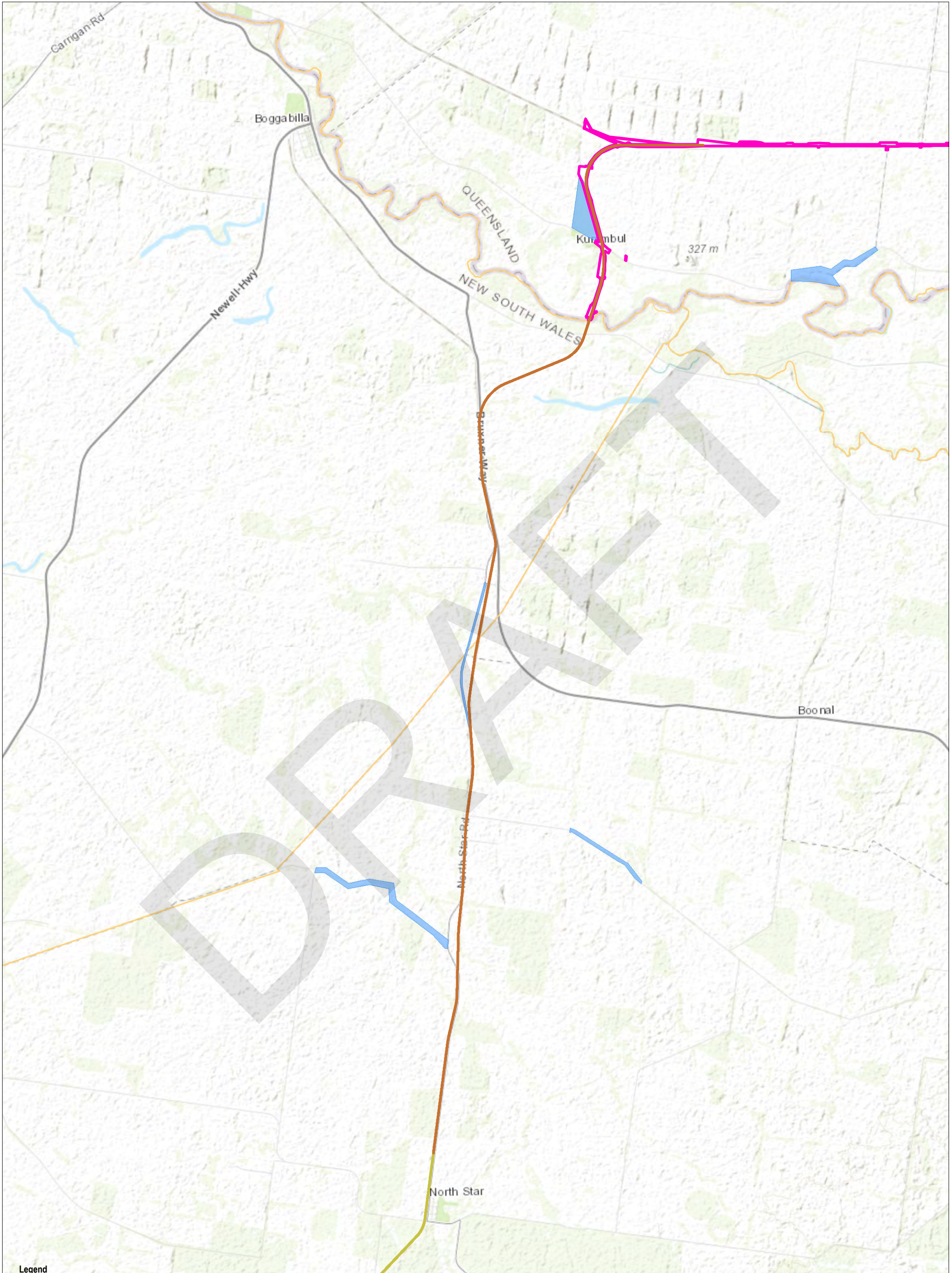




- Legend**
- Pre-fieldwork Hotspots
 - Inland Rail Alignment**
 - B2G - NSW/QLD Border to Gowrie
 - G2H - Gowrie to Helidon
 - NS2B - North Star to Border
 - LGA Boundary

Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area		F3-2e
Drawing No: 0628339_N2AB_TM_G003_R3.mxd		
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
0 2 4km		



- Legend**
- Pre-fieldwork Hotspots
 - Inland Rail Alignment**
 - B2G - NSW/QLD Border to Gowrie
 - N2NS - Narrabri to North Star
 - NS2B - North Star to Border
 - LGA Boundary

Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

Drawing No: 0628339_N2AB_TM_G003_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	
Coordinate System: GDA2020 MGA Zone 56		
024Km 		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F3-2f





- Legend**
- Pre-fieldwork Hotspots
 - Inland Rail Alignment**
 - N2N - Narramine to Narrabri
 - N2NS - Narrabri to North Star
 - NS2B - North Star to Border

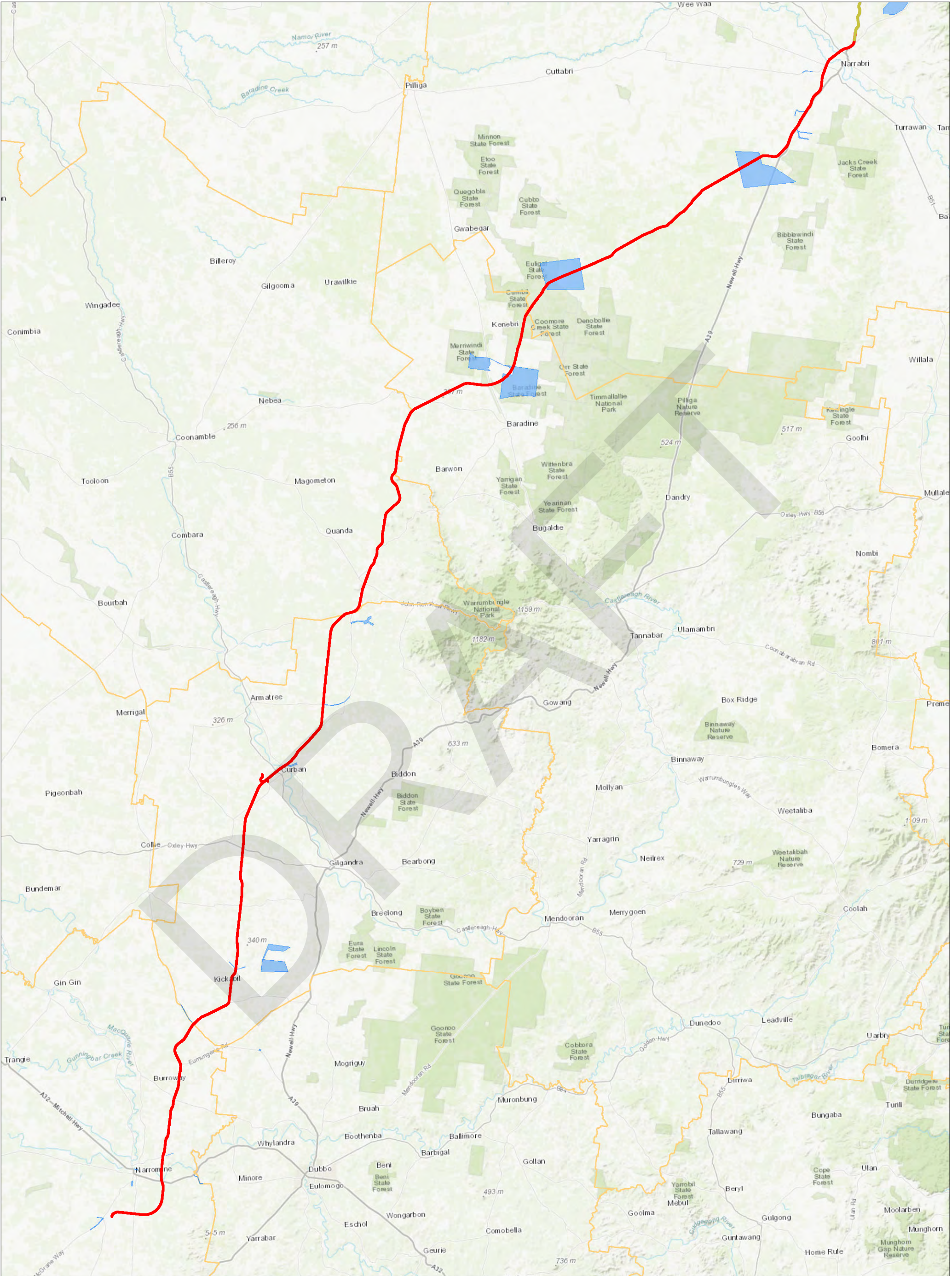
Data Source:
ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

F3-2g

Drawing No: 0628339_N2AB_TM_G003_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN/CB	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	
0 2 4Km			





Legend

Pre-fieldwork Hotspots

Inland Rail Alignment

— N2N - Narramine to Narrabri

— N2NS - Narrabri to North Star

Data Source:

ESRI World Topographic Map

Location of Pre-Fieldwork Koala Hotspots across IRP Area

Drawing No: 0628339_N2AB_TM_G003_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

0 2 4km

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Reviewed By: MD

Client: ARTC

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F3-2h



4. METHODOLOGY

4.1 Previous Survey Effort

Prior to the field surveys conducted by ERM, several field surveys have been completed to inform various stages of the IRP development process. A summary of these additional surveys can be seen in Table 4-1 below. Koalas and koala scats and tracks were confirmed throughout the IRP. Critical habitat has also been verified with ground-truthed vegetation surveys undertaken for the developmental process.

Table 4-1 Summary of previous survey effort

Inland Rail Section	Consultant	Timing of Surveys	Survey types	Scat Detection	Koala detection
N2N	GHD	- September and November 2018; - March, August, September, October 2019; - February 2022	- Active searches; - Spotlighting; - Call Playback; - Thermal Drone imaging	Yes	Yes
N2NS (Phase 2)	NGH	- December 2015; - December 2019; - February 2020	- Koala SAT searches; - Spotlighting	Yes	Yes
NS2B	FFJV	Between October 2018 and October 2019.	- Call Playback; - Spotlight searches; - Active searches	No	Yes
B2G	ELA	April -October 2016	- Koala habitat assessments; - Koala SAT searches; - Incidental fauna observations	Yes	No
		June 2018- May 2019	- Koala habitat assessments; - Koala SAT searches; - Incidental fauna observations	Yes	No
G2H	Arup	March 2017	- Spotlighting; - Active Searches; - Koala SAT searches	Yes	No
	EMM	September 2018- May 2019	- Spotlighting; - Active Searches; - Koala SAT searches	Yes	No
	Eco logical Australia	December 2018- April 2019	- Spotlighting; - Active Searches; - Koala SAT searches	Yes	Yes
H2C	Arup/SMEC	March-June 2016	- Active Searches; - Koala SAT searches	Yes	No

Inland Rail Section	Consultant	Timing of Surveys	Survey types	Scat Detection	Koala detection
	EMM	■ September-November 2018	■ Koala habitat assessments; ■ Incidental fauna observations	Yes	No
	ELA	■ December 2018-April 2019	■ Koala habitat assessments; ■ Koala SAT searches; ■ Incidental fauna observations	Yes	No
C2K	Jacobs-GHD	■ March-May 2016	■ Koala habitat assessments; ■ Koala SAT surveys; ■ Incidental fauna observations	Yes	Yes
	GHD	■ December 2016 – February 2017	■ Active Searches	Yes	No
	EMM	■ September-November 2018	■ Incidental fauna observations	No	Yes
	FFJV	■ December – April 2019; ■ May 2019; ■ June – July 2019	■ Koala habitat assessments; ■ Koala SAT surveys; ■ Incidental fauna observations	Yes	No
K2ARB	WSP	■ May-June 2016	■ Koala habitat assessments; ■ Koala SAT surveys; ■ Incidental fauna observations	Yes	No
	ERM	■ February-May 2018 ■ January 2020	■ Koala habitat assessments; ■ Koala SAT surveys; ■ Incidental fauna observations		

4.2 Current Field Survey Effort

A total of forty (40) field days have been undertaken throughout the IRP across five (5) separate field surveys between April and December of 2022. It is important to note that conditions across the survey periods were unseasonably wet. High rainfall and moisture is known to speed up the decomposition of scat material and may have had impacts on the detectability of scat when fieldwork was undertaken directly after significant rainfall.

Table 4-2 Survey Effort for Genetics Study

Inland Rail Section	Survey effort
K2ARB	4 days
C2K	5 days
H2C G2H	6 days
B2G	8 days
NS2B	5 days
N2NS	5 days
N2N	7 days
TOTAL DAYS	40

4.3 Koala Detection Dog Surveys

The application of trained detection dogs in threatened species conservation has been identified as a highly efficient, non-invasive survey technique that consistently outperforms alternative methods while also minimising risk of additional disturbance and issues surrounding detectability. Previous studies have proven the methods capacity to accurately detect scats with dogs able to distinguish between individuals within a species, as well as closely related non-target species (Bennett, et al., 2022; Cristescu, Miller, & Frère, 2020).

The field surveys for detecting and collecting koala scats for genetic analysis were completed by a UniSC dog handler and ERM ecologist with experience in fauna surveys.

Each hotspot site was distinguished using field collected data including location name, survey unique identifying number including for each sample, GPS coordinates. A purpose-built koala database developed for the Study was used field data collection. The detection dog was fitted with a GPS collar to ensure that the survey effort for each sampling location was quantifiable. Any ecological characteristics that may have influenced the detectability and decay of scats was also recorded (example: wet areas will increase decay rates; therefore scats will be detectable for a shorter amount of time, fire also decrease scat survival time).

Surveys were performed using a fresh scat detection dog, an accurate and fast way to collect genetic material in areas where koala presence has been confirmed. This method is designed to maximise the chance of detecting fresh scat for genetic analyses in the minimum amount of time and allows for coverage of large areas. Surveys were undertaken within predefined koala hotspots where land access agreements could be established by the client. Koalas/scats detected were photographed, and fresh scat material was collected and refrigerated for genetic analysis. Any opportunistic observations of koala scats, scratches or individual koalas made on foot or from the vehicle while traveling between survey locations were also recorded. Anecdotal and historic observations made by the members of the public and property owners were collected by the DDC team.

Upon detection of a koala, three characteristics were observed using binoculars. (1) The sex of the koala, (2) any external signs of Chlamydia infection (ocular infection/conjunctivitis known as pink eyes, or urinary tract infections known as wet bottom), and (3) The presence of an ear tag showing evidence of previous veterinary care.

4.4 Diet Preference and Vegetation Assessment

Variations in nutritional value and palatability is common in koala food trees, even those species considered to be important for populations in other areas. The development of DNA profiles of local food tree species was undertaken using single nucleotide polymorphism panels for comparison with DNA extracted from koala scats – informing food tree preference to guide targeted future rehabilitation efforts.

Leaf samples were taken from established trees throughout the IRP to ensure adequate spatial coverage. Only species identified as locally important koala trees were included in the study. Two samples were collected from each tree and included mature and immature leaves, provided that adequate confidence in species identification was possible. Samples were collected from all trees where a koala or koala scat was detected as well as additional samples from areas where no detections were made.

To ensure geographic coverage throughout the range, each species was sampled from a minimum of three sites. Samples were collected from four individuals of each species present at each site. Where abundant and widespread species were present, samples were only taken to ensure accurate coverage of geographic range. This approach allowed for the prioritisation of rare or restricted species, where present, without impacting on landscape level genetic diversity.

4.5 Data Analysis

The UniSC team has developed innovative and koala specific genetic analysis techniques. The use of microsatellites for analysis is now surpassed by next generation genotyping, providing thousands of markers, increasing the definition of genetic analyses for more accurate results. Our method targets both coding and non-coding regions of the DNA and enables more reliable assessments of genetic diversity.

The development of molecular tools was built on Dr Romane Cristescu's (our nominated Genetic Study Lead) proven track record in conservation genetics, especially in developing markers for koalas, as published in the peer reviewed literature:

- *Cristescu RH, Sherwin WB, Handasyde K, Cahill V & DW Cooper (2010). Detecting bottlenecks using BOTTLENECK 1.2.02 in wild populations: the importance of the microsatellite structure. Conservation Genetics, 11:1043-1049 (IF : 2.0); and*
- *Cristescu RH, Cahill V, Sherwin WB, Handasyde K, Carlyon K, Whisson D, Herbert CA, Carlsson BJ, Wilton AN & DW Cooper (2009). Inbreeding and testicular abnormalities in a bottlenecked population of koalas (Phascolarctos cinereus). Wildlife Research, 36: 299-308 (IF: 0.7).*

Genetic information was obtained from non-invasively collected koala scats detected using a detection dog trained to detect fresh koala scat. These non-invasive survey methods are valuable for detecting low density species, avoiding unnecessary disturbance to individuals, and for efficiently and cost effectively surveying large areas (Bennett, et al., 2022).

Landscape genetic analysis provides information on the health of koala populations in terms of inbreeding, genetic diversity and landscape genetic connectivity. High levels of inbreeding puts individuals at risk of decreased fitness and may lead to increased disease susceptibility. Landscape genetic analysis can also provide unique insights into how populations are connected or isolated. Gene flow reflects not just the ability of animals to move through the landscape (i.e. landscape permeability), but also survival that contributes to the next generation. Our experienced team has demonstrated experience in the collection and analysis of genetic data, and importantly interpretation of data that will provide important insights to the IRP.

The following sections provide detailed descriptions of the data analysis methodology conducted by the UniSC team.

4.5.1 Genetic Analysis

The best DNA quality is found in very fresh koala scats (Schultz, Cristescu et al. 2018). Therefore, scats were only collected if they were estimated to be less than one week old (categories 1 and 2, Table 4-3), still presenting a shiny mucus layer and a strong smell. Scats were collected in a sterile 50 ml falcon tube without direct skin contact to avoid contamination and further degradation or loss of DNA. Samples were transferred to a -20°C freezer at the end of each survey. A total of 73 samples were collected for genetic and disease analyses from dog surveys and opportunistic koala sightings.

Table 4-3 Guide used to age koala scats in the field

Scat age categories	Age	Characteristics
1	One day old or less	Very fresh (wet mucus and smell)
2	Couple of days old	Fresh (dry shine and smell)
3	Couple of weeks	Medium fresh (dry shine or smell when broken)
4	Months old	Old (no shine, no smell)
5	More than a few months	Very old and discoloured

4.5.1.1 DNA Extraction

All samples were processed for extraction of both koala and *Chlamydia* DNA. The protocol of Schultz et al. (2018) was followed to isolate DNA from koala scats. The QIAamp PowerFecal Pro DNA Kit (Qiagen) was used following the manufacturer's instructions. An additional one-hour incubation step (65° C) after adding the buffer to the faecal sample was added and samples were vortexed for seven minutes at maximum speed using Genie 2 Vortex Mixer (Scientific Industries). Final DNA isolates were eluted in 200 ul of elution buffer and concentrated down to a volume of ~ 30 ul. The amount of DNA present in extracted samples (both koala and foreign) was determined using the Thermo Scientific NanoDrop 2000 Spectrometer (Thermo Fisher Scientific, Victoria). Extracted DNA was stored at -80°C until being shipped to Diversity Arrays Technology (DArT, Canberra).

4.5.1.2 Genotyping

DNA aliquots were genotyped using a next-generation sequencing protocol for detecting single nucleotide polymorphisms (SNPs) by DArT (Kilian, Wenzl et al. 2012). For samples collected during this study, DArTag was used as a targeted approach involving a specifically designed molecular probe panel (koala specific capture probes) to select small target regions containing sequence variants. A total of 4,393 koala SNPs were genotyped. Sex and *Chlamydia* specific markers were also genotyped as an extra step.

To increase sample size and improve our ability to conduct more broad-scale genetic analyses, we increased our dataset by including data from samples genotyped in previous studies using the DArTcap method. DArTcap is a selective step after complexity reduction to genotype specific markers from DArTseq representations with the help of capture probes, which is a cost-efficient method that combines DArTseq and sequence capture techniques. The DArTcap method differs from DArTag in that genotyping is selective and restricted to specific markers selected from the DArTseq representation, but only producing approximately 2,000 SNPs for koalas. In comparison, DArTag also targets many markers, but is not restricted to markers identified by the DArTseq platform. Because SNPs generated by DArTcap and DArTag are from corresponding regions, we were able to co-analyse DArTag data generated during this study with DArTcap data generated in previous studies. The improved dataset allowed for more robust genetic analyses.

4.5.1.3 Filtering of genetic data

When working with non-invasive scat samples, genotyped data is filtered to improve the quality of the dataset by removing samples with too little data (low *individual call rate*) as well as SNP loci that were not called across most samples (low *locus call rate*). The thresholds for these filters can be adjusted depending on the type of analysis, e.g., only few loci are needed for identifying unique individuals, however many high-quality loci are needed for measuring genetic diversity. Therefore, different filtering regimes are applied for different analyses. Constant thresholds are also applied to remove potentially erroneous loci. This includes filtering for allele read depth (minimum threshold of 5) and minor allele frequency (MAF, minimum threshold of 0.01) and loci appearing on the same contig as another (*secondary loci*). Given that filtering can result in previously polymorphic loci becoming monomorphic, a filter to remove all monomorphic loci is also applied. All filtering was done using the R package *dartR* (Gruber, Unmack et al. 2018). Further details of specific filtering are presented in the respective results sections (Section 6).

4.5.1.4 Genetic fingerprinting and sexing

Genetic fingerprinting allows for each scat sample to be allocated to an individual. This adds value by avoiding double-counting of the same individual sampled in different locations or at different times. Duplicate samples were removed by using filtered data to estimate pairwise relatedness values which range from 0 (no kinship relationship) to 1 (a duplicate individual, 100% relatedness – i.e., to be removed).

Seven different relatedness estimators currently exist and several were used to investigate and remove duplicates. Results were primarily reported from the *dyadml* estimator which performed best in estimating pairwise relatedness (Milligan 2003). All relatedness analyses were conducted in R using the *related* package (Pew, Muir et al. 2014).

Koala sex can be determined through sex-linked genetic markers. When using non-invasive sampling techniques such as scat, low quality DNA can impact sex identification confidence. With this limitation in mind, this Report provides the sex call from SNP genetic markers i.e., male versus female (M /F). Sex ratio is the relationship between the number of males to the number of females. Typically, the sex ratio in natural, healthy populations is expected to be 1:1. Risks of extinction are increased if population sex ratios significantly deviate from 1:1. However, a small bias of sex ratio towards females can sometimes be desirable, especially in very small or rapidly declining populations. Sex ratio can only be calculated for a site if a sufficient proportion of random individuals are sampled, or for landscape surveys where sampling has achieved high coverage of the area.

4.5.1.5 Measuring genetic diversity

Genetic diversity was calculated using GenAIEx v. 6.5 (Peakall and Smouse 2012). We calculated three values:

- Observed Heterozygosity, H_o - the calculated level of heterozygosity from the allele frequencies of the population under study;
- Expected Heterozygosity, H_E (adjusted for small sample size) - the level of heterozygosity that could be expected based on observed allele frequencies if the population was at the Hardy-Weinberg equilibrium (panmictic population with constant genetic variation across generations). This is relevant as it allows the calculation of the inbreeding coefficient below; and
- Inbreeding coefficient, F_{IS} - the proportion of the variance in the subpopulation contained in an individual, it can range from -1 to 1 (the closer to 1, the higher the degree of inbreeding). Note that inbreeding can not only result from non-random mating but also from small, isolated populations, where all individuals are more closely related than large populations.

4.5.1.6 *Chlamydia* detection

The prevalence of *Chlamydia* (percentage of koalas with the pathogen) is an important population characteristic for informing conservation management. It has been shown that the *Chlamydia* pathogen can be detected in koala scats using SNP genotyping (Cristescu, Miller et al. 2019). However, pathogen prevalence does not equal disease, as the presence and severity of the disease varies greatly between individual koalas, as well as between populations (Ellis, Girjes et al. 1993, Waugh, Hanger et al. 2016). Notably, individual koalas can shed large numbers of *Chlamydia* organisms without clinical signs of disease (Wan, Loader et al. 2011) and populations can have high *Chlamydia* prevalence (infection) with low noticeable health impact (disease). For example, 90% of koalas in the Mt Lofty ranges were *Chlamydia* positive but had a low prevalence of clinical disease (Weigler, Girjes et al. 1988, Polkinghorne, Hanger et al. 2013). Therefore, quantifying *Chlamydia* prevalence is only the first part of understanding the threat that this pathogen presents to an individual and a population.

4.5.1.7 Koala Retrovirus Detection

Much like the prevalence of *Chlamydia*, the prevalence of koala retrovirus is an important population characteristic that informs conservation management. Unlike *Chlamydia* detection, the methodology for sampling koala retrovirus from fresh scat material is noted to retain issues regarding the specificity and sensitivity of testing. While remaining an active area of research, the reliability of results was not thought to have provided robust and meaningful results that could positively inform koala management within the IRP. As such, sampling for koala retrovirus was deemed to be beyond the scope of this genetics research.

4.5.2 Genetic co-analyses for DArTcap and DArTag data

To increase the number of samples used to calculate genetic measures, and therefore increase the robustness of comparisons, samples previously genotyped for other projects were co-analysed. As genetic technology is progressing rapidly, some of the data was created using a previous method (DArTcap), while some samples used the current method (DArTag). Only markers that are common for both methods were used for these analyses.

Genotype data developed through DArTcap and DArTag procedures were merged together for the samples collected from sites in NSW and QLD. A total of 594 koala samples and a total of 1162 koala SNPs were available for the analyses. Genotyped data were filtered following the methods described in Section 1.2.3 (Filtering of genetic data) to improve the quality of the data set. A total of 327 koala samples and 902 koala SNPs were retained after filtering for quality. Relatedness among the koala samples was estimated following the methods described in Section 4.5.1.4 (Genetic fingerprinting and sexing) to identify duplicate samples.

4.5.2.1 Genetic structure

The number of ancestral genetic clusters (K) was assessed using fastStructure (Raj, Stephens et al. 2014) and STRUCTURE software V 2.3 (Pritchard, Stephens et al. 2000). fastStructure utilises an algorithm for approximate inference of the population structure from large SNP genotype data sets using a variational Bayesian framework, hierarchical priors and heuristic scores to identify the number of populations and weak population structures within data. STRUCTURE analyses differences in the distribution of genetic variants amongst samples with a Bayesian iterative algorithm by placing samples into groups whose members share similar patterns of variation. STRUCTURE is powerful but comparatively slow for large datasets. Although fastStructure is less powerful it is much faster and provides a reasonable alternative for large datasets (Stift, Kolář et al. 2019). Hence, herein we report the results from both fastStructure and STRUCTURE analyses.

The results generated by the STRUCTURE program were collated using STRUCTURE HARVESTER web-based program to detect the most likely number of genetic clusters that best fit the data using the ΔK method (Earl and VonHoldt 2012).

The number of genetic clusters (K) was set to vary between 1 to 10 and the STRUCTURE program was set to run five independent iterations with the length of burn-in period of 10,000, and 100,000 MCMC (Markov Chain Monte Carlo) repetitions after burn-in, using admixture ancestry model with correlated allele frequencies among populations without prior sample location information. In addition, principal component analysis (PCA) was conducted for the 255 samples from 24 locations (locations were assigned to each sample in ArcGIS based on Councils) using the *dartR* package (Gruber, Unmack et al. 2018). The first two principal components that explained the majority of the variation were used to plot the data.

4.5.2.2 Genetic diversity and population differentiation

To estimate the genetic diversity among koala populations, the 255 unique koala samples from 24 different locations were grouped into ten different groups based on their geographical proximity (Figure 4-1), noting that the number of samples available at some locations was very small (Appendix Table A2). Six samples were removed from the population genetic diversity indices estimates; three from Redland City Council (sample names: DR220116KM1A, DR220115KM1E and 221015MB1A) because they were located on North Stradbroke Island, and another three from Goondiwindi (sample names: 220623Bi1C, 220623Bi1B and 220623Bi2B) due to a very small sample size for the location and no other close sample locations that these could be grouped with. To quantify the population genetic diversity, observed heterozygosity H_o , expected heterozygosity H_e and inbreeding coefficient F_{IS} were calculated using GenAlEx software V6.5 (Peakall and Smouse 2012), as described in Section 4.5.1.4 (Measuring genetic diversity). In addition, the average internal relatedness (IR), a measure that reflects the parental relatedness (Amos, Worthington Wilmer et al. 2001) was measured across the individuals in each group using GENHET function (Coulon 2009) in R. Further, contemporary effective population size (N_e) and associated parametric 95% confidence intervals were estimated using NeEstimator v2 (Do, Waples et al. 2014), implementing linkage disequilibrium method with random mating model and 0.05 as the lowest allele frequency. To estimate the genetic differentiation between populations (i.e., 10 groups here), pairwise F_{ST} values were calculated using GenAlEx software V6.5 (Peakall and Smouse, 2012). Geneflow, a measure of movement of alleles between populations via migration or gametes, was estimated as effective number of migrants (N_m) per generation using the F_{ST} values calculated in GenAlEx software V6.5 (Peakall and Smouse, 2012). Note that these numbers reflect historical rates of gene flow and may not represent current gene flow.

4.5.2.3 Genomic relationship

Genomic relationship among individual koalas was estimated as an additive relationship matrix using the R package *dartR* (Gruber et al. 2018) for all 255 samples, and categorised by group (assigned in section 1.3.2, Genetic diversity and population differentiation). The additive relationship matrix is a theoretical framework for estimating a relationship matrix that is consistent with an approach to estimate the probability that the alleles at a random locus are identical in state (Endelman and Jannink 2012). Additive relationships carry information on genetic resemblance from common inheritance and are based on probabilities that gene pairs are identical by descent (Wright 1922).

4.5.2.4 Sexing

Sex of unique individual koalas was determined using sex-linked genetic markers for koalas used in co-analyses. Of the 255 samples available for co-analyses, 115 samples passed the genotyping quality control for sex determination. Of the 36 ARTC samples available for co-analyses, 31 samples passed the genotyping quality control for sex determination.

4.5.2.5 *Chlamydia* detection

The prevalence of *Chlamydia* (percent of koalas with the pathogen) was estimated in koala scats using SNP genotyping for the samples used in DArTcap and DArTtag co-analyses. Of the 255 samples available for co-analyses, 105 samples passed the genotyping quality control for *Chlamydia* detection. Of the 36 ARTC samples available for co-analyses, 30 samples passed the genotyping quality control for *Chlamydia* detection.

4.5.2.6 Tree genetic analysis

To cross reference the diet preference of koala from scat collected during the genetics study, a DNA library of potential feed tree species was undertaken alongside the koala scat analysis by researchers from the University of Queensland.

Referring to literature a list of candidate koala food trees species for Queensland was collated (utilising species from genera Eucalyptus, Corymbia and Angophora). With this list, leaf samples were taken from four individual trees per species per sampling site along the eastern edge of QLD and NSW with the specimens being prepared (air drying, freezing etc.) for DNA extraction. Existing tree DNA sequences were supplemented into the study from other projects as well.

After specimen collection and preparation the samples underwent DNA extraction via automated plate-based extraction protocol, by Diversity Arrays Technology P/L, Canberra, Australia (DArT) to compile (DNA fragments) and single nucleotide polymorphisms (SNPs). Following this, the now created panel underwent validation to remove unusable datasets, final product being able to discriminate most eucalypt species (exceptions being closely related species or subspecies).

Further detailed information for this research can be found in Appendix C.

**Figure 4-1 Map provided by UniSC of sample groups included in co-analyses;
(A) North and (B) South**

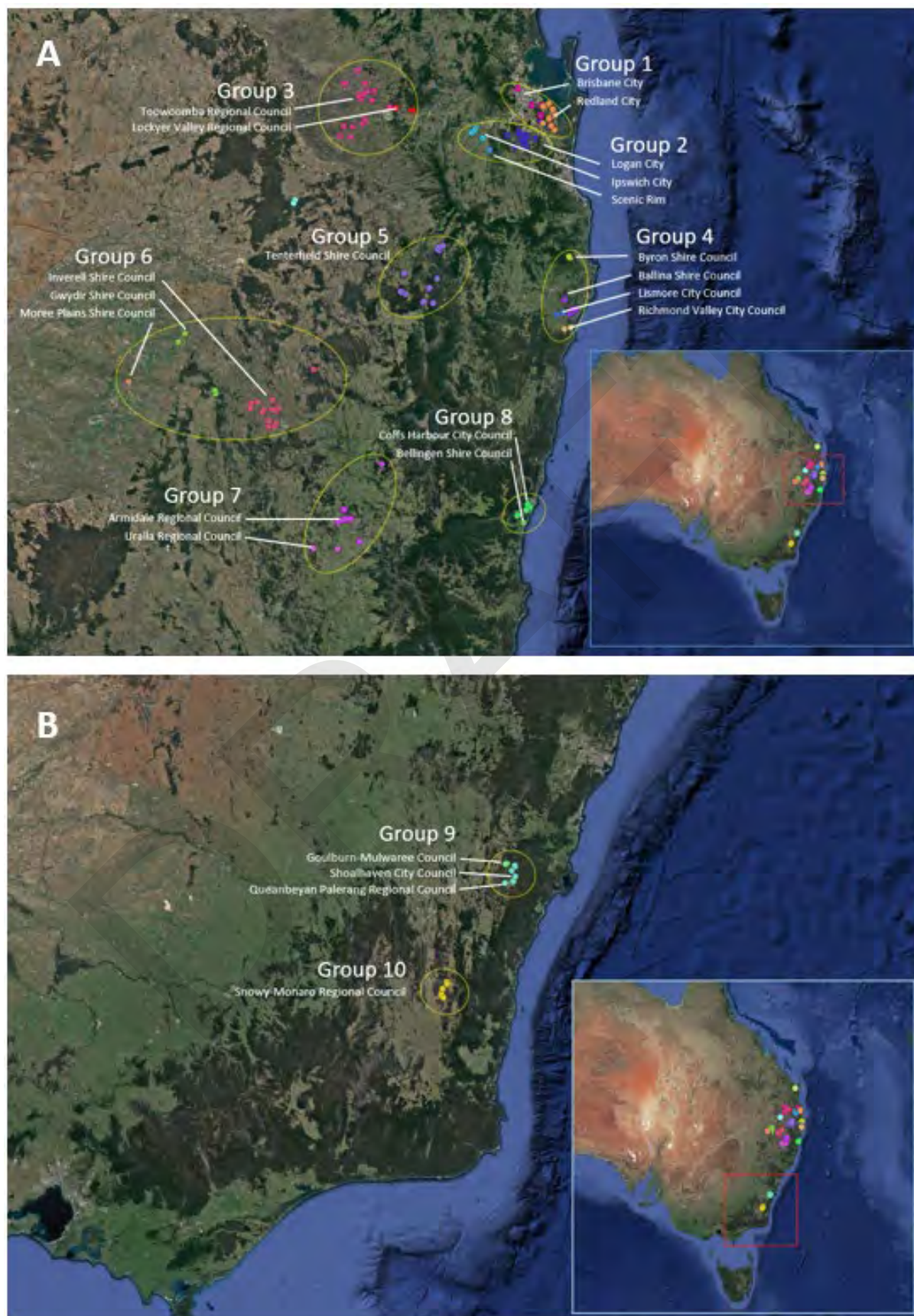


Table 4-4 Groupings of koala samples used for genetic diversity estimates

Group	Sample locations in the group (sample size)	Sample size per group	Number of ARTC Samples
Group 1	Brisbane City (05)	43	
	Redland City (37) (= Koala Coast)		
Group 2	Logan City (17)	24	4
	Ipswich City (06)		6
	Scenic Rim Regional (02)		2
Group 3	Lockyer Valley Regional (10)	34	10
	Toowoomba Regional Council (24)		6
Group 4	Byron Shire Council (02)	25	
	Ballina Shire Council (19)		
	Lismore City Council (02)		
	Richmond Valley Council (02)		
Group 5	Tenterfield Shire Council (31)	31	
Group 6	Inverell Shire Council (29)	36	
	Gwydir Shire Council (04)		2
	Moree Plains Shire Council (03)		3
Group 7	Armidale Regional Council (18)	21	
	Uralla Shire Council (03)		
Group 8	Coffs Harbour City Council (06)	08	
	Bellingen Shire Council (02)		
Group 9	Goulburn Mulwaree Council (07)	17	
	Shoalhaven City Council (09)		
	Queanbeyan–Palerang Regional Council (01)		
Group 10	Snowy Monaro Regional Council (10)	10	

4.5.3 Diet Analysis

4.5.3.1 Sequencing of potential food tree species

DNA was extracted from leaf samples using an automated plate-based extraction protocol, by Diversity Arrays Technology P/L, Canberra, Australia (DArT). The remaining reference leaves were extracted using CTAB extraction buffer with chloroform clean-up and ethanol precipitation. This protocol has been optimised for Eucalyptus by DArT in association with prior clients for Eucalyptus genotyping. Read counts for targets (DNA fragments) and single nucleotide polymorphisms (SNPs) within those targets were determined by DArT using their standard proprietary pipelines (Grewe et al. 2015, Kilian et al. 2012). Species belonging to the different genera and Eucalyptus subgenera were run through the DArT pipelines separately, to maximise the number of potentially useful loci identified. Read proportions for the reference and alternative SNP alleles at each locus were determined using custom code in R studio 1.2.5033.

4.5.3.2 Identification of species-specific SNPs and panel validation

Prior to identification of species-specific SNPs, a Principal Components Analysis was performed on the Hamming genetic distance matrix generated from the SNP data in GenAlEx 6.1 to confirm the species designations of the samples. Samples that did not cluster with their designated species or samples with one or more heterozygous loci were removed from the dataset. Additionally, for a small number of species that were taxonomically distinct from all other species in the datasets (i.e. *Araucaria cunninghamii* and *Acacia melanoxylon*), in silico DArTs that were present only in the target species were also identified as potential species-specific genetic markers.

The list of species-specific SNPs identified from the DArTseq data was filtered to retain only a single SNP per unique DArT sequencing fragment to minimise the impact of linkage disequilibrium among potential markers. Up to 30 SNPs/in silico DArTs were then selected per species for oligo design, using species-specific SNPs that were identified in the middle of the DArT target. Oligos were designed by identifying probe regions flanking the selected SNPs using primer design software in Genious (Drummond et al. 2009). The selected tags (SNPs and flanking regions) were run through a DArTag assay and were hybridised to denatured eucalyptus DNA before final amplification.

The products of DArTag assay were then sequenced on the HiSeq 2500 (Illumina), demultiplexed and targeted SNPs detected using DArT P/L's proprietary analytical pipeline (DARToolbox). There were four species (*E. prava*, *E. laevopinea*, *E. andrewsii* and *Araucaria cunninghamii*) that were not included in the validation panel due to a lack of available samples. It was confirmed that these markers did not amplify in any non-target species, however, amplification in the target species could not be confirmed.

After validation 1122 markers were retained and the marker panel was able to discriminate most eucalypt species. There were some exceptions where closely related species or subspecies could not be distinguished, although DNA from one or more of the species in question was confirmed to be present. This was particularly notable for the ironbarks from the series *Siderophloiae* (*E. crebra*, *drepanophylla*, *fibrosa*, *rhombica*, *dura*, *cullenii*, *whitei*, *melanophloia*).

4.5.3.3 Diet determination from scats

DNA was extracted from the koala scats using CTAB extraction buffer with chloroform clean-up and ethanol precipitation (Healey et al. 2014). Those SNPs that were confirmed to be species-specific on the DArTag platform were amplified and sequenced from the faecal DNA extracts (as described above) to determine the composition of the koalas' diets. The sequencing read counts were filtered and removed if the average number of reads per detected marker was less than 3 or if fewer than two SNPs were detected in target species that had 3 or more validated markers to remove likely sequencing errors and low frequency contamination. The remaining filtered readers for each marker were normalised to account for differences among markers in amplification efficiency. The number of scaled reads for each target species was then averaged across those markers that were found in the highest proportion of target tree species individuals. The averaged scaled reads per target species were then converted to relative abundance by dividing by the total number of averaged scaled reads across all target species.

4.6 Limitations to Study

While this study helps address current knowledge gaps, the restriction of access to study sites to within the boundary of the IRP and where landowner agreements could be established limited the ability to accurately sample across koala populations. Furthermore, the geographic distance between detected samples establishes challenges for movement and dispersal distance in koalas is closely associated with habitat connectivity (Rus, McArthur, Mella, & Crowther, 2021). In highly disturbed landscapes, such as those typical throughout the agricultural land of the IRP, koala home ranges are likely to be larger than in contiguous forest environments (Ellis, Melzer et al. 2002). Considering repeat surveys were not undertaken, this does potentially increase the risk of recording false absences.

Additionally, surveys were unable to be extended to areas surrounding the ARTC footprint, which would have allowed for greater geographic coverage and increased sample sizes, enabling more population-level comparisons. These factors constrained the number of samples that could be collected, limiting our ability to capture the broader landscape and seasonal context of koalas using the project footprint. Co-analysing the samples collected along the ARTC footprint with samples from previous surveys was completed to address this limitation. The results of this study should not be considered a thorough indication of koala population levels however can be used as a proxy for koala health and population genetics at the local scale.

DRAFT

5. FIELD SURVEY RESULTS SUMMARY

A total of one hundred and twenty (120) detection dog surveys were undertaken throughout the IRP. Of these, fresh scats and individual koalas were found at forty-one (41) sites with detections made in northern NSW and Southeast Queensland (Figure 5-1). These detections were made within the N2NS, B2G, G2H, H2C, C2K, and K2AB sections of the IRP.

5.1 Scat Detections

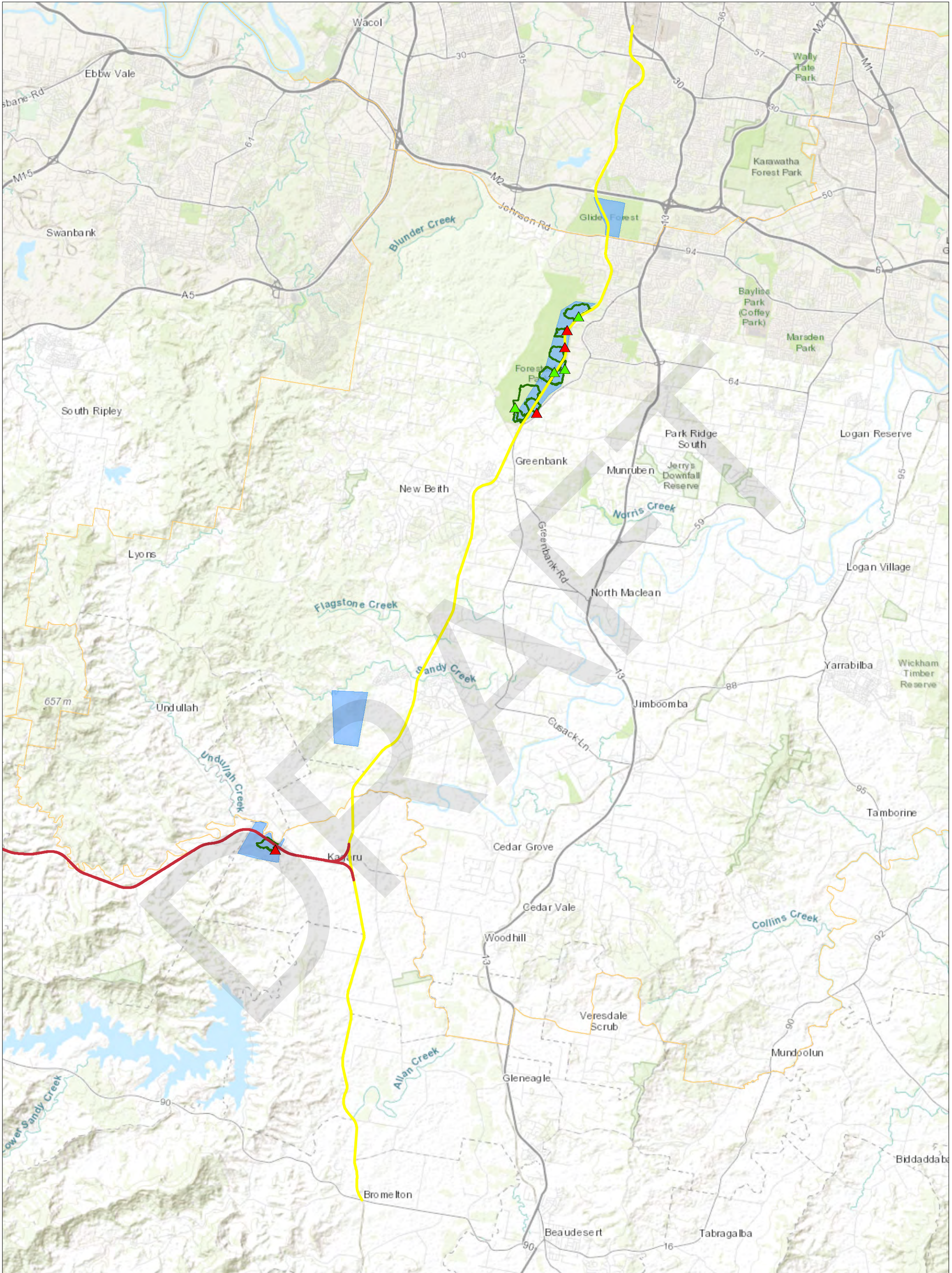
Koala detection dog surveys returned seventy-three (73) fresh scat detections throughout the IRP. The majority of these scat detections were found within QLD sections of the IRP. These were spread throughout the city council municipalities of Toowoomba, Logan City, Lockyer Valley Regional Council, City of Ipswich, Goondiwindi Region and Scenic Rim.

The remaining scats were identified in the two NSW council municipalities of Gwydir Shire and Moree Plains Shire in the townships of Croppa Creek and Moree.

5.2 Koala Detections

A total of eight (8) koala detections were made throughout the QLD sections of the IRP, within the city council municipalities of Toowoomba, Lockyer Valley Regional Council, City of Ipswich and Logan City. Five (5) individuals were identified as healthy with no signs of Chlamydia infection. Three (3) dead individuals were found, two (2) of which were identified only through bones. Cause of death could not be determined, however on one (1) dead female no obvious signs of chlamydia infection could be detected. Only one individual in the Lockyer Valley was found with 'Wet Bum', an indicator of chlamydia infection.

Koala detection dog surveys throughout the NSW sections of the IRP returned a single detection of an individual made in Moree on 22 July 2022. The individual was of unknown sex and no signs of Chlamydia infection could be observed. The individual was located in riparian vegetation along the edge of a river. No scat was found for collection within the vicinity.



Legend

Dog Surveys

 No Detection

 Detection

 Dog Track

 Pre-fieldwork Hotspots

 LGA Boundary

Inland Rail Alignment

 C2K - Calvert to Kagaru

 K2AB - Kagaru to Acacia Ridge/Bromelton

Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd

Date: 14/02/2024

Drawn By: VN

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

024km



Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

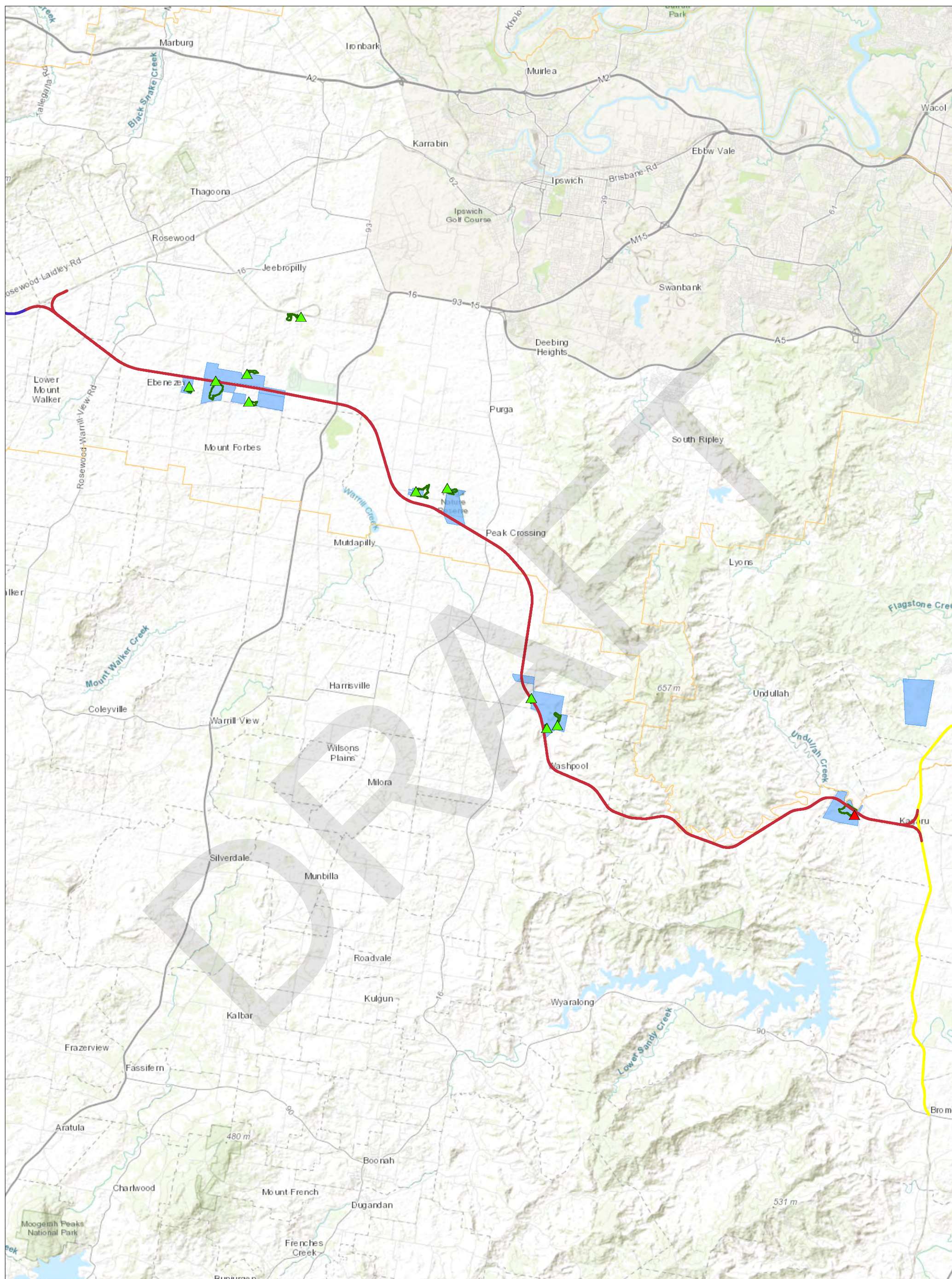
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F5-1a

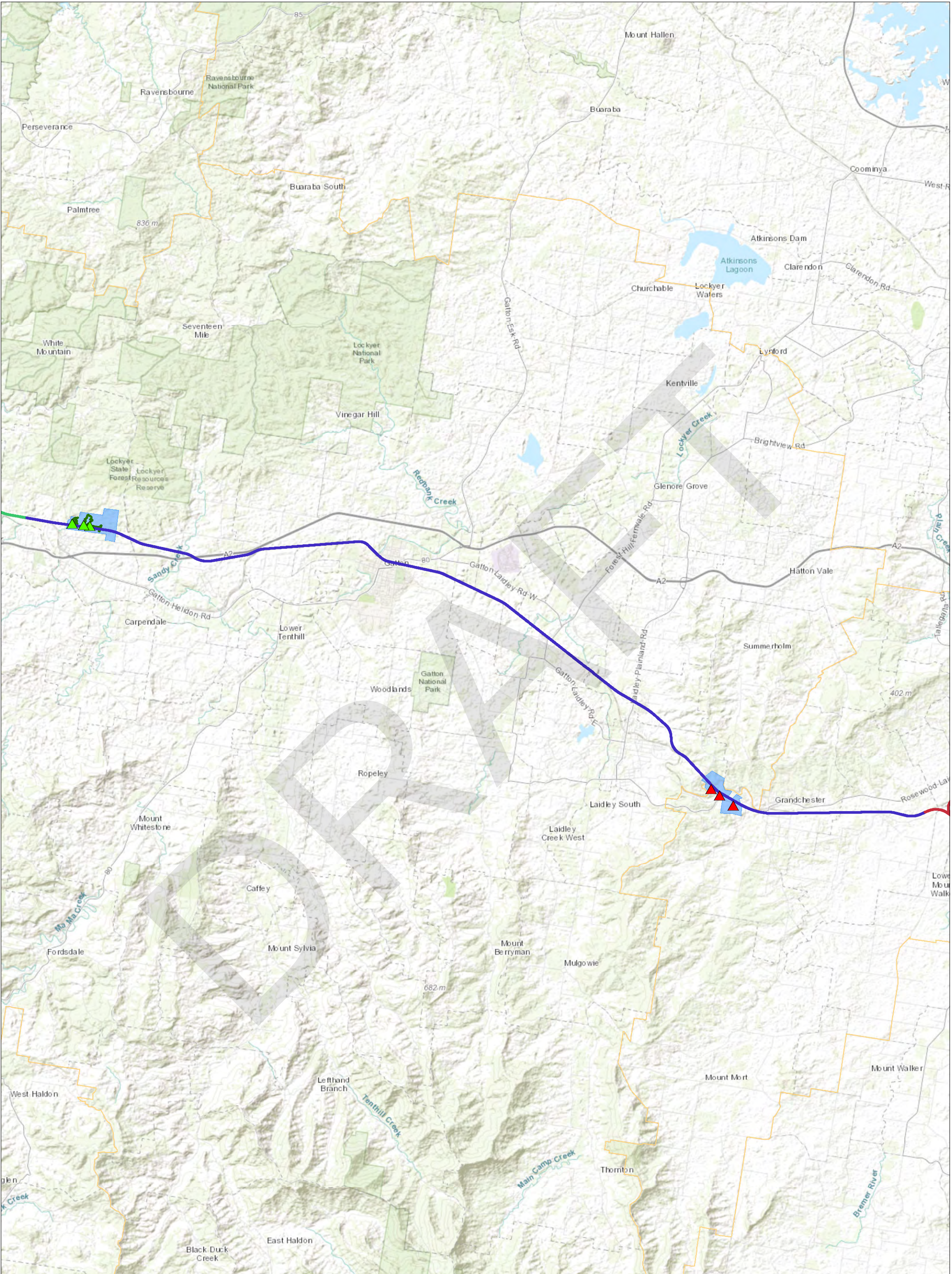
Data Source:
ESRI World Topographic Map



Legend		Inland Rail Alignment	
	No Detection		C2K - Calvert to Kagaru
	Detection		H2C - Helidon to Calvert
	Dog Track		K2AB - Kagaru to Acacia Ridge/Bromelton
	Pre-fieldwork Hotspots		
	LGA Boundary		

Data Source:
ESRI World Topographic Map

Locations of Detection Dog Surveys		F5-1b
Drawing No: 0628339_N2AB_TM_G004_R3.mxd	Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN	Reviewed By: MD	Client: ARTC
Coordinate System: GDA2020 MGA Zone 56		
		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



Legend

Dog Surveys

- No Detection
- Detection
- Dog Track
- Pre-fieldwork Hotspots
- LGA Boundary

Inland Rail Alignment

- C2K - Calvert to Kagaru
- G2H - Gowrie to Helidon
- H2C - Helidon to Calvert

Data Source:
ESRI World Topographic Map

Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd

Date: 14/02/2024

Drawn By: VN

Drawing Size: A4

Reviewed By: MD

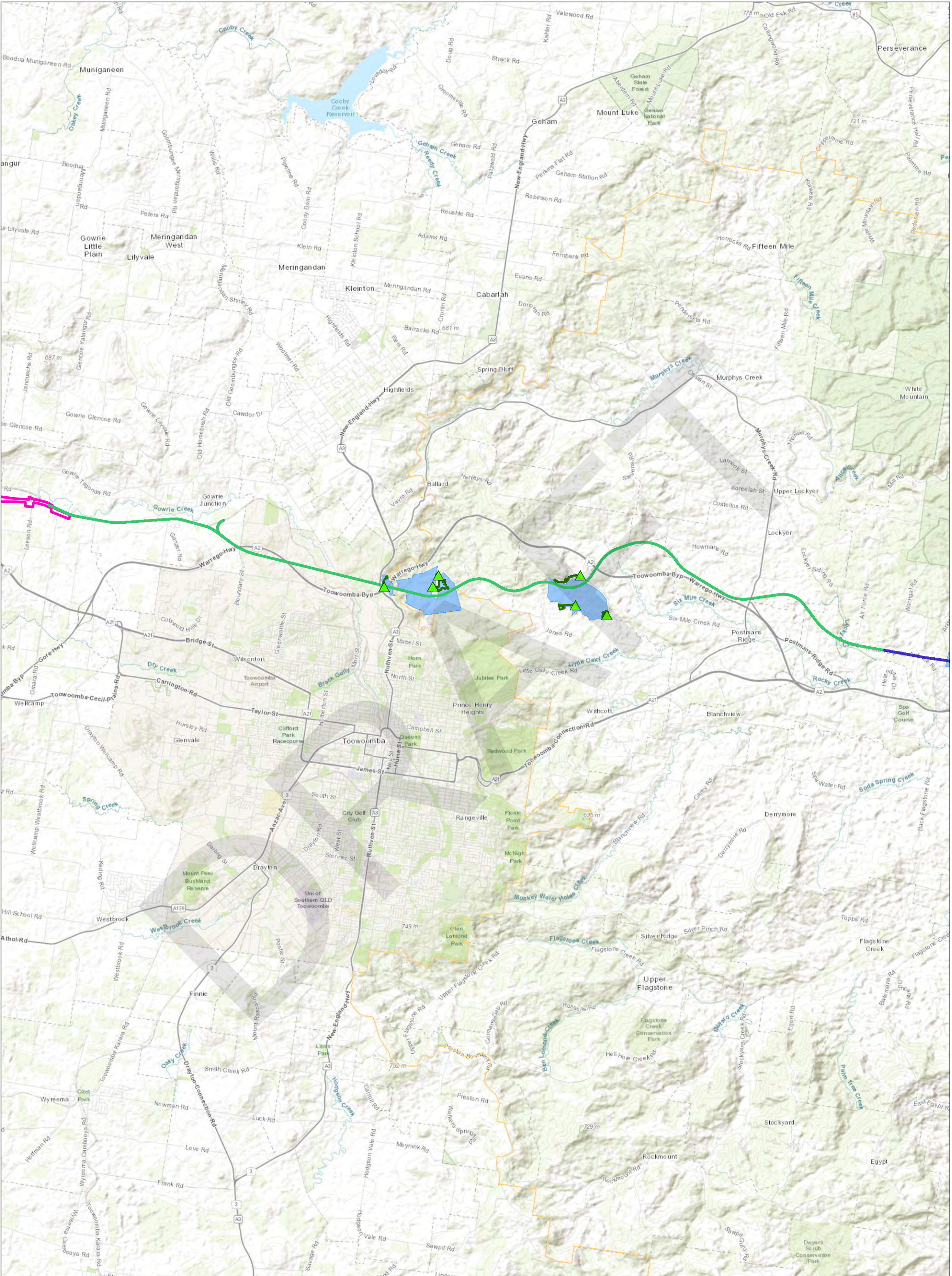
Coordinate System: GDA2020 MGA Zone 56

024Km

N

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F5-1c



Legend

Dog Surveys

Detection

Dog Track

Pre-fieldwork Hotspots

LGA Boundary

Inland Rail Alignment

B2G - NSW/QLD Border to Gowrie

G2H - Gowrie to Helidon

H2C - Helidon to Calvert

Data Source:
ESRI World Topographic Map

Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd

Date: 14/02/2024

Drawn By: VN

Coordinate System: GDA2020 MGA Zone 56

02

4km

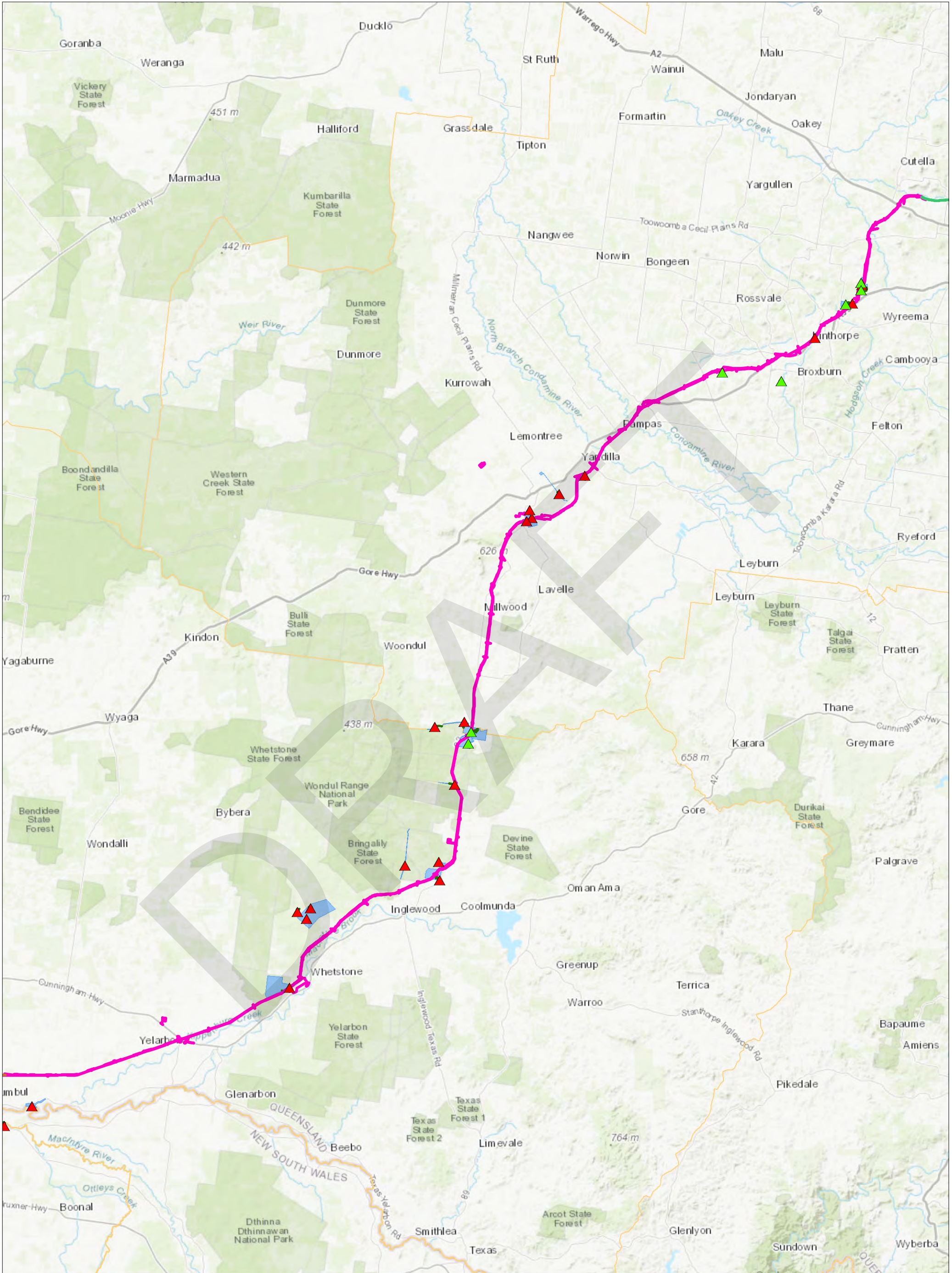
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Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

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F5-1d



Legend	
Dog Surveys	▲ No Detection
	▲ Detection
	— Dog Track
	■ Pre-fieldwork Hotspots
	— LGA Boundary
Inland Rail Alignment	
	— B2G - NSW/QLD Border to Gowrie
	— G2H - Gowrie to Helidon
	— NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

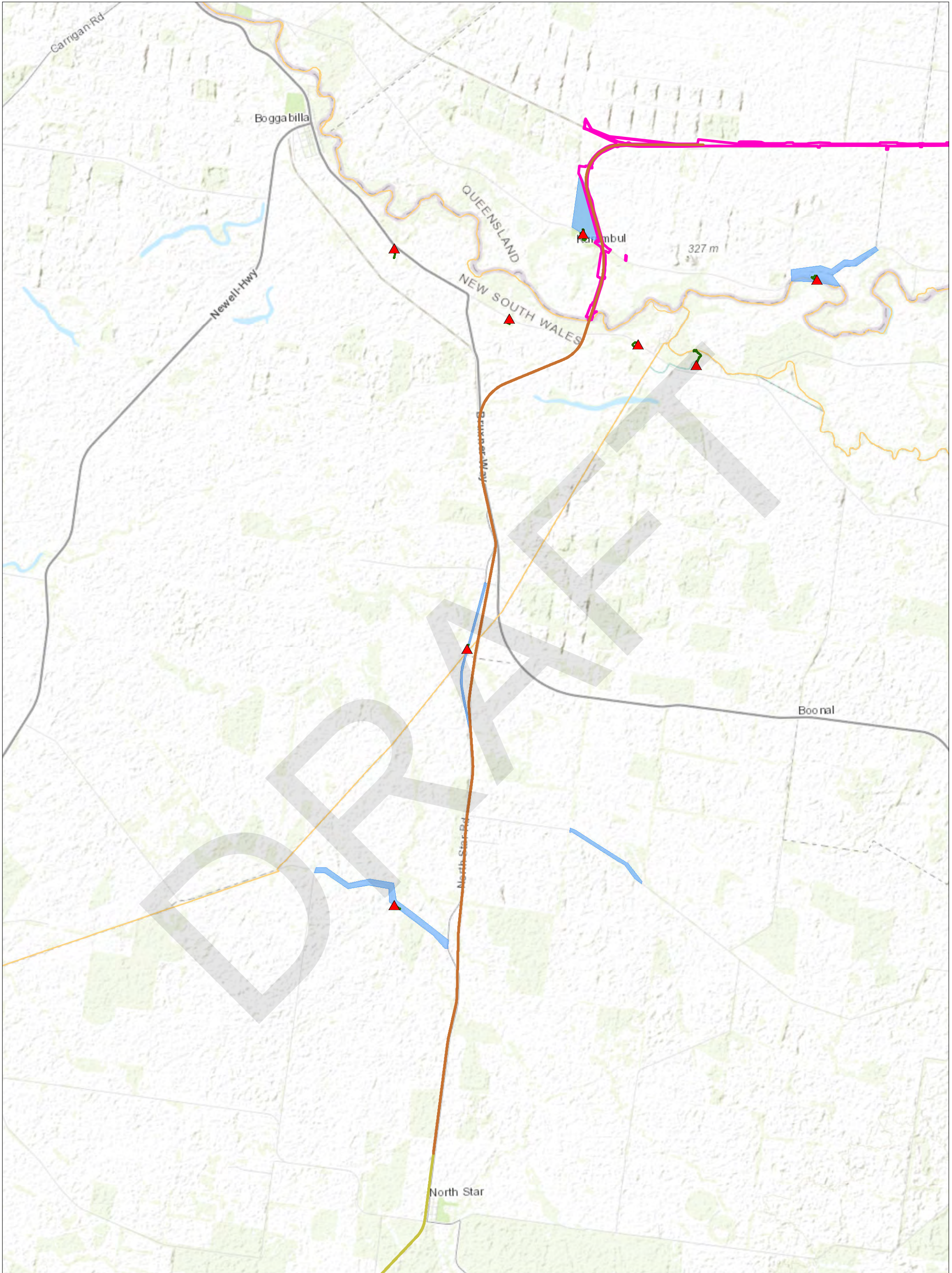
Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)		
Date: 14/02/2024	Drawing Size: A4			
Drawn By: VN	Reviewed By: MD	Client: ARTC		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.		
				
				



F5-1e





- Legend**

Dog Surveys

 - No Detection
 - Dog Track
 - Pre-fieldwork Hotspots
 - LGA Boundary
- Inland Rail Alignment**

 - B2G - NSW/QLD Border to Gowrie
 - N2NS - Narrabri to North Star
 - NS2B - North Star to Border

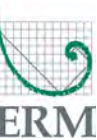
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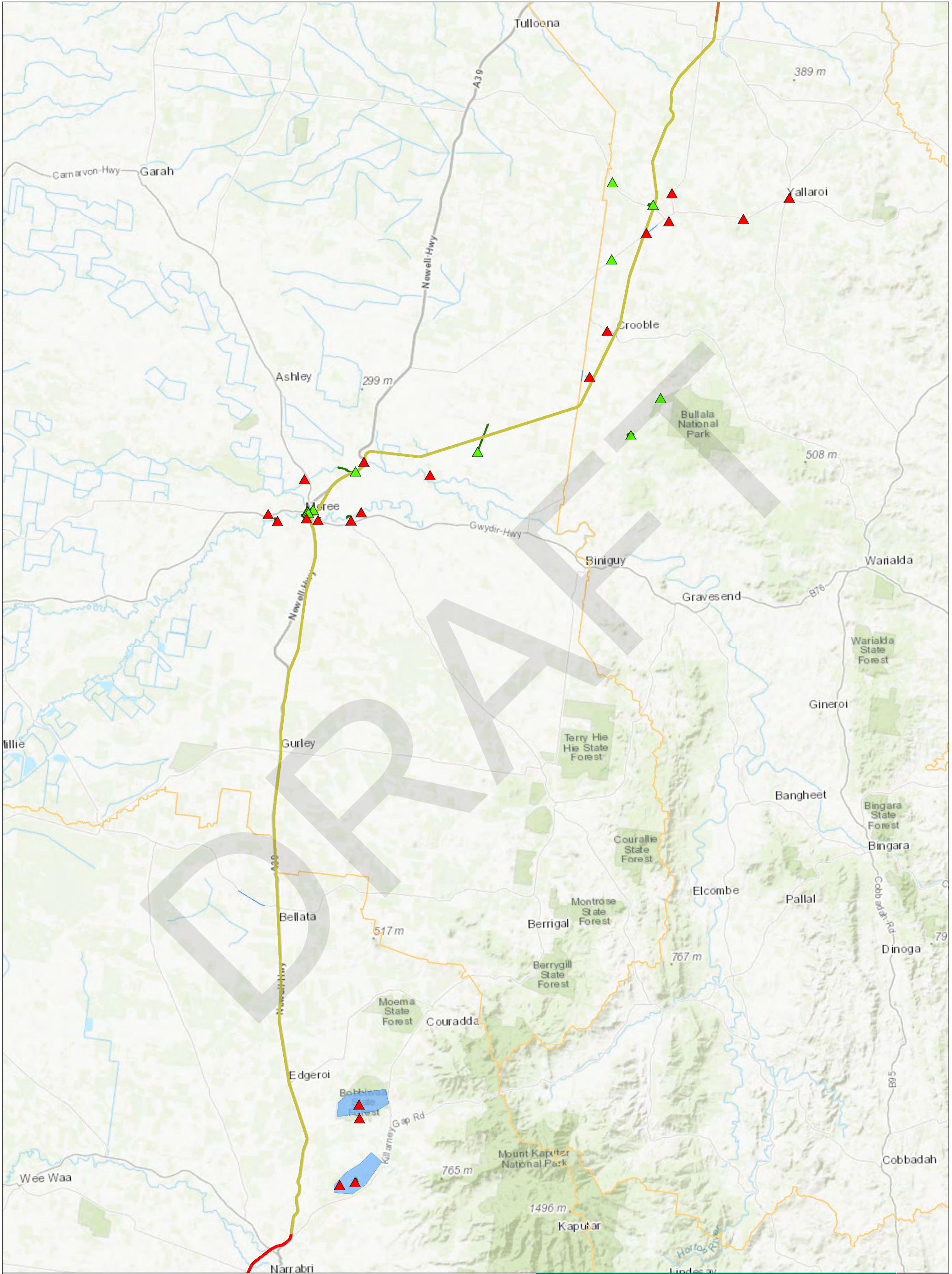
Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN	Reviewed By: MD	
Client: ARTC		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
0 2 4Km		
		



F5-1f





Legend

Dog Surveys

- No Detection
- Detection
- Dog Track
- Pre-fieldwork Hotspots

Inland Rail Alignment

- N2N - Narramine to Narrabri
- N2NS - Narrabri to North Star
- NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Locations of Detection Dog Surveys

Drawing No: 0628339_N2AB_TM_G004_R3.mxd

Date: 14/02/2024

Drawn By: VN

Coordinate System: GDA2020 MGA Zone 56

0 2 4Km

Drawing Size: A4

Reviewed By: MD

N

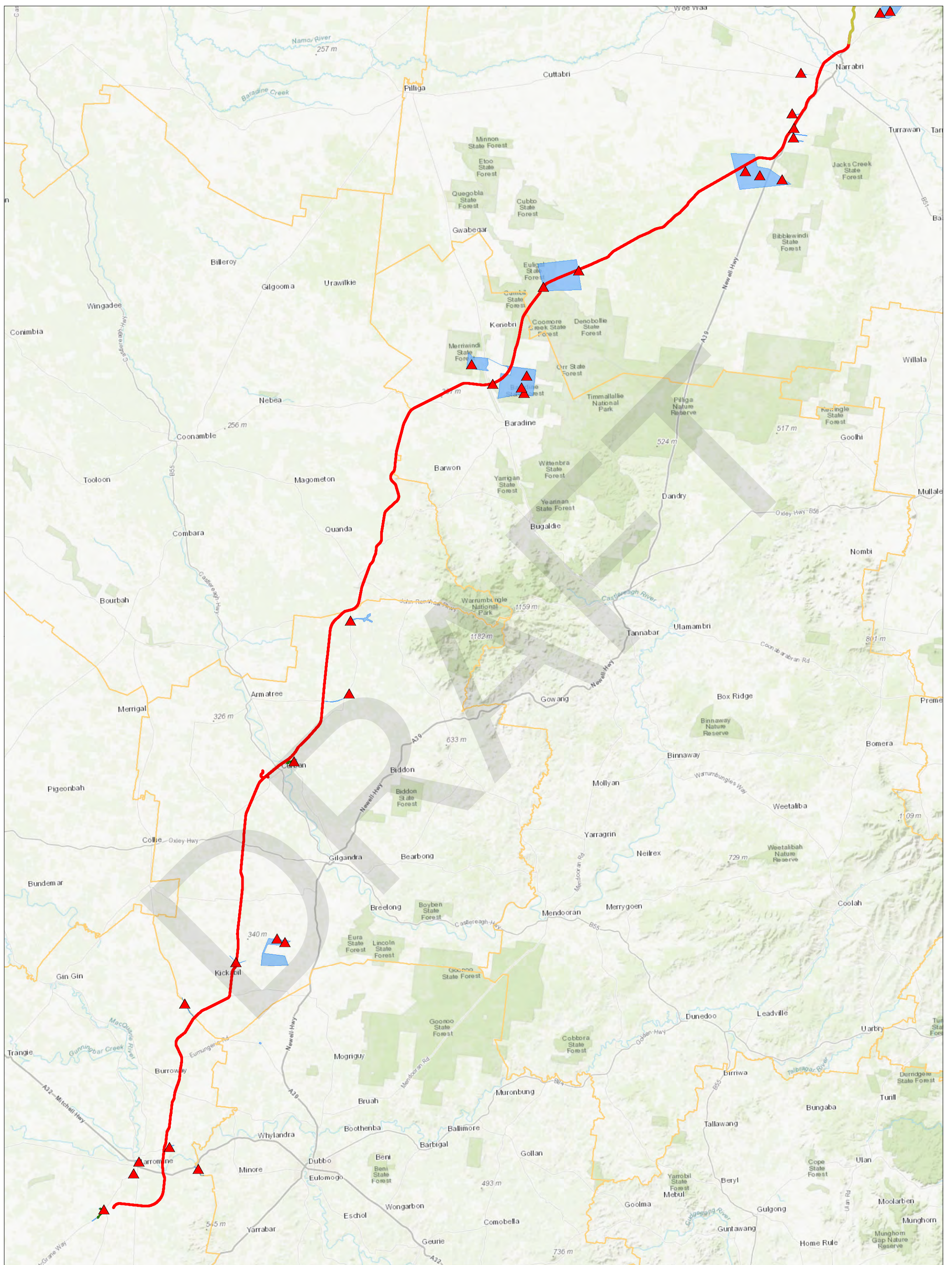
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F5-1g

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC



Legend

Dog Surveys

 No Detection

— Dog Track

Pre-fieldwork Hotspots

Inland Rail Alignment

— N2N - Narromine to Narrabri

— N2NS - Narrabri to North Star

Data Source:
ESRI Would Topographic Map

5.3 Vegetation assessments

To gain a broad understanding of the available koala habitat within the IRP a total of ninety-one (91) vegetation assessments were completed alongside the detection dog surveys. See figure 5-2 for a representation of vegetation assessment survey effort.

The landscape throughout the survey sites was dominated by fragmented and disturbed remnant or advanced regrowth vegetation found along roadsides, ephemeral creek lines and publicly accessible areas (i.e., state forest, council parklands).

Overall, three Eucalypts presented as the main dominant canopy species: *Eucalyptus populnea*, *E. crebra* and *E. camaldulensis*. Each of the regions in the study area displayed varying quality and abundance of koala habitat. Accordingly, the habitat can be broken up into three different sections of the IRP:

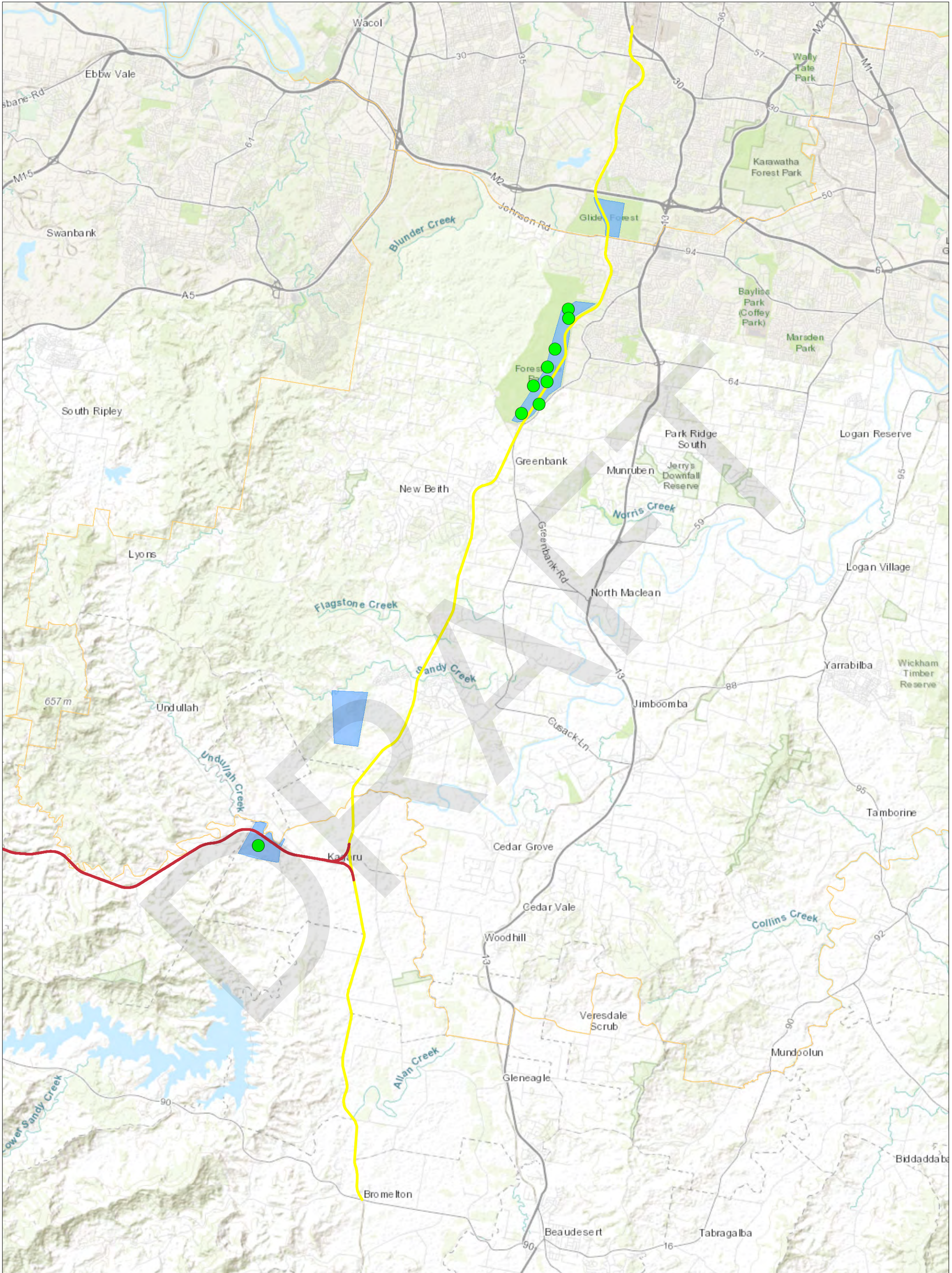
- East of the Toowoomba range (K2ARB, C2K, H2C and G2H);
- West of the Toowoomba range to the Queensland-NSW border (B2G); and
- New South Wales (NS2B, N2NS and N2N).

East of the Toowoomba Range vegetation surveys showed canopy species being dominated by *Eucalyptus crebra*, *E. citriodora* and *Corymbia intermedia*.

West of the Toowoomba region found canopy species being dominated by *E. populnea*, *E. camaldulensis*, *E. chloroclada*.

The NSW regions found canopy species being dominated by *E. camaldulensis*, *E. populnea* and *E. crebra*.

A further breakdown of koala food-tree availability across the projects of the IRP is found in Section 9 Koala Habitats in the Study Area.



Legend

● Quaternary Assessment — Inland Rail Alignment

Pre-fieldwork Hotspots —

LGA Boundary

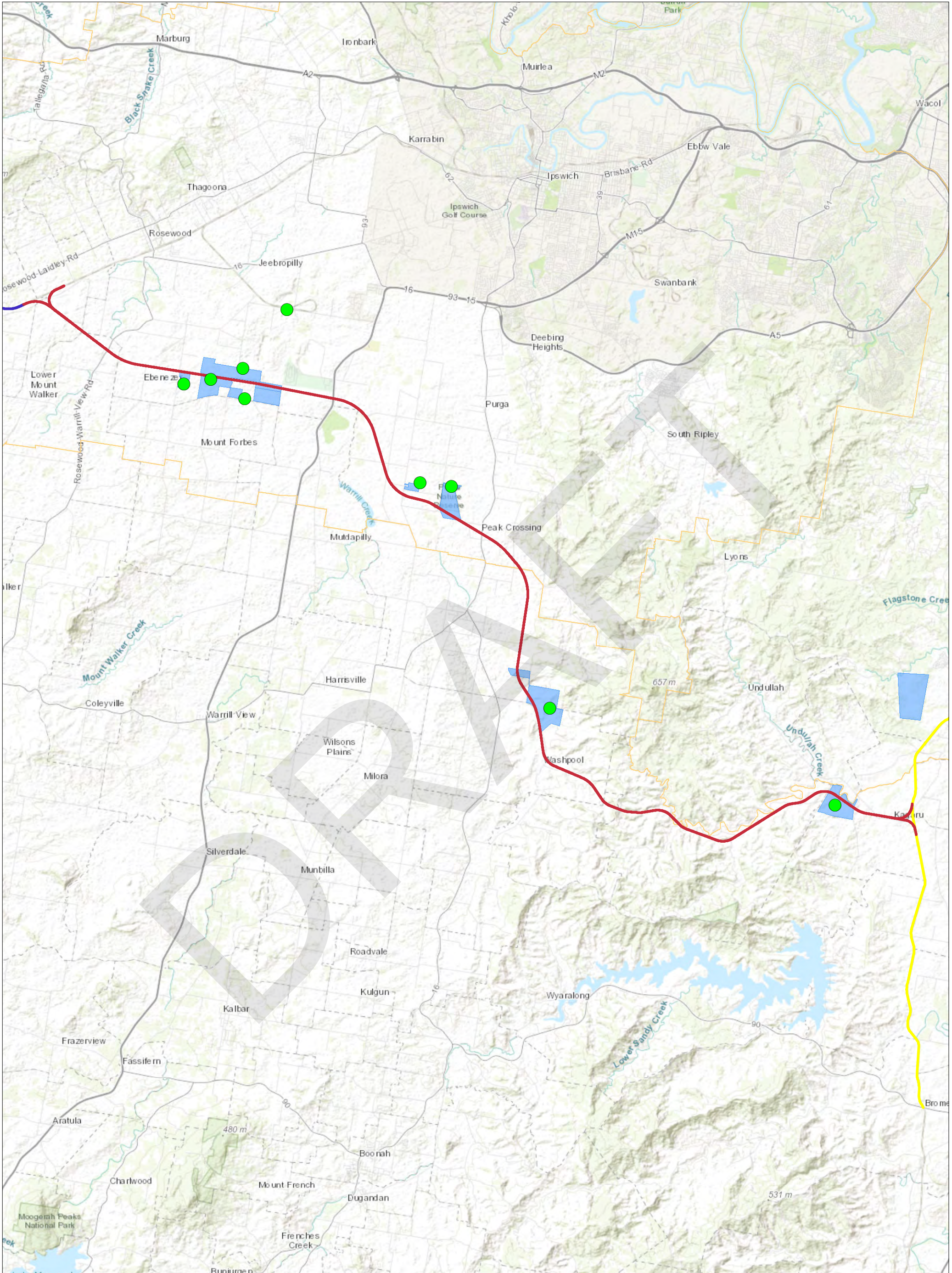
Data Source:
ESRI World Topographic Map

Vegetation Assessments Across the IRP

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Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	Client: ARTC
Coordinate System: GDA2020 MGA Zone 56		
0 2 4km		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F5-2a





- Legend**
- Quaternary Assessment
 - Pre-fieldwork Hotspots
 - LGA Boundary
 - Inland Rail Alignment

Data Source:
ESRI World Topographic Map

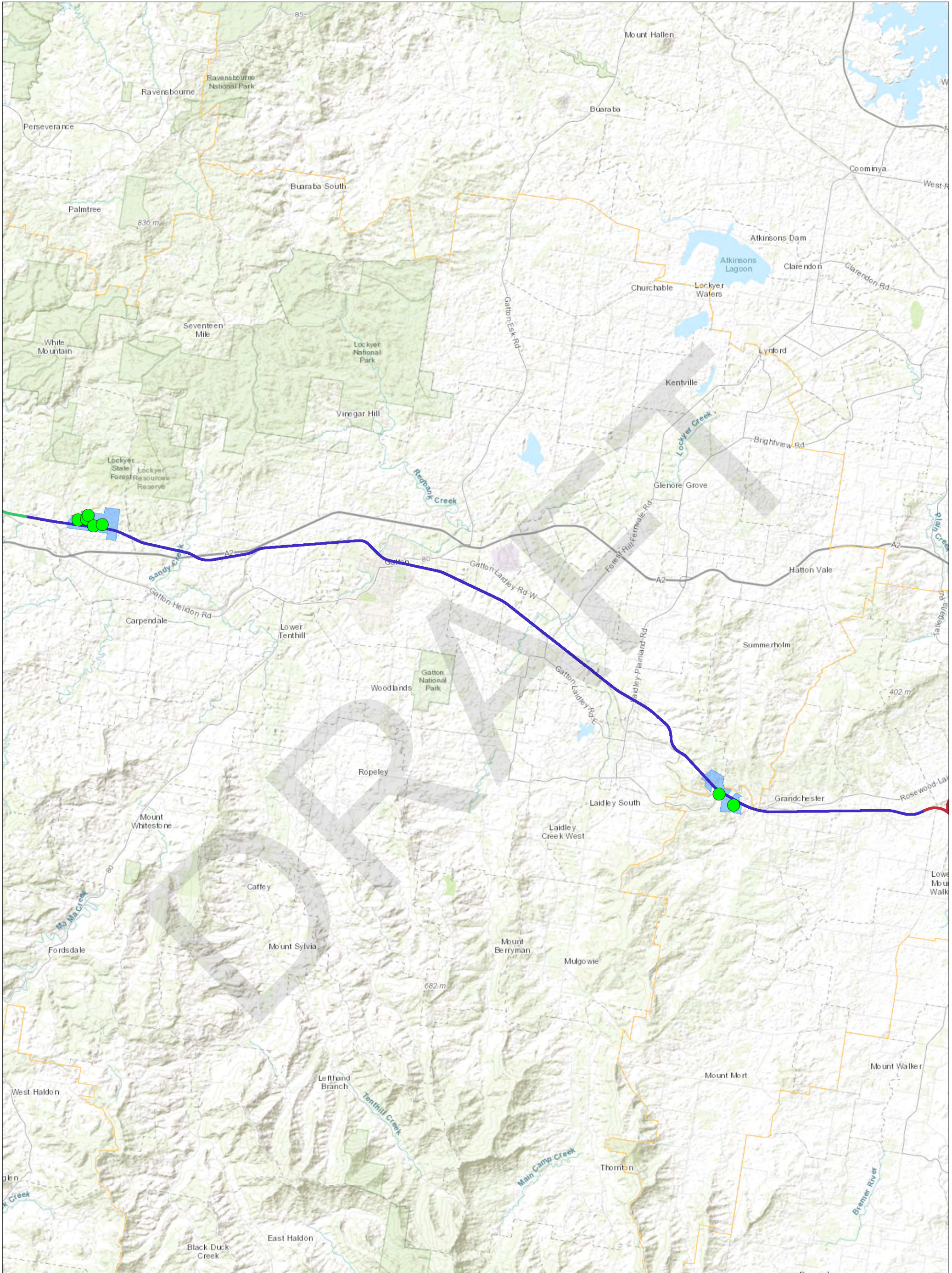
Vegetation Assessments Across the IRP

Drawing No: 0628339_N2AB_TM_G005_R3.mxd	Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC
Drawn By: VN/CB	Reviewed By: MD	
Coordinate System: GDA2020 MGA Zone 56		
0 2 4km		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



F5-2b





- Legend**
- Quaternary Assessment
 - Pre-fieldwork Hotspots
 - LGA Boundary
 - Inland Rail Alignment

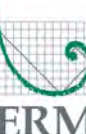
Data Source:
ESRI World Topographic Map

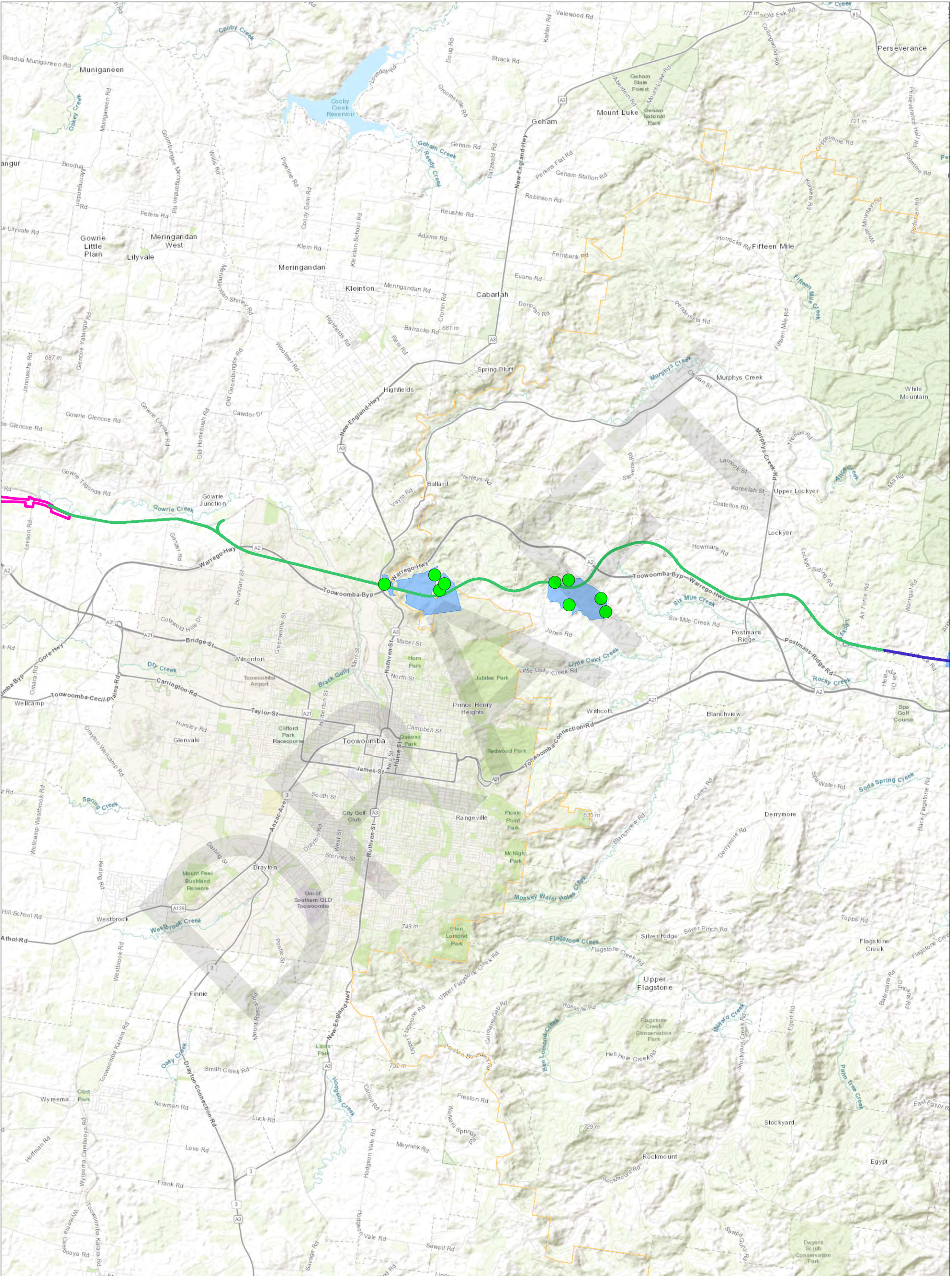
Vegetation Assessments Across the IRP

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Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	Client: ARTC
Coordinate System: GDA2020 MGA Zone 56		
0 2 4km		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



F5-2c





Legend

Quaternary Assessment

Pre-fieldwork Hotspots

LGA Boundary

Inland Rail Alignment

Data Source:
ESRI World Topographic Map

Vegetation Assessments Across the IRP

Drawing No: 0628339_N2AB_TM_G005_R3.mxd

Date: 14/02/2024

Drawn By: VN/CB

Coordinate System: GDA2020 MGA Zone 56

Drawing Size: A4

Reviewed By: MD

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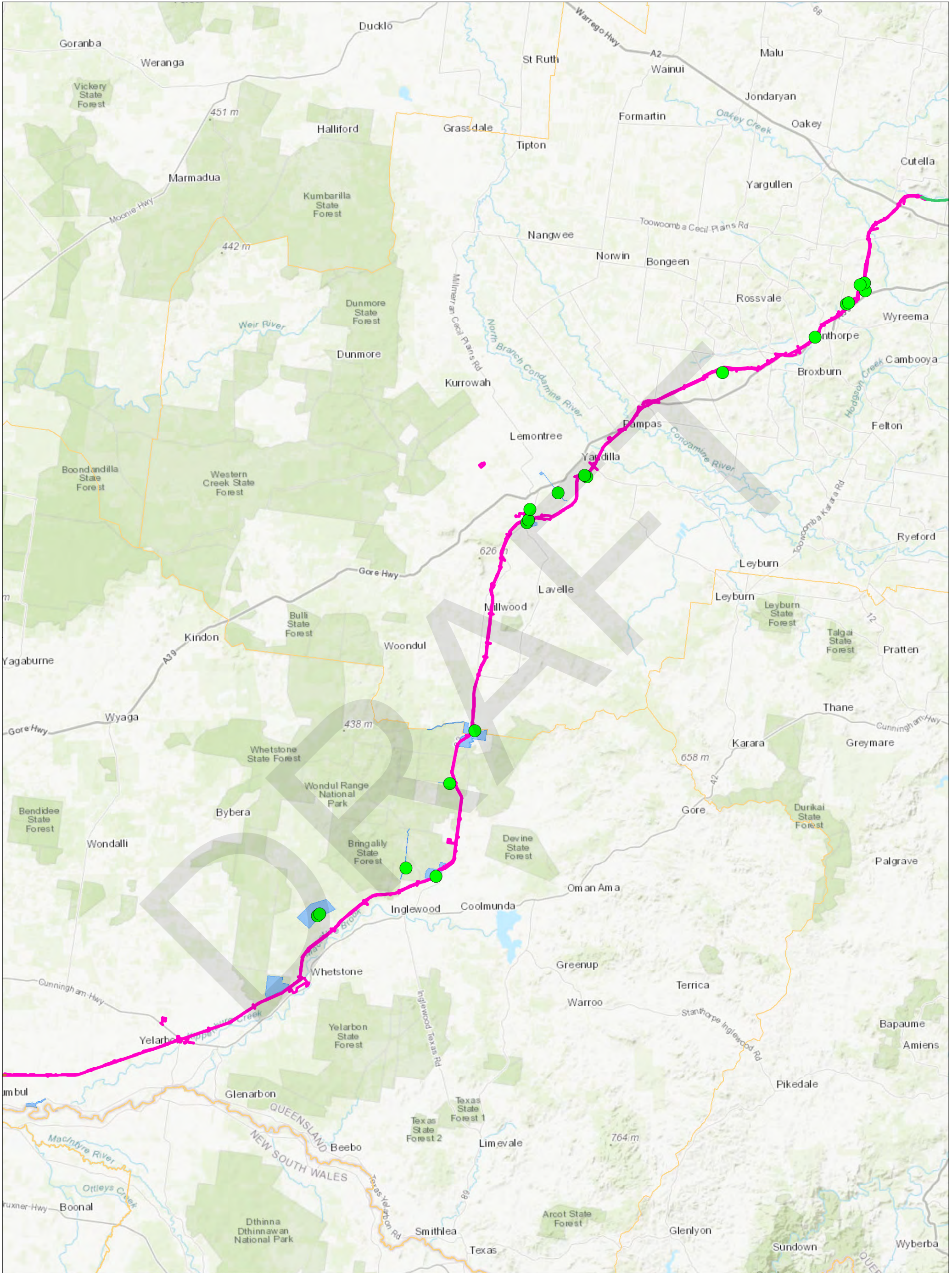
Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

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ERM

F5-2d



- Legend**
- Quaternary Assessment
 - Pre-fieldwork Hotspots
 - LGA Boundary
 - Inland Rail Alignment

Data Source:
ESRI World Topographic Map

Vegetation Assessments Across the IRP

Drawing No: 0628339_N2AB_TM_G005_R3.mxd	Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	Client: ARTC

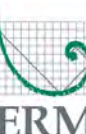
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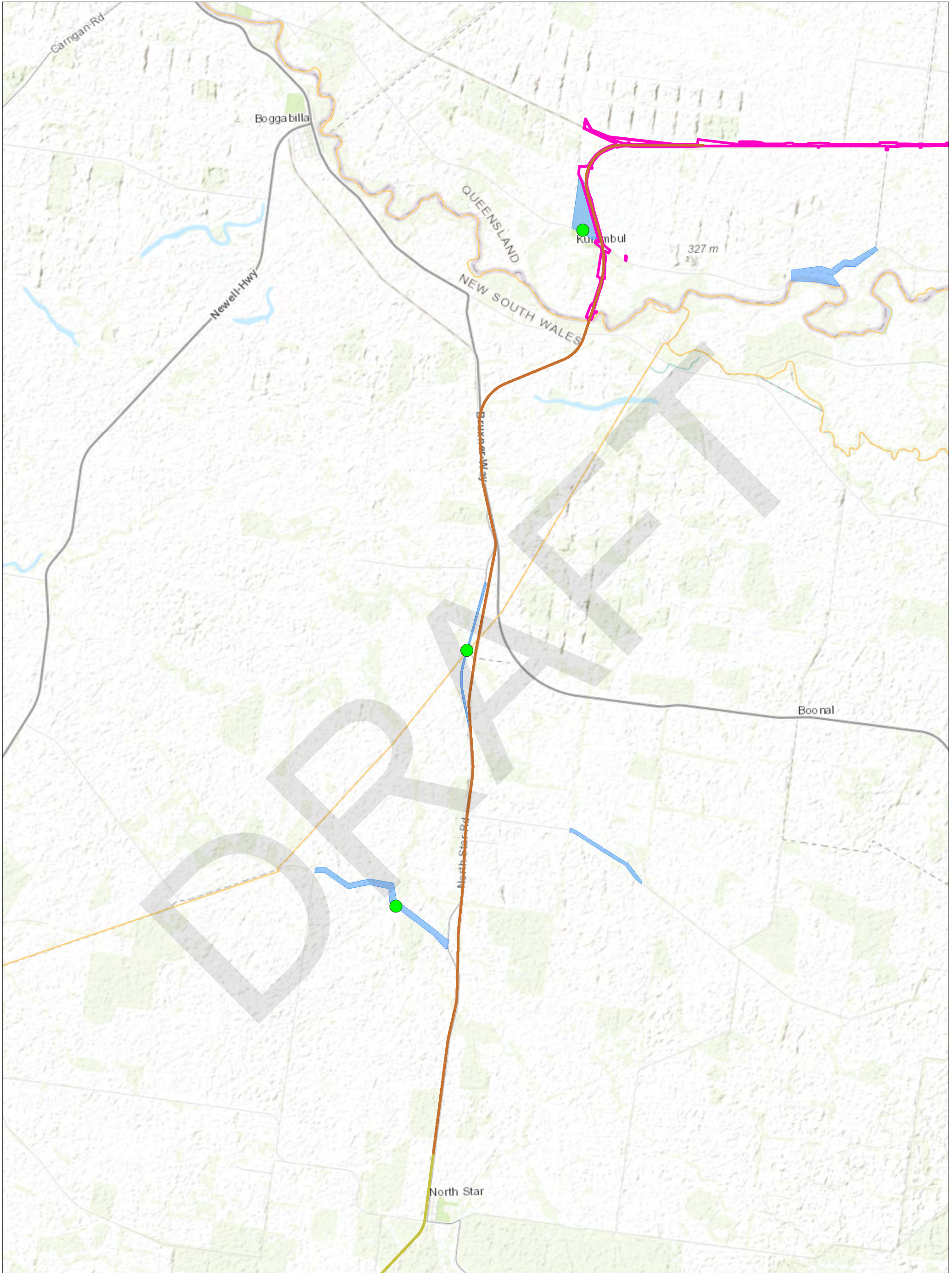
0 2 4km



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F5-2e





- Legend**
- Quaternary Assessment
 - Pre-fieldwork Hotspots
 - LGA Boundary
 - Inland Rail Alignment

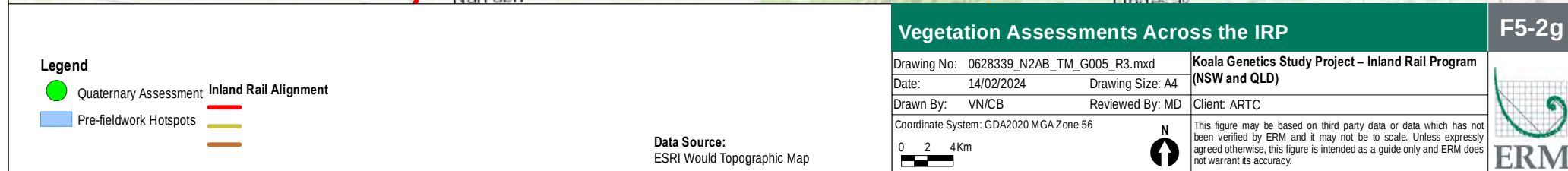
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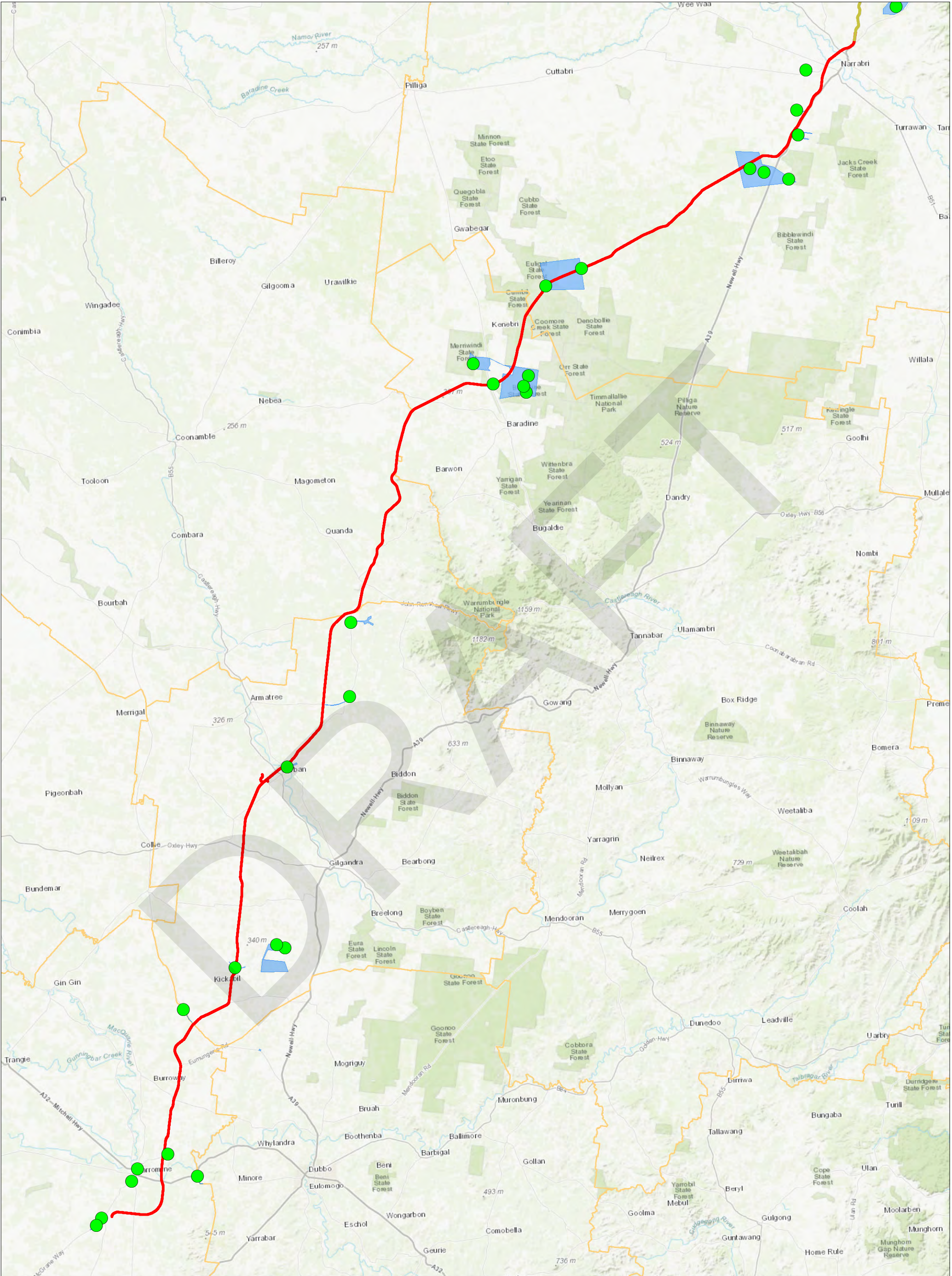
Vegetation Assessments Across the IRP

Drawing No: 0628339_N2AB_TM_G005_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN/CB	Reviewed By: MD	
Client: ARTC		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
0 2 4Km		
		

F5-2f







Legend

- Quaternary Assessment
- Pre-fieldwork Hotspots
- Inland Rail Alignment

Data Source:
ESRI World Topographic Map

Vegetation Assessments Across the IRP

Drawing No: 0628339_N2AB_TM_G005_R3.mxd
Date: 14/02/2024
Drawn By: VN/CB
Reviewed By: MD

Coordinate System: GDA2020 MGA Zone 56
0 2 4km

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Client: ARTC

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F5-2h

6. GENETIC ANALYSIS RESULTS AND DISCUSSION

Genetic analysis of koala scats detected using detection dog surveys was completed by the Detection Dogs for Conservation research group at the University of the Sunshine Coast. This section provides a compilation of the analysis and findings written by the team from UniSC, with the draft technical outputs from UniSC included in Appendix A.

6.1 Extraction, quality control unique individuals

A total of 73 fresh koala scat samples were collected for genetic analyses. All samples were genotyped using DArTag, however, as is typical in genotyping, particularly with non-invasive samples, genotypes differed in DNA quality. Therefore, some samples were excluded from subsequent analyses due to insufficient data. Figure 2-3 in Appendix A shows the location of all genetic samples and also which samples were used in subsequent analyses (successful genotyping), samples that were duplicates of the same individual koala (successful genotyping but removed due to duplication) and samples with poor DNA quality (insufficient genotype data). For further details see Appendix A Table A3.

Only approximately 200 SNPs are required for identifying unique individuals (Schultz et al. 2018); therefore, the focus was on maximising the number of individuals that could be used while retaining sufficient high-quality SNPs. In addition to the constant filters described in the methods, we applied a stepwise increasing locus call rate filtering, from 0.2 to 0.9, resulting in only retaining SNPs with at least 90% data. Samples were also filtered for individual call rate using an increasing call rate filtering from 0.1 to 0.2, resulting in only retaining individuals with at least 20% data. This resulted in the removal of 22 samples due to insufficient data, with 51 genotyped samples left for this analysis. A total of 230 loci were retained with 8.4% missing data.

Further genetic analyses revealed that there were 25 samples had at least one duplicate sample (scats collected from the same individual; see Appendix A Table A4). Sixteen of the duplicates were removed from the data set, as they did not represent unique individuals. This resulted in a total of 36 unique individual koalas successfully sampled. We have therefore genetically identified the minimum number of unique individuals present at the time of survey, but not the maximum, due to samples that did not meet our data quality thresholds being excluded.

6.1.1 Measures of Genetic Diversity

For detailed genetic analyses, such as determining genetic diversity, a different filtering process is required. For these analyses, the focus was on maximising the quality of the data while trying to maintain as many individuals as possible. In addition to the constant filters, we applied a stepwise increasing locus call rate filtering, from 0.2 to 0.8, resulting in retaining only SNPs with at least 80% data. Samples were also filtered for individual call rate through another stepwise increasing individual call rate filter, from 0.2 to 0.5, resulting in retaining only SNPs from individuals with at least 50% data. This resulted in the removal of 31 samples due to insufficient data, with 42 genotyped samples remaining for this analysis. A total of 2,805 loci were retained with 6.94% missing data. Thirteen duplicate samples (from 10 individuals) were identified in this dataset and subsequently removed from further analyses, leaving 32 individual koalas for examination of genetic diversity.

From these 32 individual koalas, we calculated three values of genetic diversity: observed Heterozygosity H_O , expected Heterozygosity H_E (adjusted for small sample size), and inbreeding coefficient F_{IS} . The 32 individual koalas from the footprint were spread across a large geographical area, therefore we grouped the samples between Coastal and Inland, splitting the samples between east (Coastal: $N = 20$) and west (Inland: $N = 12$) of Toowoomba (Table 6-1).

Table 6-1 Heterozygosity and inbreeding for Inland versus Coastal samples collected as part of the IRP project.

	H_O <i>(Higher is better)</i>	H_E <i>(Higher is better)</i>	F_{IS} <i>(Lower is better)</i>
Coastal (N = 20)	0.275	0.319	0.138
Inland (N = 12)	0.295	0.349	0.157

Caution should be taken when interpreting this geographically split data, as the sample sizes were low (≤ 20), which decreased the robustness of these estimates.

These results are best interpreted by comparing them with other populations where diversity measures were calculated using similar methods. For example, using similar methods, the UniSC team estimated diversity measures for NSW koalas in the Northern Tablelands (N = 76) to be $H_O = 0.225$, $H_E = 0.279$ and $F_{IS} = 0.190$; and for Redland City Council (mainland), Southeast Queensland koalas (N = 227) to be $H_O = 0.237$, $H_E = 0.320$ and $F_{IS} = 0.259$. Additional examples are provided in Table 6-2 and; all used the same method as in this report and indicate that the Inland and Coastal groups have high heterozygosity compared to other populations and average inbreeding. It is important to note, however, that samples grouped as Inland and Coastal are widely spread and geographically distant koalas were artificially pooled together. The comparison would have been improved by having a larger sample size over smaller geographic areas.

Table 6-2 Observed heterozygosity for Inland versus Coastal samples collected as part of this study compared to other populations (note that for heterozygosity, higher values are better).

Population	H_O
*ARTC Inland (N = 13)	0.295
*ARTC Coastal (N = 20)	0.275
Coastal NSW (Port Macquarie Hospital group 1) (35)	0.265
Northern Tablelands (20)	0.258
Coastal NSW (Port Macquarie Hospital group 2) (25)	0.247
Coffs Harbour (8)	0.235
Redlands mainland (44)	0.215

** Caution should be exercised when interpreting these results, as samples were obtained across a wide geographic range and may not be comparable with restricted geographic areas.*

Table 6-3 Inbreeding for Inland versus Coastal samples collected as part of the project compared to other populations (note that for inbreeding, lower values are better).

Population	F _{IS}
Northern Tablelands (20)	0.083
Northern Rivers (18)	0.096
Coffs Harbour (8)	0.099
Coastal NSW (Port Macquarie Hospital group 1) (35)	0.113
Redlands mainland (44)	0.117
*ARTC Coastal (N = 20)	0.138
Redlands Minjerribah urban areas (52)	0.154
*ARTC Inland (N = 13)	0.157
Coastal NSW (Port Macquarie Hospital group 2) (25)	0.178
Redlands Minjerribah (73)	0.196
Snowy Mountains (41)	0.235

** Caution should be exercised when interpreting these results, as samples were obtained across a wide geographic range and may not be comparable with results obtained from more restricted geographic areas.*

Further comparisons can be made by consulting from Kjeldsen et al. (2016). Here, measures are presented from other wild koala populations across Queensland, New South Wales and Victoria, using SNPs obtained through double digest restriction-associated (DARTseq), which differed from our koala specific DARTag panel (a panel we developed to increase non-invasive data recovery and consistency).

Here again, comparison with the Inland and Coastal groups suggest that these groups may have healthy observed heterozygosity and inbreeding averages; however, as noted above, the ARTC samples are spread over a vast geographical range and are compared to populations that are likely more geographically restricted (the difference in geographic spread could not be ascertained from Kjeldsen's paper).

Table 6-4 Genetic diversity established through double digest restriction-associated SNP sequencing (DArTseq)

State	Location	n	H _o	H _E	F _{IS}
QLD	St Bees Island	19	0.29	0.35	0.23
QLD	St Lawrence	19	0.26	0.30	0.20
QLD	Koala Coast	24	0.22	0.30	0.32
QLD	Ipswich	23	0.27	0.31	0.19
NSW	Port Macquarie	45	0.23	0.28	0.21
NSW	Campbelltown	9	0.27	0.33	0.27
VIC	South Gippsland	19	0.24	0.30	0.27
VIC	Cape Otway	13	0.24	0.25	0.11

Note: Wild koala populations across QLD, NSW and Victoria (note that the geographic spread of the samples for this study is unknown). n = sample size, H_O = observed heterozygosity, H_E = expected heterozygosity, F_{IS} = inbreeding coefficient. Table taken from Kjeldsen et al. (2016).

6.1.2 Sexing

Applying quality control for genotype data, locus call rate of 0.9 and individual call rate of 0.8, retained 31 unique individuals for sexing from the 36 ARTC samples. Of the 31 samples tested for sexing, 15 were female, and 16 were male (Appendix Table A3).

6.1.3 Chlamydia detection

Quality control of genotype data for locus call rate and individual call rate of 0.8 retained 30 unique individuals for *Chlamydia* pathogen detection, of which 19 (63.3%) had *Chlamydia* pathogen present. Samples that tested positive for the *Chlamydia* pathogen were evenly distributed across the ARTC footprint. It is important to note, however, that presence of the *Chlamydia* pathogen does not always equate to clinical disease.

6.2 Genetic co-analyses for DArTcap and DArTag data

From the 327 samples retained after the basic filtrations, 72 samples were identified as duplicates. After removing the 72 duplicates, a total of 255 unique koala samples were retained for further genetic analyses (Appendix Table A1). Of the 255 samples used in DArTcap and DArTag co-analyses, 101 samples were genotyped using DArTcap methodology and 154 samples were genotyped using DArTag methodology. The samples were collected across multiple projects; of the 255 samples used in this report, 36 were collected for the ARTC project.

6.2.1 Genetic structure

To identify possible genetic clusters, all 255 samples were analysed together without prior population information using fastStructure and STRUCTURE software. fastStructure predicted the presence of two to six (i.e., $K = 2 - 6$) genetic clusters (Figure 6-1), while STRUCTURE results indicated the presence of three genetic clusters (i.e. $K = 3$, Figure 6-2), as inferred by the ΔK which peaked at $K = 3$ (Figure 6-3).

Samples from Brisbane and Redland City had membership proportions different to other QLD and Northern NSW samples (Figure 6-2). Similarly, samples from Inverell were different from the other samples, although marginally similar to samples from Armidale, Uralla, Coffs Harbour and Bellingen (Figure 6-2). The samples from the most Southern NSW locations, such as Goulburn-Mulwaree, Shoalhaven City, Queanbeyan–Palerang and Snowy Monaro were genetically distinct from all other sample locations (Figure 6-2).

A similar pattern of membership proportions was evident in fastStructure plots (K3 plot in Figure 6-3). Further increasing the number of predicted genetic clusters to $K = 4-6$ showed similar genetic structure of the samples from neighbouring locations (K4 to K6 plots in Figure 6-1). Overall, samples from closer geographic proximities showed similar genetic structure, which supported grouping samples for further genetic analyses.

DRAFT



Figure 6-1 The number of genetic clusters as predicted from fastStructure form K = 2 to K = 6. Each bar represents an individual koala and its membership proportions to defined clusters.

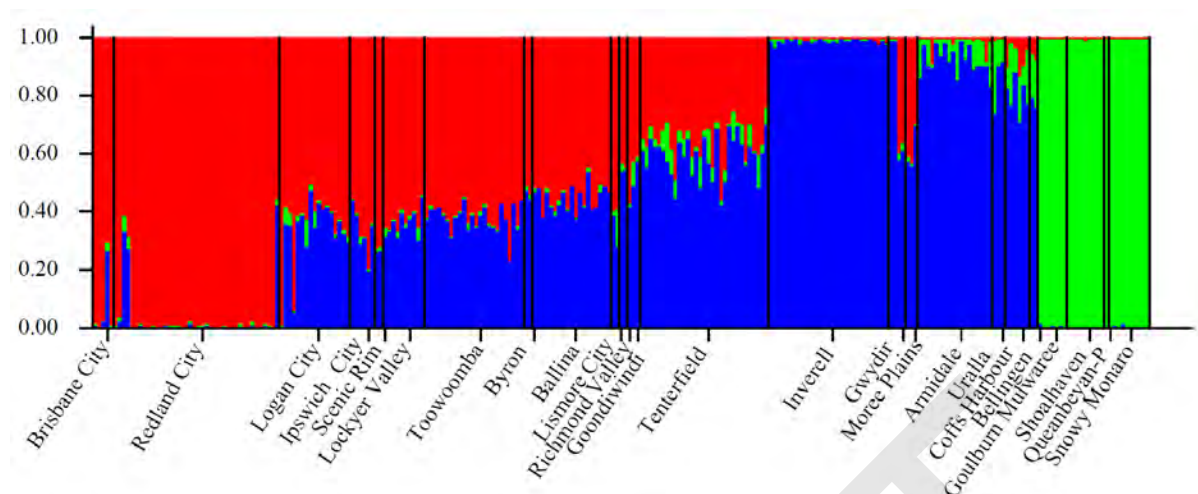


Figure 6-2 STRUCTURE plot showing the ancestral membership proportions defined by STRUCTURE results at K = 3 for 255 koala samples from 24 locations.

Each bar represents individual koala and its membership proportions to defined clusters. The details of individual koala and location information are given in Appendix A Table A1 in the order as it appears in Figure 3.

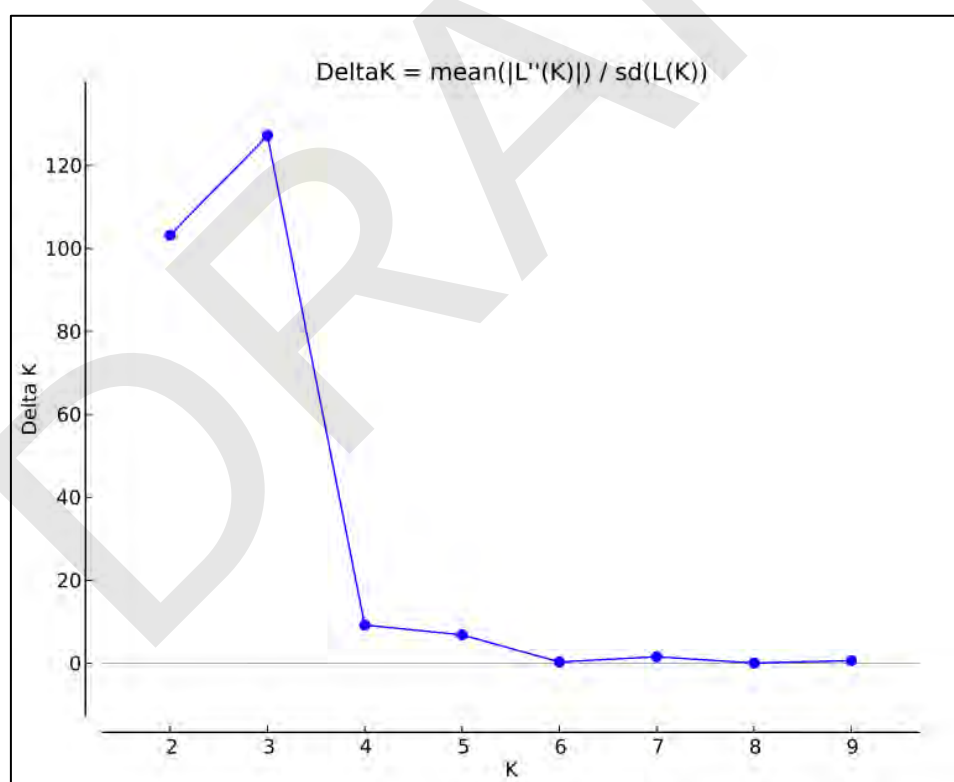


Figure 6-3 Delta K value generated for the STRUCTURE result at different K, which indicates the optimal number of ancestral clusters (K = 3).

PCA analysis of the 255 samples indicated that the samples from Goulburn-Mulware, Shoalhaven City, Queanbeyan–Palerang and Snowy Monaro formed a single cluster that was distinct from all other locations (Figure 6-4 and Appendix A Figure A2). Samples from Brisbane City and Redland City also formed a cluster that was somewhat separated from all other samples. Apart from the two clusters, the remaining samples from all other locations did not form easily separated clusters.

6.2.2 Genetic diversity between koala groups

Observed heterozygosity was broadly similar between koala groups (Table 6-5), with the exception of the two most Southern NSW groups, which had lower values for observed heterozygosity than other groups (i.e., Group 9 and Group 10). Observed heterozygosity was less than the expected heterozygosity in all koala groups. The lowest level of inbreeding was observed for Group 10 (samples from Snowy Monaro Regional Council), followed by Group 7 (samples from Armidale and Uralla).

Internal relatedness, which describes inbreeding at an individual level, was averaged across individuals and compared at population level and showed the highest averages in Groups 9 and 10 (Table 6-5). IR values can vary between 1 and -1, where maximum value of 1 indicates when all loci are homozygotes regardless allelic frequencies and the minimum value -1 is only reachable when all loci present only two alleles and the individual is heterozygote for all loci (Aparicio, Ortego et al. 2006). Overall, the average IR of populations observed in the present report is comparable to past studies (e.g., Kjeldsen et al., 2016; presented here in Table 6-6 for ease of comparison).

The estimated effective population size (N_E) varied between different koala groups and was lowest for Group 6 (samples from Inverell, Gwydir and Moree Plains). Groups 7, 8, 9 and 10 had N_E over 100 (Table 6-5).

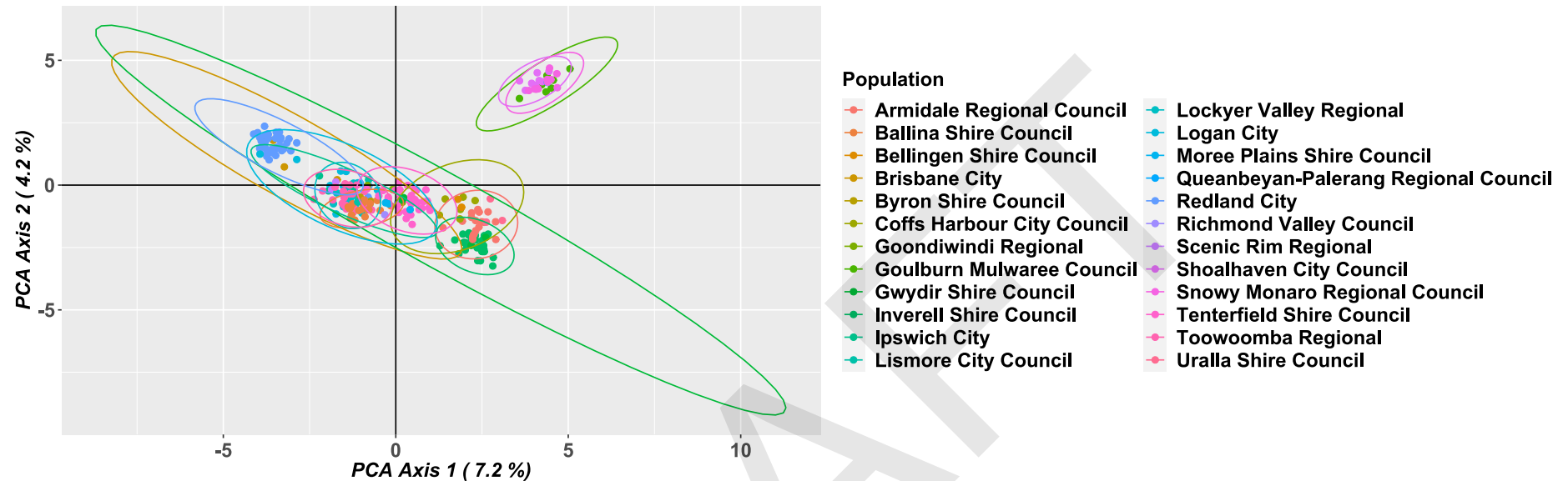


Figure 6-4 Principal component analysis (PCA) plot for 255 unique koalas from 24 sample locations.

Each location has its own 95% CI ellipse and each dot represents an individual koala. A duplicate figure with location name next to the ellipse is given in Appendix A Figure A2 and the details of individual koala and location information are given in Appendix A Table A1.

Table 6-5 Genetic diversity indices for ten groupings of koalas from 24 separate locations, divided into 10 geographic groupings.

Details of grouping by location are given in Appendix Table A2. ARTC samples fall into groups 2, 3 and 6 (Group 2: Logan City + Ipswich City + Scenic Rim Regional; Group 3: Lockyer Valley Regional + Toowoomba Regional Council; and Group 6: Inverell Shire Council + Gwydir Shire Council + Moree Plains Shire Council).

Group	Sample size	$H_O \pm SE$	$H_E \pm SE$	$F_{IS} \pm SE$	$IR \pm SD$	N_E (CI)
Group_1	42	0.219 $\pm$ 0.005	0.256 $\pm$ 0.006	0.144 $\pm$ 0.008	0.276 $\pm$ 0.146	79.9 (76.6 – 84.1)
Group_2	25	0.245 $\pm$ 0.005	0.298 $\pm$ 0.005	0.178 $\pm$ 0.008	0.215 $\pm$ 0.159	69.1 (64.1 – 72.5)
Group_3	34	0.261 $\pm$ 0.005	0.299 $\pm$ 0.005	0.125 $\pm$ 0.007	0.170 $\pm$ 0.129	170.1 (155.6 – 187.9)
Group_4	25	0.215 $\pm$ 0.006	0.251 $\pm$ 0.006	0.144 $\pm$ 0.009	0.288 $\pm$ 0.134	48.7 (46.0 – 51.5)
Group_5	31	0.253 $\pm$ 0.005	0.283 $\pm$ 0.005	0.106 $\pm$ 0.008	0.153 $\pm$ 0.114	156.0 (137.2 – 165.9)
Group_6	36	0.228 $\pm$ 0.006	0.260 $\pm$ 0.006	0.124 $\pm$ 0.007	0.230 $\pm$ 0.102	43.8 (42.5 – 45.4)
Group_7	21	0.224 $\pm$ 0.006	0.245 $\pm$ 0.006	0.084 $\pm$ 0.013	0.242 $\pm$ 0.107	108.7 (97.3 – 129.8)
Group_8	08	0.202 $\pm$ 0.007	0.233 $\pm$ 0.006	0.132 $\pm$ 0.009	0.312 $\pm$ 0.124	151.5 (94.4 – 499.5)
Group_9	17	0.160 $\pm$ 0.006	0.191 $\pm$ 0.006	0.162 $\pm$ 0.013	0.451 $\pm$ 0.095	120.8 (97.2 – 167.4)
Group_10	10	0.171 $\pm$ 0.007	0.177 $\pm$ 0.006	0.037 $\pm$ 0.009	0.412 $\pm$ 0.078	210.4 (116.5 – 1481.9)

Note - H_O = observed heterozygosity, H_E = expected heterozygosity, F_{IS} = inbreeding coefficient, IR = internal relatedness and N_E = effective population size. SE: standard error, SD: standard deviation, CI: 95% confidence interval.

Table 6-6 Genetic diversity of wild koala populations across QLD, NSW and Victoria (from Kjeldsen et al., 2016).

State	Location	n	H_O	H_E	F_{IS} ($P < 0.01$)	IR ($\pm SD$)	$N_{E_{LD}}$ (95 %CI)
QLD	St Bees Island	19	0.29	0.35	0.23	0.29 (± 0.15)	Infinite (∞)
QLD	St Lawrence	19	0.26	0.30	0.20	0.21 (± 0.11)	Infinite (∞)
QLD	Koala Coast	24	0.22	0.30	0.32	0.42 (± 0.29)	Infinite (921.20- ∞)
QLD	Ipswich	23	0.27	0.31	0.19	0.26 (± 0.16)	Infinite (∞)
NSW	Port Macquarie	45	0.23	0.28	0.21	0.25 (± 0.15)	116.8 (109.8-124.6)
NSW	Campbelltown	9	0.27	0.33	0.27	0.34 (± 0.27)	2.7 (2.4-3.2)
VIC	South Gippsland	19	0.24	0.30	0.27	0.31 (± 0.34)	Infinite (∞)
VIC	Cape Otway	13	0.24	0.25	0.11	0.20 (± 0.11)	46.7 (40.8-54.4)

6.2.3 Genetic differentiation among groups

Significant genetic differentiation was observed among the 10 koala groups ($F_{ST} = 0.117$, $P < 0.001$, $F'_{ST} = 0.166$). Pairwise comparison of F_{ST} values indicated significant differences between all koala groups (Table 6-7), where Group 9 and 10 (samples from most Southern NSW) indicated high level of genetic differentiation to all other groups, although the pairwise F_{ST} value is very small for between group 9 and 10 (Table 6-7).

Table 6-7 Pairwise F_{ST} values for ten groupings.

All values are statistically significant ($P < 0.001$) for each comparison. Details of grouping by location are given in Appendix A Table A2. Lower values indicate higher level of genetic similarity.

	Group_1	Group_2	Group_3	Group_4	Group_5	Group_6	Group_7	Group_8	Group_9
Group_2	0.059								
Group_3	0.086	0.035							
Group_4	0.132	0.075	0.099						
Group_5	0.092	0.035	0.047	0.08					
Group_6	0.153	0.092	0.098	0.134	0.055				
Group_7	0.166	0.105	0.119	0.151	0.072	0.072			
Group_8	0.142	0.086	0.107	0.130	0.058	0.088	0.066		
Group_9	0.222	0.170	0.183	0.214	0.147	0.18	0.179	0.164	
Group_10	0.23	0.181	0.188	0.226	0.154	0.188	0.192	0.185	0.066

Gene flow between koala groups was tested as the number of effective migrants (N_m) between groups. A high number of effective migrations was observed between Group 2 and Group 3 (i.e. between Logan City + Ipswich City + Scenic Rim Regional Council populations and Lockyer Valley + Toowoomba Regional Council populations), as well as between Group 2 and Group 5 (i.e. between Logan City + Ipswich City + Scenic Rim Regional Council populations and Tenterfield population, Table 10). Overall, $N_m > 1$ was observed for all comparisons, except those involving Group 1 (Brisbane + Redland City) vs Group 9, as well as Group 10 (samples from two groups in most Southern NSW) and Group 4 (samples from Byron, Ballina, Lismore and Richmond Valley) vs Group 9 and Group 10 (samples from two groups in most Southern NSW, Table 10).

Table 6-8 Number of migrants (N_m) between koala groups as estimated using F_{ST} values.

	Group_1	Group_2	Group_3	Group_4	Group_5	Group_6	Group_7	Group_8	Group_9
Group_2	3.985								
Group_3	2.649	6.766							
Group_4	1.651	3.076	2.257						
Group_5	2.458	6.966	5.007	2.864					
Group_6	1.381	2.470	2.301	1.618	4.293				
Group_7	1.255	2.132	1.849	1.410	3.241	3.208			
Group_8	1.506	2.672	2.053	1.671	4.093	2.584	3.513		
Group_9	0.875	1.226	1.109	0.919	1.454	1.140	1.151	1.281	
Group_10	0.839	1.131	1.073	0.860	1.372	1.080	1.051	1.105	3.522

6.2.4 Genomic relationship

The genomic relationship heatmap indicates higher relatedness of koalas within the same location or to neighbouring locations in comparison to the distal locations (Figure 6-5). Overall, the genomic relationship heatmap indicated a relatedness pattern that supported the observed genetic structure analyses (Section 6.2.1).

6.2.5 Sexing

The 115 samples that passed quality control for sex determination belonged to the following groups: Group 1 (n = 27), Group 2 (n = 10), Group 3 (n = 14), Group 4 (n = 23), Group 5 (n = 20), Group 6 (n = 5), Group 9 (n = 11) and Group 10 (n = 2). Two samples from Goondiwindi and another sample from North Stradbroke Island are not presented here, due to being geographically separated from the koala location groups. Koala sex by group is indicated in Table 6-9.

Table 6-9 Koala sex by group as estimated using genotyping of sex markers.

ARTC samples fall into Group 2, 3 and 6 (Group 2: Logan City + Ipswich City + Scenic Rim Regional Council; Group 3: Lockyer Valley Regional Council + Toowoomba Regional Council; and Group 6: Inverell Shire Council + Gwydir Shire Council + Moree Plains Shire Council).

Group	Male	Female	Sex ratio
1	8	19	1:2.4
2	6	4	1:0.7
3	7	7	1:1
4	11	12	1:1.1
5	13	7	1:0.5
6	2	3	1:1.5
9	5	6	1:1.2
10	1	1	1:1

6.2.6 Chlamydia detection

From the 105 samples that passed quality control for *Chlamydia* analysis, 57 samples (54.3%) were positive for *Chlamydia*. *Chlamydia* prevalence in each group is indicated in Table 6-10. Two samples from Goondiwindi and another sample from North Stradbroke Island were removed from the analyses.

Table 6-10 Chlamydia prevalence for each group as indicated by the genotyping of Chlamydia markers for 105 samples.

ARTC samples fall into Groups 2, 3 and 6 (Group 2: Logan City + Ipswich City + Scenic Rim Regional Council; Group 3: Lockyer Valley Regional Council + Toowoomba Regional Council; and Group 6: Inverell Shire Council + Gwydir Shire Council + Moree Plains Shire Council).

Group	Positive	Negative	Prevalence
1	16	8	67%
2	8	2	80%
3	7	7	50%
4	9	11	45%
5	6	12	33%
6	3	1	75%
9	6	4	60%
10	1	1	50%

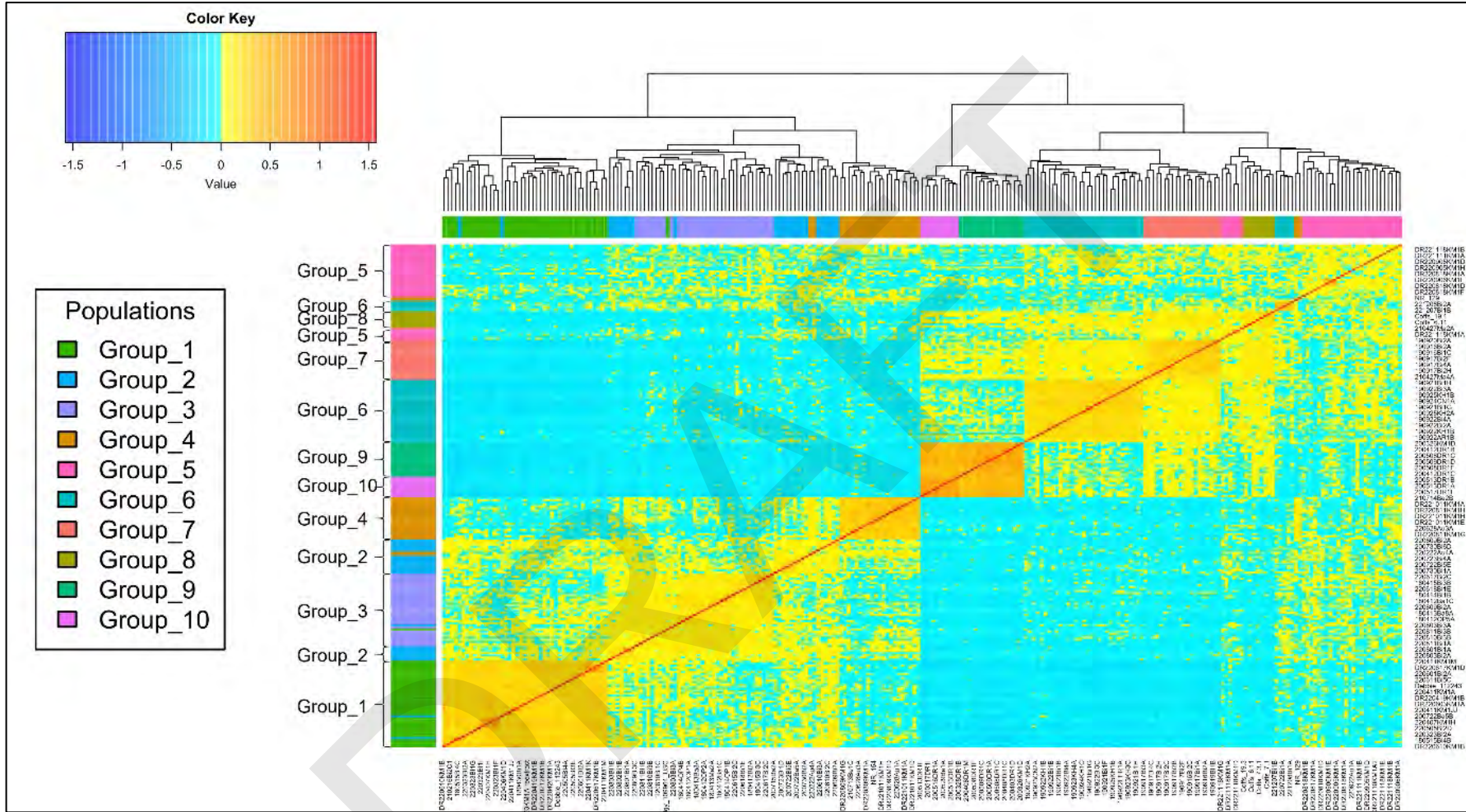


Figure 6-5 Genomic relationship matrix heat map for 10 geographic groupings as indicated in Table 2. Relatedness varies from high (red) to low (blue) as indicated by the colour key.

6.3 Diet Analysis

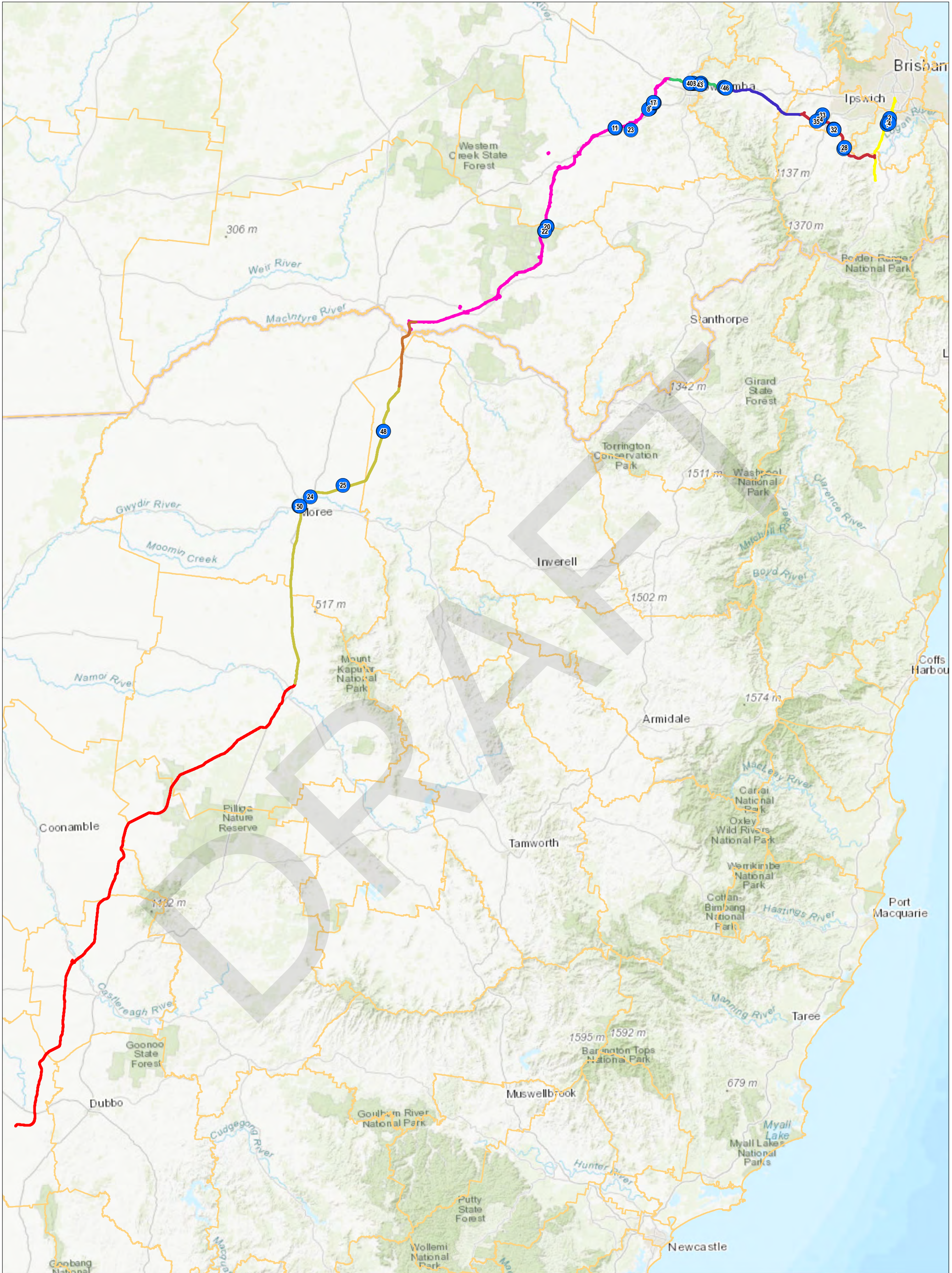
Of the 55 scat samples sequenced in this study, 49 returned reads for the validated diet markers after quality control filtering. Across all samples, between 1 and 7 tree species were detected per sample (average = 3.35). Thirty-seven individual species were detected across the 49 validated samples with several other species potentially present as indicated by the presence of markers for groups of target species. The most frequently detected species were *Eucalyptus chloroclada* (detected in 18 samples), *E. tereticornis* (17 samples), *E. amplifolia* (16 samples) and *E. camaldulensis* (16 samples). These species were also often found at high relative abundance within samples (range of average relative abundances: 24% to 44%). *E. prava* was detected in a single sample (IR21: 220623BI1B), however, as the markers for this species have not been validated it could not be included in the relative abundance calculations. The diet species detected differed between geographic regions and between individuals (Figure 6-6). See Appendix B for a breakdown of sample number identification and location.

In the Brisbane region *Eucalyptus seeana* was detected in three out of four samples collected in the south at an average relative abundance of 48.35%. *E. tereticornis* was detected in seven out of nine samples collected west of Brisbane at an average relative abundance of 62.6% (Figure 6-7, Table 6-11).

In the Toowoomba region, the tree species detected varied considerably between samples. *E. amplifolia*, *E. tereticornis*, *E. chloroclada* and *E. melliodora* were all detected in four or more samples (from 11) at relative abundances between 10.3% and 34.6% (Figure 6-8, Table 6-12).

In the region to the north-east of Goondiwindi *E. camaldulensis* was found in all six samples at an average relative abundance of 39.7%, while *E. amplifolia* and *E. tereticornis* were also found at high relative abundance in two individuals each (Figure 6-9, Table 6-13).

In the Moree Region, five out of seven samples contained *E. camaldulensis* with an average relative abundance of 35.2%, however the abundances ranged from 1% to 100%. While *E. populnea* and *E. chloroclada* were also found at high relative abundance (64.6% and 58.7%, respectively) in 3 and 2 samples, respectively (Figure 6-10, Table 6-14).



- Legend**
- Diet Samples

Inland Rail Alignment

B2G - NSW/QLD Border to Gowrie

C2K - Calvert to Kagaru

G2H - Gowrie to Helidon

H2C - Helidon to Calvert

K2AB - Kagaru to Acacia Ridge/Bromelton

N2N - Narramine to Narrabri

N2NS - Narrabri to North Star

NS2B - North Star to Border

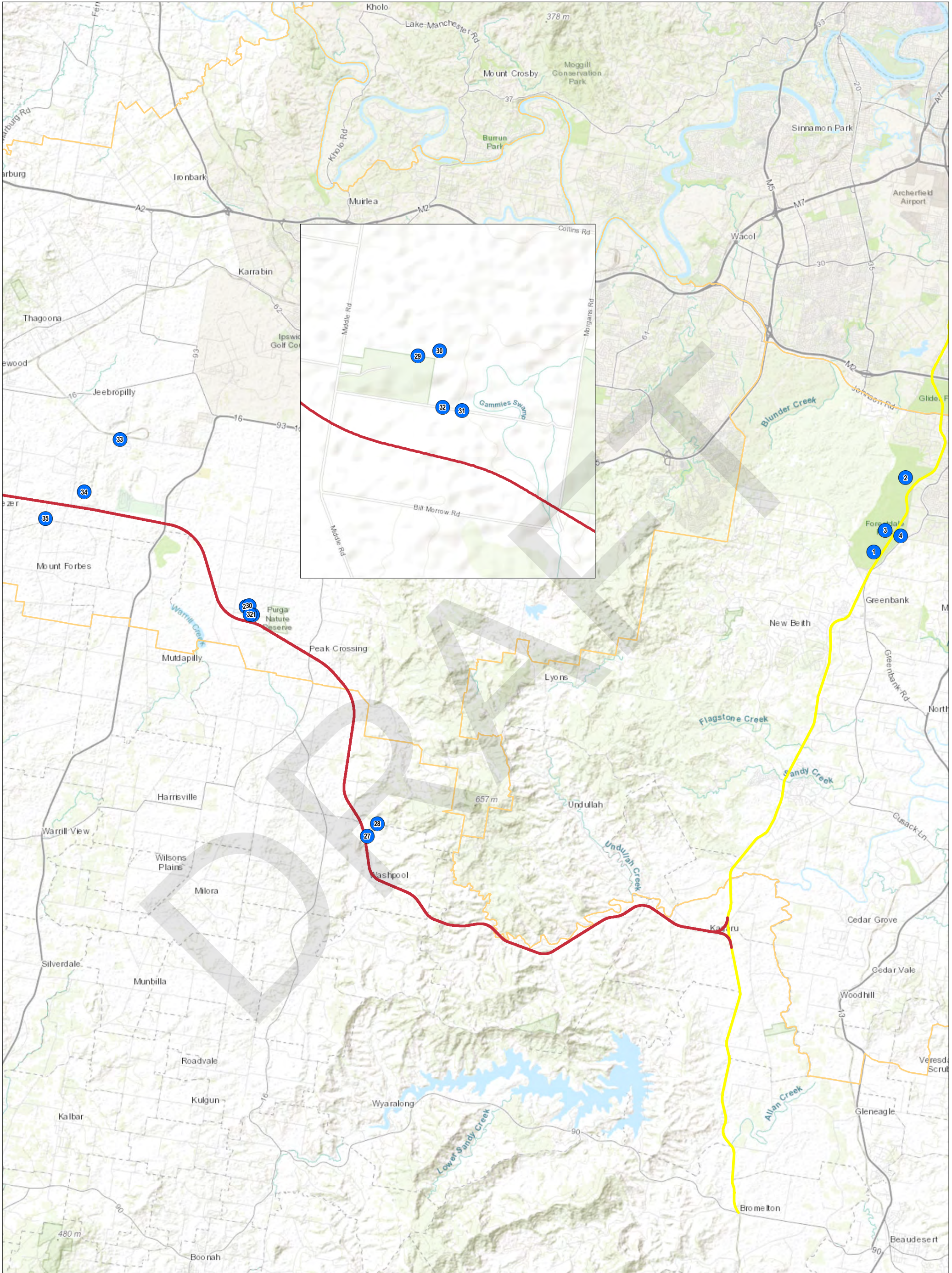
LGA Boundary

Data Source:
ESRI World Topographic Map

Map Of Diet Sample Locations Across The Entire Study Area

Drawing No: 0628339_N2AB_TM_G011_R0.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4		
Drawn By: VN	Reviewed By: MD	Client: ARTC	
Coordinate System: GDA2020 MGA Zone 56			
0 10 20 30km		N	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F6-6



Map of sample locations in the Brisbane Region, relative abundances of the different dietary tree species detected in each sample as indicated in Table 6-11

F6-7

Drawing No: 0628339_N2AB_TM_G012_R0.mxd
Date: 15/02/2024
Drawn By: VN

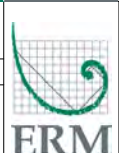
Koala Genetics Study Project – Inland Rail Program
(NSW and QLD)
Reviewed By: MD
Client: ARTC

Coordinate System: GDA2020 MGA Zone 56

0 1 2 3km



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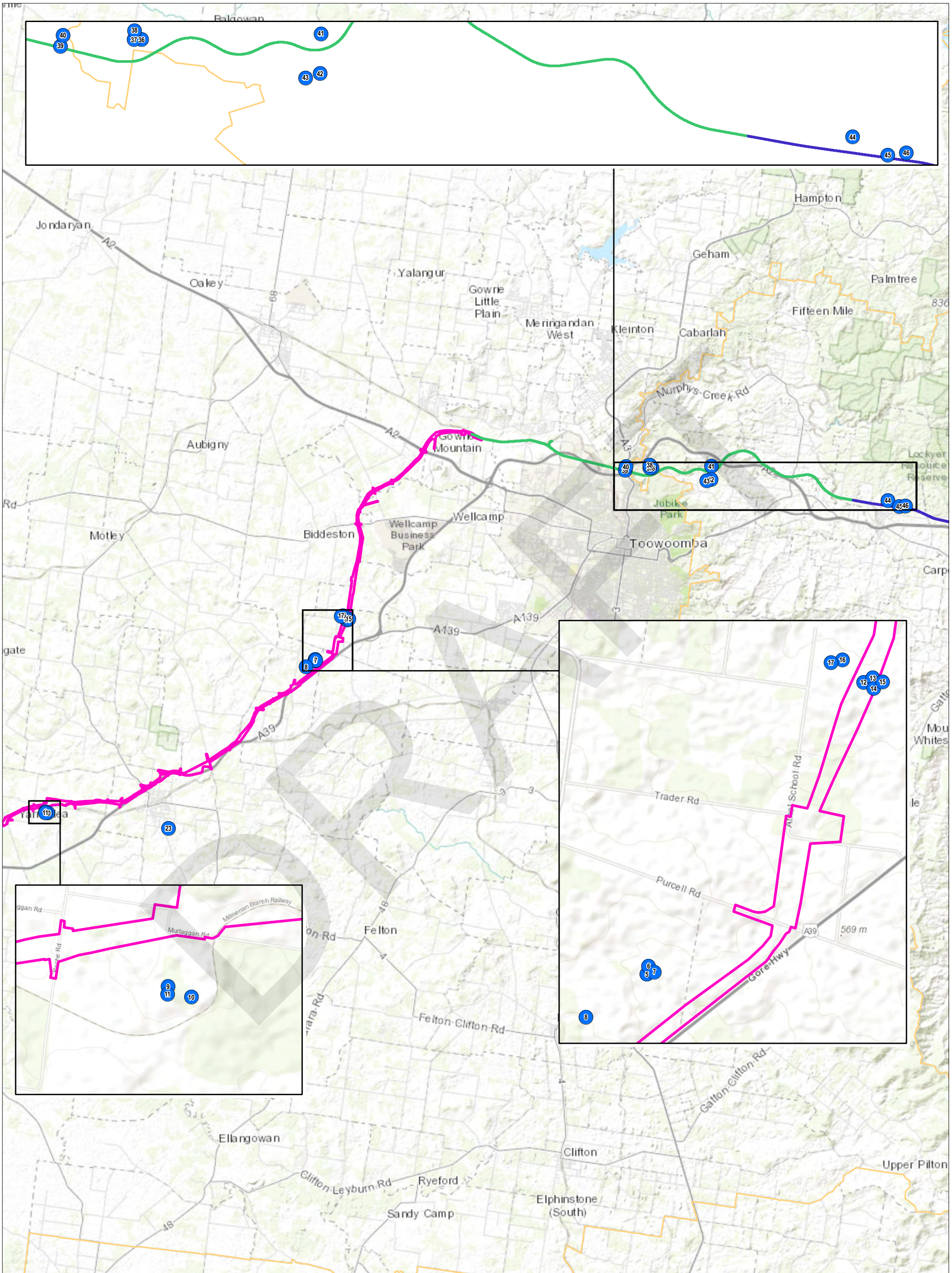
Legend

-  Diet Samples
-  C2K - Calvert to Kagaru
-  K2AB - Kagaru to Acacia Ridge/Bromelton
-  LGA Boundary

Data Source:
ESRI World Topographic Map

Table 6-11 relative abundances of the different dietary tree species detected in each sample in the Brisbane region, each abundance is given in a percentage of the sample

	Sample Number												
Species	1	2	3	4	27	28	29	30	31	32	33	34	35
<i>Angophora leiocarpa</i>			56.1										
<i>Corymbia citriodora</i>					6.7							8.3	
<i>Corymbia variegata</i>					15.6								
<i>Eucalyptus amplifolia</i>			4.6	4.7				58.2	43.4		0.2		
<i>Eucalyptus camaldulensis</i>								21.0	3.5				
<i>Eucalyptus cambageana</i>				1.2									
<i>Eucalyptus chloroclada</i>				1.6	2.1		100		2.1		2.9	4.7	
<i>Eucalyptus crebra and/or elegans</i>												4.8	
<i>Eucalyptus crebra, elegans and/or fibrosa</i>					5.6								
<i>Eucalyptus exserta</i>								0.2				0.2	
<i>Eucalyptus platyphylla</i>									1.2				
<i>Eucalyptus populnea</i>											1.3		
<i>Eucalyptus punctata</i>			10.2										
<i>Eucalyptus melanophloia</i>											22.6		
<i>Eucalyptus melanophloia and/or whiteii</i>													4.2
<i>Eucalyptus resinifera</i>											14.3		
<i>Eucalyptus rhombica</i>					13.0								
<i>Eucalyptus seeana</i>	66.5	100	26.9										
<i>Eucalyptus tereticornis</i>	33.5		2.3		57.2	100		20.5	49.8	100	58.7	82.0	95.8
<i>Eucalyptus tereticornis and/or robusta</i>				92.4									



Legend
● Diet Samples

Inland Rail Alignment
— B2G - NSW/QLD Border to Gowrie
— G2H - Gowrie to Helidon
— H2C - Helidon to Calvert
— LGA Boundary

Data Source:
ESRI World Topographic Map

Map of sample locations in the Toowoomba Region, relative abundances of the different dietary tree species detected in each sample as indicated in Table 6-12

Drawing No: 0628339_N2AB_TM_G013_R0.mxd
Date: 14/02/2024
Drawn By: CB

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)

Drawing Size: A4
Reviewed By: MD

Client: ARTC

Coordinate System: GDA2020 MGA Zone 56

0 1 2 3km



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F6-8

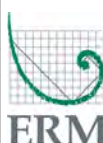
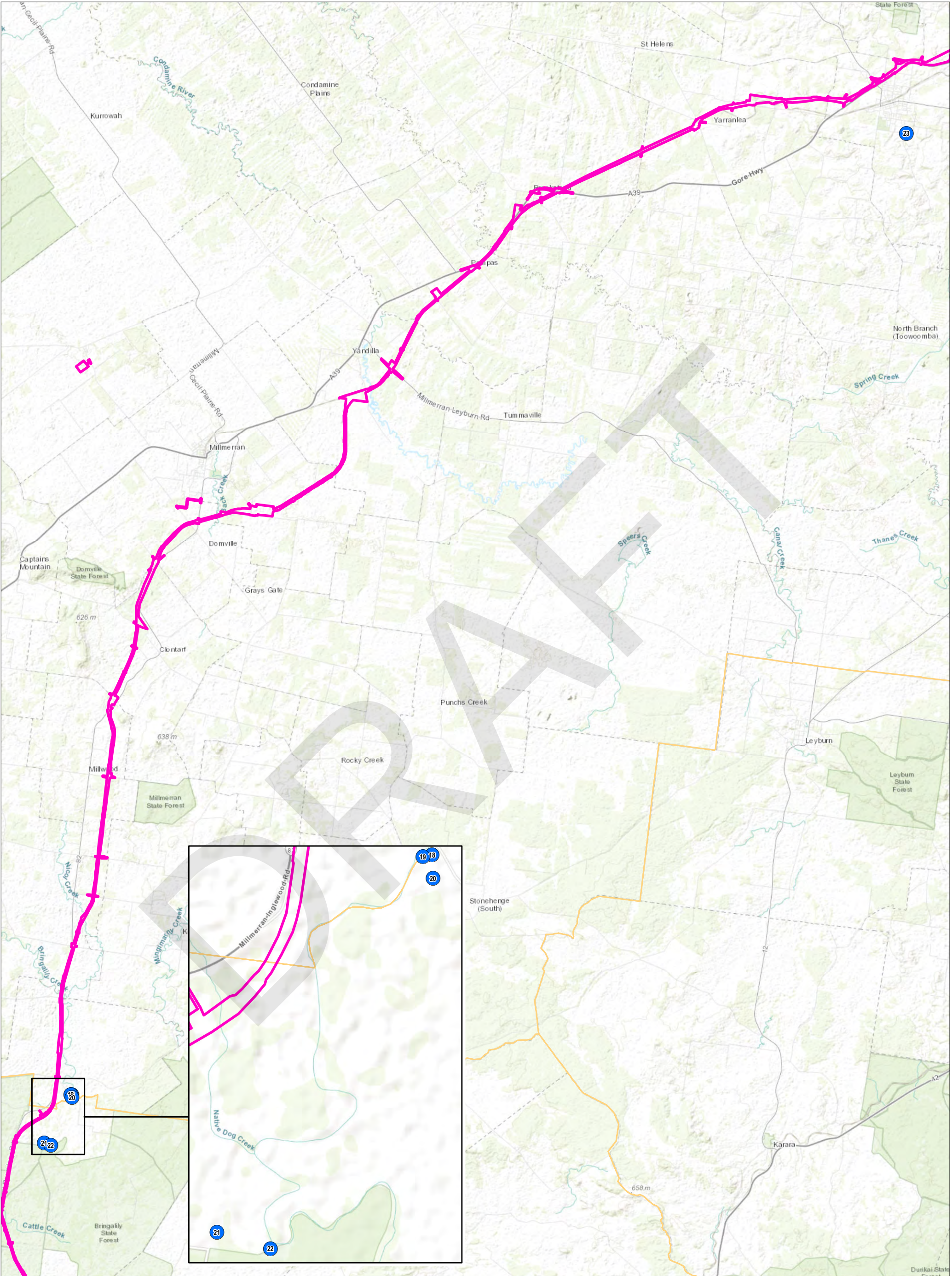


Table 6-12 relative abundances of the different dietary tree species detected in each sample in the Toowoomba region, each abundance is given in a percentage of the sample

	Sample Number																							
Species	5	6	7	8	9	10	11	12	13	14	15	16	17	36	37	38	39	40	41	42	43	44	45	46
<i>Corymbia maculata</i>																							48.3	21.7
<i>Eucalyptus albens</i>								5.2	0.2										37.7					
<i>Eucalyptus amplifolia</i>			68.6	58.6												11.1			0.9		55.4	100	18.4	22.2
<i>Eucalyptus blakelyi</i>			6.0											59.7										
<i>Eucalyptus brownii</i>					84.2		2.1																	
<i>Eucalyptus camaldulensis</i>		24.4		41.4																8.9				
<i>Eucalyptus carnea</i>														38.2										
<i>Eucalyptus chloroclada</i>	26.5	61.3	7.2						4.5					2.1			49.0		1.3	17.6				
<i>Eucalyptus conica</i>								6.1																
<i>Eucalyptus coolabah</i>							0.1																	
<i>Eucalyptus crebra, elegans and/or fibrosa</i>	33.0								8.1		11.9													40.1
<i>Eucalyptus cullenii and/or whitteii</i>							8.0																	
<i>Eucalyptus dura</i>					15.8	21.1																		
<i>Eucalyptus dura and/or siderophloia</i>															100									

	Sample Number																							
Species	5	6	7	8	9	10	11	12	13	14	15	16	17	36	37	38	39	40	41	42	43	44	45	46
<i>Eucalyptus dura, fibrosa and/or rhombica</i>												7.8												
<i>Eucalyptus eugenoides</i>																	0.4							
<i>Eucalyptus exserta</i>		3.1																		12.1				
<i>Eucalyptus fibrosa</i>													5.7											
<i>Eucalyptus granitica and/or whitteii</i>									19.1	38.6	68.9													
<i>Eucalyptus longirostrata</i>																73.5	2.4	18.0						
<i>Eucalyptus macta</i>	40.5		10.5																					
<i>Eucalyptus melanophloia</i>												85.8	74.2							50.1				
<i>Eucalyptus melanophloia and/or whiteii</i>								70.7																
<i>Eucalyptus melliodora</i>									2.4	1.0						15.4	15.7	2.3	7.7					
<i>Eucalyptus microcarpa</i>						5.0																		
<i>Eucalyptus orgadophila</i>						53.7	4.7	14.9	64.8	60.5	18.1		10.4											
<i>Eucalyptus platyphylla</i>							0.0	0.3																
<i>Eucalyptus populnea</i>						20.2	85.0	2.9																
<i>Eucalyptus punctata</i>																		79.3						

	Sample Number																							
Species	5	6	7	8	9	10	11	12	13	14	15	16	17	36	37	38	39	40	41	42	43	44	45	46
<i>Eucalyptus rhombica</i>									0.9		1.1													
<i>Eucalyptus siderophloia</i>													4.9											
<i>Eucalyptus tereticornis</i>		11.2															9.9			23.4	32.4		33.3	16.0
<i>Eucalyptus tereticornis and/or robusta</i>																			52.4					
<i>Eucalyptus tindaliae</i>			7.7																					
<i>Eucalyptus whiteii</i>												6.4	4.8											



Map of sample locations in the Region north-east of Goondiwindi, relative abundances of the different dietary tree species detected in each sample as indicated in Table 6-13

Drawing No: 0628339_N2AB_TM_G014_R0.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56		N <	

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Legend

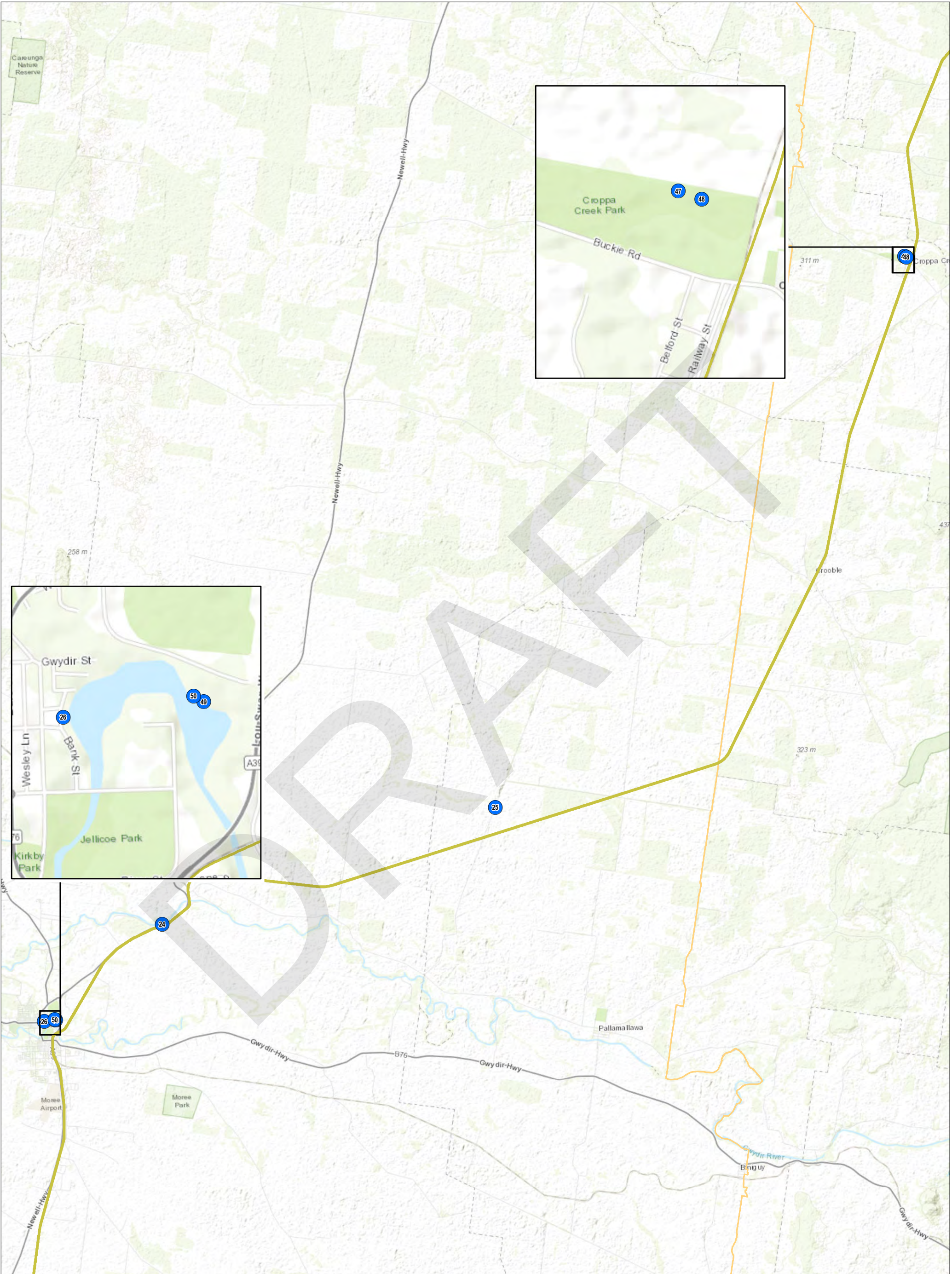
-  Diet Samples
-  B2G - NSW/QLD Border to Gowrie
-  LGA Boundary
-  Inland Rail Alignment

Data Source:
ESRI World Topographic Map



Table 6-13 relative abundances of the different dietary tree species detected in each sample in the region north-east of Goondiwindi, each abundance is given in a percentage of the sample

	Sample number					
Species	18	19	20	21	22	23
<i>Eucalyptus amplifolia</i>		13.4	63.3			
<i>Eucalyptus blakelyi</i>					29.5	
<i>Eucalyptus camaldulensis</i>	39.0	21.9	28.1	17.6	57.2	74.7
<i>Eucalyptus chloroclada</i>		15.7	8.7		12.2	
<i>Eucalyptus conica</i>	61.0	6.3				
<i>Eucalyptus drepanophylla</i>				21.3		
<i>Eucalyptus major</i>		14.7				
<i>Eucalyptus platyphylla</i>						25.3
<i>Eucalyptus tereticornis</i>		28.1		61.1		
<i>Eucalyptus woollsiana</i>					1.2	



Map of scat sample locations in the Moree Region, relative abundances of the different dietary tree species detected in each sample as indicated in Table 6-14

Drawing No: 0628339_N2AB_TM_G015_R0.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4		
Drawn By: VN	Reviewed By: MD	Client: ARTC	
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	
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Legend
 Diet Samples

Inland Rail Alignment
 N2NS - Narrabri to North Star
 LGA Boundary

Data Source:
ESRI World Topographic Map

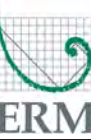


Table 6-14 relative abundances of the different dietary tree species detected in each sample in the Moree region, each abundance is given in a percentage of the sample

Species	Sample Number						
	24	25	26	47	48	49	50
<i>Eucalyptus amplifolia</i>						51.5	
<i>Eucalyptus blakelyi</i>	47.4						
<i>Eucalyptus camaldulensis</i>	4.7		1.0	22.5		48.0	100
<i>Eucalyptus chloroclada</i>	18.3		99.0				
<i>Eucalyptus melliodora</i>					6.9		
<i>Eucalyptus platyphylla</i>						0.4	
<i>Eucalyptus populnea</i>		23.2		77.5	93.1		
<i>Eucalyptus tereticornis</i> and/or <i>robusta</i>	29.6						
<i>Eucalyptus rhombica</i>		35.4					
<i>Eucalyptus woollsiana</i>		41.5					

7. KOALA GENETIC ANALYSIS AND CONCLUSIONS

The IRP transects the Queensland and New South Wales landscape, and as part of the genetics study, data collected by UniSC from the broader landscape has been utilised for further analysis and therefore a deeper understanding of how the koalas in close proximity to the IRP play compare to other koala populations in the broader New South Wales and Queensland regions.

A key priority for IRP is to preserve current landscape connectivity for movement of koalas, despite creating a potential linear barrier. Unfortunately, along the footprint, and within the accessible area for sampling, the number of individual koalas sampled presents a challenge for connectivity analyses across the IRP. Indeed, for genetic samples to be collected, a koala needs to have been present at the survey site in the few days prior to a site visit. In low koala density or large home range areas, a koala might only be present at a specific site for a very narrow window throughout the year.

On this basis, some samples were pooled from other studies with IRP samples to form groups along the IRP, while other groups were included to help contextualise the population status associated with the IRP and include.

- Narrabri to North Star (Group 6);
- Border to Gowrie and Gowrie to Helidon (Group 3); and
- Calvert to Kagaru and Kagaru to Acacia Ridge and Bromelton (Group 2).

We further calculated genetic differentiation between these groups, and to other groups added for context. How similar or dissimilar the groups are to one another reveals the extent of gene flow. Group 2 and 3 values showed low differentiation between Border to Helidon and Calvert to Acacia Ridge.

Overall the three groups which included IRP samples, compared to other groups in the larger landscape had:

- High levels of heterozygosity: Higher levels of heterozygosity equate to larger genetic diversity within a population(s), which is positive as genetic diversity is linked to both individual health and at population level, evolutionary potential; with Group 3 (B2G + G2H) higher than the other groups;
- Low levels of inbreeding and of relatedness between individuals: this suggests gene flow is currently occurring within the groups and the potential of negative impacts due to excessive inbreeding is minimal;
- Relatively small population size, with Group 3 (B2G + G2H) having a larger population size relative to other groups. This results in overall lower densities of koalas across the landscape; and
- No concerns regarding sex ratio, but high chlamydia prevalence, except Group 3 which is medium prevalence (however the sample size remain very low). The ratio of males to females is not of concern for genetic health although chlamydia prevalence is high. Caution should be taken when interpreting these findings as the sample size is small.

To overcome current limitations, future studies should attempt to sample across a broader geographic range than just the IRP. This may assist in overcoming the geographic gaps in detected samples while also enabling more robust assessments of koala genetics and current threats at a landscape level. Repeat surveys may also assist in increasing the rate of detection of individuals across the IRP.

8. KOALA DIET ANALYSIS AND CONCLUSIONS

A key priority for IRP is to preserve the foraging variability and options for koalas, while also removing the necessary trees used for foraging by koalas in the vicinity of the rail alignment. The relative abundances of the tree species detected in each scat sample analysed by UniSC were provided to offer insight into the dominant and minor components of the diet to identify preferred foraging trees.

Overall, four species should be considered to be the main preferred foraging trees: *Eucalyptus chloroclada*, *E. tereticornis*, *E. amplifolia*, and *E. camaldulensis*. This may be a result of local availability of species, that is, some individuals may only have access to woodlands dominated by *E. tereticornis* and as a result their diet is also dominated by this species. Each of the regions in the study area showed significant differences in the diet preferences of koalas. Accordingly, we will examine the preferred foraging trees in three different sections of the IRP:

- East of the Toowoomba range;
- West of the Toowoomba range to the Queensland-NSW border; and
- New South Wales.

The Brisbane region had the lowest variety of tree species identified, with the southern samples dominated by *E. seeana*, and the western samples dominated by *E. tereticornis*. However, a total of 20 species or species groups were recorded in the 13 samples, although at lower abundances.

The Toowoomba region had the greatest number of samples and also the largest variety of tree species identified (total 35 species or species groups), featuring 4 main species at relatively equal abundances: *E. amplifolia*, *E. tereticornis*, *E. chloroclada* and *E. melliodora*. The region north-east of Goondiwindi added an additional three species to the large variety of species identified in Toowoomba: *E. drepanophylla*, *E. major*, and *E. woollsiana*. However, these were found in lower abundances as *E. camaldulensis* was the dominant species in all samples. This makes this region the most diverse for the foraging preferences of the individuals.

The diet analysis in the NSW region near Moree was also dominated by *E. camaldulensis*, however, *E. populnea* and *E. chloroclada* were also identified as important foraging species. There were 10 total species identified in the diet analysis.

Section 5.3 reveals the results from the in-field vegetation analysis supports the diet preference further with vegetation samples in the Brisbane region being dominated by *E. crebra*, *E. citriodora* and *Corymbia intermedia*, the Toowoomba region being dominated by *E. populnea*, *E. camaldulensis* and *E. chloroclada*, and the NSW regions being dominated by *E. camaldulensis*, *E. populnea* and *E. crebra*. Noting there was a difference in field observed canopy dominance versus the scat analysis of the same regions.

For example, the Toowoomba region scat analysis indicated feed tree preferences due to results lacking the three dominant tree species that were observed for that region. The most common species detected in scat samples for this region were *E. amplifolia*, *E. tereticornis*, *E. chloroclada* and *E. melliodora*. This supports the idea that while a eucalypt species is dominating a region, the individual koala will seek out its desired food tree. Appendix C also agrees stating '*The diet species detected differed between geographic regions and between individuals*'.

The spatial variability in the preferred diet trees of koalas indicates that any replacement planting should be done in accordance with the bioregion. Preferred food trees should be planted, however care should be taken to not develop a monoculture that would result in individual diets becoming dominated by one or two species, therefore reducing the nutritional value to be gained.

As with the genetic analysis, future studies should attempt to cover a broader range across the IRP to provide a more robust analysis. Repeat surveys may also assist in increasing the rate of detection of individuals across the IRP.

9. KOALA HABITATS IN THE STUDY AREA

The IRP comprising of eight sections, being of eight distinct projects, reflects considerably varying histories across the IRP. Land use varies from agricultural areas (largely cleared and utilised for intensive cultivation through to livestock grazing), to large areas of state forests and protected areas as well as extending through heavily urbanised areas particularly the suburbs of southern Brisbane and regional cities and townships of Toowoomba, Narrabri, Moree and Narromine.

To overcome the limitations of a small sample size from this study, a landscape approach was taken that incorporated historic koala observation data and ground-truthed koala habitat assessments to evaluate the potential suitability of habitat and opportunities to maintain connectivity of key areas within the IRP and surrounding landscape. This section (Sections 8.1.1-8.1.8) therefore presents a discussion based on the findings of this study including:

- areas of high density of koala records, identified as koala hotspot region;
- areas where maintenance of connectivity are important (post-identification of survey hotspots);
- key areas to undertake ongoing koala monitoring to assess the performance of proposed mitigation measures determined to maintain or improve genetic diversity in identified koala populations;
- a project-specific habitat connectivity strategy to maintain and improve habitat connectivity to avoid and minimise impacts to koala; and
- how knowledge from this study can inform impact assessment and offsetting of significant impacts resulting from the IRP.

Using a combination of approaches including results from this study and desk-top assessments of historic koala records and habitat availability, koala hotspot regions within each project were defined. as:

- A high density of historic koala records is known;
- Suitable koala habitat is present; and
- Detection dog surveys returned positive detections of koala occupancy.

9.1 Kagaru to Acacia Ridge and Bromelton

The K2ARB is no longer apart of the IRP, however data from the study associated in the areas within the K2ARB section will still provide beneficial data on important koala populations, habitat areas and identification of genetic diversity.

9.1.1.1 Historic Koala Records

The 2016, 2018 and 2020 field investigations did not record any sightings of koalas. There are records for this species within 10 km of Beaudesert Road, Bromelton Loop, Middle Road/Greenbank Loop and Kagaru Loop Enhancement Work Areas. As a part of the environmental investigations for K2ARB a search of the Queensland Government Wildlife database returned koala records within the Glider Forest (in 2018), as well as near the southern part of the Greenbank Military Training Area (in 2015), closest to the Middle Road/Greenbank Loop Enhancement Work Area. Since 2011, there have been 10 records of koalas within 5 km of the EIS Disturbance Footprint. The infrequent and low number of records indicate that koalas occur within the Study Area, and at very low densities. As a part of the environmental investigations for K2ARB potential koala scratch marks were found on *Eucalyptus propinqua* trees and likely koala scats were observed within the Glider Forest, close to the Project Area.

ALA records of koala presence show a high density of recent records throughout the K2ARB, particularly within Karawatha Forest, Glider Forest and throughout patches of retained vegetation and creeks adjacent to and surrounded by heavily urbanised areas. It should be noted that the proximity to urban areas may influence the number of sightings that have historically been made of individuals in relation to the size and quality of habitat.

From 2014-2018, OWAD Environment undertook surveys with detection dogs to determine koala distribution, genetics and infection status across selected areas (protected areas, forests, and reserves) in the Brisbane City Council (BCC) and Logan City Council (LCC) Local Government Areas (LGAs). The results of the BCC Koala Detection Dog Study showed a decline in koala genetic diversity from 2016 to 2018 (most noticeable in the Larapinta, Karawatha and Larapinta locations which make up part of the broader Flinders Karawatha Bioregional Corridor) and was concluded to be a result of habitat fragmentation due to industrial and residential developments in the area (OWAD Environment, 2018a). The LCC LGA Detection Dog Studies found koala scats at 63% of the 50 parks sampled in the initial work across the LCC LGA (OWAD Environment, 2014), koala scats at 11 of the 21 properties surveyed in the following survey (OWAD Environment, 2015), and KoRV-A detected in 28% of the individuals identified during 2018 surveys across 84 locations (OWAD Environment, 2018b). The results of these surveys identified three main genetic populations across LCC LGA and BCC LGA including:

- Northern cluster within the BCC LGA;
- Central cluster within predominately the BCC LGA; and
- South-western cluster which is within the LCC LGA.

When comparing these populations, the results of these surveys indicated that the northern and central clusters of koala populations in the BCC LGA were less genetically diverse than those in the south-western cluster found in LCC LGA, demonstrating a greater level of permeability across the landscape in LCC LGA (OWAD Environment, 2018b). It also noted that koala movement and dispersal in the LCC LGA was largely constrained by geographical areas, showing four main populations within this LGA (OWAD Environment, 2018b).

9.1.1.2 Findings from the Study

A single hotspot was identified in K2ARB and was located inside the Greenbank Military Reserve. Four koala scat detections were made following detection dog surveys and numerous historic koala records are present. The hotspot is defined as extending from the Logan Motorway south to the edge of contiguous forest and Teviot Brook. A few key forests and reserve provide. These include The Glider Forest, Parkinson Bushland Reserve and Karrawatha Forest which both contain historic records of koalas, provide important corridors within the hotspot connecting the surrounding landscape. Retained vegetation in riparian zones is likely to be of high importance for maintaining connectivity.

Table 9-1 Koala Hotspot Region within K2ARB

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of New Beith to Glider Forest (Hilcrest)	Remnant vegetation and high-value regrowth vegetation patches, and remnant vegetation lining creeks, both dominated by Koala food trees.	The Glider Forest Parkinson Bushland Reserve Greenbank Military Training Area	Koala records within intact remnant vegetation with linkage to other vegetated area.

9.1.1.3 Available Koala Habitat

In line with the environmental investigations for the K2ARB, extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the K2ARB. Survey effort was conducted in-line with state and federal guidelines undertaken by WSP in May-June 2016, and ERM in February-May 2018 and January 2020. This consisted of active searches and Spot Assessment Technique (SAT) searches.

The environmental investigations for K2ARB identified that this Project Area is characterised by urbanisation, notably adjacent to the Greenbank Military Training Area, with patches of vegetation within the Project Area being frequently managed (cleared) for existing general rail operations. Koala habitat is available in the form of regrowth woodlands and some wildlife corridors of remnant-to-advanced-regrowth vegetation dominated by eucalypt species common across the Project Area.

Typical koala food tree species found in this region include *Corymbia intermedia*, *E. seena* and *E. tereticornis*, see Table 8-2 for a breakdown of canopy species identified on the Koala Detection Dog Surveys.

Table 9-2 Available Koala Habitat within K2ARB

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
84	■ <i>Melaleuca quinquinervia</i> ■ <i>Corymbia intermedia</i> ■ <i>Lophostemon suaveolens</i> ■ <i>Eucalyptus seeana</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
85	■ <i>Eucalyptus tereticornis</i> ■ <i>Eucalyptus crebra</i> ■ <i>Corymbia intermedia</i> ■ <i>Lophostemon suaveolens</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
86	■ <i>Eucalyptus tereticornis</i> ■ <i>Corymbia intermedia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
87	■ <i>Lophostemon suaveolens</i> ■ <i>Eucalyptus seeana</i> ■ <i>Melaleuca quinquinervia</i> ■ <i>Corymbia intermedia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
88	■ <i>Eucalyptus tereticornis</i> ■ <i>Lophostemon suaveolens</i> ■ <i>Melaleuca quinquinervia</i> ■ <i>Corymbia intermedia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads

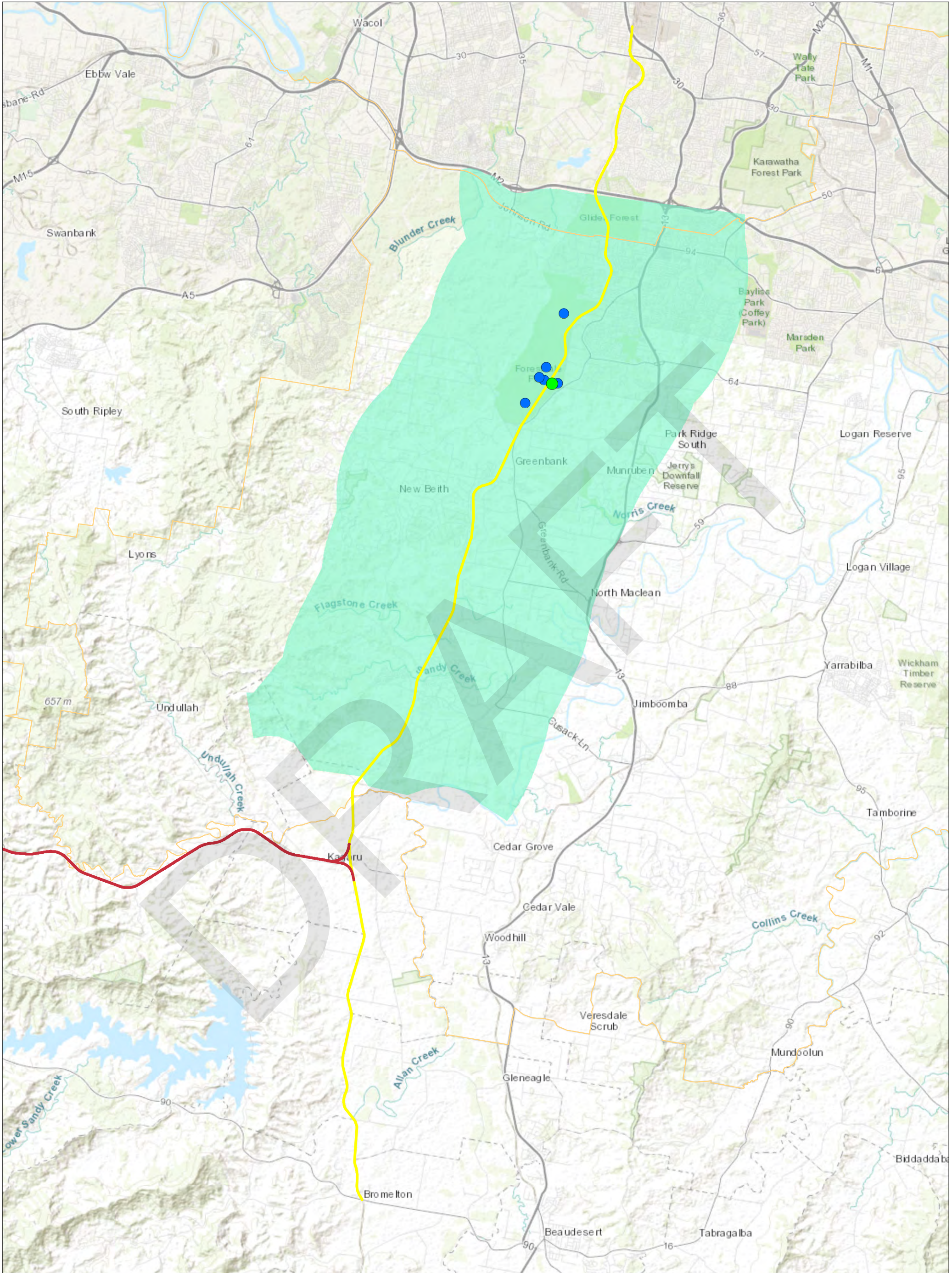
Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
89	■ <i>Eucalyptus seeana</i> ■ <i>Melaleuca quinquinervia</i> ■ <i>Corymbia intermedia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
90	■ <i>Corymbia citriodora</i> ■ <i>Lophostemon suaveolens</i> ■ <i>Melaleuca quinquinervia</i> ■ <i>Corymbia intermedia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads
91	■ <i>Corymbia citriodora</i> ■ <i>Lophostemon suaveolens</i> ■ <i>Melaleuca quinquinervia</i>	Intact remnant vegetation	Located in Greenbank Military Reserve, adjacent to heavily urbanised landscape and major roads

9.1.1.4 Opportunity for Connectivity

Locations considered important for maintaining connectivity include the eucalypt dominated woodland of the Glider Forest as well as the vegetation of the Greenbank Military Training Area, existing as a fauna corridor in contrast to the surrounding predominately urban landscape. Both forested areas are important components of the broader Flinders-Karawatha Biodiversity Corridor which is notable as one of the largest and last remaining stretches of continuous forest within SEQ (McGregor & Jones, 2016). The full extent of this corridor extends from Karawatha Forest to Flinders Peak to Brisbane's south and west to the southern side of Ipswich (McGregor & Jones, 2016). The continued connectivity of suitable habitat provided by the corridor will be critical for koalas within the SEQ extent and the surrounding landscape. Maintenance of connectivity through utilising existing crossing structures should be prioritised. Crossing structures should be in line with the koala Sensitive Design Guidelines (2022) and consider the best practice design of structures recommended in the WSP Preliminary Fauna Connectivity Strategy for the B2G Project, however within this section of the IRP the proponent was able to demonstrate that no additional fauna connectivity structures were required for KARB for the EPBC referral application.

Where offsetting is required for significant residual impacts to the koala, priority should be given to potential offset sites within 5km of the alignment, and with vegetation connected to, or in close proximity to, the hotspot region and containing koala food trees important for the K2ARB such as *E. tereticornis*, *E. crebra* and *Lophostemon* and *Corymbia* spp.

See Figure 9-1 for hotspot region associated within K2ARB.



- Legend**
- Koala sightings
 - Scat detections - East
 - Active Koala Hotspots
 - LGA Boundary
 - Inland Rail Alignment**
 - C2K - Calvert to Kagaru
 - K2AB - Kagaru to Acacia Ridge/Bromelton

Data Source:
ESRI World Topographic Map

Active Koala Hotspots with K2AB

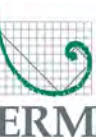
Drawing No: 0628339_N2AB_TM_G006_R3.mxd
Date: 14/02/2024
Drawn By: VN
Reviewed By: MD

Koala Genetics Study Project – Inland Rail Program
(NSW and QLD)
Client: ARTC

Coordinate System: GDA2020 MGA Zone 56
0 2 4km



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9.2 Calvert to Kagaru

9.2.1.1 Historic Koala Records

Studies undertaken for the C2K EIS confirmed koala presence throughout the Project Area. Observations of nine individuals and scat/scratch marks were found in Ebenezer, Peak Crossing and Washpool localities. ALA database showed several records throughout Project Area and even more in the greater surroundings. These records were largely concentrated in patches of protected forest, particularly across the ranges. The majority of these records are recent and were made post 2010.

9.2.1.2 Findings from the Study

Two hotspots have been identified within C2K and have been ranked in terms of priority for mitigation and management actions. Hotspot one is inclusive of the towns of Ebenezer to Peak Crossing and incorporates a mosaic of cleared agricultural land, advanced regrowth, and remnant vegetation. Riparian zones and protected nature reserves offer important corridors to koala dispersal within this hotspot, with prominence of Warrill Creek and the eucalypt dominated woodland of Purga Nature Reserve. Six scat detections were made following detection dog surveys and were noticeably within proximity to clusters of historic koala records.

Hotspot two is within proximity to hotspot one and is separated by a narrow section of cleared agricultural land. Due to the absence of historic records in between these hotspots, and the inability to survey in these areas, these hotspots have been delineated for the purpose of this study. It is possible that dispersal between hotspots occurs through the use of paddock trees and riparian vegetation, however this cannot be confirmed through this study. Hotspot two is inclusive of sandy creek south of Peak Crossing to the town of Washpool. Sandy Creek, Purga Creek and the eucalypt dominated woodlands across the Tevoit Range that extends beyond the IRP offer the primary corridors for koala movement within this hotspot and likely enables connectivity to suitable habitat in the surrounding area. Three koala scat detections were made just north of Washpool following detection dog surveys.

Table 9-3 Koala Hotspot Regions within C2K

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of Ebenezer to Peak Crossing	Remnant vegetation and high-value regrowth vegetation patches, and remnant vegetation lining creeks, both dominated by Koala food trees.	Warrill Creek Purga Nature Reserve	Koala records within intact remnant vegetation with linkage to other larger vegetated area.
2	Inclusive of Sandy Creek (Peak Crossing) to Washpool.	Remnant vegetation of the Mountain Range, and remnant vegetation lining creeks, both dominated by Koala food trees.	Sandy Creek Purga Creek Teviot Range	Koala records within intact remnant vegetation with linkage to other larger vegetated area.

9.2.1.3 Available Koala Habitat

In line with the C2K EIS extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for C2K. Survey effort was conducted in-line with state and federal guidelines undertaken by Jacobs-GHD in March-May 2016, GHD in December-February 2017, EMM September-November 2018 and FFJV December-April, May-July 2019. This consisted of habitat assessments, active searches, SAT searches and incidental observations.

The C2K EIS studies undertaken identified that this Project Area has remnant vegetation associated with sloping and steep topography or is highly fragmented with majority of the IRP dominated by pasture grassland, isolated trees and areas of advanced regrowth; by-products of historic land clearing. Remnant eucalypt vegetation is associated with the Peak Crossing, Teviot Range and Ebenezer areas (To the North and South of the Project Area). Most koala records are associated with riparian habitat near Western Creek, Warrill Creek and Purga Creek including its associated floodplains.

Typical koala food tree species found in this region include *E. crebra*, *C. citriodora* and *C. tessellaris*, see Table 9-4 for a breakdown of canopy species identified on the koala detection dog surveys.

Table 9-4 Available Koala Habitat within C2K

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
75	■ <i>Corymbia citriodora</i> ■ <i>Eucalyptus crebra</i>	Likely remnant	Edge of cleared pastoral land
76	■ <i>Corymbia citriodora</i> ■ <i>Eucalyptus crebra</i>	Advanced regrowth/remnant	Edge of cleared pastoral land
77	■ <i>Eucalyptus tereticornis</i> ■ <i>Callitris glaucophylla</i>	Advanced regrowth/remnant	Purga Nature Reserve
78	■ <i>Eucalyptus crebra</i> ■ <i>Eucalyptus tereticornis</i> ■ <i>Corymbia tessellaris</i>	Advanced regrowth/remnant	Purga Nature Reserve
79	■ <i>Corymbia tessellaris</i> ■ <i>Eucalyptus crebra</i> ■ <i>Corymbia citriodora</i>	Advanced regrowth/remnant	Connectivity with local nature reserved edging pastoral land
80	■ <i>Eucalyptus woollsiana</i>	Advanced regrowth/remnant	Connectivity with local nature reserved edging pastoral land
81	■ <i>Corymbia tessellaris</i> ■ <i>Eucalyptus crebra</i> ■ <i>Eucalyptus tereticornis</i> ■ <i>Lophostemon suaveolens</i>	Advanced regrowth/remnant	Connectivity with local nature reserved edging pastoral land
82	■ <i>Corymbia citriodora</i> ■ <i>Eucalyptus crebra</i>	Advanced regrowth/remnant	Connectivity with local nature reserved edging pastoral land
83	■ <i>Eucalyptus crebra</i> ■ <i>Corymbia tessellaris</i>	Advanced regrowth/remnant	Connectivity with local nature reserved edging pastoral land

9.2.1.4 Opportunity for Connectivity

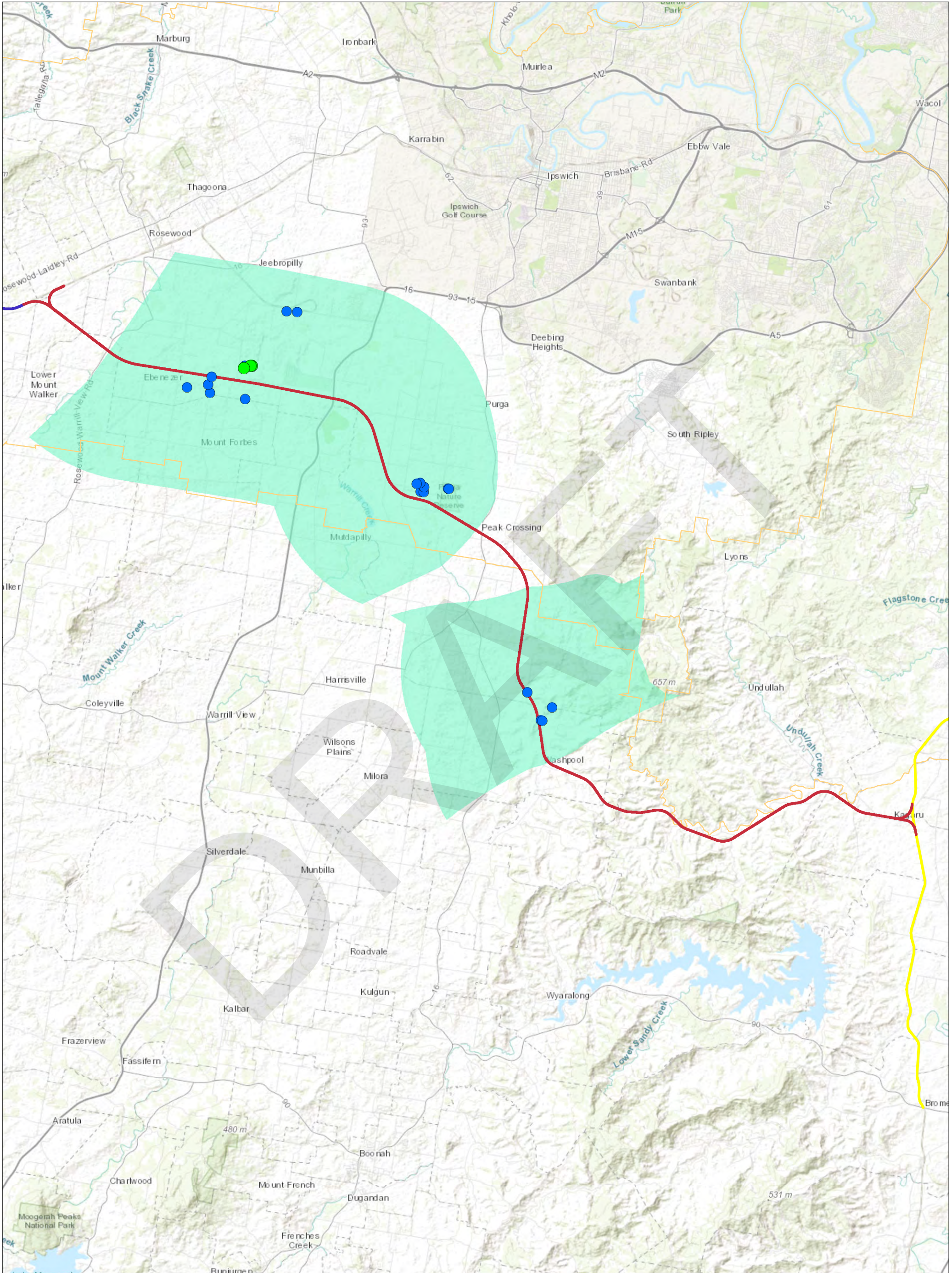
Locations considered important for maintaining connectivity include the eucalypt dominated woodland of the Purga Nature Reserve as well as the riparian vegetation along Purga, Sandy and Warrill creeks. These provide important fauna corridors throughout otherwise heavily cleared agricultural land. Connecting fragmented eucalypt vegetation to the contiguous forest of the Teviot Ranges will also be important for improving connectivity. Maintenance of connectivity through utilising existing crossing structures should be prioritised. Crossing structures should be in line with the Koala Sensitive Design Guidelines (2022) and consider the WSP Preliminary Fauna Connectivity Strategy for the B2G Project.

The eastern edge of C2K overlaps with the Flinders-Karawatha Biodiversity Corridor. In addition to providing important continuous koala habitat, this corridor is critical for facilitating extensive connectivity across the broader landscape. In particular, this corridor is likely to provide connectivity between the second hotspot of C2K and the active hotspot identified within K2ARB. As such, any efforts to maintain or improve connectivity will be beneficial to local koalas across the landscape, beyond the extent of the IRP.

Where offsetting is required for significant residual impacts to the koala, priority should be given to potential offset sites within 5km of the alignment, and with vegetation connected to, or in close proximity to, the hotspot region and containing koala food trees important for the C2K such as *E. tereticornis*, *E. crebra*, and *Lophostemon* and *Corymbia spp.*

See Figure 9-2 for hotspot locations associated within the Project Area.

DRAFT



- Legend**
- Koala sightings
 - Scat detections - East
 - Active Koala Hotspots
 - LGA Boundary
 - Inland Rail Alignment**
 - C2K - Calvert to Kagaru
 - H2C - Helidon to Calvert
 - K2AB - Kagaru to Acacia Ridge/Bromelton

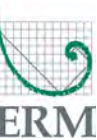
Data Source:
ESRI World Topographic Map

Active Koala Hotspots with C2K

Drawing No: 0628339_N2AB_TM_G006_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56			
		 This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	



F9-2



9.3 Helidon to Calvert

Studies undertaken for the H2C EIS confirmed koala presence throughout the IRP. Observations of five individuals and scat/scratch marks localised to between Helidon and Gatton as well as between Laidley to Calvert. One was recorded near Helidon, three between Laidley and Grandchester and one near Calvert. ALA database showed several records throughout Project Area and even more in the greater surroundings.

9.3.1.1 Findings from the Study

Two hotspots have been identified within H2C following desk top assessments and detection dog surveys and have been ranked in terms of priority for intervention and mitigation measures. Hotspot one is inclusive of Helidon, Lockyer State Forest and Ringwood and is likely to connect to the Adjacent hotspot in G2H. Remnant eucalypt vegetation is still dominant, particularly across the range and in riparian creek vegetation. Historic koala records are numerous surrounding the town of Helidon and three scat detections were made following detection dog surveys.

A considerable gap between hotspot one and hotspot two is present in H2C with the landscape dominated primarily by cleared agricultural land and urban areas with minimal records of koala presence. Hotspot two is bordered by the town of Laidley and is inclusive of the remnant forest surrounding the town of Grandchester and Western Creek on the outskirts of Calvert. Historic koala records are present within the area defined as the hotspot but no detections were made following detection dog surveys. Consultation with community members and local organisations have confirmed that anecdotal observations of koalas within the hotspot is known with sightings and known instances of koala fatalities presented in community consultation workshops for the IRP.

Table 9-5 Koala Hotspot Regions within H2C

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of Helidon, Lockyer State Forest to Ringwood.	Remnant vegetation of the Mountain Range and lining creeks, dominated by Koala food trees.	Lockyer State Forest Helidon Hills	Koala records within intact remnant vegetation with linkage to other larger vegetated area.
2	Inclusive of Laidley to Western Creek (Calvert).	Remnant vegetation of the Mountain Range and lining creeks, dominated by Koala food trees.	Little Liverpool Range	Koala records within intact remnant vegetation with linkage to other larger vegetated area.

9.3.1.2 Available Koala Habitat

In line with the H2C EIS, extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the Helidon to Calvert Project. Survey effort was conducted in-line with state and federal guidelines undertaken by Arup/SMEC in March-June 2016, EMM in September-November 2018 and ELA December-April 2019. This consisted of habitat assessments, active searches, SAT searches and incidental observations. Studies undertaken to support the H2C EIS identified that remnant vegetation was fragmented and typically occurred in areas characterised by rocky ranges and sloping topography such as the Lockyer Valley, Helidon Hills and the Little Liverpool Range. Regrowth of varying quality is also present along roadsides and in isolated patches adjoining pastoral land and urban areas.

Typical koala food tree species found in this region include *E. crebra* and *C. citriodora*, see Table 8-6 for a breakdown of canopy species identified on the koala detection dog surveys.

Table 9-6 Available Koala Habitat within H2C

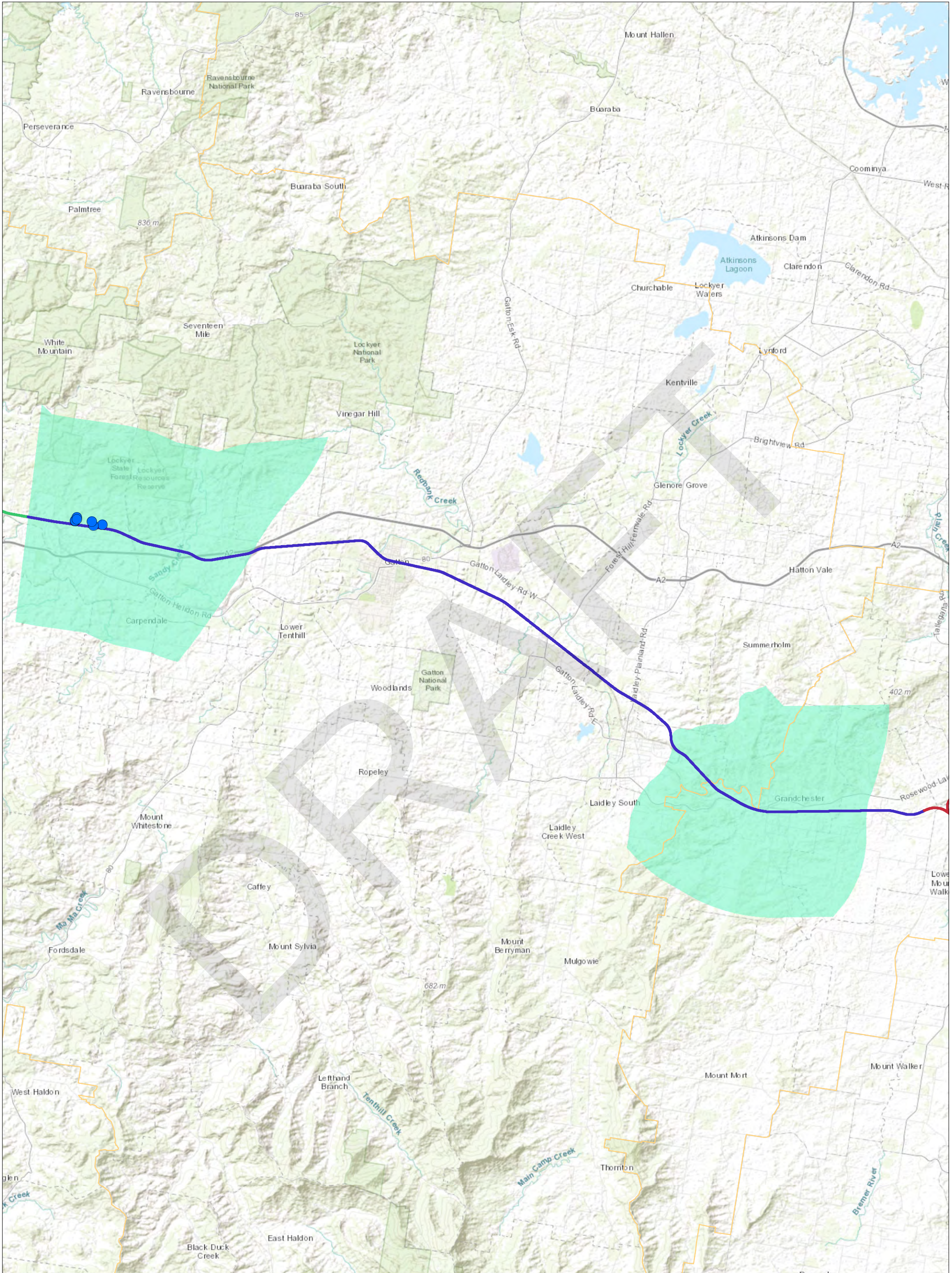
Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
68	■ <i>Eucalyptus crebra</i> ■ <i>Corymbia citriodora</i>	Advanced Regrowth	Riparian zone adjacent to cleared agricultural land
69	■ <i>Eucalyptus crebra</i> ■ <i>Corymbia citriodora</i>	Advanced regrowth	Cleared pastoral land
70	■ <i>Corymbia citriodora</i> ■ <i>Corymbia gummifera</i> ■ <i>Lophostemon suaveolens</i>	Remnant	Riparian zone in continuous forest
71	■ <i>Corymbia citriodora</i>	Remnant	Continuous forest
72	■ <i>Lophostemon suaveolens</i> ■ <i>Corymbia citriodora</i>	Remnant	Continuous forest
73	■ <i>Corymbia citriodora</i>	Remnant	Continuous forest
74	■ <i>Corymbia citriodora</i>	Remnant	Continuous forest

9.3.1.3 Opportunity for Connectivity

Locations considered important for maintaining connectivity include the eucalypt dominated woodland of the Lockyer State Forest as well as the Little Liverpool Range and Helidon Hills. These provide important fauna corridors throughout otherwise heavily cleared agricultural land. Also of note for potential connectivity are the riparian vegetation along the Lockyer Creek and Gatton National Park. Maintenance of connectivity through utilising existing crossing structures should be prioritised. Crossing structures should be in line with the Koala Sensitive Design Guidelines (2022) and consider the WSP Preliminary Fauna Connectivity Strategy for the B2G Project.

Where offsetting is required for significant residual impacts to the koala, priority should be given to potential offset sites within 5km of the alignment, and with vegetation connected to, or in close proximity to, the hotspot region and containing koala food trees important for the H2C such as, *E. crebra* and *Lophostemon* and *Corymbia spp.*

See Figure 9-3 for hotspot locations associated with the Project Area.



- Legend**
- Scat detections - East
 - Active Koala Hotspots
 - LGA Boundary
 - Inland Rail Alignment
 - C2K - Calvert to Kagaru
 - G2H - Gowrie to Helidon
 - H2C - Helidon to Calvert

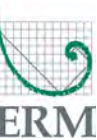
Data Source:
ESRI World Topographic Map

Active Koala Hotspots with H2C

Drawing No: 0628339_N2AB_TM_G006_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	
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F9-3



9.4 Gowrie to Helidon

9.4.1.1 Historic Koala Records

High densities of koala records are present within G2H with the vast majority recorded between 2010 and 2021. These records occur within the eucalypt woodland between Postmans Ridge and Toowoomba, particularly adjacent to the Toowoomba bypass. Records are present within the more heavily urbanised Toowoomba however these are less frequent. Rocky creek and the adjacent vegetation contain many records between Helidon Spa and Postmans ridge all of which are recent. Many of these records are likely to be in association with the recent infrastructure upgrades, namely the development of the Toowoomba bypass.

9.4.1.2 Findings from the Study

A single hotspot of koala activity was identified within G2H and is inclusive of Mt Kynoch on the outskirts of Toowoomba to Helidon. Extensive historic records are present and numerous detections were made following detection dog surveys. The hotspot also possesses key koala habitat corridors across the Toowoomba range, which is heavily dominated by remnant forest, and the Lockyer Creek. The hotspot is also likely to overlap with adjoining hotspots within H2C.

Table 9-7 Koala Hotspot Region within G2H

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of Mt Kynoch to Helidon.	Remnant vegetation of the Mountain Range and lining creeks, dominated by Koala food trees.	Lockyer Creek Toowoomba Range	Koala records within intact remnant vegetation with linkage to other larger vegetated area.

9.4.1.3 Available Koala Habitat

In line with the G2H EIS, extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the Gowrie to Helidon Project. Survey effort was conducted in-line with state and federal guidelines undertaken by Arup in March 2017, EMM in September-May 2019 and ELA December-April 2019. This consisted of habitat assessments, active searches, SAT searches and incidental observations.

The majority of G2H is dominated by cleared pasture and cropping land with considerable barriers to koala movement. Of the available eucalypt vegetation, the majority is highly fragmented regrowth of mixed quality with remnant mature eucalypt open forest isolated to the central portion of G2H. Notably the Toowoomba Bypass is a major existing barrier to koalas in the region. Suitable koala habitat is found in the Helidon Hills and Toowoomba Ranges areas as well as being characterised by riparian habitat, notably Gowrie Creek.

Typical koala food tree species found in this region include Narrow-leaved ironbark *E. crebra* and *C. citriodora*, see Table 8-8 for a breakdown of canopy species identified on the Koala Detection Dog Surveys.

Table 9-8 Available Koala Habitat within G2H

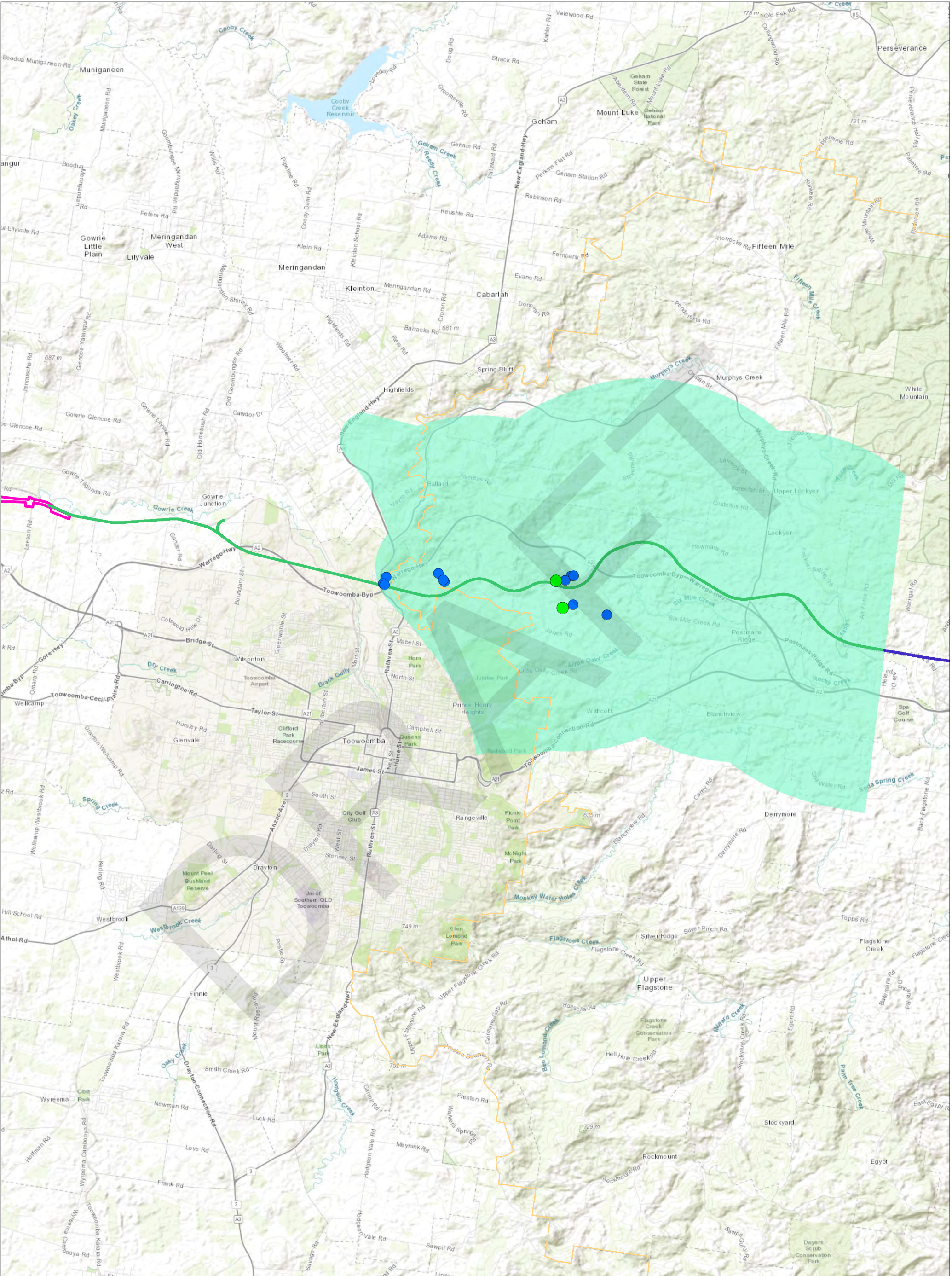
Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
59	■ <i>Eucalyptus crebra</i> ■ <i>Corymbia citriodora</i>	Remnant	Continuous forest
60	■ <i>Eucalyptus crebra</i> ■ <i>Corymbia</i>	Remnant	Continuous forest
61	■ <i>Eucalyptus crebra</i>	Remnant	Continuous forest with powerline track
62	■ <i>Eucalyptus citriodora</i>	Remnant	Continuous forest with access tracks
63	■ <i>Eucalyptus moluccana</i> ■ <i>Corymbia citriodora</i>	Remnant/Advanced regrowth	Continuous forest
64	■ <i>Corymbia citriodora</i> ■ <i>Eucalyptus crebra</i>	Remnant	Continuous forest
65	■ <i>Eucalyptus tereticornis</i> ■ <i>Corymbia citriodora</i>	Remnant	Continuous forest
66	■ <i>Eucalyptus tereticornis</i> ■ <i>Corymbia sp</i>	Remnant	Road corridor
67	■ <i>Lophostemon confertus</i>	Remnant	Continuous forest adjacent to urban infrastructure

9.4.1.4 Opportunity for Connectivity

Locations considered important for maintaining connectivity include the eucalypt dominated woodland of the Toowoomba range and the remnant riparian vegetation of the Lockyer Creek. These areas provide important fauna corridors across a landscape that has been heavily modified for both agriculture and urban development. Smaller creeks such as Rocky Creek also provide valuable corridors between remnant woodland and retained advanced regrowth. Major roads, such as the Toowoomba bypass, offer significant barriers to koala movement within G2H. Crossing structures should be in line with the Koala Sensitive Design Guidelines (2022) and consider the WSP Preliminary Fauna Connectivity Strategy for the B2G Project.

Where offsetting is required for significant residual impacts to the koala, priority should be given to potential offset sites within 5km of the alignment, and with vegetation connected to, or in close proximity to, the hotspot region and containing koala food trees important for the G2H such as, *E. crebra*, *E. moluccana*, *E. tereticornis* and *Lophostemon* and *Corymbia spp.*

See Figure 9-4 for hotspot locations associated with the Project Area.



- Legend**

 - Koala sightings
 - Scat detections - East
 - Active Koala Hotspots
 - LGA Boundary
- Inland Rail Alignment**

 - B2G - NSW/QLD Border to Gowrie
 - G2H - Gowrie to Helidon
 - H2C - Helidon to Calvert

Data Source:
ESRI World Topographic Map

Active Koala Hotspots with G2H

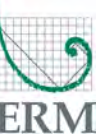
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Drawn By: VN

Koala Genetics Study Project – Inland Rail Program
(NSW and QLD)
Reviewed By: MD
Client: ARTC

Coordinate System: GDA2020 MGA Zone 56
0 2 4km

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F9-4



9.5 Border to Gowrie

9.5.1.1 Historic Koala Records

Historic koala records accessed from ALA are present in high densities throughout the B2G project with a particularly dense cluster of records surrounding Toowoomba. Noticeably, a high proportion of these records are recent (between 2010 and 2021). Large areas of intact forest are present adjacent to B2G, yet records are also common throughout more heavily cleared agricultural land. These are largely located in linear stretches of roadside vegetation however riparian zones and fragmented patches of regrowth and remnant vegetation throughout the landscape also appear to provide a degree of habitat.

Previous active searches and SAT searches undertaken in 2016 returned detections of koala scat within the B2G IRP however no individuals were detected.

9.5.1.2 Findings from the Study

Three hotspots were identified in B2G and have been provided with an initial ranking of priority for management and mitigation measures. Hotspot one is inclusive of Pittsworth to Athol and it largely dominated by isolated regrowth vegetation surrounded by cleared or semi-cleared pastoral land. Patches of isolated roadside vegetation also are present. No major corridors for koala movement have been identified, however connectivity may be provided by the paddock trees and small isolated remnant vegetation and regrowth that is present. Koala records are known from both historic presence data and detection dog surveys within the IRP. Extensive anecdotal evidence of koala activity has also been provided by local organisations and community members following community consultations.

Hotspot two is inclusive of Bringalily, Whetstone State Forests within the IRP and is noted to provide extensive corridors of suitable koala habitat. While slightly adjacent to the IRP, the Yelarbon State Forest and Devine State Forest also offer important areas of protected koala habitat. Corridors are maintained between these state forests through remnant roadside vegetation, paddock trees and riparian vegetation along key creeks and waterways. Historic koala records and detection dog surveys both confirm the presence of koalas within the IRP and is likely to be an important area for koala persistence and dispersal in the landscape.

The third hotspot is inclusive of Domville State Forest, Millmerran and the Condomine River. While relatively few records are known from historic data records or from detection dog surveys, numerous anecdotal evidence was provided by local organisations and community members. Of note within this hotspot is the presence of mining outside Domville. Existing riparian vegetation is likely to still provide corridors for connectivity and critical koala habitat, however existing land use practices may establish barriers to connectivity.

Table 9-9 Koala Hotspot Regions within B2G

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of Pittsworth to Athol.	Isolated regrowth vegetation dominated by koala food trees surrounded by pastoral land.		Patches of isolated and roadside vegetation with Koala records.
2	Inclusive of Bringalily State Forest, Whetstone State Forest, and Yelarbon State Forest	Intact remnant vegetation in the State Forests is dominated by koala food trees.	Bringalily State Forest, Whetstone State Forest, and Canning Creek	Being of continuous remnant vegetation forming part of a larger protected vegetation area. Riparian habitat with Koala records.
3	Inclusive of Domville State Forest, Millmerran, to the Condamine River.	Isolated regrowth vegetation dominated by koala food trees surrounded by pastoral land. Remnant vegetation in both the State Forest and lining creeks, dominated by koala food trees. Surrounded by pastoral land.	Condamine River and floodplain Domville State Forest	Isolated riparian habitat and roadside vegetation with Koala records, and intact remnant vegetation with linkage to other larger vegetated area.

9.5.1.3 Available Koala Habitat

In line with the B2G EIS extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the Border to Gowrie Project. Survey effort was conducted in-line with state and federal guidelines undertaken by ELA from April to October 2016 and June 2018 to May 2019. This consisted of active searches, SAT searches, call playback and spotlighting.

The B2G EIS studies found the Project Area has been significantly modified by the clearing of native vegetation, overall being heavily fragmented by agriculture and urbanised land use. Suitable koala habitat was revealed to be within the riparian corridor of the Condamine River and associated floodplain and in regrowth and isolated vegetation around Pittsworth and surrounding regions in the north of the Project Area. Notably this Project is characterised by its proximity to Durakai and Bringalily State Forests.

Typical koala food tree species found in this region include *Eucalyptus camaldulensis*, *Eucalyptus populnea* and *Eucalyptus chloroclada*, see Table 9-10 for a breakdown of canopy species identified on the koala detection dog surveys.

Table 9-10 Available Koala Habitat within B2G

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
41	■ <i>E. populnea</i> ■ <i>E. camaldulensis</i>	Historically cleared pastoral land with advanced regrowth	Isolated vegetation amongst pastoral land
42	■ <i>E. populnea</i> ■ <i>E. camaldulensis</i>	High dieback Historically cleared pastoral land with advanced regrowth	Isolated vegetation amongst pastoral land
43	■ <i>Eucalyptus camaldulensis</i> ■ <i>Corymbia erythrophloia</i>	Historically cleared pastoral land with advanced regrowth	Riparian zone
44	■ <i>E. populnea</i> ■ <i>E. camaldulensis</i> ■ <i>E. tereticornis</i> ■ <i>Casuarina cristata</i>	Historically cleared pastoral land with advanced regrowth	Isolated vegetation amongst pastoral land
45	■ <i>E. tereticornis</i> ■ <i>E. populnea</i> ■ <i>Acacia salicina</i>	Historically cleared pastoral land with advanced regrowth Significant dieback	Isolated vegetation amongst pastoral land
46	■ <i>E. tereticornis</i> ■ <i>Casuarina cunninghamiana</i> ■ <i>Acacia salicina</i>	Remnant/advanced regrowth Some dieback	Isolated patch of trees surrounded by cleared agricultural land
47	■ <i>E. chloroclada</i> ■ <i>E. melanophloia</i> ■ <i>Callistris glaucophylla</i>	Historically cleared agricultural land with some remnant/advanced regrowth	Adjacent to ephemeral creek
48	■ <i>E. crebra</i>	Historically cleared with moderate dieback along agricultural land	Adjacent to Creekline surrounded by cleared pastoral land
49	■ <i>E. melanophloia</i> ■ <i>E. crebra</i>	Narrow linear strip of remnant vegetation	Isolated roadside vegetation surrounded by cleared pastoral land
50	■ <i>E. crebra</i> ■ <i>E. chloroclada</i>	Historically cleared Creekline on pastoral land	Isolated vegetation surrounded by cleared pastoral land
51	■ <i>E. melanophloia</i> ■ <i>E. chloroclada</i>	Advanced regrowth along potential Creekline	Isolated vegetation surrounded by cleared pastoral land
52	■ <i>E. melanophloia</i> ■ <i>E. chloroclada</i>	Mature paddock trees along Creekline with cleared understory	Adjacent to mine site and surrounded by cleared pastoral land
53	■ <i>E. chloroclada</i> ■ <i>Corymbia erythrophloia</i> ■ <i>E. melanophloia</i>	Advanced regrowth with occasional mature trees	Along ephemeral creek Pastoral land connected to Devine State Forest and Bringalily State Forest
54	■ <i>E. populnea</i> ■ <i>Eucalyptus camaldulensis</i>	Remnant	Road corridor through state forest

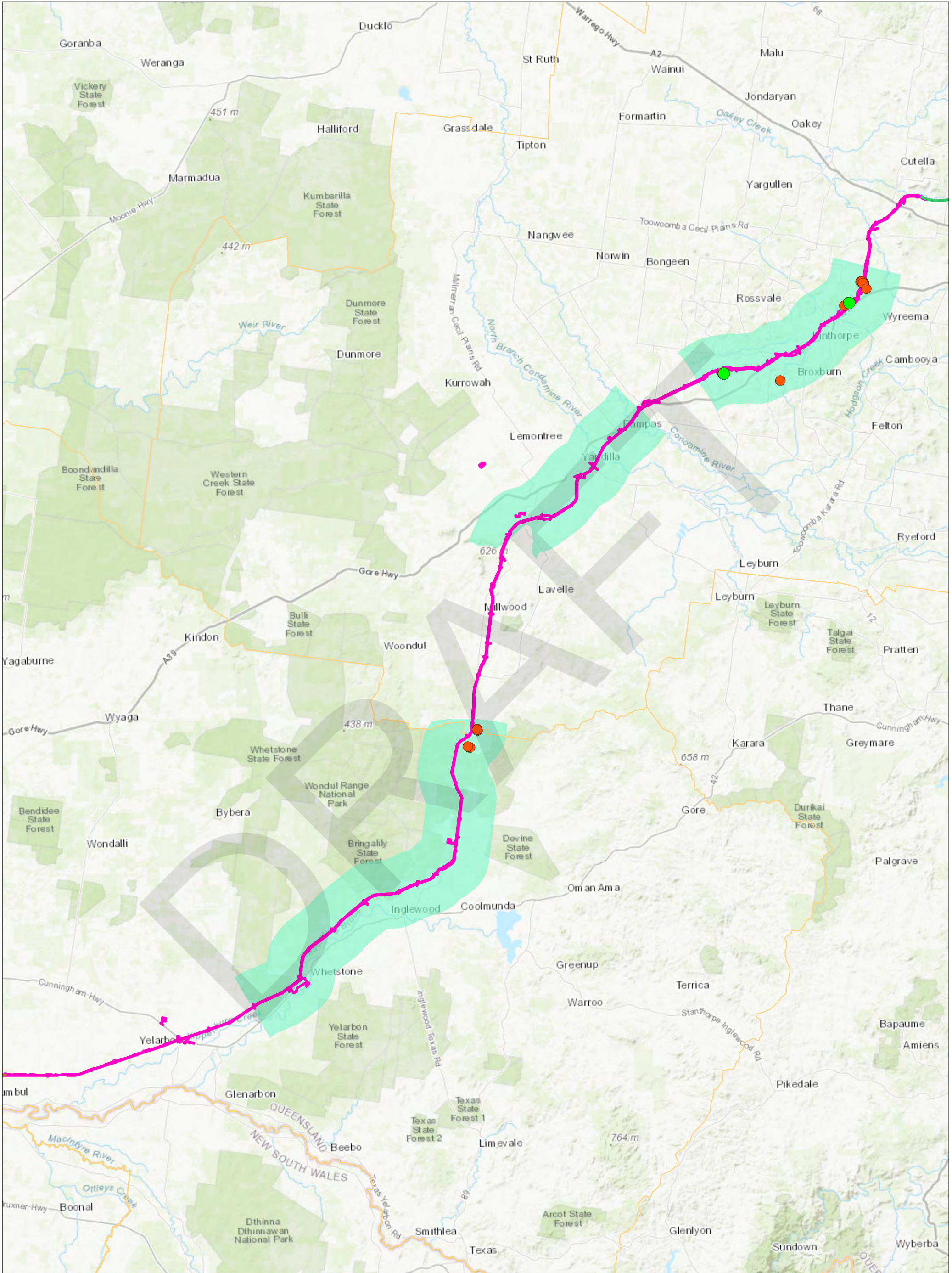
Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
55	■ <i>E. populnea</i> ■ <i>Eucalyptus camaldulensis</i>	Remnant	Road corridor through state forest
56	■ <i>Eucalyptus camaldulensis</i> ■ <i>Corymbia erythrophloia</i>	Advanced regrowth with occasional mature trees	Cleared pastoral land within close proximity to state forest
57	■ <i>E. populnea</i> ■ <i>Eucalyptus camaldulensis</i> ■ <i>E. tereticornis</i> ■ <i>Casuarina cristata</i>	Advanced regrowth and evidence of historic fires	Adjacent to quarry and connected to state forest
58	■ <i>E. tereticornis</i> ■ <i>E. populnea</i> ■ <i>Acacia salicina</i>	Advanced regrowth and evidence of historic fires	Adjacent to quarry and connected to state forest

9.5.1.4 Opportunity for Connectivity

Locations considered important for maintaining connectivity include the eucalypt dominated woodland of the Bringalily, Whetstone and Domville State Forests, which provide important corridors to more contiguous forests outside of the IRP, including Devine and Yelabon State Forests and Wondul Range National Park. Riparian zones are also important corridors for fauna connectivity with the Canning Creek and the Condamine River and associated floodplains providing critical connectivity across otherwise cleared agricultural land. Crossing structures should be in line with the Koala Sensitive Design Guidelines (2022) and the WSP Preliminary Fauna Connectivity Strategy for the B2G Project.

Where offsetting is required for significant residual impacts to the koala, priority should be given to potential offset sites within 5km of the alignment, and with vegetation connected to, or in proximity to, the hotspot region and containing koala food trees important for the B2G such as, *E. crebra*, *E. tereticornis*, *E. Camaldulensis*, *E. populnaea*, *E. melanophloia*, and *Lophostemon*, *Angophora*, and *Corymbia spp.*

See Figure 9-5 for hotspot locations associated within the Project Area.



- Legend**
- Koala sightings
 - Scat detections - West
 - Active Koala Hotspots
 - LGA Boundary
 - Inland Rail Alignment**
 - B2G - NSW/QLD Border to Gowrie
 - G2H - Gowrie to Helidon
 - NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Active Koala Hotspots with B2G

Drawing No: 0628339_N2AB_TM_G006_R3.mxd	Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	
Drawn By: VN	Reviewed By: MD	Client: ARTC

Coordinate System: GDA2020 MGA Zone 56

0 2 4km



This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

F9-5



9.6 North Star to Border

9.6.1.1 Historic Koala Records

Historic koala records accessed from ALA are present in the Project Area, with records seen near heavily cleared agricultural land. These are largely located in linear stretches of roadside vegetation in the North Star locality. Riparian zones and fragmented patches of regrowth and remnant vegetation throughout the landscape also appear to provide a degree of habitat with records from the Macintyre River. It should be noted that the proximity to urban areas may influence the number of sightings that have historically been made of individuals in relation to the size and quality of habitat.

Previous active searches and SAT searches undertaken in 2018 returned detections of one individual along the Macintyre River as well as scat and scratch marks found in 2021 across the Project Area.

9.6.1.2 Findings from the Study

No historic koala presence records are known across NS2B and field surveys did not return detections. NS2B is mostly comprised of highly modified agricultural land with very little available habitat that could support koalas or aid in dispersal. No hotspots have been identified within NS2B. Further field surveys have been proposed for July 2023.

9.6.1.3 Available Koala Habitat

In line with the NS2B EIS extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the North Star to Border Project. Survey effort was conducted in-line with state and federal guidelines undertaken by FFJV in October 2018 to October 2019 and in 2021. This consisted of active searches, SAT searches, call playback and spotlighting.

The NS2B EIS studies found the Project Area has been significantly modified by agricultural land use, where the clearing of native vegetation has been extensive. Large tracts of remnant vegetation are rare within the Project Area, with most of the remaining native vegetation occurring in small fragments, often in a highly degraded state. Koala habitat is available in the form of riparian vegetation along waterways or drainage lines, with an individual identified within the riparian vegetation of the Macintyre River. Typical koala food tree species found in this region include Poplar box (*Eucalyptus populnea*), see Table 9-11 for a breakdown of canopy species identified on the Koala Detection Dog Surveys.

Table 9-11 Available Koala Habitat within NS2B

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
38	■ <i>Eucalyptus populnea</i> ■ <i>Casuarina cristata</i>	Some mature trees and advanced regrowth with cleared understory and limited recruitment	Isolated patch of vegetation surrounded by cleared pastoral and cropping land
39	■ <i>Eucalyptus populnea</i>	Narrow linear roadside vegetation with some mature trees and advanced regrowth	Isolated patch of vegetation surrounded by cleared pastoral and cropping land
40	■ <i>Eucalyptus populnea</i>	Narrow linear roadside vegetation with some mature trees and advanced regrowth	Isolated patch of vegetation surrounded by cleared pastoral and cropping land

9.6.1.4 Opportunity for Connectivity

No hotspots of koala activity have been identified within the NS2B owing to its relatively small size and a lack of koala detections. However, the Macintyre River offers important opportunities for maintaining connectivity and improving available habitat and, across the broader landscape, can provide some connection to Yelarbon State Forest, albeit over large geographic distances. Smaller creeks and drainage lines throughout the cleared agricultural land may also provide opportunities for improving connectivity across the landscape. Crossing structures should be in line with the best practice designs and aim to support the objectives of the Koala Habitat Protection Guidelines (2019) and State Environmental Planning Policy (SEPP) (Biodiversity and Conservation) (Chapter 4 Koala habitat protection) 2021. The design and best practice recommendations provided by the WSP Preliminary Fauna Connectivity Strategy and NSW Koala Strategy (Environment and Heritage Department of Planning and Environment, 2022) for the B2G Project will also provide valuable learnings for the implementation of suitable koala crossing structure.

9.7 Narrabri to North Star (Phase 2)

9.7.1.1 Historic Koala Records

Numerous historic records sourced from ALA exist within N2NS. These records are largely more recent than those of N2N being made between 2010 and 2021. These records are noticeable concentrated around the town of Moree with records present within the riparian vegetation of the Mehi river as well as roadside vegetation across the broader landscape. Spotlighting and SAT searches undertaken in 2015 returned positive detections of both koala individuals and scats.

Another cluster of historic records is present surrounding the town of Crooble. Records made before 2010 exist in the nearby Bullala National Park. More recent records are present but appear to be restricted to linear strips of riparian vegetation and roadsides with minimal connectivity.

As presented in the N2NS EIS (2017), an additional fourteen individuals have been sighted across the project. These detections were made at fauna survey sites 15 and 16, with an additional four being made opportunistically along the project. Two additional scats were found along the project.

9.7.1.2 Findings from the Study

Desk-top assessments of historic presence data and field surveys have identified one koala hotspot within N2NS. This hotspot extends from the Mehi River in Moree to the town of Croppa Creek. Riparian vegetation along the Mehi River and Gwydir River, as well as along roadside vegetation in the surrounding landscape are likely to be important corridors for koala movement and surveys returned detections of scats and individual koalas.

Table 9-12 Koala Hotspot Region within N2NS

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	Inclusive of Moree to Croppa Creek.	Isolated regrowth vegetation dominated by koala food trees surrounded by pastoral land. Remnant vegetation lining a creek dominated by koala food trees. Surrounded by pastoral land.	Mehi River Gwydir River	Isolated riparian habitat and roadside vegetation with Koala records.

9.7.1.3 Available Koala Habitat

In line with the N2NS EIS extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the Narrabri to North Star Project. Survey effort was conducted in-line with state and federal guidelines undertaken by NGH in December of 2015 and 2019, and February 2020 within Phase 2. This consisted of active searches, SAT searches and spotlighting.

The N2NS EIS studies revealed majority of the Project Area has been heavily modified by past and ongoing disturbances associated with the rail corridor and surrounding agricultural activities. Patches of koala habitat were determined to exist sporadically within the Project Area and are typically associated with riparian corridors, Travelling Stock Reserves (TSRs), road reserves or remnant to regrowth vegetation skirting farmland. Typical koala food tree species found in this region include *Eucalyptus tereticornis*, *Eucalyptus camaldulensis* and *Eucalyptus populnea*, see Table 9-13 for a breakdown of canopy species identified on the Koala Detection Dog Surveys.

The southern end of the IRP is located immediately north of Narrabri on an embankment above the Namoi River. Of significance, the alignment traverses the Gwydir River floodplain. The northern end of the Project Area at North Star is located south of the Macintyre River.

The implementation of dedicated wildlife culverts is considered best practice for koala sensitive design however other options are also available to ensure connectivity is maintained. These include refuge poles and koala rails within culverts are also proven to still be useful.

Table 9-13 Available Koala Habitat within N2NS

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
26	■ <i>Eucalyptus camaldulensis</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Creek line
27	■ <i>Eucalyptus camaldulensis</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Creek line
28	■ <i>Eucalyptus camaldulensis</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Creek line
29	■ <i>Eucalyptus populnea</i> ■ <i>Casuarina cristata</i>	Isolated regrowth patch of vegetation surrounded by pastoral land	Road corridor
30	■ <i>Eucalyptus populnea</i> ■ <i>Casuarina cristata</i>	Isolated regrowth patch of vegetation surrounded by pastoral land	Road corridor
31	■ <i>Eucalyptus crebra</i> , ■ <i>Eucalyptus tereticornis</i> ■ <i>Eucalyptus amplifolia</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
32	■ <i>Eucalyptus tereticornis</i> ■ <i>Allocasuarina costata</i> ■ <i>Eucalyptus melanophloia</i> ■ <i>Eucalyptus amplifolia</i> ■ <i>Casuarina glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
33	■ <i>Eucalyptus tereticornis</i> ■ <i>Corymbia tessellaris</i> ■ <i>Allocasuarina luehmannii</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
34	■ <i>Eucalyptus moluccana</i> ■ <i>Allocasuarina luehmannii</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Creek line
35	■ <i>Angophora floribunda</i> ■ <i>Eucalyptus. sp</i> ■ <i>Casuarina glaucophylla</i> ■ <i>Allocasuarina luehmannii</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
36	■ <i>Casuarina cristata</i>	Isolated regrowth patch of vegetation surrounded by pastoral land	Road corridor
37	■ <i>Eucalyptus populnea</i> ■ <i>Casuarina cristata</i>	Isolated regrowth patch of vegetation surrounded by pastoral land	Road corridor

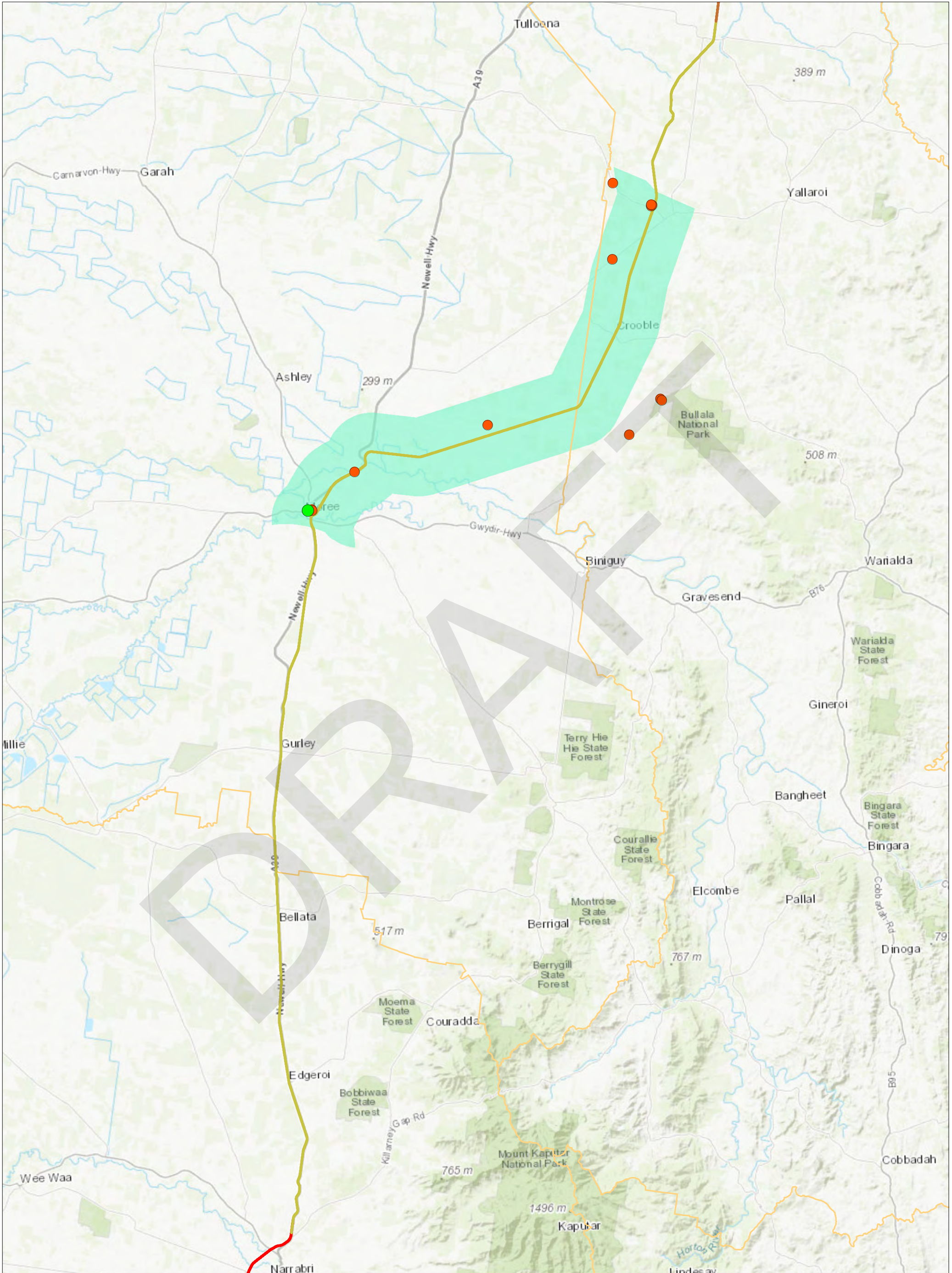
9.7.1.4 Opportunity for Connectivity

Focus should be placed on sections of the Project Area which cross riparian habitat and therefore could have the potential to form a barrier. Locations of importance would include Mehi River and Gwydir River. Refuge poles will likely be beneficial where canopy and mature trees are limited.

Culverts and koala

The landscape of N2NS (Phase 2) is largely heavily cleared agricultural land with little in the way of contiguous remnant forest. Riparian zones are considered important for maintaining fauna corridors within N2NS and of particular importance is Mehi and Gwydir Rivers. Riparian vegetation does provide opportunities to maintain connections with remnant forest outside of the IRP, such as Bullala CCA Zone 1 National Park, and other smaller retained vegetation. Maintenance of connectivity through utilising existing crossing structures should be prioritised. Crossing structures within N2NS (phase 2) should be in line with the best practice designs and aim to support the objectives of the Koala Habitat Protection Guidelines (2019) and State Environmental Planning Policy (SEPP) (Biodiversity and Conservation) (Chapter 4 Koala habitat protection) 2021. Design will also be in line with The Koala Sensitive Design Guidelines (2022) and consider the WSP Preliminary Fauna Connectivity Strategy for the B2G Project.

See Figure 9-6 for hotspot locations associated within the Project Area.



Koala sightings

Scat detections - West

Active Koala Hotspots

Inland Rail Alignment

N2N - Narramine to Narrabri

N2NS - Narrabri to North Star

NS2B - North Star to Border

Data Source:
ESRI World Topographic Map

Active Koala Hotspots with N2NS

Drawing No: 0628339_N2AB_TM_G006_R3.mxd		Koala Genetics Study Project – Inland Rail Program (NSW and QLD)	
Date: 14/02/2024	Drawing Size: A4	Client: ARTC	
Drawn By: VN	Reviewed By: MD		
Coordinate System: GDA2020 MGA Zone 56		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	
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9.8 Narromine to Narrabri

9.8.1.1 Historic Koala Records

Historic koala records sourced from ALA throughout the N2N alignment of the IRP are heavily concentrated around the Pilliga Nature Reserve with additional records located sporadically towards the south. Presence records are noticeably absent between the town of Kickabil and Tenandra State Forest, an approximately 54km stretch of the IRP. While pockets of vegetation do exist in the form of roadside vegetation and small reserves, suitable habitat is largely absent from the landscape, with the bulk of surrounding land cleared pastoral and/or cropping land. The bulk of these records were recorded before 2010. Some records made between 2012 and now exist however are themselves not recent with the most recent record made in 2016. Post 2010 records within N2N are isolated to the Pilliga Nature Reserve with no recent records made anywhere else along the project.

During previous survey work along the IRP, koala scats were detected at Coolangala Creek and Etoo Creek following surveys in 2018 and 2019. The age of these scats was not known, and no individuals were observed. While this is an indication that some individuals were at least present at the time, it is unknown if these areas provided permanent habitat or were merely used for dispersal.

Findings from the Study

With a combination of desktop reviews of historic presence data and ground-truthing field surveys, a single hotspot has been identified within N2N. This hotspot is located south of Narrabri and is inclusive of the Pilliga Nature Reserve. While koala detections were not made within this hotspot following the field surveys for the IRP, the high density of historic records and the presence of potentially suitable habitat were identified as being suitable for inclusion as an area of priority for the IRP.

Table 9-14 Koala Hotspot Region within N2N

Hotspot Number	Hotspot Extent	Local Habitat Values	Corridors	Reason for Hotspot
1	South of Narrabri inclusive of The Pilliga Nature Reserve.	Remnant vegetation dominated by koala food trees.	The Pilliga Nature Reserve	Being of continuous remnant vegetation forming part of a larger protected vegetation area.

9.8.1.2 Available Koala Habitat

In line with the N2N EIS extensive ground-truthing and field surveys were undertaken to determine the extent of koala habitat for the Narrabri to Narromine Project. Survey effort was conducted in-line with state and federal guidelines undertaken by GHD in September and November of 2018 as well as March, August, September, October of 2019. This consisted of active searches, drone surveys, spotlighting and call playback.

Results revealed much of the southern and central portion of the Project Area is located in land cleared for agriculture. In the northern end of the Project Area, large sections are in areas dominated by vegetation associated with state forests of the Pilliga National Park (state forest sections). Typical koala food tree species found in this region include *Eucalyptus camaldulensis*, *Eucalyptus crebra* and *Eucalyptus microcarpa*. A detailed assessment of canopy species identified along the IRP is presented in Table 9-15.

It was determined that for the N2N Project riparian vegetation is likely to provide habitat and dispersal corridors for this species, with Etoo Creek (near the Aloes picnic area in the Pilliga), identified as a key site for observing koalas from both anecdotal and the GHD survey data. There is a record from 2019 associated with roadside vegetation south of Narromine.

The N2N EIS stated that evidence provided to the recent inquiry in koala populations in NSW noted that the Pilliga koala population was ‘completely unviable’ or already extinct (Legislative Council Portfolio Committee 7 2020) and this is supported by *Lunney et. al.* in 2017, which found decline of over 80 per cent in both the distribution and activity of koalas. These findings support those of this study that suggests that any koalas still present within the Pilliga are in extremely low densities and population viability is likely to be in decline.

Table 9-15 Available Koala Habitat within N2N

Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
1	■ <i>Eucalyptus tereticornis</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest creek line
2	■ <i>Eucalyptus microcarpa</i> ■ <i>Eucalyptus dwyerii</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
3	■ <i>Eucalyptus crebra</i> ■ <i>Callitris glaucophylla</i> ■ <i>Allocasuarina luehmannii</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
4	■ <i>Eucalyptus camaldulensis</i> ■ <i>Eucalyptus crebra</i> ■ <i>Angophora floribunda</i> ■ <i>Allocasuarina luehmannii</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest creek line
5	■ <i>Eucalyptus camaldulensis</i> ■ <i>Callitris glaucophylla</i> ■ <i>Brachychiton</i> sp. ■ <i>Eucalyptus populnea</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
6	■ <i>Eucalyptus camaldulensis</i> ■ <i>Callitris glaucophylla</i> ■ <i>Allocasuarina luehmannii</i> ■ <i>Angophora floribunda</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest creek line
7	■ <i>Eucalyptus chloroclada</i> ■ <i>Eucalyptus crebra</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
8	■ <i>Eucalyptus crebra</i> ■ <i>Allocasuarina luehmannii</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
9	■ <i>Eucalyptus camaldulensis</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Ephemeral creek line
10	■ <i>Eucalyptus camaldulensis</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Ephemeral creek line
11	■ <i>Eucalyptus populneus</i> ■ <i>Eucalyptus microcarpa</i>	Advanced regrowth, historically cleared	Road corridor
12	■ <i>Eucalyptus microcarpa</i> ■ <i>Callitris glaucophylla</i>	Advanced regrowth, historically cleared	Road corridor

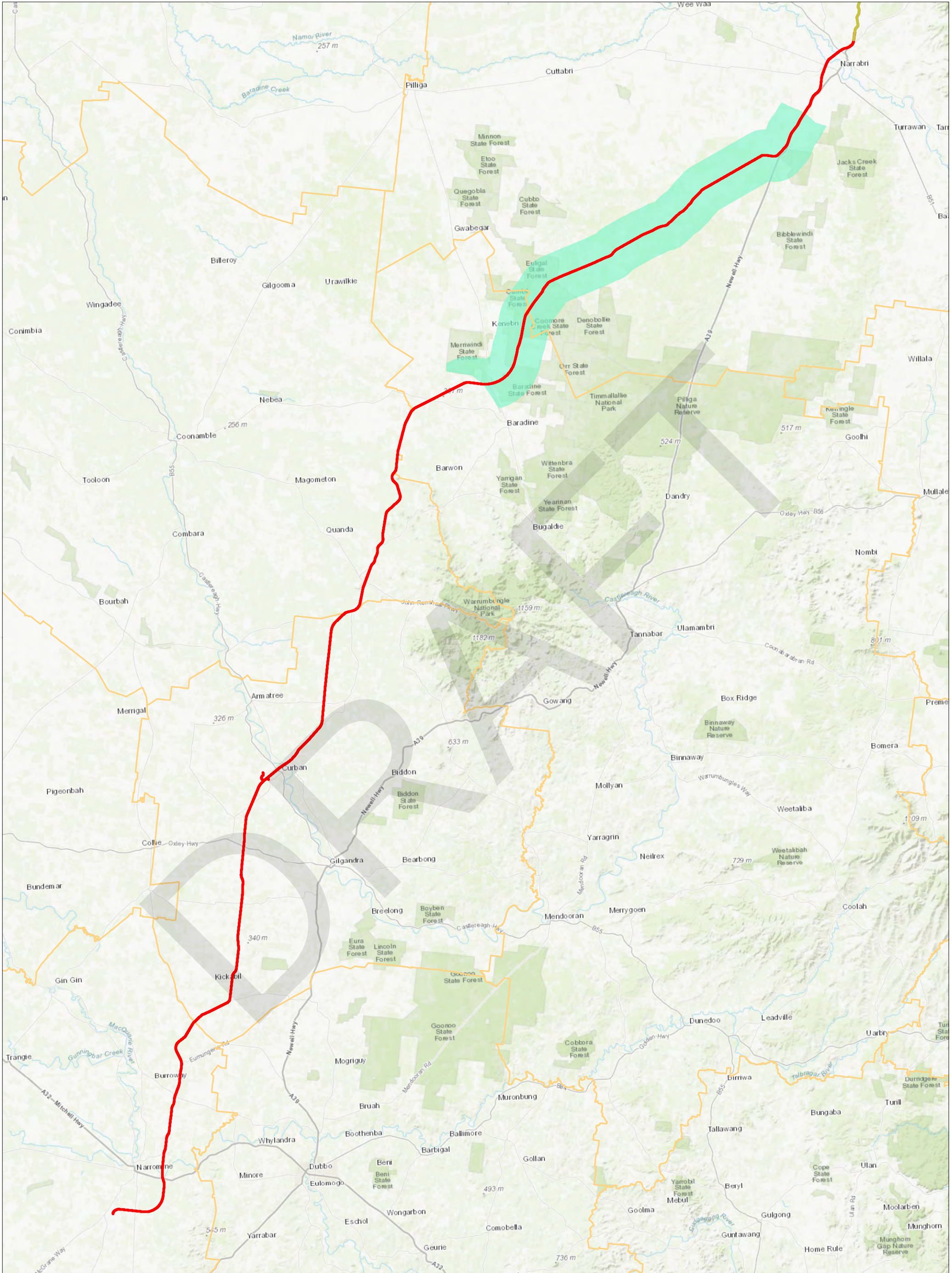
Quaternary Number	Dominant Canopy Species	Vegetation Quality	Landscape Context
13	■ <i>Eucalyptus tereticornis</i> ■ <i>Eucalyptus populnea</i> ■ <i>Casuarina glauca</i>	Advanced regrowth, planted canopy species	Managed Parkland
14	■ <i>Eucalyptus camaldulensis</i>	Remnant canopy, understory cleared	Riparian habitat edging urbanised area
15	■ <i>Eucalyptus populneus</i>	Remnant canopy, understory cleared	Road corridor
16	■ <i>Eucalyptus dealbata</i> ■ <i>Callitris glaucophylla</i>	Isolated remnant patch of vegetation surrounded by pastoral land	Road corridor
17	■ <i>Eucalyptus dealbata</i> ■ <i>Eucalyptus microcarpa</i> ■ <i>Callitris glaucophylla</i> ■ <i>Allocasuarina luehmannii</i>	Isolated remnant patch of vegetation surrounded by pastoral land	Road corridor
18	■ <i>Eucalyptus woollsiana</i> ■ <i>Eucalyptus dealbata</i> ■ <i>Callitris glaucophylla</i> ■ <i>Allocasuarina luehmannii</i>	Isolated advanced regrowth patch of vegetation surrounded by pastoral land	Road corridor
19	■ <i>Eucalyptus woollsiana</i> ■ <i>Eucalyptus crebra</i> ■ <i>Allocasuarina luehmannii</i> ■ <i>Callitris glaucophylla</i>	Isolated remnant patch of vegetation surrounded by pastoral land	Managed land/State Forest
20	■ <i>Eucalyptus crebra</i> ■ <i>Callitris glaucophylla</i> ■ <i>Allocasuarina luehmannii</i>	Isolated remnant patch of vegetation surrounded by pastoral land	Managed land/State Forest
21	■ <i>Eucalyptus camaldulensis</i> ■ <i>Casuarina Cunninghamiana</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Ephemeral creek line
22	■ <i>Eucalyptus moluccana</i> ■ <i>Allocasuarina luehmannii</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation as a part of a larger protected vegetation area.	Managed land/State Forest
23	■ <i>Eucalyptus tereticornis</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Ephemeral creek line
24	■ <i>Eucalyptus blakelyi</i> ■ <i>Callitris glaucophylla</i>	Remnant vegetation lining a creek. Surrounded by pastoral land.	Ephemeral creek line
25	■ <i>Eucalyptus microcarpa</i> ■ <i>Eucalyptus dwyeri</i> ■ <i>Callitris glaucophylla</i>	Isolated advanced regrowth patch of vegetation surrounded by pastoral land and managed land/state forest	Road corridor

9.8.1.3 Opportunity for Connectivity

Despite the lack of recent koala records in this section, focus should be placed on sections of the Project Area which cross riparian habitat and therefore could have the potential to form a barrier. Locations of importance would include Coolangala Creek and Etoo Creek.

The Pillaga Nature reserve is considered important for maintaining connectivity. While no koala detections were made in N2N and historic records are largely from before 2010, the Pillaga and surrounding state forests still offers an extensive network of suitable eucalypt woodland that extends across the broader landscape beyond the IRP. Riparian vegetation is noted to be of particular importance for connecting smaller state forests and retained vegetation towards the south of the IRP. Crossing structures should be in line with the Koala Sensitive Design Guidelines (2022) and consider the WSP Preliminary Fauna Connectivity Strategy for the N2N Project.

See Figure 9-7 for hotspot locations associated within the Project Area.



Legend

Active Koala Hotspots Inland Rail Alignment

N2N - Narromine to Narrabri

N2NS - Narrabri to North Star

Data Source:
ESRI World Topographic Map

Active Koala Hotspots with N2N

Drawing No:	0628339_N2AB_TM_G006_R3.mxd
Date:	14/02/2024
Drawn By:	VN
Reviewed By:	MD
Coordinate System:	GDA2020 MGA Zone 56
Scale:	0 2 4km

Koala Genetics Study Project – Inland Rail Program (NSW and QLD)
Client: ARTC
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



F9-7



10. CONCLUSION AND RECOMMENDATIONS

This study aimed to help support already existing knowledge of the koala in the IRP regions, and to dive deeper into the movement of the species across the vast landscape. The new information gathered from this study can further support decisions made to maintain and/or improve habitat connectivity and help acknowledge key areas for ongoing koala monitoring to ensure measures put in place are effective.

A key priority for IRP is to preserve current landscape connectivity for movement of koalas, despite creating a potential linear barrier. Due to low koala density and a low number of koala's sampled across the IRP, previous samples were pooled from other studies to form groups along the IRP in order to perform connectivity analysis across the IRP. Other groups outside the IRP were also formed for comparison and to help contextualise the population status associated with the IRP.

The genetic diversity results from this study indicated 10 geographical groupings of koalas, three of which Included IRP ARTC samples:

- Calvert to Kagaru and Kagaru to Acacia Ridge and Bromelton (Group 2);
- Border to Gowrie and Gowrie to Helidon (Group 3); and
- Narrabri to North Star (Group 6).

Overall, these three groups compared to the other groups in the larger landscape had:

- High levels of heterozygosity: Higher levels of heterozygosity equate to larger genetic diversity within a population(s), which is a positive indicator as genetic diversity is linked to both individual health and, at population level, evolutionary potential (with Group 3 (B2G + G2H) showing higher heterozygosity than the other groups);
- Low levels of inbreeding and of relatedness between individuals: This suggests gene flow is currently occurring within the groups along the IRP and the potential of negative impacts due to excessive inbreeding is minimal;
- Relatively small population size, with Group 3 (B2G + G2H) having a larger population size relative to other groups. This results in overall lower densities of koalas across the landscape; and
- No concerns regarding sex ratio, but high chlamydia prevalence, except Group 3 which is medium prevalence (however the sample size remain very low). The ratio of males to females is not of concern for genetic health although chlamydia prevalence is high. Caution should be taken when interpreting these findings as the sample size is small.

When compared with the results of the vegetation assessments, the analysis of eucalypt forage species from the sampled scats indicates some variability between the dominant eucalypt species measured and the eucalypts detected in the scats (Table 10-1). The spatial variability in the preferred diet trees of koalas indicates that any replacement planting should be done in accordance with the bioregion. Preferred food trees as detected in the scat analysis should be planted, however care should be taken to not develop a monoculture that would result in individual diets becoming dominated by one or two species, therefore reducing the nutritional value to be gained.

Table 10-1 Summary of dominant eucalypt detected in samples and vegetation assessments

Locality	Dominant eucalypt detected in scat samples	Dominant canopy trees from vegetation assessments
Brisbane region (east of the divide)	<i>E. seeana</i> , <i>E. tereticornis</i>	<i>E. tereticornis</i> <i>C. citriodora</i> , <i>C. intermedia</i> , <i>E. crebra</i>
Toowoomba region (west of the divide)	<i>E. amplifolia</i> , <i>E. tereticornis</i> , <i>E. chloroclada</i> and <i>E. melliodora</i>	<i>E. crebra</i> , <i>E. citriodora</i> and <i>C. intermedia</i>
Moree region	<i>E. camaldulensis</i> , <i>E. populnea</i> , <i>E. chloroclada</i>	<i>E. camaldulensis</i> , <i>E. populnea</i> and <i>E. crebra</i> .

Based on these findings, the following recommendations should be prioritised throughout the IRP:

1. This genetics study provides a baseline assessment of koala genetics within the IRP; however it is recommended that additional surveys be completed beyond the IRP in order to increase the robustness of genetic analysis and allow for further analysis to identify distinct population groups of koalas within the IRP.
2. It is evident that there is considerable movement/dispersal of koalas along the Study Area, therefore it is imperative to adhere to the objectives and recommendations of the KMP to ensure adequate corridors and or ways for koalas to be able to move through the IRP respectively.
3. To further the effectiveness of this study in identifying distinct koala population groups within the IRP and beyond, an effort to enable surveys to be conducted in all landholder properties along the IRP and beyond should be prioritized as this would enable true representation of the movements and dispersal ranges of koala groups within each area.
4. Forage tree preference indicates that koalas may seek out preferred forage trees that are not part of the dominant tree species within a landscape. Although the current study represents a small sample size, the eucalypt species detected in the sampled scats did not always contain the dominant species as measured from vegetation assessments.

This genetics study revealed that mitigation measures are necessary to maintain and/or improve current koala genetic diversity by allowing gene flow along and across the Inland Rail alignment, supporting the objectives of the Draft Koala Management Plans (KMPs) developed for the IRP. The KMPs will ensure that these mitigation measures are successful by monitoring measurable outcomes and adopting an adaptive management approach.

This study provides data to support assessments of koalas along the IRP alignment and forms part of the baseline for ongoing monitoring as a part of the KMPs. To overcome the current limitations of the study, additional surveys across areas unable to be sampled and beyond the IRP will likely provide more accurate assessments of priority areas for koala mitigation and management measures within the IRP.

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APPENDIX A UNISC GENETICS METHODS AND RESULTS

DRAFT

Note – Results presented here are preliminary as the genetic analyses were somewhat limited by the small sample size; caution should be exercised when interpreting these results. Additional work will be conducted to increase the data set, including re-extraction of samples that failed quality control and further detection dog surveys to locate and collect additional koala scat samples. Once this is complete, the combined genetic data set will be re-analysed, which may alter the results.

Acronyms and glossary

Allele: a variant of a gene. The size of an allele can vary in size (e.g., between one nucleotide to hundreds of nucleotides). At the population level, variation in alleles is used to estimate patterns of genetic diversity.

Coverage: also called read depth, describes the number of times that a given nucleotide in the genome has been read. In Next Generation sequencing methods such as used here, the genome is fragmented into short sections of base pairs. These are read individually and then assembled through bioinformatics. For this assemblage to work with minimal error, multiple individual reads are required per fragment and nucleotide to achieve a certain level of confidence for a SNP call.

DDC: Detection Dogs for Conservation at the University of the Sunshine Coast.

DNA: Deoxyribonucleic acid, a molecule carrying genetic information.

Effective population size (N_e): Broadly, this refers to the number individuals in a population who are able to contribute to the next generation's genetic material and is usually a subset of the census population. More specifically, N_e is the size of an idealised population that would lose genetic diversity at the same rate as the actual population. This is one of the most important parameters in population genetics and conservation biology because the genetic 'health' of a population is directly dependent on the effective population size, and indirectly linked to the census size of a population. The likelihood that a gene will be sampled as the next generation is produced is affected by the breeding structure of the population. In an 'ideal population':

- The number of breeding males is equal to the number of breeding females.
- Mating is random and all of the organisms will produce offspring.
- One organism doesn't produce more offspring than another.
- The population of breeding organisms remains constant from one generation to the next.

In an ideal population, all individuals have an equal opportunity to pass on their genes and the effective population size should be equal to the census population. In reality, this does not occur because not all members within a population mate, the ratio of males to females is rarely equal, mating isn't random, and generations overlap. Due to these factors, the effective population size is never as large as the census population. It is important to note that N_e is particularly sensitive to an unequal number of males and females in the population.

In short, the effective population size translates the census size of a real population into the size of an idealised population showing the same rate of loss of genetic diversity, inbreeding, or genetic drift for a population under study. In a natural population, the ratio of effective population size to census population size (N_e/N) is typically 0.1 (Frankham 1995, Palstra and Ruzzante 2008). The relationship between these two measures is complex and it is important to refrain from making inferences about census population size based on effective population size (Palstra and Fraser 2012).

Current recommendations for the genetic conservation of species in the wild are that:

- to avoid inbreeding depression, effective population size needs to be ≥ 100 , and
- to maintain evolutionary potential of a species, effective population size needs to be ≥ 1000 .

Effective population size recommendations are based on Extinction Theory, as summarised in Mace et al. (2008). The explanations below are extensively drawn from Mace et al. (2008), for specific references see the original paper.

All things being equal, the probability of extinction is greater when a population size is small or its decline rate is high. Small populations are more susceptible to demographic stochasticity, whereby random variations in birth and death rates can lead to extinction even when the average population growth rate is positive. In addition, small populations can suffer disproportionately from genetic effects, such as accumulation of recessive deleterious alleles under inbreeding, loss of quantitative characters that allow adaptation, accumulation of mildly deleterious mutations, and various other behavioural, social, and demographic factors. To safeguard genetic variability over hundreds of years, it was previously recommended that minimum effective population sizes of at least 50 be maintained, however has been revised to 100 (Frankham, Bradshaw et al. 2014).

Evolutionary potential: the capacity of a population to evolve to cope with environmental changes. Often simplistically equated with genetic diversity (especially for quantitative characters, such as fitness), but it is also influenced by N_e .

F-statistics (fixation index) is the basic method used to measure the amount of subdivision in populations, and consists of three measures, F_{IS} , F_{ST} , and the less commonly used F_{IT} . These measures relate to the amounts of heterozygosity at various levels of a population structure: individual (I), subpopulation (S) and total (T).

F_{ST} estimates the amount of structuring of a population into subpopulations, and can range from 0 to 1 (where 0 means complete sharing of genetic material and 1 means no sharing). In this report, F'_{ST} , the standardised F_{ST} (produced by dividing F_{ST} by the maximum value it can obtain, given the observed within-population diversity) was also calculated to enable comparisons of our results to other studies.

F_{IS} , also called inbreeding coefficient, is the proportion of the variance in the subpopulation contained in an individual and can range from -1 to 1 (the closer to 1, the higher the degree of inbreeding). Note that inbreeding can not only result from non-random matings (matings between cousins for example), but also from small isolated populations, where all individuals are more closely related than large populations.

Gene flow: movement of alleles between populations via migrants or gametes. Gene flow maintains genetic diversity and promotes evolution by spreading new genes and combinations of genes throughout a species' range, however it may also constrain evolution by preventing adaptation to local conditions (and therefore, animal translocations need to be carefully thought out).

Genetic diversity: The extent of genetic variation in a population (or species, or across a group of species), for example heterozygosity or allelic diversity.

Genetic drift: changes in the genetic composition of a population due to random sampling in finite populations.

Genetic stochasticity: genetic consequences of small populations, including inbreeding, loss of genetic diversity due to genetic drift and chance fixation of deleterious mutations that reduce

fitness and can drive a population or species towards extinction (often in combination with other factors).

Genotype: in diploid species (species with two sets of chromosomes - paternal and maternal copies), genotype is often used to refer to the particular pair of alleles that are carried by an individual. A genotype is described as homozygous if it features two identical alleles and as heterozygous if the two alleles differ. The process of determining a genotype is called genotyping.

Hardy-Weinberg Equilibrium: is a principle that is used to examine, based on observed genotype frequencies (see observed / expected heterozygosity), whether a population is experiencing forces such as natural selection, non-random mating, genetic drift, and gene flow. The Hardy-Weinberg Equilibrium states that in the absence of these forces, the genetic variation in a population will remain constant from one generation to the next. Therefore, if a population of interest is found not to be at the Hardy-Weinberg Equilibrium, underlying causes can be explored.

Heterozygosity: refers to the presence of two different alleles within a diploid individual, here it refers to the presence of two different nucleotides at a specific SNP locus. Commonly, at the population level, two measures of average heterozygosity (calculated for all SNP loci and all individuals) are reported:

H_O = observed heterozygosity, the calculated level of heterozygosity from the allele frequencies of the population under study,

H_E = expected heterozygosity, the level of heterozygosity that could be expected based on observed allele frequencies if the population was at the Hardy-Weinberg* equilibrium.

The comparison between observed and expected level of heterozygosity is a measure of interest:

- A lower observed heterozygosity compared to the expected heterozygosity can be a sign of inbreeding.
- A higher observed heterozygosity compared to the expected heterozygosity can be due to the mixing of two previously isolated populations.

IR: Internal Relatedness is a measure of inbreeding at the individual level (as opposed to population level, such as F_{IS}). It is calculated from heterozygosity data and does not require a pedigree, which is difficult to obtain in wild populations. Internal relatedness is currently the most widespread used index for inbreeding and its main strength is that allele frequencies are incorporated into the measure.

Inbreeding occurs when individuals are more likely to mate with relatives than with randomly chosen individuals in the population. Inbreeding increases the probability that offspring are homozygous, which can lead to lower fitness, a phenomenon commonly referred to as inbreeding depression.

Inbreeding depression: reduction in fitness due to inbreeding.

Koala Coast: The Koala Coast is a region in southeast Queensland that extends from Brisbane (south of the Brisbane River) through to Logan (east of the M1 Motorway) and Redland Coast Local Government Areas. The Koala Coast has been identified as one of the most important natural koala populations in Australia.

Locus (plural **loci**): refers to a specific position in the genetic material (such as in a chromosome), for example where a SNP is detected.

Nucleotide: A nucleotide is the basic structural unit and building block for DNA. These building blocks are hooked together to form a chain of DNA. There are four types of bases in DNA. They are called: Adenine (A), Cytosine (C), Guanine (G) and Thymine (T).

PCA (Principal Component Analysis): a method that attempts to represent the dissimilarities between samples in a low dimensional space (2-3 dimensions).

Polymorphism: any difference in the nucleotide sequence between individuals. Here, we refer to polymorphic loci when, across the population, differences occur between individuals (the opposite situation is a monomorphic locus where all individuals in the population have the same DNA sequence).

SD: Standard Deviation

SE: Standard Error

Sex ratio: the relationship between the number of males to the number of females. Typically, the sex ratio in natural populations is expected to be 1:1. Risks of extinction are increased if population sex ratios deviate from 1:1. However, a small bias of sex ratio towards females can sometimes be desirable, especially in very small or rapidly declining populations.

SEQ: South East Queensland

Small populations: the fact that small, isolated, populations are more prone to extinction (or extirpation) is well established, and therefore a goal in conservation is to avoid species being fragmented into small populations. In general, there are four sources of stochasticity that can cause small population to go extinct (from Shaffer 1981):

- demographic stochasticity: chance events in the survival and reproductive success of a finite number of individuals,
- environmental stochasticity: due to temporal variation of habitat parameters and the populations of competitors, predators, parasites, and diseases,
- natural catastrophes: such as floods, fires, droughts,
- genetic stochasticity: resulting from changes in gene frequencies due to founder effect, random fixation, or inbreeding – all influencing survival.

SNP: Single Nucleotide Polymorphism is the most common type of genetic variation. Each SNP represents a difference in a single DNA building block, called a nucleotide (there are four nucleotides: A, C, T and G).

Structure: within a species, genetic structure exists because not all individuals are able to breed with all other individuals of the same species, due to geographic proximity (even if a species distribution is continuous). Simplistically, this reflects that individuals that live close to each other have a higher chance of breeding than individuals further apart. Population structure (i.e., the genetic differentiation of local populations) is increased by mutation, genetic drift (due to finite population size) and natural selection favouring adaptations to local environmental conditions; but is decreased by gene flow (the movement of gametes, or individuals). Population structure is higher when gene flow between populations is lower, and so population structure is increased by habitat fragmentation and isolation.

Population structure can be studied through allele frequencies and can only be inferred with a sample size large enough to calculate robust allele frequencies. Therefore, sample size dictates the unit of comparison and the scale at which genetic structure can be examined.

Genetic structure can be hierarchically described:

- **Broad-scale structure** (often studied through a Bayesian statistic programs) usually defines ‘populations’ as independent breeding units, with each population descending from a different lineage and with very little to no gene flow. The software usually tests whether distinct populations can be inferred **without any *a priori* geographic information** and identifies migrants (individuals belonging genetically to one population, but geographically to another one), and admixed individuals, that are offspring of migrants between populations.
- **Fine-scale structure** (often calculated through F_{ST} , see F-statistics) usually describes sub-populations (also called local populations or demes) where gene flow exists but is restricted. Genetic structure at this level is studied by comparing allele frequencies between artificially constructed populations (e.g. between countries, between states, between councils) and then testing whether the populations should be considered one or multiple, and how similar the populations are to one another (pairwise F_{ST}).
- Finally, the distribution of related individuals in space, an even finer structure that can be referred to as “cryptic”, can be described through autocorrelation measures, where distances between all individuals and their genetic relatedness are compared.

Table A1. The list of 255 unique samples available from 24 sample locations for genetic data analysis with DArTcap and DArTag genotype data.

Sample Name	Sample Location	Latitude	Longitude	ARTC sample
180430Bi1A	Brisbane City	-27.5023	153.1839	No
210216Bi2B1	Brisbane City	-27.5738	153.1815	No
210216Bi2C1	Brisbane City	-27.5729	153.1803	No
Kidgy_109964_USC	Brisbane City	-27.382	152.993	No
Debbie_112243	Brisbane City	-27.5006	153.1067	No
180515Bi4B	Redland City	-27.6511	153.249	No
201127Bi1B1	Redland City	-27.6153	153.1799	No
DR220115KM1E	Redland City	-27.4139	153.4706	No
DR220116KM1A	Redland City	-27.4297	153.4988	No
220411KM1P	Redland City	-27.5944	153.2478	No
220411KM1JJ	Redland City	-27.5982	153.2424	No
220323BI2A	Redland City	-27.5683	153.2966	No
220323BI1F	Redland City	-27.4899	153.246	No
220406KM1D	Redland City	-27.5083	153.1974	No
220411KM1A	Redland City	-27.6024	153.2472	No
220323BI1G	Redland City	-27.4887	153.2458	No
220411KM1N	Redland City	-27.596	153.2463	No
DR220212KM1B	Redland City	-27.6788	153.2893	No
220323BI1I	Redland City	-27.4897	153.2448	No
220406KM1G	Redland City	-27.5108	153.1986	No
220411KM1M	Redland City	-27.5974	153.2444	No
220407KM1H	Redland City	-27.4903	153.2481	No
DR220420KM1A	Redland City	-27.4909	153.2449	No
DR220623KM1A	Redland City	-27.6302	153.1963	No
DR220603KM1A	Redland City	-27.6037	153.2448	No
220411KM1K	Redland City	-27.5985	153.2405	No
220505BI3E	Redland City	-27.5353	153.2785	No
DR220419KM1B	Redland City	-27.5916	153.2487	No
DR220617KM1D	Redland City	-27.595	153.2443	No
DR220603KM1A-reextract	Redland City	-27.6037	153.2448	No
DR220610KM1C	Redland City	-27.6504	153.264	No
220505BI2A	Redland City	-27.5315	153.2815	No
DR220610KM1D	Redland City	-27.6488	153.2611	No
DR220617KM1B	Redland City	-27.6003	153.2433	No
DR220420KM1D	Redland City	-27.4899	153.2458	No
DR220610KM1B	Redland City	-27.6491	153.2644	No
DR220622KM1H	Redland City	-27.489	153.2448	No
220505BI2D	Redland City	-27.5331	153.2821	No
220505BI4A	Redland City	-27.5251	153.2777	No

DR220610KM1A	Redland City	-27.6464	153.2667	No
220601Bi5F	Redland City	-27.5289	153.2728	No
220611Bi5C	Redland City	-27.5299	153.2742	No
220601Bi2A	Redland City	-27.5318	153.2815	No
220601Bi5C	Redland City	-27.5347	153.2737	No
221015MB1A	Redland City	-27.401	153.4382	No
180515Bi4C	Redland City	-27.6513	153.2488	No
200722Bi5E	Logan City	-27.7406	153.0629	No
200723Bi4A	Logan City	-27.8013	152.9727	No
200722Ba5B	Logan City	-27.7388	153.063	No
200730Bi2A	Logan City	-27.7858	153.0442	No
200723Bi1D	Logan City	-27.7236	153.0661	No
200722Ba5A	Logan City	-27.7416	153.0625	No
200730Bi1A	Logan City	-27.79	153.0616	No
200730Bi6D	Logan City	-27.7381	153.133	No
200714Bi5D	Logan City	-27.7544	153.029	No
200722Ba3A	Logan City	-27.7124	153.0506	No
200715Ba2A	Logan City	-27.7491	153.022	No
200730Bi8B	Logan City	-27.7162	152.9054	No
220610Bi2C	Logan City	-27.7047	152.9959	Yes
220610Bi3A	Logan City	-27.7058	152.9989	Yes
220610Bi2A	Logan City	-27.7004	152.9966	Yes
220609Bi2A	Logan City	-27.6827	153.0032	Yes
220803Bi3A	Ipswich City	-27.6984	152.6182	Yes
220803Bi2A	Ipswich City	-27.6878	152.6358	Yes
220803Bi1A	Ipswich City	-27.6672	152.6562	Yes
220803Bi1B	Ipswich City	-27.667	152.6517	Yes
220802Bi1B	Ipswich City	-27.7334	152.7094	Yes
220802Bi1E	Ipswich City	-27.7368	152.7097	Yes
220801Bi1A	Scenic Rim Regional	-27.8256	152.7624	Yes
220801Bi2A	Scenic Rim Regional	-27.8204	152.7666	Yes
220811Bi1B	Lockyer Valley Regional	-27.5365	152.1315	Yes
220810Bi1B	Lockyer Valley Regional	-27.5163	152.0096	Yes
220811Bi3B	Lockyer Valley Regional	-27.5398	152.1436	Yes
220809Bi1B	Lockyer Valley Regional	-27.5163	151.9722	Yes
220809Bi2A	Lockyer Valley Regional	-27.5141	151.9703	Yes
220810Bi1D	Lockyer Valley Regional	-27.5151	152.0113	Yes
220811Bi1A	Lockyer Valley Regional	-27.5374	152.1315	Yes
220810Bi1C	Lockyer Valley Regional	-27.5164	152.0067	Yes
220811Bi1D	Lockyer Valley Regional	-27.5380	152.1306	Yes
220810Bi3B	Lockyer Valley Regional	-27.5238	152.0087	Yes
180415Bi3B	Toowoomba Regional	-27.6558	151.6588	No
180412Bi2A	Toowoomba Regional	-27.4432	151.7337	No
180413Ba6A	Toowoomba Regional	-27.5165	151.9525	No

180415Bi3C	Toowoomba Regional	-27.6562	151.6586	No
180412Ba1A	Toowoomba Regional	-27.4246	151.737	No
180413Ba8A	Toowoomba Regional	-27.3973	151.8326	No
180410Ma5A	Toowoomba Regional	-27.4585	151.7289	No
180412Ba1C	Toowoomba Regional	-27.4247	151.7387	No
180414OP1B	Toowoomba Regional	-27.3427	151.6049	No
180415Ba3A	Toowoomba Regional	-27.6506	151.5874	No
180412OP1A	Toowoomba Regional	-27.4242	151.7428	No
180414OP4B	Toowoomba Regional	-27.2503	151.6978	No
180412OP2A	Toowoomba Regional	-27.4217	151.7436	No
180414Bi1B	Toowoomba Regional	-27.347	151.59	No
180413Ma1A	Toowoomba Regional	-27.4364	151.7059	No
180415OP2B	Toowoomba Regional	-27.4032	151.7768	No
180412OP5A	Toowoomba Regional	-27.3463	151.7582	No
180413Ma2A	Toowoomba Regional	-27.4665	151.8157	No
220624Bi1A	Toowoomba Regional	-27.7306	151.6415	Yes
220617Bi2C	Toowoomba Regional	-27.7205	151.5597	Yes
220809Bi3C	Toowoomba Regional	-27.5149	151.9543	Yes
220615Bi2C	Toowoomba Regional	-27.6296	151.7422	Yes
220618Bi1E	Toowoomba Regional	-27.6033	151.7614	Yes
220615Bi2E	Toowoomba Regional	-27.634	151.736	Yes
220222Au4A	Byron Shire Council	-28.5877	153.415	No
220222Au5A	Byron Shire Council	-28.5794	153.4059	No
210713Be1C	Ballina Shire Council	-28.8837	153.3723	No
210714Be2B	Ballina Shire Council	-28.9826	153.4146	No
220628Au1A	Ballina Shire Council	-28.9609	153.4544	No
DR221011KM1E	Ballina Shire Council	-28.9468	153.4462	No
DR220811KM1H	Ballina Shire Council	-28.9676	153.4453	No
DR220809KM1E	Ballina Shire Council	-28.959	153.4544	No
DR221011KM1G	Ballina Shire Council	-28.9544	153.4574	No
DR220809KM1D	Ballina Shire Council	-28.9585	153.454	No
DR221011KM1A	Ballina Shire Council	-28.9494	153.4349	No
DR220811KM1G	Ballina Shire Council	-28.9646	153.4473	No
DR220809KM1G	Ballina Shire Council	-28.9604	153.4539	No
220627Au3B	Ballina Shire Council	-28.954	153.4565	No
DR221011KM1D	Ballina Shire Council	-28.9482	153.4431	No
DR220811KM1C	Ballina Shire Council	-28.9703	153.4334	No
DR220809KM1F	Ballina Shire Council	-28.965	153.432	No
DR220809KM1A	Ballina Shire Council	-28.9608	153.4334	No
220628Au3A	Ballina Shire Council	-28.9667	153.4336	No
DR220809KM1B	Ballina Shire Council	-28.955	153.4547	No
DR221011KM1H	Ballina Shire Council	-28.9524	153.4589	No
NR_154	Lismore City Council	-28.9895	153.3078	No
NR_39	Lismore City Council	-28.9747	153.3596	No

NR_129	Richmond Valley Council	-29.0794	153.42	No
NR_A_14	Richmond Valley Council	-29.0913	153.3699	No
220623Bi1C	Goondiwindi Regional	-28.1784	151.1934	Yes
220623Bi1B	Goondiwindi Regional	-28.1771	151.1927	Yes
220623Bi2B	Goondiwindi Regional	-28.2007	151.1819	Yes
DR220905KM1A	Tenterfield Shire Council	-28.6983	152.0688	No
DR220906KM1H	Tenterfield Shire Council	-28.8251	152.0438	No
DR220818KM1E	Tenterfield Shire Council	-28.5297	152.3489	No
DR220906KM1D	Tenterfield Shire Council	-28.8292	152.0557	No
DR221111KM1B	Tenterfield Shire Council	-28.9091	152.3083	No
DR221118KM1B	Tenterfield Shire Council	-28.8098	152.2742	No
DR220905KM1H	Tenterfield Shire Council	-28.6974	152.0775	No
DR220906KM1A	Tenterfield Shire Council	-28.834	152.0568	No
DR220818KM1A	Tenterfield Shire Council	-28.5282	152.3476	No
DR220906KM1E	Tenterfield Shire Council	-28.8244	152.0448	No
DR221111KM1A	Tenterfield Shire Council	-28.9046	152.3108	No
DR221118KM1E	Tenterfield Shire Council	-28.8045	152.2778	No
DR220905KM1B	Tenterfield Shire Council	-28.7008	152.0724	No
220922Au1A	Tenterfield Shire Council	-28.8442	152.0843	No
DR220818KM1D	Tenterfield Shire Council	-28.5263	152.3457	No
DR221110KM1B	Tenterfield Shire Council	-28.897	152.2338	No
DR221118KM1A	Tenterfield Shire Council	-28.8115	152.2722	No
DR220818KM1F	Tenterfield Shire Council	-28.5265	152.3441	No
DR221118KM1D	Tenterfield Shire Council	-28.8026	152.2715	No
DR220817KM1A	Tenterfield Shire Council	-28.5379	152.356	No
DR220819AS1A	Tenterfield Shire Council	-28.5121	152.3574	No
DR221110KM1A2	Tenterfield Shire Council	-28.9013	152.225	No
DR221118KM1C	Tenterfield Shire Council	-28.8026	152.2715	No
DR221110KM1C	Tenterfield Shire Council	-28.8968	152.2332	No
DR221119KM1A	Tenterfield Shire Council	-28.7362	152.3421	No
DR220818KM1B	Tenterfield Shire Council	-28.5278	152.3476	No
DR220906KM1I	Tenterfield Shire Council	-28.8267	152.0451	No
DR221116KM1A	Tenterfield Shire Council	-28.5031	152.3896	No
DR221118KM1G	Tenterfield Shire Council	-28.8005	152.2794	No
DR220905KM1D	Tenterfield Shire Council	-28.7021	152.0767	No
DR220906KM1B	Tenterfield Shire Council	-28.8351	152.0573	No
190921Bi1N	Inverell Shire Council	-29.6137	150.8406	No
190923KH4A	Inverell Shire Council	-29.779	151.0259	No
190925KH2A	Inverell Shire Council	-29.655	150.9435	No
190922KH1B	Inverell Shire Council	-29.6584	151.0015	No
190921Bi1B	Inverell Shire Council	-29.617	150.8299	No
190923KH3C	Inverell Shire Council	-29.779	150.9793	No
190922Bi3C	Inverell Shire Council	-29.606	150.8912	No
190923Bi1B	Inverell Shire Council	-29.7376	150.9701	No

190921Bi1A	Inverell Shire Council	-29.6181	150.8296	No
190921Bi1H	Inverell Shire Council	-29.6161	150.8273	No
190923CN2A	Inverell Shire Council	-29.7796	150.9835	No
190922KH2A	Inverell Shire Council	-29.6594	151.0253	No
190922AR1A	Inverell Shire Council	-29.6469	151.0615	No
190922Bi1B	Inverell Shire Council	-29.661	151.0434	No
190922AR1B	Inverell Shire Council	-29.6469	151.0615	No
190922FFR1A	Inverell Shire Council	-29.6467	151.0623	No
190923Bi1F	Inverell Shire Council	-29.7344	150.9826	No
190925KH1A	Inverell Shire Council	-29.6762	150.9315	No
190921KH2A	Inverell Shire Council	-29.7517	151.0413	No
190921Bi3A	Inverell Shire Council	-29.6512	150.8315	No
190925KH1B	Inverell Shire Council	-29.6762	150.9315	No
190922Bi2A	Inverell Shire Council	-29.666	151.0463	No
190922Bi4C	Inverell Shire Council	-29.5895	151.0128	No
190922Bi4A	Inverell Shire Council	-29.5896	151.0133	No
190921Bi1F	Inverell Shire Council	-29.6167	150.8281	No
190921Bi1G	Inverell Shire Council	-29.6162	150.8276	No
190923KH3A	Inverell Shire Council	-29.779	150.9793	No
190922Bi3A	Inverell Shire Council	-29.6062	150.8913	No
210310Ba6A1	Inverell Shire Council	-29.3755	151.3444	No
190924KH1C	Gwydir Shire Council	-29.5238	150.5468	No
190924CN1A	Gwydir Shire Council	-29.5462	150.554	No
221207Bi1B	Gwydir Shire Council	-29.1218	150.3052	Yes
221207Bi7A	Gwydir Shire Council	-29.183	150.2515	Yes
220722Bi1A	Moree Plains Shire Council	-29.4626	149.844	Yes
221208Bi2A	Moree Plains Shire Council	-29.4621	149.85	Yes
221208Bi1A	Moree Plains Shire Council	-29.4619	149.8443	Yes
190916Bi4A	Armidale Regional Council	-30.4223	151.6029	No
190917Bi1B	Armidale Regional Council	-30.4455	151.543	No
190917Bi2B	Armidale Regional Council	-30.3613	151.5843	No
190916Bi1B	Armidale Regional Council	-30.4177	151.6346	No
190920Bi2A	Armidale Regional Council	-30.5776	151.714	No
190916Bi1C	Armidale Regional Council	-30.4172	151.6337	No
190917Bi2J	Armidale Regional Council	-30.3578	151.5898	No
190919Bi1A	Armidale Regional Council	-30.4327	151.5658	No
190916Bi2A	Armidale Regional Council	-30.4193	151.645	No
190917Bi2C	Armidale Regional Council	-30.3608	151.5833	No
190917Bi2H	Armidale Regional Council	-30.3524	151.5855	No
190916Bi2C	Armidale Regional Council	-30.4212	151.6466	No
190919Bi1B	Armidale Regional Council	-30.4322	151.5659	No
190916Bi3B	Armidale Regional Council	-30.4276	151.598	No
190917Bi1A	Armidale Regional Council	-30.4455	151.543	No
190917Bi2F	Armidale Regional Council	-30.3576	151.5825	No

210427Ma2A	Armidale Regional Council	-30.0395	151.8967	No
210427Ma4A	Armidale Regional Council	-30.5796	151.7139	No
190917Bi3A	Uralla Shire Council	-30.6313	151.5375	No
190917Bi4C	Uralla Shire Council	-30.626	151.3416	No
190917Bi4A	Uralla Shire Council	-30.6259	151.3393	No
Coffs_1.7	Coffs Harbour City Council	-30.3371	153.0927	No
Coffs_6.11	Coffs Harbour City Council	-30.3193	153.0727	No
Coffs_19.3	Coffs Harbour City Council	-30.3972	152.9917	No
Coffs_2.1	Coffs Harbour City Council	-30.3393	153.0935	No
Coffs_7.3.1	Coffs Harbour City Council	-30.3602	153.061	No
Coffs_7.1	Coffs Harbour City Council	-30.3638	153.0617	No
Coffs_19.1	Bellingen Shire Council	-30.4028	152.9869	No
Coffs_22.1	Bellingen Shire Council	-30.4482	153.0416	No
200508DR1C	Goulburn Mulwaree Council	-34.8999	150.0571	No
200509DR1D	Goulburn Mulwaree Council	-34.9078	150.0369	No
200509DR1C	Goulburn Mulwaree Council	-34.9112	150.0392	No
200509DR1A	Goulburn Mulwaree Council	-34.9049	150.0494	No
200508DR1F	Goulburn Mulwaree Council	-34.9028	150.0569	No
200508DR1A	Goulburn Mulwaree Council	-34.8958	150.0528	No
200507DR1B	Goulburn Mulwaree Council	-34.9081	150.0517	No
200412DR1A	Shoalhaven City Council	-34.9711	150.1017	No
200403DR1D	Shoalhaven City Council	-35.0656	150.1231	No
200412DR1E	Shoalhaven City Council	-35.0214	150.1472	No
200408DR1M	Shoalhaven City Council	-34.9204	150.142	No
200328DR1B	Shoalhaven City Council	-35.07	150.1299	No
200326KM1D	Shoalhaven City Council	-35.0645	150.1256	No
200412DR1B	Shoalhaven City Council	-34.9716	150.1039	No
200408DR1C	Shoalhaven City Council	-34.9326	150.1458	No
200412DR1C	Shoalhaven City Council	-34.9702	150.1058	No
200511DR1A	Queanbeyan-Palerang Regional Council	-35.0853	150.0286	No
200516DR1D	Snowy Monaro Regional Council	-36.1089	149.3072	No
200517DR1M	Snowy Monaro Regional Council	-36.0637	149.3187	No
200516DR1B	Snowy Monaro Regional Council	-36.1278	149.3076	No
200517DR1I	Snowy Monaro Regional Council	-36.066	149.3144	No
200516DR1A	Snowy Monaro Regional Council	-36.1317	149.3037	No
200529Be1A	Snowy Monaro Regional Council	-36.1445	149.3298	No
200513DR1B	Snowy Monaro Regional Council	-36.0099	149.3721	No

200513DR1F	Snowy Monaro Regional Council	-36.002	149.3663	No
200527DR1B	Snowy Monaro Regional Council	-36.0217	149.3727	No
200513DR1A	Snowy Monaro Regional Council	-36.0088	149.3719	No

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Table A2. Groupings of koala samples used for genetic diversity estimates.

Group	Sample locations in the group (sample size)	Sample size per group	Number of ARTC Samples
Group 1	Brisbane City (05)	43	
	Redland City (37) (= Koala Coast)		
Group 2	Logan City (17)	24	04
	Ipswich City (06)		06
	Scenic Rim Regional (02)		02
Group 3	Lockyer Valley Regional (10)	34	10
	Toowoomba Regional (24)		06
Group 4	Byron Shire Council (02)	25	
	Ballina Shire Council (19)		
	Lismore City Council (02)		
	Richmond Valley Council (02)		
Group 5	Tenterfield Shire Council (31)	31	
Group 6	Inverell Shire Council (29)	36	
	Gwydir Shire Council (04)		02
	Moree Plains Shire Council (03)		03
Group 7	Armidale Regional Council (18)	21	
	Uralla Shire Council (03)		
Group 8	Coffs Harbour City Council (06)	08	
	Bellingen Shire Council (02)		
Group 9	Goulburn Mulwaree Council (07)	17	
	Shoalhaven City Council (09)		
	Queanbeyan–Palerang Regional Council (01)		
Group 10	Snowy Monaro Regional Council (10)	10	

Note. Three samples from Goondiwindi were collected for the ARTC project but do not appear in this table, as they were not included in the analyses.

Table A3. Overview of all ARTC samples, including sample name, whether samples were duplicates, data quality control (QC) for subsequent analyses, whether data was used to estimate number of unique individuals, whether data was used for genetic diversity analyses, Sex, Chlamydia detection, and geographical coordinates (DARtag analyses).

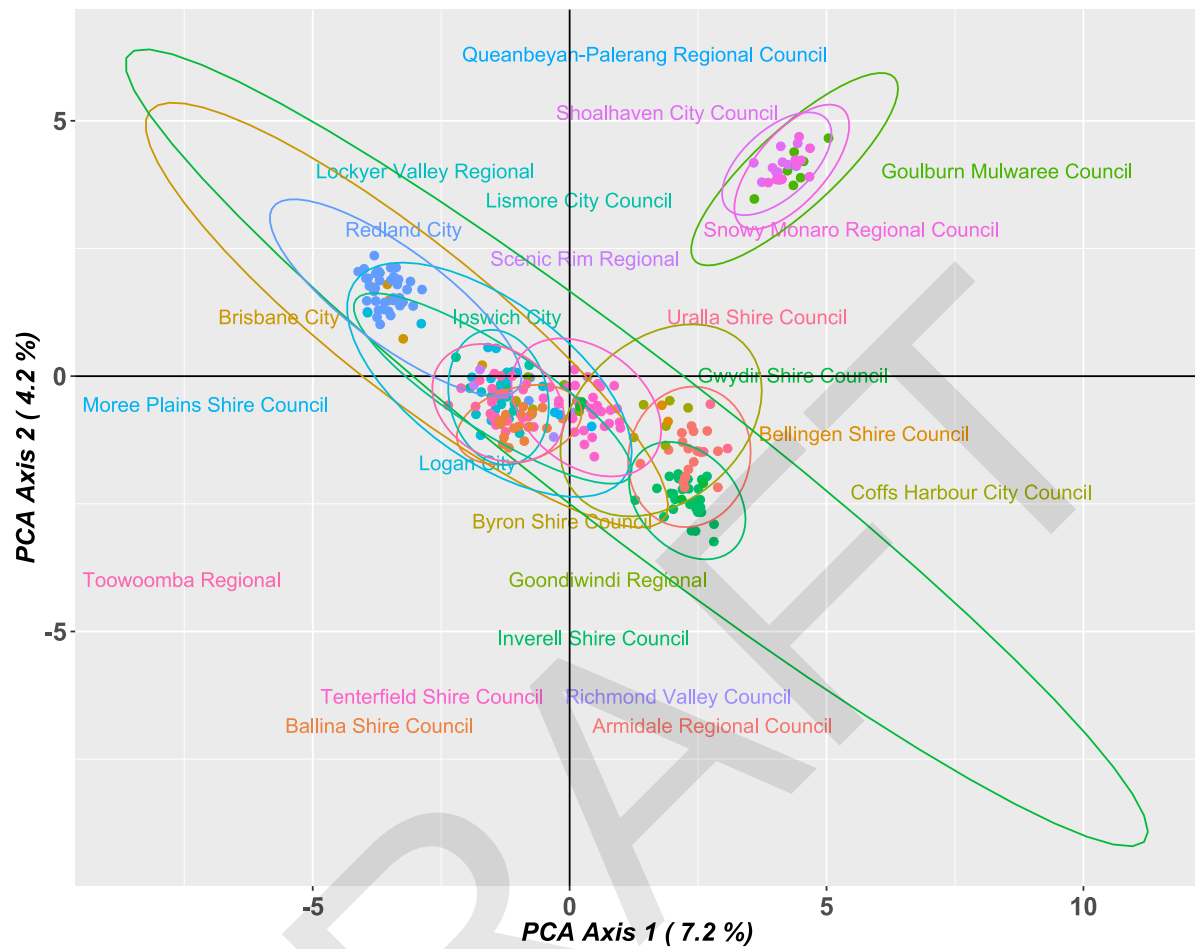
Sample ID	Duplicate	QC for Unique individual (Pass/Fail)	Unique individuals	Genetic diversity	QC for Sex (Pass/Fail)	Sex	QC for Chlamydia (Pass/Fail)	Chlamydia detection	Lat	Long
220609Bi1A	-	Failed	-	No	Failed	-	Failed	-	-27.7122	152.9889
220609Bi2A	No	Pass	Yes	Yes	Pass	F	Pass	Yes	-27.6827	153.0032
220610Bi2A	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.7004	152.9966
220610Bi2B	-	Failed	-	No	Failed	-	Failed	-	-27.7036	152.9941
220610Bi2C	No	Pass	Yes	Yes	Pass	F	Pass	Yes	-27.7047	152.9959
220610Bi3A	No	Pass	Yes	Yes	Pass	F	Pass	Yes	-27.7058	152.9989
220610Bi3B	-	Failed	-	No	Failed	-	Failed	-	-27.7058	153.001
220615Bi2A	-	Failed	-	No	Failed	-	Failed	-	-27.6307	151.7425
220615Bi2B	-	Failed	-	No	Failed	-	Failed	-	-27.6301	151.7423
220615Bi2C	No	Pass	Yes	Yes	Pass	F	Pass	No	-27.6296	151.7422
220615Bi2D	Yes	Pass	No	No	Failed	-	Failed	-	-27.6301	151.7427
220615Bi2E	Yes	Pass	No	No	Failed	-	Failed	-	-27.634	151.736
220617Bi2A	-	Failed	-	No	Failed	-	Failed	-	-27.7193	151.5579
220617Bi2B	Yes	Pass	No	No	Failed	-	Failed	-	-27.7198	151.5579
220617Bi2C	Yes	Pass	Yes	Yes	Pass	F	Pass	No	-27.7205	151.5597
220617Bi2D	Yes	Pass	No	No	Failed	-	Failed	-	-27.7203	151.5579
220618Bi1A	-	Failed	No	No	Failed	-	Failed	-	-27.6052	151.7634
220618Bi1B	-	Failed	No	No	Failed	-	Failed	-	-27.6058	151.7643
220618Bi1C	Yes	Pass	No	No	Failed	-	Failed	-	-27.6058	151.7644
220618Bi1D	-	Failed	-	No	Failed	-	Failed	-	-27.6052	151.7652
220618Bi1E	Yes	Pass	Yes	No	Pass	M	Pass	No	-27.6033	151.7614
220618Bi1F	Yes	Pass	Yes	Yes	Failed	-	Failed	-	-27.6035	151.7603
220623Bi1A	-	Failed	Yes	No	Failed	-	Failed	-	-28.1773	151.1926
220623Bi1B	No	Pass	Yes	Yes	Pass	F	Pass	No	-28.1771	151.1927
220623Bi1C	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-28.1784	151.1934
220623Bi2A	-	Failed	-	No	Failed	-	Failed	-	-28.1997	151.1782
220623Bi2B	Yes	Pass	No	No	Failed	-	Failed	-	-28.2007	151.1819
220624Bi1A	No	Pass	Yes	Yes	Pass	F	Pass	Yes	-27.7306	151.6415
220713Bi2A	-	Failed	-	No	Failed	-	Failed	-	-29.4195	149.9071
220713Bi4A	-	Failed	-	No	Failed	-	Failed	-	-29.3697	150.0833
220721Bi3A	Yes	Pass	No	No	Failed	-	Failed	-	-29.4632	149.8442
220722Bi1A	Yes	Pass	Yes	Yes	Pass	M	Pass	Yes	-29.4626	149.844

220801Bi1A	Yes	Pass	Yes	Yes	Pass	F	Pass	No	-27.8256	152.7624
220801Bi1B	Yes	Pass	No	No	Failed	-	Failed	-	-27.8252	152.7619
220801Bi2A	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.8204	152.7666
220802Bi1A	-	Failed	-	No	Failed	-	Failed	-	-27.7337	152.7079
220802Bi1B	-	Failed	-	No	Failed	-	Failed	-	-27.7334	152.7094
220802Bi1C	-	Failed	-	No	Failed	-	Failed	-	-27.735	152.7112
220802Bi1D	-	Failed	-	No	Failed	-	Failed	-	-27.737	152.711
220802Bi1E	Yes	Pass	No	No	Failed	-	Failed	-	-27.7368	152.7097
220802Bi3A	No	Pass	Yes	No	Failed	-	Failed	-	-27.6961	152.6082
220803Bi1A	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.6672	152.6562
220803Bi1B	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.667	152.6517
220803Bi2A	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.6878	152.6358
220803Bi3A	No	Pass	Yes	Yes	Pass	M	Pass	No	-27.6984	152.6182
220809Bi1A	-	Failed	-	No	Failed	-	Failed	-	-27.5159	151.9719
220809Bi1B	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.5163	151.9722
220809Bi2A	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.5141	151.9703
220809Bi3A	-	Failed	-	No	Failed	-	Failed	-	-27.5171	151.9536
220809Bi3B	No	Pass	Yes	No	Failed	-	Failed	-	-27.5167	151.9533
220809Bi3C	No	Pass	Yes	Yes	Pass	M	Pass	No	-27.5149	151.9543
220810Bi1A	-	Failed	-	No	Failed	-	Failed	-	-27.515	152.0122
220810Bi1B	No	Pass	Yes	Yes	Pass	M	Pass	No	-27.5163	152.0096
220810Bi1C	No	Pass	Yes	Yes	Pass	F	Failed	-	-27.5164	152.0067
220810Bi1D	No	Pass	Yes	Yes	Pass	F	Pass	No	-27.5151	152.0113
220810Bi3A	-	Failed	-	No	Failed	-	Failed	-	-27.523	152.0119
220810Bi3B	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.5238	152.0087
220811Bi1A	Yes	Pass	Yes	Yes	Pass	F	Pass	Yes	-27.5374	152.1315
220811Bi1B	No	Pass	Yes	No	Failed	-	Failed	-	-27.5365	152.1315
220811Bi1C	Yes	Pass	No	No	Failed	-	Failed	-	-27.5379	152.1305
220811Bi1D	Yes	Pass	Yes	Yes	Pass	F	Pass	No	-27.538	152.1306
220811Bi3A	Yes	Pass	No	No	Failed	-	Failed	-	-27.5402	152.1394
220811Bi3B	No	Pass	Yes	Yes	Pass	M	Pass	Yes	-27.5398	152.1436
221207Bi1A	Yes	Pass	No	No	Failed	-	Failed	-	-29.1214	150.3042
221207Bi1B	Yes	Pass	Yes	Yes	Pass	M	Pass	Yes	-29.1218	150.3052
221207Bi1C	Yes	Pass	No	No	Failed	-	Failed	-	-29.1228	150.3042
221207Bi5A	No	Pass	Yes	Yes	Failed	-	Failed	-	-29.0955	150.2545
221207Bi7A	No	Pass	Yes	Yes	Pass	F	Pass	No	-29.183	150.2515
221208Bi1A	No	Pass	Yes	Yes	Pass	F	Pass	Yes	-29.4619	149.8443
221208Bi1B	-	Failed	-	No	Failed	-	Failed	-	-29.4621	149.8443
221208Bi2A	Yes	Pass	Yes	No	Pass	F	Pass	Yes	-29.4621	149.85
221208Bi2B	Yes	Pass	No	No	Failed	-	Failed	-	-29.4619	149.8496
221208Bi2C	Yes	Pass	Yes	Yes	Failed	-	Failed	-	-29.4614	149.8493

Table A4. Pairwise table showing relatedness values between samples that are very likely from the same individual koala. Note that, on five instances, individuals were identified as the same individual with more than one other sample, whilst the other samples are duplicates. The asterisk indicates which sample was removed based on insufficient data.

Sample 1	Sample 2	Wang (2002)	Lynch and Ritland (1999)	Milligan (2003)
220615Bi2D	220615Bi2E	0.934	0.906	0.944
220615Bi2E	220623Bi1A	0.839	0.527	0.796
220623Bi1A	220623Bi2B	0.887	0.735	0.854
220623Bi2B	220802Bi1E	0.982	0.962	1
220802Bi1E	220615Bi2D	0.980	0.963	0.971
220615Bi2D	220623Bi1A	0.877	0.642	0.804
220615Bi2D	220623Bi2B	0.939	0.897	0.948
220615Bi2E	220623Bi2B	1	1	1
220615Bi2E	220802Bi1E	0.929	0.827	0.937
220623Bi1A	220802Bi1E	0.913	0.829	0.866
220617Bi2B*	220617Bi2C	0.687	0.798	1
220617Bi2C	220617Bi2D*	0.687	0.790	1
220617Bi2D*	220617Bi2B*	0.391	0.560	0.947
220618Bi1C*	220618Bi1E	0.908	0.898	0.966
220618Bi1E	220618Bi1F*	0.962	0.964	1
220618Bi1F*	220618Bi1C*	0.903	0.889	1
220721Bi3A	220722Bi1A	1	1	1.098
220801Bi1A	220801Bi1B	0.604	0.717	1.041
220811Bi1A	220811Bi3A*	0.995	0.994	1
220811Bi1C*	220811Bi1D	0.958	0.953	1
221207Bi1A*	221207Bi1B	0.905	0.913	1.036
221207Bi1B	221207Bi1C*	0.728	0.800	1.055
221207Bi1C*	221207Bi1A*	0.758	0.819	1.088
221208Bi2A*	221208Bi2B*	1	1	1
221208Bi2B*	221208Bi2C	1	1	1
221208Bi2C	221208Bi2A*	1	1	1.119

Figure A2. Principal component analysis (PCA) plot for 255 unique koalas from 24 locations. Each location has its 95% CI ellipse.



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APPENDIX B

UNISC DIET STUDY SAMPLE ID

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Table 11-1 Sample Id And Locations Taken From Unisc Koala Diet Analysis Data, Sample Number Was Assigned For The Purposes Of Mapping And Identification In This Report

Sample ID	Latitude	Longitude	Sample number	Sample ID	Latitude	Longitude	Sample number
220609Bi1A	-27.7122361	152.9889027	1	220722Bi1A	-29.4625715	149.8439588	26
220609Bi2A	-27.6826527	153.0032046	2	220801Bi1B	-27.8252010	152.7619230	27
220610Bi2B	-27.7036150	152.9941374	3	220801Bi2A	-27.8203614	152.7665640	28
220610Bi3B	-27.7057817	153.0009636	4	220802Bi1A	-27.7336759	152.7079343	29
220615Bi2B	-27.6300514	151.7423274	5	220802Bi1B	-27.7333631	152.7094265	30
220615Bi2C	-27.6296256	151.7421600	6	220802Bi1D	-27.7370225	152.7109793	31
220615Bi2D	-27.6301272	151.7427218	7	220802Bi1E	-27.7368031	152.7096508	32
220615Bi2E	-27.6339930	151.7360492	8	220803Bi1B	-27.6669582	152.6516855	33
220617Bi2B	-27.7198355	151.5579458	9	220803Bi2A	-27.6877892	152.6357785	34
220617Bi2C	-27.7205485	151.5596708	10	220803Bi3A	-27.6983854	152.6182173	35
220617Bi2D	-27.7203316	151.5579190	11	220809Bi1A	-27.5159188	151.9718864	36
220618Bi1A	-27.6052280	151.7633827	12	220809Bi1B	-27.5163362	151.9721761	37
220618Bi1B	-27.6058229	151.7642981	13	220809Bi2A	-27.5141105	151.9702833	38
220618Bi1C	-27.6057513	151.7643698	14	220809Bi3A	-27.5170733	151.9536104	39
220618Bi1D	-27.6051905	151.7652475	15	220809Bi3C	-27.5148848	151.9542791	40
220618Bi1E	-27.6032513	151.7613683	16	220810Bi1A	-27.5150194	152.0122013	41
220618Bi1F	-27.6034761	151.7602613	17	220810Bi3A	-27.5230155	152.0119375	42
220623Bi1A	-28.1773021	151.1926390	18	220810Bi3B	-27.5238411	152.0087000	43
220623Bi1B	-28.1771044	151.1927035	19	220811Bi1B	-27.5365243	152.1315362	44
220623Bi1C	-28.1784397	151.1933634	20	220811Bi3A	-27.5402114	152.1394267	45
220623Bi2A	-28.1996994	151.1782250	21	220811Bi3B	-27.5397950	152.1436227	46
220623Bi2B	-28.2007315	151.1818646	22	221207Bi1A	-29.1214000	150.3041700	47
220624Bi1A	-27.7306276	151.6414796	23	221207Bi1B	-29.1217500	150.3052200	48
220713Bi2A	-29.4194731	149.9071345	24	221208Bi2A	-29.4621400	149.8500100	49
220713Bi4A	-29.3697201	150.0832739	25	221208Bi2B	-29.4619100	149.8495700	50

APPENDIX C

KOALA DIET ANALYSIS BY UQ

DRAFT

Koala Diet Analysis

Australian Inland Rail



December 2023

By Michaela Blyton



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Scope and Limitations

This report details the tree species identified in koala scat samples through the detection of species-specific genetic markers (SNPs: single nucleotide polymorphisms) on the DarTag platform (Diversity Arrays Technologies) using a panel of 1029 validated and 93 unvalidated oligos covering 89 potential food tree species found in the state of Queensland. Only species included in the oligo panel can be detected using this method. As such, if other species not in the panel were eaten by the koalas sampled, then those species would not be identified.

Failure to detect a species in a sample does not guarantee that the species was not eaten, particularly where the total number of diet associated reads returned for that sample is low (< 50). As such, it is recommended that the total number of diet associated reads returned be taken into account when considering the results for a particular sample.

The relative abundances of the tree species detected in a sample are provided to offer insight into the dominant and minor components of the diet. However, it should be noted that at this time the method for assigning the relative abundance values has not been validated against data from koalas with known diets. Validation of the method is currently in process but until it is completed the relative abundance values should be treated with caution.

Methods

Queensland Diet DarTag Oligo Panel

Potential food tree species sampling: A list of candidate koala food trees species for Queensland was assembled with reference to numerous published lists of koala food and shelter trees for Queensland and New South Wales. The list included not only eucalypts (the genera *Eucalyptus*, *Corymbia* and *Angophora*), but also a number of non-eucalypts, including species from the genera *Melaleuca*, *Acacia*, *Allocasuarina*, *Casuarina* and *Lophostemon*.

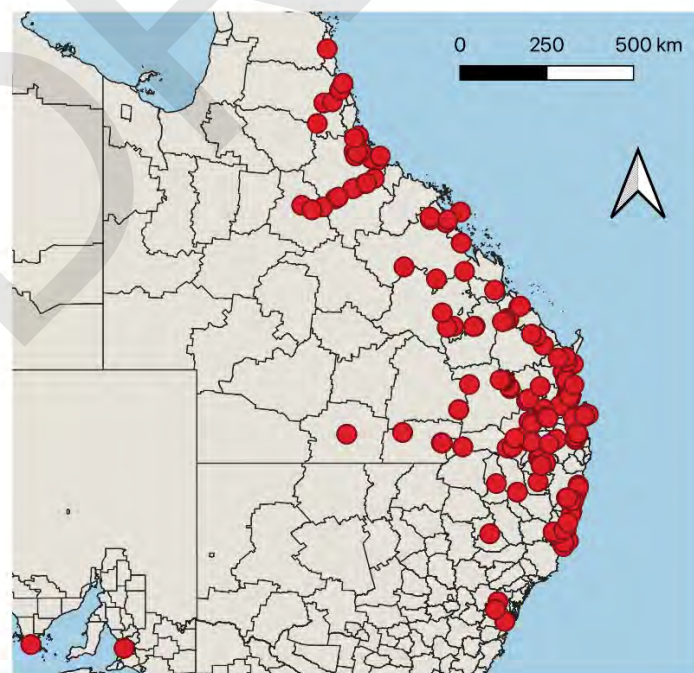


Figure 1. Map illustrating the geographic distribution of sites where leaf samples were collected from candidate koala food tree species.

The locations of all trees from which genetic material was included in the development of the Queensland panel can be seen in *Figure 1*. A more detailed, interactive, map can also be viewed on the “Our Methods” page of our website www.whatdokoalaseat.org and we encourage the reader to view this map to better understand our collections. The viewer can click on individual points to learn more about the samples included and to access links to websites providing information about each species. A complete list of tree taxa and number of replicates included in the development of the Queensland panel is listed in *Table 1*. Most leaf samples were collected specifically for this project by Dean Nicolle, of Currency Creek Arboretum, in June 2021. Dr Nicolle is Australia’s pre-eminent eucalypt expert. During these collections, 4 individual trees were sampled per species/site combination, for 73 taxa from 135 locations, for a total of 144 unique site-species combinations and 576 leaf samples. Sequencing was performed on combined DNA extracts from two individual trees from each site/species combination, so that these collections contributed 288 sequence representations.

Existing tree sequence data from other projects was also included. This included the red gum species *E. tereticornis* and *E. blakelyi*, which were collected by John Whale at locations throughout NSW and Queensland as part of his PhD research into the genetics of this group. It also included numerous ironbark species from the series *Siderophloiae*, collected by Ben Moore during a previous research project in Queensland, and some species that had been included in a previous study of koala diet composition in the forests of northeast NSW. These were included to increase the range of geographic and thereby genetic variation included in our collection, and in some instances trees from beyond Queensland were also included.

After collection in the field, leaf samples were either air-dried immediately, dried on silica immediately, or returned frozen to a university and subsequently freeze-dried prior to extraction of DNA.

Table 1: List of candidate koala food tree taxa for which gene sequences were included in the development of the Queensland panel. Note that most sequencing wells included DNA from two individuals.

Taxon	Number of Sequencing Wells
<i>Acacia melanoxylon</i>	2
<i>Allocasuarina littoralis</i>	10
<i>Allocasuarina</i> sp.	5
<i>Allocasuarina torulosa</i>	9
<i>Angophora costata</i>	3
<i>Angophora floribunda</i>	4
<i>Angophora leiocarpa</i>	2
<i>Araucaria cunninghamii</i>	2
<i>Casuarina glauca</i>	4
<i>Casuarina</i> sp.	2
<i>Corymbia citriodora</i>	6
<i>Corymbia clarksoniana</i>	2
<i>Corymbia dallachiana</i>	2
<i>Corymbia erythrophloia</i>	4
<i>Corymbia gummifera</i>	5
<i>Corymbia intermedia</i>	10
<i>Corymbia maculata</i>	6
<i>Corymbia tessellaris</i>	8
<i>Corymbia trachyphloia</i> subsp. <i>trachyphloia</i>	8
<i>Corymbia variegata</i>	4
<i>Eucalyptus acmenoides</i>	8
<i>Eucalyptus albens</i>	6
<i>Eucalyptus amplifolia</i> subsp. <i>sessiliflora</i>	2

<i>Eucalyptus andrewsii</i>	2
<i>Eucalyptus bancroftii</i>	4
<i>Eucalyptus blakelyi</i>	8
<i>Eucalyptus brownii</i>	2
<i>Eucalyptus brunnea</i>	2
<i>Eucalyptus camaldulensis</i>	5
<i>Eucalyptus camaldulensis</i> subsp. <i>acuta</i>	4
<i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i>	2
<i>Eucalyptus cambageana</i>	4
<i>Eucalyptus campanulata</i>	2
<i>Eucalyptus carnea</i>	6
<i>Eucalyptus chloroclada</i>	2
<i>Eucalyptus citrodora</i>	2
<i>Eucalyptus conica</i>	4
<i>Eucalyptus coolabah</i>	8
<i>Eucalyptus crebra</i>	10
<i>Eucalyptus cullenii</i>	4
<i>Eucalyptus drepanophylla</i>	8
<i>Eucalyptus dunnii</i>	2
<i>Eucalyptus dura</i>	4
<i>Eucalyptus elegans</i>	4
<i>Eucalyptus eugenioides</i>	6
<i>Eucalyptus exserta</i>	7
<i>Eucalyptus fibrosa</i>	4
<i>Eucalyptus fibrosa</i> <i>nubilla</i>	4
<i>Eucalyptus grandis</i>	7
<i>Eucalyptus granitica</i>	4
<i>Eucalyptus haemostoma</i>	2
<i>Eucalyptus intertexta</i>	2
<i>Eucalyptus laevopinea</i>	4
<i>Eucalyptus largiflorens</i>	2
<i>Eucalyptus latisinensis</i>	2
<i>Eucalyptus longirostrata</i>	4
<i>Eucalyptus macta</i>	2
<i>Eucalyptus major</i>	4
<i>Eucalyptus melanophloia</i>	2
<i>Eucalyptus melanophloia</i> subsp. <i>melanophloia</i>	6
<i>Eucalyptus melliodora</i>	4
<i>Eucalyptus microcarpa</i>	4
<i>Eucalyptus microcorys</i>	8
<i>Eucalyptus moluccana</i>	6
<i>Eucalyptus nobilis</i>	2
<i>Eucalyptus ochrophloia</i>	2
<i>Eucalyptus orgadophila</i>	6
<i>Eucalyptus pellita</i>	4
<i>Eucalyptus pilularis</i>	8
<i>Eucalyptus platyphylla</i>	8
<i>Eucalyptus populnea</i>	8
<i>Eucalyptus portuensis</i>	2
<i>Eucalyptus prava</i>	3
<i>Eucalyptus propinqua</i>	8
<i>Eucalyptus punctata</i>	6

<i>Eucalyptus racemosa</i>	7
<i>Eucalyptus resinifera</i>	3
<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i>	4
<i>Eucalyptus rhombica</i>	2
<i>Eucalyptus robusta</i>	8
<i>Eucalyptus saligna</i>	8
<i>Eucalyptus scoparia</i>	2
<i>Eucalyptus seeana</i>	4
<i>Eucalyptus siderophloia</i>	8
<i>Eucalyptus sideroxylon</i>	2
<i>Eucalyptus signata</i>	2
<i>Eucalyptus taurina</i>	4
<i>Eucalyptus tereticornis</i>	18
<i>Eucalyptus tindaliae</i>	5
<i>Eucalyptus whitei</i>	5
<i>Eucalyptus woollsiana</i>	2
<i>Lophostemon confertus</i>	6
<i>Lophostemon suaveolens</i>	2
<i>Melaleuca quinquenervia</i>	2
<i>Syncarpia glomulifera</i>	2
<i>Syncarpia glomulifera</i> subsp. <i>glomulifera</i>	4
Grand Total	447

Sequencing of potential food tree species: DNA was extracted from leaf samples collected by Dean Nicolle using an automated plate-based extraction protocol, by Diversity Arrays Technology P/L, Canberra, Australia (DART). The remaining reference leaves were extracted using CTAB extraction buffer with chloroform clean-up and ethanol precipitation. DNA extracts were sequenced at high density (returning approximately 2.5 million reads per sample) on the DARTseq platform by Diversity Arrays Technology P/L, Canberra, Australia (DART). The *Eucalyptus* Dartseq (1.0) product was selected that uses the PstI/HpaII restriction enzyme combination, which returns approximately 50 000, 64 bp loci with an average read depth for the reference allele of > 20. This protocol has been optimised for *Eucalyptus* by Diversity Arrays Technologies in association with prior clients for *Eucalyptus* genotyping. Read counts for targets (DNA fragments) and single nucleotide polymorphisms (SNPs) within those targets were determined by DART using their standard proprietary pipelines [1, 2]. As DART's pipelines are optimised to identify loci that are present and variable across the majority of the samples in the dataset, loci with private alleles may not be retained if the species in the dataset are too taxonomically distinct. As such, species belonging to the different genera and *Eucalyptus* subgenera were run through the pipelines separately, to maximise the number of potentially useful loci identified. Read proportions for the reference and alternative SNP alleles at each locus were determined using custom code in R studio 1.2.5033 [3].

Identification of species-specific SNPs and panel validation: Prior to identification of species-specific SNPs, a Principal Components Analysis was performed on the Hamming genetic distance matrix generated from the SNP data in GenAlEx 6.1 to confirm the species designations of the samples. Samples that did not cluster with their designated species were then removed from the dataset. Loci for which one or more individuals were heterozygous were also removed from the dataset as these loci could not contain fixed private alleles. Species-specific SNPs were identified in the remaining loci using custom written code in R studio 1.2.5033 [3]. Additionally, for a small number of species that were taxonomically distinct from all other species in the datasets (i.e. *Araucaria cunninghamii* and *Acacia melanoxylon*), in silico darts that were present only in the target species were also identified as potential species-specific genetic markers.

The list of species-specific SNPs identified from the DArTseq data was filtered to retain only a single SNP per unique DArT sequencing fragment to minimise the impact of linkage disequilibrium among potential markers. Up to 30 SNPs/in silico darts were then selected per species for oligo design. Of the suitable SNPs, those that were fixed, had higher DArTseq read counts and higher reproducibility were preferentially selected. Where SNPs from DArT targets that were only present in some individual trees had to be included, those that were present in a higher proportion of the individuals were given preference. Oligos were designed for the selected SNPs in house by DArT by identifying probe regions flanking the selected SNPs using primer design software in Genious [4]. Of the candidate species-specific SNPs only those that were found in the middle of the DArT target were suitable for oligo design.

The selected tags (SNPs and flanking regions) were then amplified and sequenced using the designed oligos from generally four individual trees of each species using the DArTag platform to establish that they remained species specific on the different platform. Briefly, the pooled species-specific oligos were hybridized to denatured eucalyptus DNA, then the targeted SNPs were copied and amplified with simultaneous addition of demultiplexing primers. The products of DArTag assay were then sequenced on the HiSeq 2500 (Illumina), demultiplexed and targeted SNPs detected using DArT P/L's proprietary analytical pipeline (DarToolbox). There were four species (*E. prava*, *E. laevopinea*, *E. andrewsii* and *Araucaria cunninghamii*) that were not included in the validation panel due to a lack of available samples. As such, the SNPs/in silico darts for these species could not be fully validated. We confirmed that these markers did not amplify in any non-target species, however, we could not confirm amplification in the target species.

After validation we retained 1122 markers with the number of markers identified per taxon/species shown in Table 2. The marker panel demonstrated the ability to discriminate most eucalypt species, with some exceptions where closely related species or subspecies could not be distinguished, even though we could be confident that DNA from one or more of the species in question was present. This was particularly notable for the ironbarks from the series *Siderophloiae* (*E. crebra*, *drepanophylla*, *fibrosa*, *rhombica*, *dura*, *cullenii*, *whitei*, *melanophloia*).

Table 2: List of DarTag markers in the Queensland panel for candidate koala food tree taxa

Taxon	Number of DarTag Markers	
<i>Acasia melanoxylon</i>	28	
<i>Allocasuarina</i>	10	
<i>Allocasuarina littoralis</i>	19	
<i>Allocasuarina torulosa</i>	0	
<i>Angophora</i>	24	
<i>Angophora costata</i>	7	
<i>Angophora floribunda</i>	6	
<i>Angophora leiocarpa</i>	17	
<i>Araucaria cunninghamii</i>	60	unvalidated
<i>Casuarina glauca</i>	15	
<i>Casuarina sp1</i>	9	
<i>Casuarina sp2</i>	18	
<i>Corymbia citriodora</i>	8	
<i>Corymbia clarkoniana</i>	17	
<i>Corymbia dallachiana</i>	16	
<i>Corymbia erythrophloia</i>	14	
<i>Corymbia gummifera</i>	8	
<i>Corymbia gummifera</i> and/or <i>intermedia</i>	1	
<i>Corymbia intermedia</i>	5	
<i>Corymbia maculata</i>	10	
<i>Corymbia tessellaris</i>	5	

<i>Corymbia trachyphloia</i>	11	
<i>Corymbia variegata</i>	15	
<i>Eucalyptus acmenoides</i>	9	
<i>Eucalyptus albens</i>	14	
<i>Eucalyptus amplifolia</i>	14	
<i>Eucalyptus andrewsii</i>	13	unvalidated
<i>Eucalyptus bancroftii</i>	19	
<i>Eucalyptus bancroftii</i> and/or <i>seeana</i>	8	
<i>Eucalyptus blakelyi</i>	7	
<i>Eucalyptus brownii</i>	13	
<i>Eucalyptus brunnea</i>	12	
<i>Eucalyptus camaldulensis</i>	35	
<i>Eucalyptus cambageana</i>	15	
<i>Eucalyptus campanulata</i>	12	
<i>Eucalyptus carnea</i>	9	
<i>Eucalyptus chloroclada</i>	17	
<i>Eucalyptus conica</i>	11	
<i>Eucalyptus coolabah</i>	16	
<i>Eucalyptus crebra</i>	3	
<i>Eucalyptus crebra</i> and/or <i>elegans</i>	1	
<i>Eucalyptus crebra</i> and/or <i>drepanophylla</i>	1	
<i>Eucalyptus crebra</i> , <i>elegans</i> and/or <i>fibrosa</i>	1	
<i>Eucalyptus cullenii</i>	5	
<i>Eucalyptus cullenii</i> and/or <i>crebra</i>	1	
<i>Eucalyptus cullenii</i> and/or <i>melanophloia</i>	1	
<i>Eucalyptus cullenii</i> and/or <i>whitteii</i>	1	
<i>Eucalyptus drepanophylla</i>	2	
<i>Eucalyptus drepanophylla</i> and/or <i>dura</i>	1	
<i>Eucalyptus dunnii</i>	13	
<i>Eucalyptus dura</i>	7	
<i>Eucalyptus elegans</i>	3	
<i>Eucalyptus eugenioides</i>	13	
<i>Eucalyptus exserta</i>	11	
<i>Eucalyptus fibrosa</i>	4	
<i>Eucalyptus fibrosa</i> and/or <i>taurina</i>	1	
<i>Eucalyptus fibrosa</i> and/or <i>whiteii</i>	1	
<i>Eucalyptus grandis</i>	13	
<i>Eucalyptus granitica</i>	12	
<i>Eucalyptus granitica</i> and/or <i>whitteii</i>	1	
<i>Eucalyptus haemastoma</i>	5	
<i>Eucalyptus intertexta</i>	10	
<i>Eucalyptus laevopinea</i>	9	unvalidated
<i>Eucalyptus largiflorens</i>	11	
<i>Eucalyptus latisinensis</i>	9	
<i>Eucalyptus longirostrata</i>	19	
<i>Eucalyptus macta</i>	13	
<i>Eucalyptus macta</i> and/or <i>resinifera</i>	1	
<i>Eucalyptus major</i>	20	
<i>Eucalyptus melanophloia</i>	6	
<i>Eucalyptus melliodora</i>	12	
<i>Eucalyptus microcarpa</i>	10	
<i>Eucalyptus microcorys</i>	14	

<i>Eucalyptus moluccana</i>	5	
<i>Eucalyptus nobilis</i>	12	
<i>Eucalyptus ochrophloia</i>	11	
<i>Eucalyptus orgadophila</i>	9	
<i>Eucalyptus pellita</i>	17	
<i>Eucalyptus pilularis</i>	6	
<i>Eucalyptus platyphylla</i>	15	
<i>Eucalyptus populnea</i>	13	
<i>Eucalyptus portuensis</i>	6	
<i>Eucalyptus prava</i>	11	unvalidated
<i>Eucalyptus propinqua</i>	15	
<i>Eucalyptus punctata</i>	11	
<i>Eucalyptus racemosa</i>	7	
<i>Eucalyptus resinifera</i>	12	
<i>Eucalyptus rhombica</i>	18	
<i>Eucalyptus robusta</i>	6	
<i>Eucalyptus saligna</i>	13	
<i>Eucalyptus scoparia</i>	17	
<i>Eucalyptus seeana</i>	13	
<i>Eucalyptus siderophloia</i>	4	
<i>Eucalyptus sideroxylon</i>	17	
<i>Eucalyptus signata</i>	8	
<i>Eucalyptus taurina</i>	2	
<i>Eucalyptus tereticornis</i>	8	
<i>Eucalyptus tindaliae</i>	15	
<i>Eucalyptus whiteii</i>	4	
<i>Eucalyptus woollsiana</i>	9	
<i>Eucalyptus dura</i> and/or <i>siderophloia</i>	1	
<i>Eucalyptus dura</i> , <i>fibrosa</i> and/or <i>rhombica</i>	1	
<i>Eucalyptus dura</i> , <i>fibrosa</i> and/or <i>taurina</i>	1	
<i>Eucalyptus fibrosa</i> and/or <i>rhombica</i>	1	
<i>Eucalyptus melanophloia</i> and/or <i>whiteii</i>	1	
<i>Eucalyptus tereticornis</i> and/or <i>robusta</i>	2	
<i>Lophostemon confertus</i>	6	
<i>Lophostemon suaveolens</i>	12	
<i>Melaleuca glutaraldehyde</i>	17	
<i>Syncarpia glomulifera</i>	14	
Grand Total	1122	

Diet Determination from Scats

DNA was extracted from the koala scats using CTAB extraction buffer with chloroform clean-up and ethanol precipitation [5]. 100 mg of material taken from the centre of each scat sample was ground into a fine powder using the TissueLyser II (Qiagen). Each sample was bead beaten three times at 30 Hz for 1 minute after snap freezing in liquid nitrogen. The samples were then digested in 1000 µl (scats) of extraction buffer (0.1 M Tris-HCL, 1.4 M NaCl, 0.02M EDTA, 20 g.l⁻¹ of cetyltrimethyl ammonium bromide and 0.3 % β-mercaptoethanol) in a ThermoMixer (Eppendoff) at 65 °C for 1 hour with mixing at 1000 rpm. The digested samples were centrifuged for 10 minutes at 16 000 g. The supernatant was then washed twice in one volume of chloroform:isoamyl alcohol (24:1). The DNA was then precipitated by addition of a half volume of 5M NaCl to the separated aqueous phase, followed by 3 volumes of cold 95% ethanol and incubation at -20 °C for 1 hour. The samples were then centrifuged for 10 minutes at 16 000 g. The DNA pellet was washed with 700 µl of 70% ethanol followed by 700 µl of 95% ethanol. The DNA was dried for

30 minutes at 65 °C and resuspended in 40 µl of TE buffer. Inhibitors were removed from the DNA extracts using the OneStep PCR Inhibitor Removal Kit (Zymo) according to the manufacturer's instructions.

Those SNPs that were confirmed to be species-specific on the DArTag platform were amplified and sequenced from the faecal DNA extracts (as described above) to determine the composition of the koalas' diets. The resulting sequencing read counts by sample table was then filtered to remove likely sequencing errors and low frequency contamination. For each target species, sequencing reads were pruned from the dataset if the average number of reads per detected marker was less than 3 or if fewer than two SNPs were detected in target species that had 3 or more validated markers. The remaining filtered readers for each marker were then divided by the average number of reads returned for that marker in the target tree species to account for differences among markers in amplification efficiency. The number of scaled reads for each target species was then averaged across those markers that were found in the highest proportion of target tree species individuals (e.g if three markers were detected for a target species in a sample with two of those found in all trees sequenced for that species while the last marker was only found in half the target trees, then the scaled reads would be averaged across to two fixed markers while the reads from the last marker were not considered). The averaged scaled reads per target species were then converted to relative abundance by dividing by the total number of averaged scaled reads across all target species.

Results

Of the 55 scat samples sequenced on the DArTag platform using the Queensland diet oligo panel, 49 returned reads for the validated diet markers after quality control filtering. An average of 333.59 filtered diet reads were returned per sample (range: 3 to 1591) with less than 50 filtered reads returned for three samples.

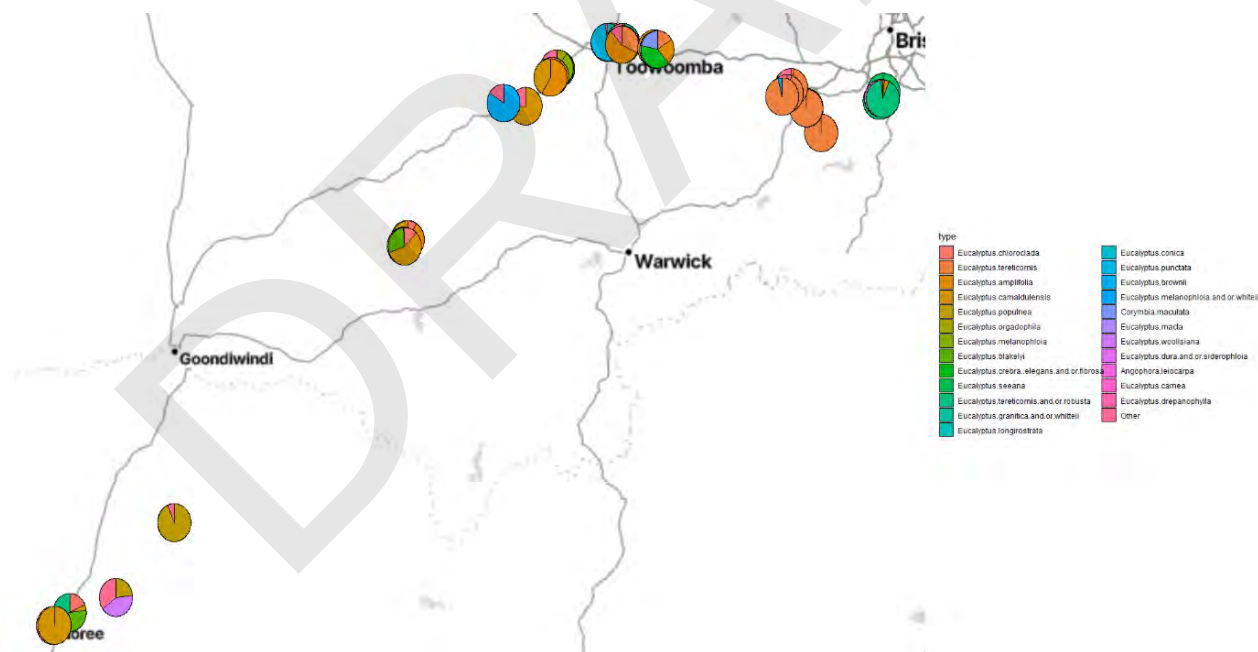


Figure 2. Map of scat sample locations with pie charts illustrating the relative abundance of the different dietary tree species detected in each sample.

Across all samples, between 1 and 7 tree species were detected per sample (average = 3.35). Thirty-seven individual species were detected across the 49 samples with several other species potentially present as indicated by the presence of markers for groups of target species. The most frequently detected species were *Eucalyptus chloroclada* (detected in 18 samples), *E. tereticornis* (17 samples), *E. amplifolia* (16 samples) and *E. camaldulensis* (16 samples). These species were also often found at high relative abundance within samples (range of average relative abundances: 24% to 44%). *E. prava* was detected in a single sample (IR21: 220623BI1B), however, as the markers for this species have not been validated it

could not be included in the relative abundance calculations. Please see a breakdown of the results by sample in the excel workbook “ARTC diet analysis results”. The diet species detected differed between geographic regions and between individuals (*Figure 2*).



*Figure 3. Map of scat sample locations in the **Brisbane Region** with pie charts illustrating the relative abundance of the different dietary tree species detected in each sample.*

In the Brisbane region *Eucalyptus seeana* was detected in 3/4 samples collected in the south at an average relative abundance of 64.5%, while *Eucalyptus tereticornis* was detected in 7/8 samples collected west of Brisbane at an average relative abundance of 72.4% (*Figure 3*).



*Figure 4. Map of scat sample locations in the **Toowoomba Region** with pie charts illustrating the relative abundance of the different dietary tree species detected in each sample.*

In the Toowoomba region, the tree species detected varied considerably between samples. *E. amplifolia*, *E. tereticornis*, *E. chlorocladia* and *E. melliodora* were all detected in four or more samples (from 11) at relative abundances between 10.3% and 34.6% (*Figure 4*).

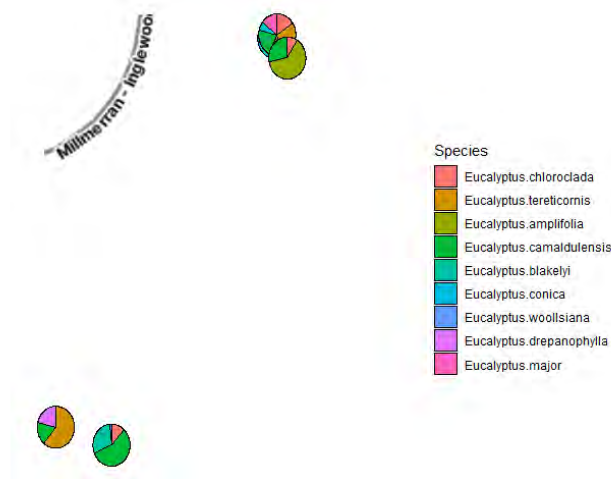


Figure 5. Map of scat sample locations in the **Region to the north-east of Goondiwindi** with pie charts illustrating the relative abundance of the different dietary tree species detected in each sample.

In the region to the north-east of Goondiwindi *E. camaldulensis* was found in all five samples at an average relative abundance of 32.7%, while *E. amplifolia* and *E. tereticornis* were also found at high relative abundance in two individuals each (*Figure 5*).

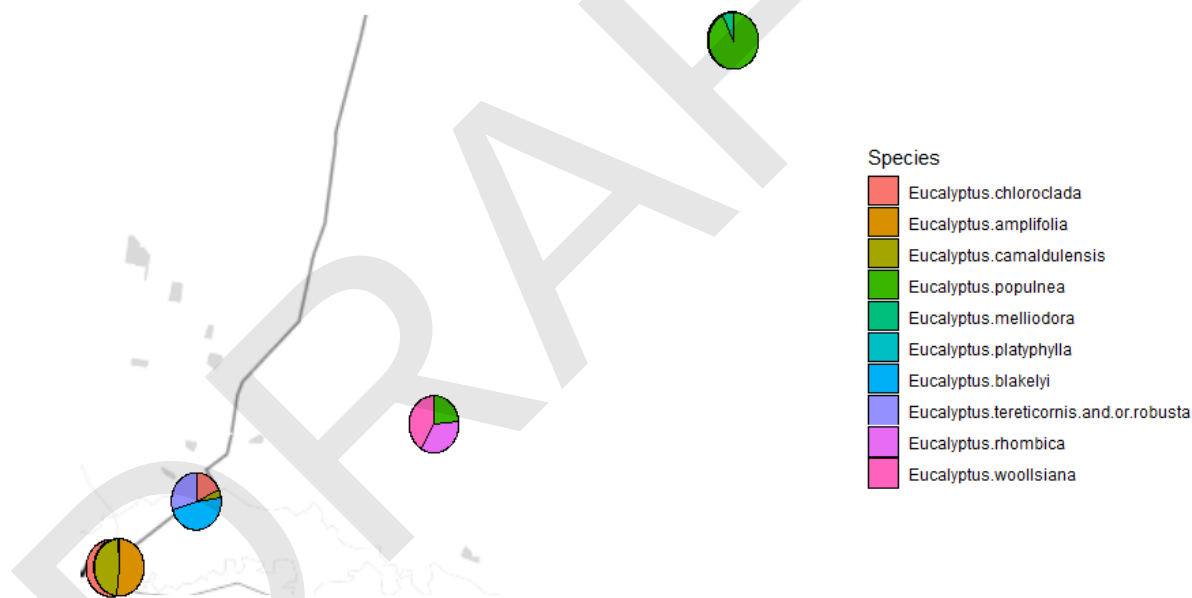


Figure 6. Map of scat sample locations in the **Moree Region** with pie charts illustrating the relative abundance of the different dietary tree species detected in each sample.

In the Moree Region, 5/7 samples contained *E. camaldulensis* with an average relative abundance of 35.2%, while *E. populnea* and *E. chloroclada* were also found at high relative abundance (64.6% and 58.7%, respectively) in 3 and 2 samples, respectively (*Figure 6*).

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DRAFT

B2G SUPPLEMENTARY ECOLOGY SURVEY REPORT MEMO

TO	Phoebe Moore
FROM	David Dique
DATE	9 February 2024
REFERENCE	0618472
SUBJECT	Supplementary Ecology Surveys – greater glider (southern and central) and TEC surveys

Dear Phoebe Moore:

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by Australian Rail Track Corporation (ARTC) to assist with the ecological studies associated with the proposed Border to Gowrie Project (B2G) (the Study Area) of the Inland Rail Program within the Darling Downs Region, Queensland.

Areas within the Study Area have been previously surveyed and classified as potential greater glider (*Petauroides* spp.) habitat by Ausecology (see Attachment A). ERM was engaged to re-examine these areas using spotlighting surveys and new habitat assessment methodology published in Eyre et al. (2022), the key guidance on describing greater glider habitat in relation to assessments under the EPBC Act.

Additionally, in a previous survey conducted by Cardno, the threatened ecological community (TEC) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (WB TEC) was identified as potentially occurring in an isolated patch within the Study Area (Cardno, 2021). Surveys undertaken by Ausecology (Ausecology, 2023) identified between 3.19 and 3.43 ha of potential TEC within that patch, however the report supplied from Ausecology does not detail the effort undertaken and surveys were only able to be conducted on a portion of the potential WB TEC within the Project footprint due to limited access to the site in wet weather.

As Cardno conducted this survey from outside the property boundaries and via GIS analysis, ERM was engaged to undertake a field survey to define the extent of the TEC patch more accurately within the property boundaries.

Information and data collected during these surveys undertaken by ERM will be documented in the technical report and will also be summarized in the B2G EIS Flora and Fauna Chapter. The results of both surveys are detailed in upcoming sections.



David Dique
Partner

1. BACKGROUND INFORMATION

1.1 GREATER GLIDER

The greater glider (southern and central) (*Petauroides volans*) is mostly restricted to eucalypt forest and woodlands of eastern Australia, inhabiting areas from approximately Townsville in Queensland through to southern Victoria. Areas of tall and moist montane eucalypt forests on fertile soils with abundant old hollow bearing trees typically provide habitat for high abundances of greater gliders, however they also inhabit drier habitats in south-eastern Queensland. In such areas of potential habitat, the distribution of gliders may be patchy due to variability in forage quality (DCCEEW, 2022). The majority of greater glider habitat are forests or woodlands where *Corymbia citriodora*, *Eucalyptus moluccana*, *E. tereticornis*, *E. crebra*, *C. intermedia* and/or *E. portuensis* are dominant or co-dominant (Eyre et al., 2022).

Modelled distribution mapping in the species SPRAT Profile (DCCEEW, 2023a) shows that most of the Study Area overlaps habitat where the species may occur and is likely to occur, with only small portions of the Study Area located outside of the modelled species distribution:

- at the southern end of the railway alignment from the border to the Gore Highway;
- between Canning Creek and south Millmerran; and
- between Millmerran and Pittsworth, excluding drainage lines and creeks with suitable vegetation and regional ecosystems.

Greater gliders den in tree hollows, with a preference for large hollows (>10 cm in diameter) in large, old trees. Multiple dens are used by individuals, with a preference for live hollow-bearing trees over standing dead trees. Regrowth forest where sufficient hollows are present can support the species. In southern Queensland, greater gliders appear to require a minimum of 2-4 live den trees for every 2 ha of suitable habitat (DCCEEW, 2022). Due to the difficulty in identifying hollow-bearing trees, the density of 'large' trees can be used as a surrogate for hollow-bearing trees (Eyre et al., 2022). Individuals use multiple dens, with those in south-eastern Queensland recorded using between four and 20 different den trees (DCCEEW, 2022). Of the den trees recorded in the Brigalow Belt bioregion, 84% were live trees, and 16% were stags, indicating that while dead trees cannot be used for foraging, they hold value for denning (Smith et al., 2007).

Greater gliders have been found to occupy hollows with entrances <10 m high, and as high as 40 m from the ground in Victoria (Goldingay, 2011). This indicates that trees should be tall for both denning and dispersal reasons, as it is unlikely that a hollow would form close to the base of a tree.

Greater gliders are sensitive to disturbance and fragmentation and prefer large remnant patches of habitat that are highly connected, however, will reside in small remnant habitat patches (<20 ha) in some areas, particularly if they are connected to other patches (DCCEEW, 2022; Eyre et al., 2022). Average density for patches with large trees in the Brigalow Belt bioregion has been recorded as 14.9 ($\pm$ 5.1) per ha. This appears to be sufficient for greater gliders to persist, and where connected with appropriate vegetated corridors, to disperse through the environment (Eyre et al., 2022).

Greater glider preference for tree species varies regionally. In the Brigalow Belt bioregion, the species shows a primary preference for *Eucalyptus fibrosa*, and secondary preferences for *E. moluccana* and *C. citriodora* for both foraging and denning (Eyre et al., 2022; Smith et al., 2007). As systematic assessments of species preferences have not been undertaken, this does not exclude other tree species from use by greater gliders in the bioregion.

1.2 WHITE BOX-YELLOW BOX-BLAKELY'S RED GUM GRASSY WOODLAND AND DERIVED NATIVE GRASSLAND

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland is a threatened ecological community (TEC) listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. This TEC can occur either as woodland or derived grassland (i.e. a grassy woodland where the tree overstorey has been removed) (DECCW NSW, 2010) and provides important habitat for a suite of woodland animals including marsupials, reptiles, amphibians, birds and invertebrates. The ecological community occurs in the following bioregions: Brigalow Belt South, Murray Darling Depression, Nandewar, New England Tableland, NSW North Coast, NSW South Western Slopes, Riverina, South Eastern Queensland, South East Corner, South East Coastal Plain, South Eastern Highlands, Southern Volcanic Plain, Sydney Basin and Victorian Midlands (TSSC, 2006; DECCW NSW, 2010; DCCEEW, 2023b).

The ecological community must be, or have previously been, dominated or co-dominated by one or more of the following overstorey species (or hybrids of these species with any other *Eucalyptus* species): white box (*Eucalyptus albens*), yellow box (*E. melliodora*) or Blakely's red gum (*E. blakelyi*). It must have a predominately native understorey (i.e. more than 50% of the perennial vegetative ground layer must comprise native species). The area covered by the ecological community (i.e. the patch size) must be greater than 0.1 hectares (ha) and contain 12 or more native understorey species (excluding grasses), including one or more important species.

If the ground layer does not meet this last criterion (i.e. does not contain 12 or more native forb species and one or more important species) then the patch size must be 2 ha or greater in area and have an average of 20 or more mature trees per ha, or natural regeneration of the identified dominant overstorey eucalypts (DECCW NSW, 2010).

Areas which do not meet the above criteria are not considered to be part of the listed ecological community. In addition, communities with a continuous shrub layer of more than 30% cover are excluded from the listed ecological community, as they are considered to be shrubby woodland and do not constitute Box-Gum Grassy Woodland. Areas which are degraded to the extent they are excluded from the community definition may still retain important components of the ecological community (e.g. seed bank, soil biota) and/or provide important habitat for fauna (fallen logs, tree hollows, native grasses, paddock trees, bush rocks, rocky outcrops). Consequently, the restoration and management of these degraded areas is important for the successful recovery of the ecological community (DECCW NSW, 2010).

2. METHODOLOGY

2.1 SURVEY TIMING AND TEAM

Surveys were conducted in the Study Area by two experienced fauna ecologists over a four-day period between 18 and 21 December 2023. Weather conditions during the day were warm, cloudy, and dry. While spotlighting at night, cloud cover and light showers were experienced. During the survey period, a total of 4.2 mm of rain was recorded at the Gray's Gate Exchange TM Station, Millmerran on Tuesday 19 December (BoM, 2024). In the six weeks prior to the surveys, a total of 104 mm of rainfall was recorded in the region (BoM, 2024).

No preferred survey period for greater gliders was stated in the guidelines defined by Eyre et al. (2022). Surveys to assess TEC condition and extent are to be conducted after significant rain or in autumn (TSSC, 2006), this is further discussed in upcoming sections. Leading the field planning and design was Dr David Dique, a 30-year experienced Principal Ecologist. Leading the TEC assessments was Tim Callaghan, a Senior Ecologist and Botanist with 9 years' experience.

2.2 GREATER GLIDER SURVEYS

2.2.1 VEGETATION AND HABITAT ASSESSMENTS

Vegetation and habitat assessments were undertaken to describe important habitat features within the Study Area. These assessments were required to determine the vegetation present on site and the suitability of habitat for greater gliders and were undertaken to collect data in accordance with appropriate guidelines (Eyre et al., 2022).

Thirteen sites that had been previously mapped by Ausecology in the Study Area (refer to Attachment A) were surveyed by ERM using the updated habitat definitions and guideline methodology (refer to below and Table 1) with approximately one habitat assessment conducted per 100 m of previously mapped habitat (30 in total).

Habitat attributes that were considered are outlined below:

- Presence of *C. citriodora*, *E. fibrosa*, and/or *E. moluccana* as the dominant or co-dominant species, as these have been reported as the preferred species used for both denning and foraging in the Brigalow Belt;
- Presence of other potential denning or foraging tree species;
- Trees >30 cm diameter at breast height (DBH) that can be selected for foraging;
- Trees >50 cm DBH that can be selected for denning as these trees are more likely to contain suitable hollows for sheltering by greater gliders. These can be live or dead;
- Patch size >20 ha if habitat connectivity is low and large tree density is suitable; and
- Small patches <20 ha and as small as 3 ha are potentially suitable if trees are sufficiently close together to facilitate gliding between patches (Eyre et al., 2022).

In accordance with the new methodology guidelines (Eyre et al., 2022), the number of hollows was not used as a defining habitat attribute. This decision was made following a review of studies of ground-based tree hollow estimates which found that utilising estimates of hollows in trees results in inconsistent reporting due to high variability and low reliability among observers. Additionally, tree DBH and the presence of hollows is a demonstrated correlation throughout Australia and can be used as a surrogate measure for tree habitat value (Eyre et al., 2022).

TABLE 1. HABITAT, POTENTIAL HABITAT AND NOT HABITAT AS DEFINED BY EYRE ET AL. (2022)

Habitat	Potential habitat	Not habitat
Regional ecosystems with confirmed greater glider records	Regional ecosystems that do not have confirmed greater glider records but are identified by experts as potential greater glider habitat	Regional ecosystems with no confirmed records of greater gliders, and identified by experts as non-habitat
Contains habitat attributes (but not necessarily all attributes)	Contains habitat attributes (but not necessarily all attributes)	Does not contain habitat attributes

The vegetation and habitat assessments were conducted in accordance with the Survey guidelines for Australia's threatened mammals (DSEWPC, 2011), were non-invasive and involved visual techniques along a transect to record:

- Habitat connectivity and proximity to water sources;
- Condition of vegetation types;
- Signs of threatened species, such as scats, tracks and/or scratches; and
- Breeding or denning habitat features – tree species, tree height, and DBH.

Additionally, general observations were made at each of the vegetation and habitat assessment sites for the potential presence of listed threatened species.

2.2.2 SPOTLIGHTING

In accordance with the Survey guidelines for Australia's threatened mammals (DSEWPC, 2011) nocturnal spotlighting surveys searching for greater glider (*Petauroides volans*) were undertaken at important habitats across the Study Area, generally between 7:00pm and 9:00pm. Thirteen patches were surveyed for greater gliders (refer to Figures 1 and 2), with one spotlighting survey conducted per patch using handheld spotlights (50 watt) and two observers.

2.2.3 THREATENED ECOLOGICAL COMMUNITY SURVEY

The TEC survey location was on the corner of two cattle properties on Blackwell Road, Clontarf (Figure 3). The vegetation outside of the Project footprint was unable to be surveyed adequately due to the heavily disturbed nature of the ground layer. The relevant areas of the properties within the alignment were surveyed as one continuous 2.1 ha patch of potential White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC. Surveys were conducted using the key diagnostic criteria and the condition thresholds (refer to Attachment B) established in *Approved Conservation Advice for the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DCCEEW, 2023b):

- It has, or previously had, an overstorey dominated or co-dominated by: *Eucalyptus albens* (white box) and/or *E. melliodora* (yellow box) and/or *E. blakelyi* (Blakely's red gum).
- It has a predominantly native ground layer.
- Tussock grasses are conspicuous in the ground layer (except in some situations, such as under dense groves of shrubs or regenerating trees), usually with several native species from some the following genera: *Austrostipa*, *Bothriochloa*, *Chloris*, *Cymbopogon*, *Dichanthium*, *Microlaena*, *Poa*, *Themeda*, *Rytidosperma* or *Sorghum*.
- Amongst the grass tussocks and sometimes in swathes, a range of broad-leaved forbs and petaloid monocots (e.g. lilies *sens. Lat.*) may be a major component of the plant diversity.

- While shrubs may be dominant locally within areas of the ecological community, areas of native vegetation with a continuous shrub layer, in which the average shrub cover of the whole patch is greater than 30%, is considered to be a shrubby woodland and is not part of the listed ecological community. In assessing this, the effects of disturbance need to be considered, for example where heavy grazing may result in high densities of shrubs during a recovery phase.

This was conducted using a meandering quaternary survey method throughout the 2.1 ha patch, where flora species are recorded, samples are taken for identification, and community assemblage and landform observations are made.

Three person hours were spent characterising the patch of TEC in the field. A further one and half person hours were spent reviewing field results, verifying species and classifications with Tim Callaghan (SME). The team had adequate experience to perform this assessment.

2.3 SURVEY LIMITATIONS

Three patches of potential greater glider habitat were unable to be accessed due to the unavailability of a land access agreement prior to commencement of the surveys. Two of these patches were located around Yandilla, and the third patch was located near Potters Road outside of Inglewood (refer to Attachment A – circled areas). The area outside of the Project footprint was unable to be surveyed adequately for potential TEC as the ground layer was heavily grazed, and no identification of groundcover species could be made.

3. RESULTS

3.1 GREATER GLIDER HABITAT ASSESSMENTS

While conducting habitat assessments no signs of greater gliders were observed – scats, tracks, or scratches on trees – in any of the thirteen sites surveyed.

Ten of the sites assessed (total of 13) were identified as not greater glider habitat (refer to Table 1; Eyre et al., 2023) due to the presence of one or more of the following attributes:

- were dominated by *Callitris* spp. or *Angophora* spp.;
- did not feature preferred food trees in the bioregion *C. citriodora*, *E. fibrosa*, or *E. moluccana*, or other eucalypt species;
- did not meet the minimum patch size to support greater gliders as the large tree density was unsuitable for a small patch (average 14.9 trees per ha);
- did not feature large trees (>30 cm DBH); or
- the large trees that were present were in too low a density to allow greater glider dispersal/movement in the Brigalow Belt, that is, they did not meet the minimum density of 9.8 large trees per hectare (refer to Plate 1).

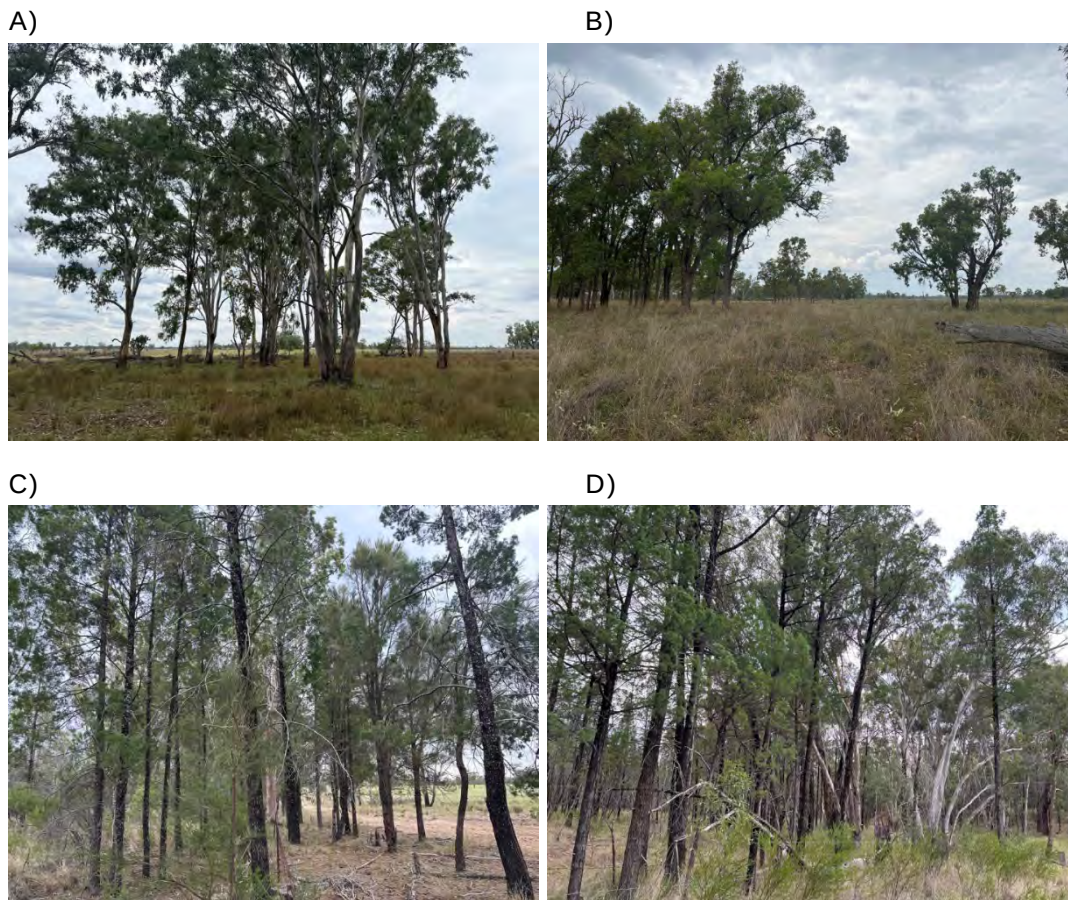


PLATE 1. REPRESENTATIVE PHOTOS FROM UNSUITABLE GREATER GLIDER HABITAT – A) FIGURE 1, INSET 2, NORTHERN PATCH; B) FIGURE 1, INSET 3, CENTRAL PATCHES; C) FIGURE 2, INSET 5; AND D) FIGURE 2, INSET 7.

Three patches were identified as potential greater glider habitat (refer to Table 1) as they had some habitat attributes, but did not have records nearby, and there were no records located within 10 km of the Study Area. One patch, of which 2.44 ha was located within the railway alignment, was located on Back Creek (refer to Figure 1, inset 1, eastern patch). The remaining two patches were located along Bringalily Creek, 1.46 ha of the northern patch and 1.55 ha of the southern patch was located within the railway alignment (refer to Figure 1, inset 3, northern and southern patches). These two patches are 0.88 km apart, with poor connectivity along the creek between them. All three patches were classed as regional ecosystem (RE) 11.3.25: *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines. Additionally, they met the following habitat attribute requirements, as defined by Eyre et al. (2022):

- Presence of other potential denning or foraging species;
- Trees > 30 cm DBH that can be selected for foraging;
- Trees > 50 cm DBH that can be selected for denning as these trees are more likely to contain suitable hollows for sheltering by greater gliders. These can be live or dead; and

- Small patches <20 ha and as small as 3 ha are potentially suitable if trees are sufficiently close together to facilitate gliding between patches.

While Eyre et al. (2022) did not mention tree height as a key habitat attribute, the greater glider has been documented to prefer tall trees with hollows >10 m high (Goldingay, 2011). The trees observed in these patches were comparatively short, averaging approximately 15 m, with a maximum height of 20 m. Hollows that were observed were between 6 and 10 m high.

A)



B)



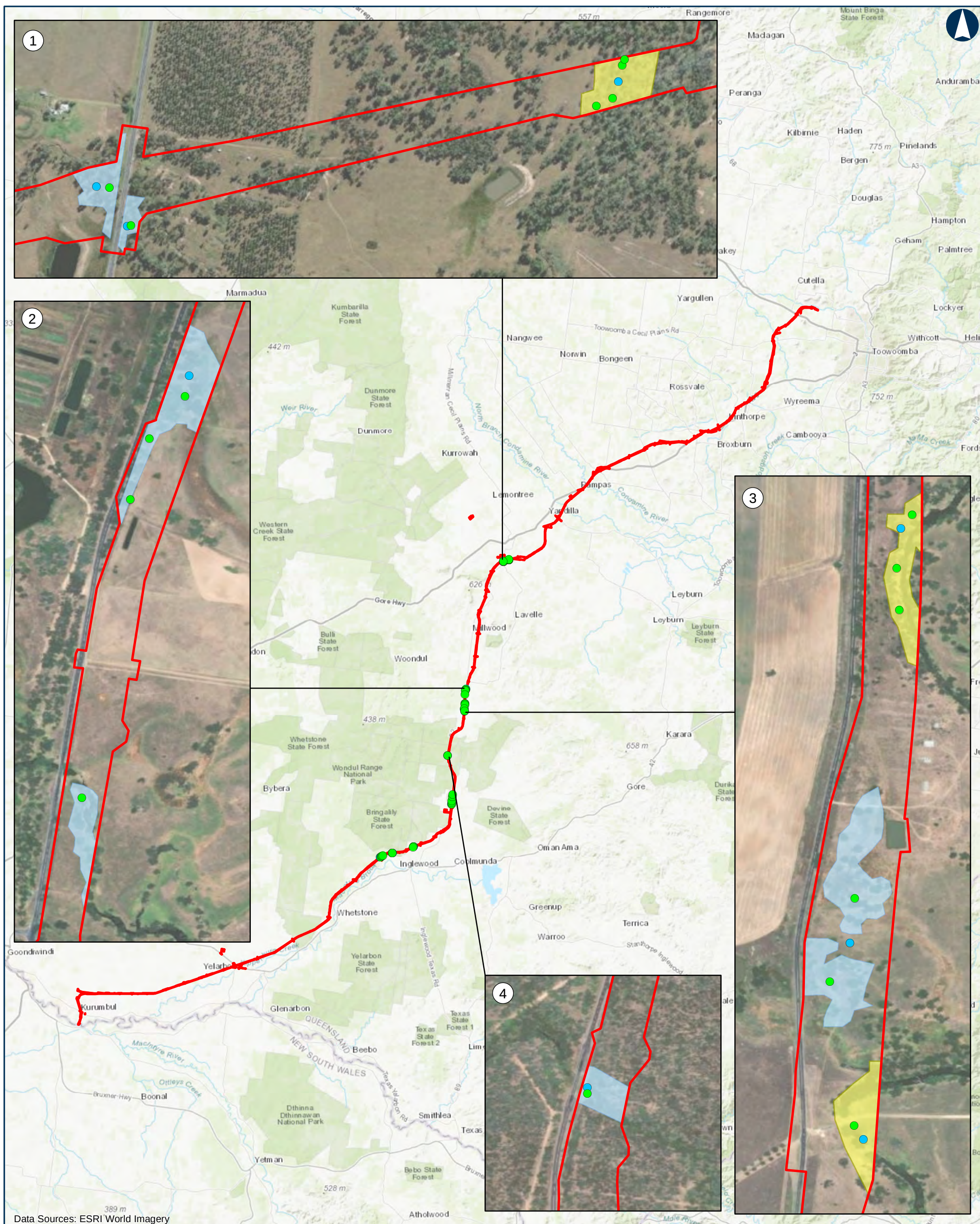
C)



D)



PLATE 2. REPRESENTATIVE PHOTOS FROM POTENTIAL SUITABLE HABITAT – A) FIGURE 1, INSET 1, EASTERN PATCH; B) FIGURE 1, INSET 3, NORTHERN PATCH; C) FIGURE 1, INSET 3, NORTHERN PATCH; AND D) FIGURE 1, INSET 3, SOUTHERN PATCH.



Border to Gowrie



Coordinate System: GDA 1994 MGA Zone 56

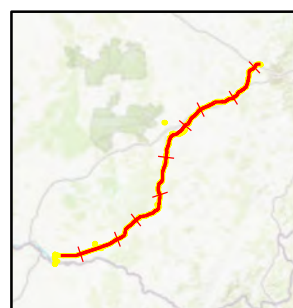
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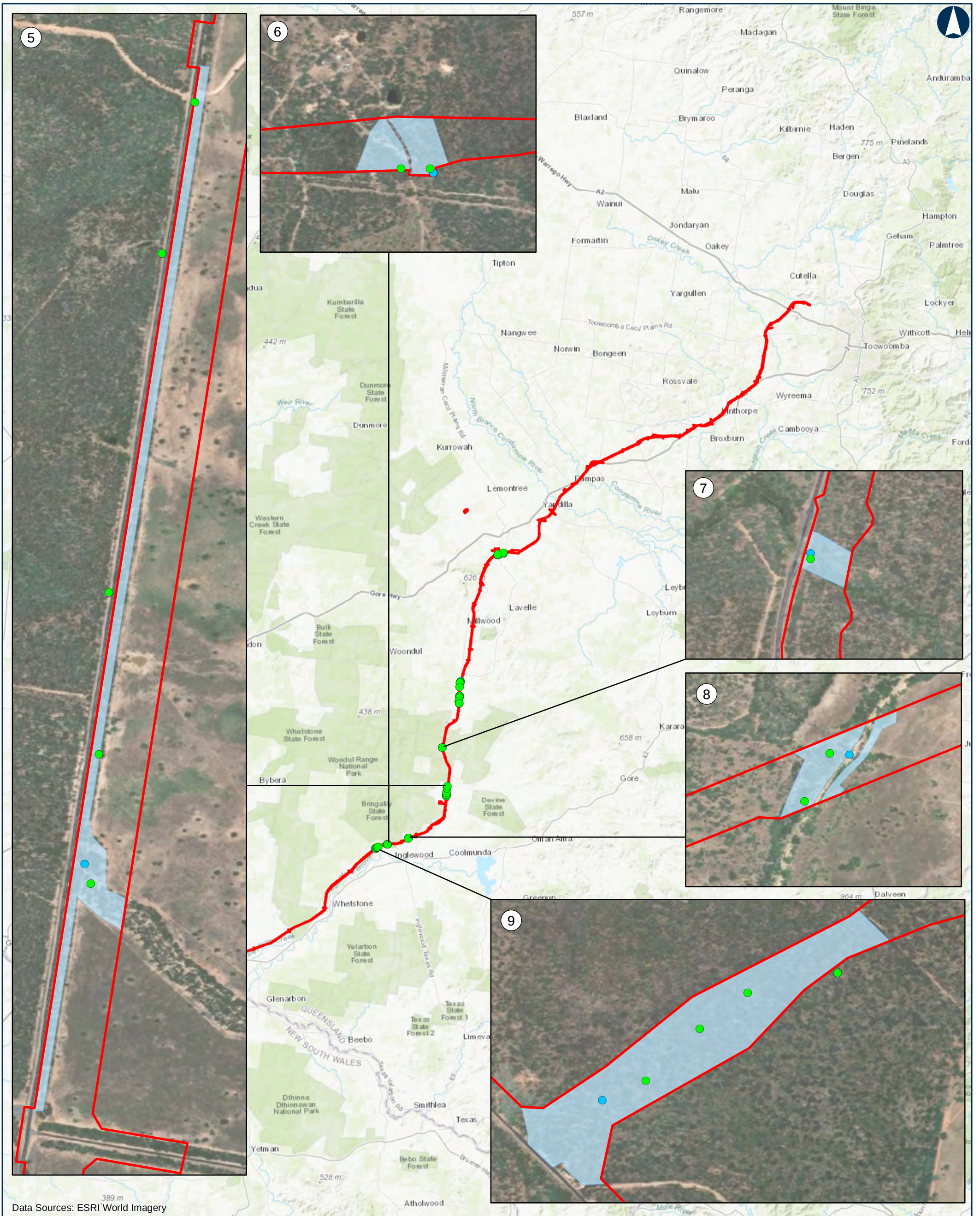
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Date: 1/02/2024 Paper: A3
Author: ERM - VN Scale: 1:8,000
Data Sources: OLD DNRM 2017, ESRI

LEGEND

-  Habitat Assessment
 Spotlighting
 Construction Impact Zone
 Potential Greater Glider Habitat
 Greater Glider Habitat Previously Mapped by Ausecology





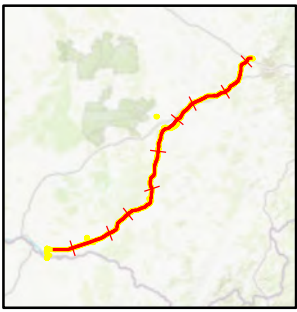
Data Sources: ESRI World Imagery

Border to Gowrie

Figure 2 - Sites ground verified as suitable *Petauroides volans sensu lato* - Greater Glider habitat in the Southern portion of the Study Area

0 10 20 km
Coordinate System: GDA 1994 MGA Zone 56
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Date: 1/02/2024 Paper: A3
Author: ERM - VN Scale: 1:8,000
Data Sources: QLD DNRM 2017, ESRI

- LEGEND**
- Habitat Assessment
 - Spotlighting
 - Construction Impact Zone
 - Potential Greater Glider Habitat
 - Greater Glider Habitat Previously Mapped by Ausecology



INLAND RAIL **ARTC**

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3.2 GREATER GLIDER SPOTLIGHTING

No greater gliders were observed while spotlighting. Additionally, no other threatened species were observed. Of the hollows identified during the habitat mapping surveys, spotlighting confirmed some were occupied by brushtail possums (*Trichosurus vulpecula*) (refer to Plate 3). This indicates that the hollows that are present are large enough for greater gliders to reside in, however, they would need to be able to disperse to these sites via connected patches of habitat.



PLATE 3. SPOTLIGHTING PHOTOS OF *T. VULPECULA*

3.3 WHITE-BOX TEC EXTENT AND CONDITION OF PATCHES

The following observations relate to the site surveyed for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC (refer to Plate 4):

- The site is located in the Brigalow Belt South IBRA bioregion, and the regional ecosystem was identified and ground verified as 11.9.9a - *Eucalyptus crebra* woodland on fine-grained sedimentary rocks by the state-wide mapping. This regional ecosystem correlates to the TEC;
- The total area confirmed to be TEC within the Project footprint was 2.1 ha;
- The dominant overstorey species was *Eucalyptus albens* (white box);
- The ground layer that was conspicuous was predominantly native. There were two tussock grasses that were present and conspicuous – *Dichanthium sericeum* and *Chloris ventricose*. No other native or non-native grasses were identifiable due to high grazing pressure;
- Broad leaved forbs and petaloid monocots were not observed due to high grazing pressure, despite recent rain;

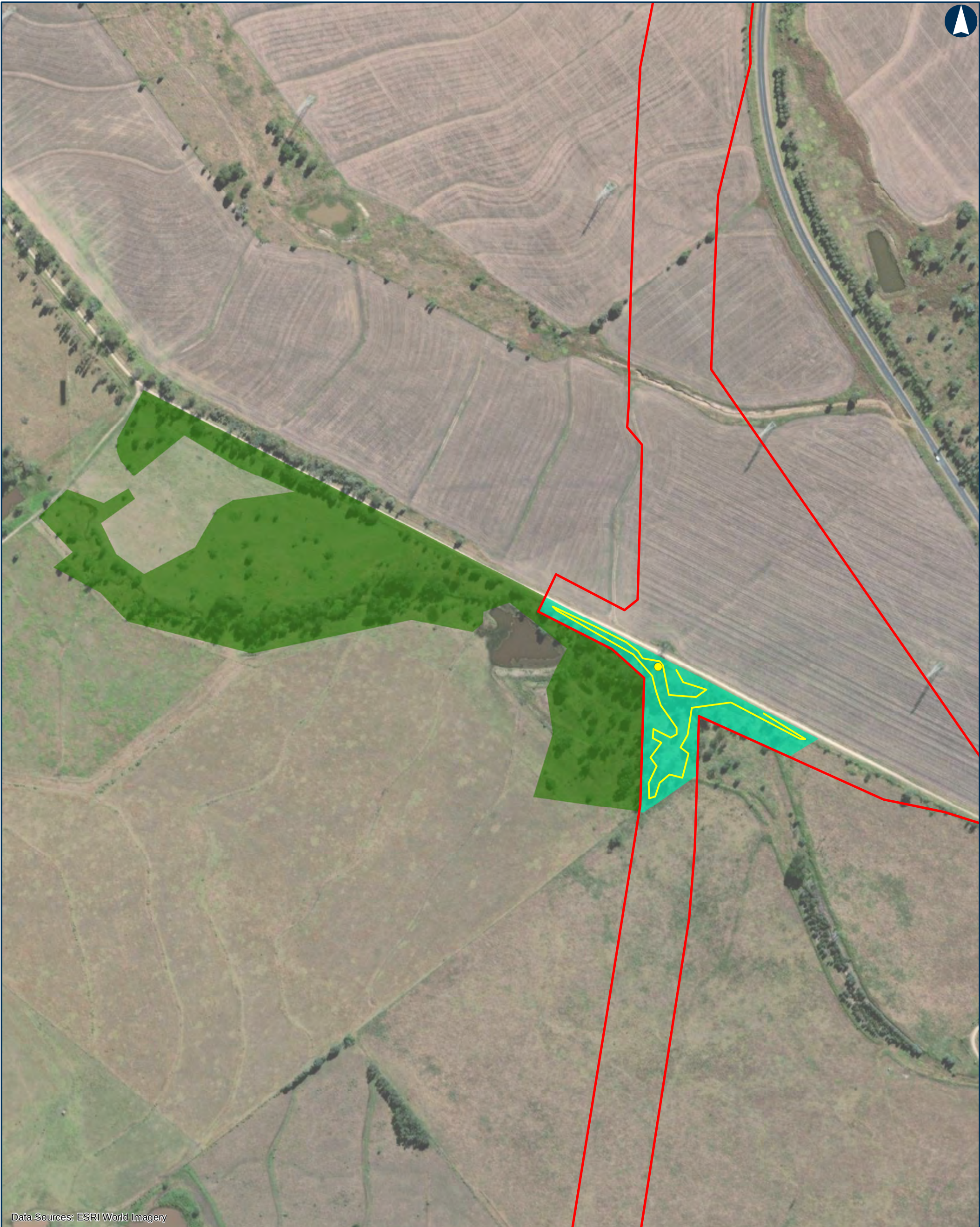
- At the time of assessment, the woodland had an average shrub cover of less than 30%; and
- The patch contained natural regeneration of *E. albens*.

Following this, the site surveyed is considered to be a continuous patch (refer to Figure 3) as the gap between the trees was not greater than 75 m. The patch was assessed to be in Class C according to the condition thresholds (refer to Attachment B), as it meets each of the criteria. According to the state and transition model, this patch has been classed as a fertilised pasture, largely due to the high grazing pressure and low diversity of grasses and herbs. It is likely that a reduction in grazing pressure would raise the condition to Class B, as additional ground layer species would become conspicuous and identifiable. This would also likely change the patch to be classified as a native pasture under the state and transition model.

The TEC may extend outside of the Project footprint; however, it was unable to be surveyed adequately due to the disturbed and heavily grazed nature of the ground layer species. It was determined that the TEC extends beyond the Project footprint to the tree line based on general observations in the field, desktop assessment and expert analysis (refer to Figure 3). The patch likely extends beyond the properties within the scope of this survey, and therefore the entire patch size would not be able to be determined definitively without surveying these areas as well. This area would also be classed as a Class C according to the condition thresholds (refer to Attachment B). As the ground layer species present could not be determined, the classification under the state and transition model is also unable to be determined.



PLATE 4. PHOTOS TAKEN DURING THE TEC SURVEY



Data Sources: ESRI World Imagery

Border to Gowrie

Figure 3 - Site mapped for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC

0 50 100
m

Coordinate System: GDA 1994 MGA Zone 56

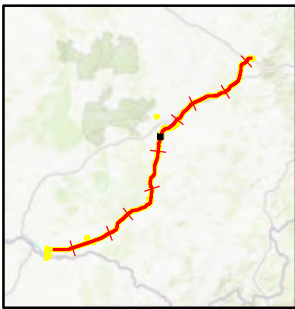
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Date: 2/02/2024
Author: ERM - VN
Data Sources: QLD DNRM 2017, ESRI

Paper: A3
Scale: 1:5,000

LEGEND

- Quaternary Assessment
- Timed Meander
- Construction Impact Zone
- Extent of potential TEC
- Likely TEC outside of alignment



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4. CONCLUSIONS

Three sites within the Study Area have potential to be suitable foraging or breeding habitat for the greater glider, however it is likely that these sites are not accessible by individuals due to low connectivity. Two of the sites are tenuously connected to one another on Bringalily Creek in a narrow habitat corridor. While the third is more isolated, it still has the potential to be connected to other suitable habitat along Back Creek. This is reflected by the spotlighting surveys, where no greater gliders were observed. In accordance with guidelines established in Eyre et al. (2022), the remaining 10 sites surveyed are considered not suitable as greater glider habitat due to lack of connectivity, lack of large trees, low tree density, and/or dominance by tree species unable to be used for foraging or denning.

Based on this field survey, the site assessed for the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland TEC within the Study Area is a Class C patch of the ecological community. While the TEC survey requirements state that surveys in northern regions of the TEC distribution with summer dominant rainfall should be conducted in autumn to obtain the best measure of species richness, we believe that the November and December rainfall was sufficient to provide opportunities for vegetation growth. Given the survey timing and the recent rainfall a reasonably representative sample of species richness was taken, particularly given the heavy grazing pressure. Outside of the Project footprint, the TEC was determined to extend to the tree line based on general observations in the field, desktop assessment and expert analysis. This area was unable to be sampled adequately due to the highly grazed nature of the ground layer. Therefore, using a precautionary approach we assume this site, both inside and outside the Project footprint, meets the requirements of the threatened ecological community.

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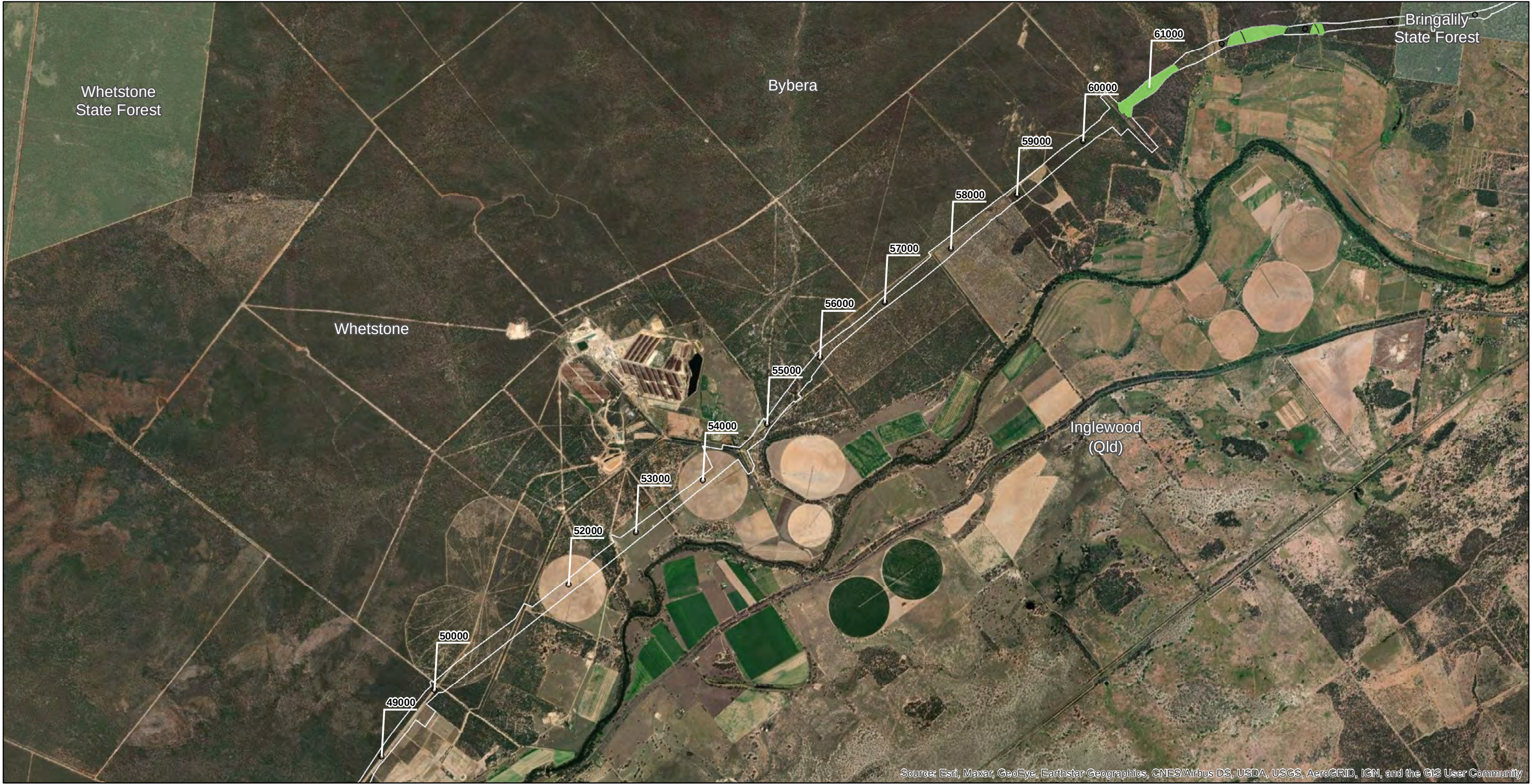
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ATTACHMENT A AUSECOLOGY HABITAT MAPPING SURVEYS





Appendix E - 15 Fauna Matters Habitat

Petauroides volans sensu lato - Greater Glider

N



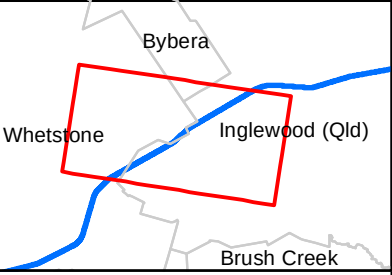
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Scale 1:43,680 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Legend

	Habitat		Chainage Points
	Bringallily state forest		
	Whetstone state forest		
	B2G Alignment		

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
Basemap ESRI



Document History:

Rev	Reason for Issue	Author	Reviewer	Approver	Date
0	Internal Draft	JS	AD	LG	21/12/2021
1	Issue for Information	JS	LG	LG	07/01/2022
2	Issue for Information	JS	LG	LG	01/04/2022
2	Issue for Information	JS	LG	LG	12/04/2022





Appendix E - 15 Fauna Matters Habitat
Petauroides volans sensu lato - Greater Glider

N



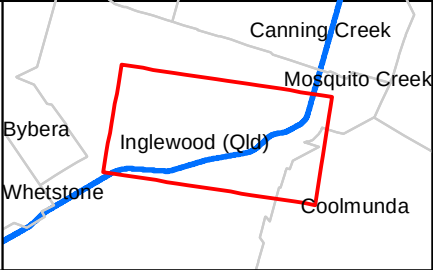
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Scale 1:43,550 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Legend

	Habitat		Chainage Points
	Bringalily state forest		
	B2G Alignment		

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
Basemap ESRI



Document History:

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Appendix E - 15 Fauna Matters Habitat
Petauroides volans sensu lato - Greater Glider

N

0

1

2

Kilometers

Scale 1:43,480 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Legend

Habitat

Chainage Points

Bringalily state forest

B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
Basemap ESRI

Document History:

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Appendix E - 15 Fauna Matters Habitat

Petauroides volans sensu lato - Greater Glider

N

0

1

2

Kilometers

Scale 1:43,680 at A3

Coordinate System: GDA2020 MGA Zone 56

Datum: GDA2020

Legend

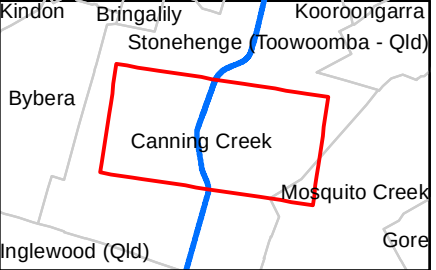
Habitat

Chainage Points

Bringalily state forest

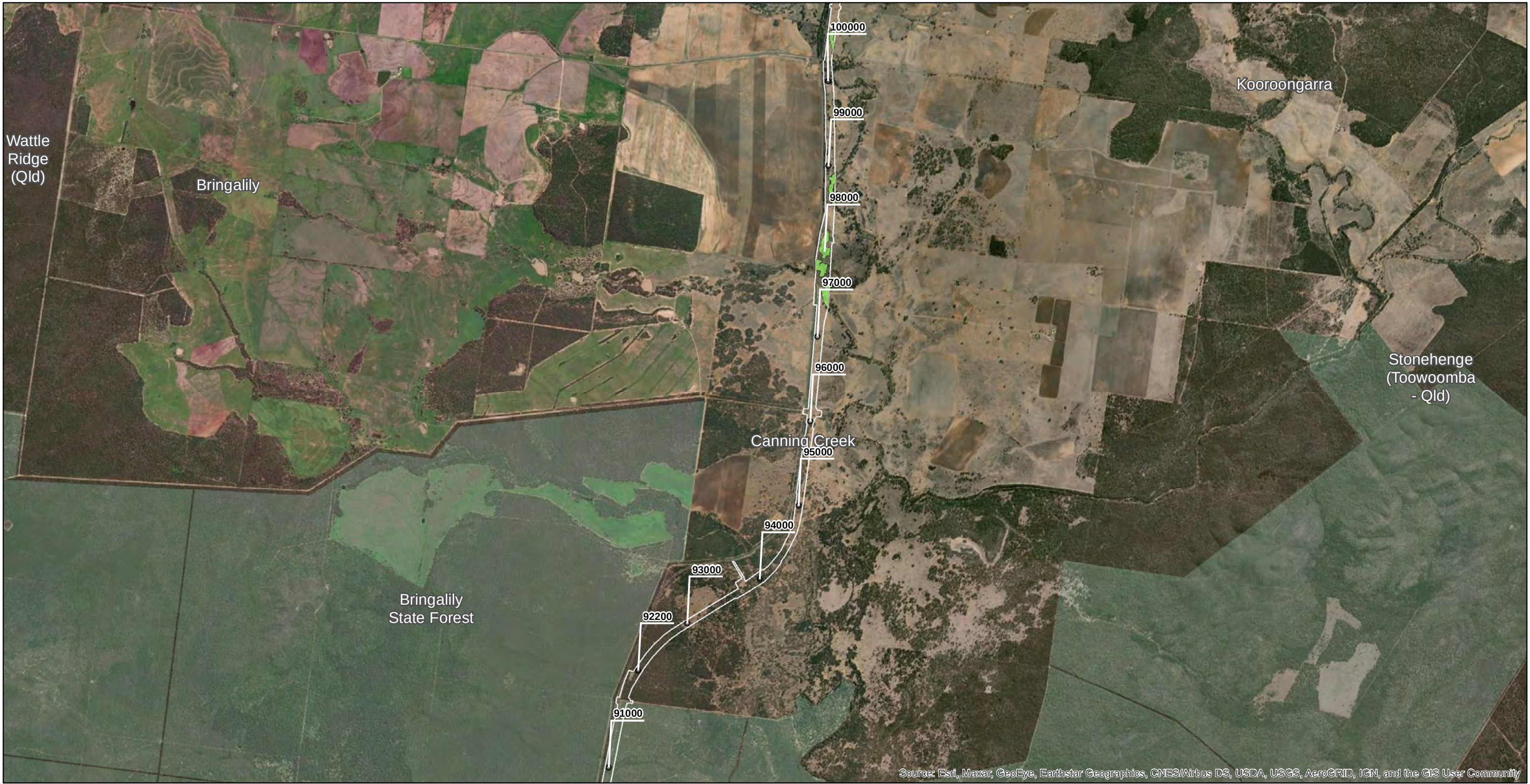
B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
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Appendix E - 15 Fauna Matters Habitat

Petauroides volans sensu lato - Greater Glider

N



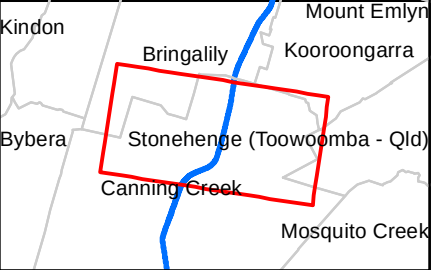
0 1 2 Kilometers

Scale 1:43,580 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

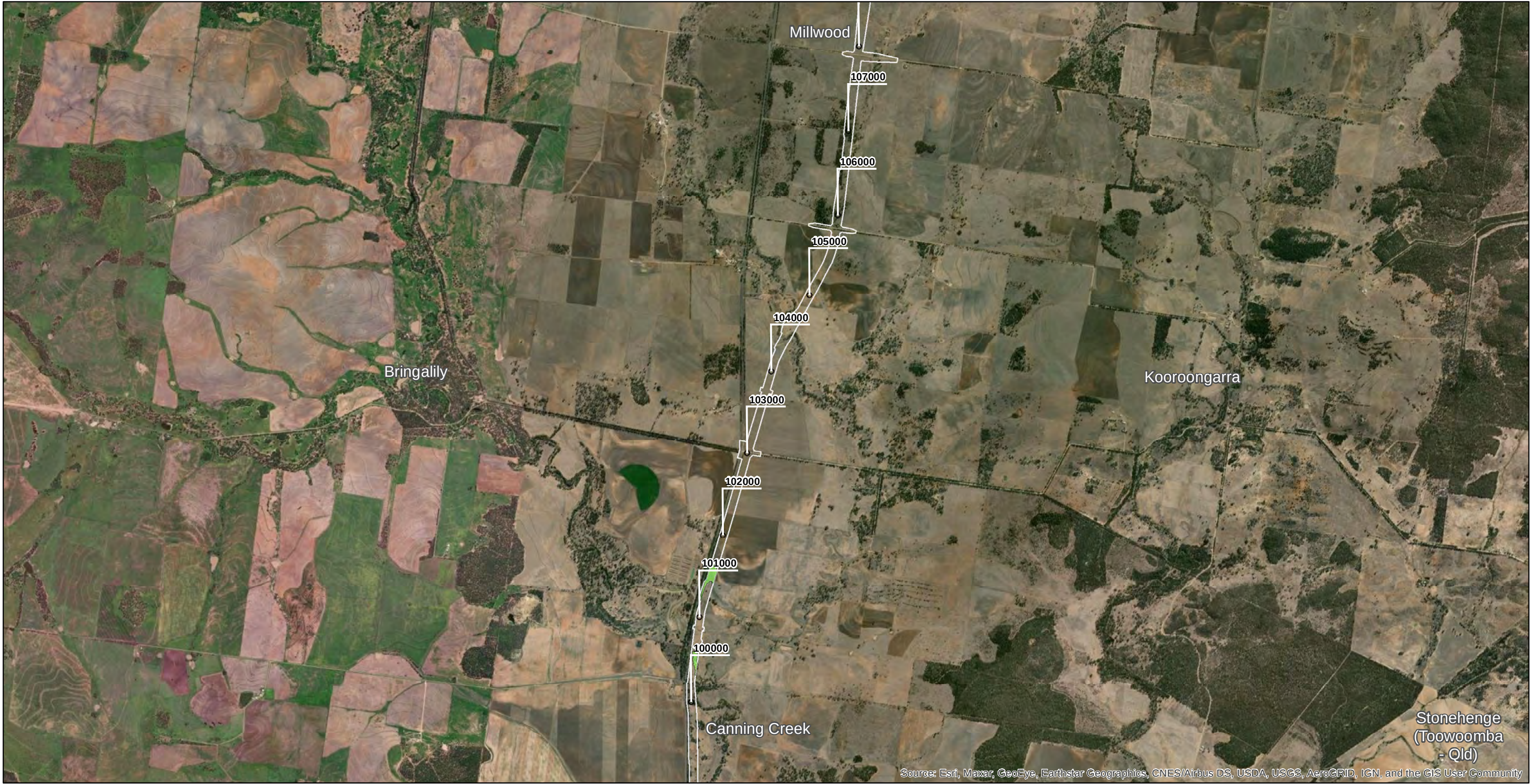
Legend

	Habitat		Chainage Points
	Bringalily state forest		
	B2G Alignment		

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
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Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Appendix E - 15 Fauna Matters Habitat

Petauroides volans sensu lato - Greater Glider

N



0 1 2 Kilometers

Scale 1:43,550 at A3

Coordinate System: GDA2020 MGA Zone 56

Datum: GDA2020

Legend

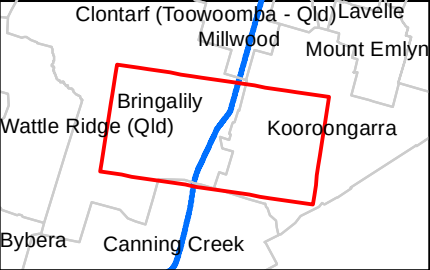
 Habitat

 Chainage Points

 B2G Alignment

Data Sources:

- Ausecology
- Survey Layers
- State of Queensland Department of Environment
- Major watercourse lines
- MSES Protected areas
- ARTC
- Footprint
- Chainage
- Basemap ESRI



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Appendix E - 15 Fauna Matters Habitat

Petauroides volans sensu lato - Greater Glider

N



012



Kilometers

Scale 1:43,420 at A3

Coordinate System: GDA2020 MGA Zone 56

Datum: GDA2020

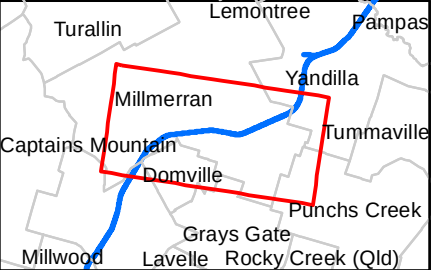
Legend

Habitat

Chainage Points

B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
Basemap ESRI



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Appendix E - 15 Fauna Matters Habitat
Petauroides volans sensu lato - Greater Glider

N

0

1

2

Kilometers

Scale 1:43,620 at A3
Coordinate System: GDA2020 MGA Zone 56
Datum: GDA2020

Legend

Habitat

Chainage Points

B2G Alignment

Data Sources:
Ausecology
Survey Layers
State of Queensland Department of Environment
Major watercourse lines
MSES Protected areas
ARTC
Footprint
Chainage
Basemap ESRI

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2	Issue for Information	JS	LG	LG	12/04/2022

ATTACHMENT B TEC CONDITION THRESHOLDS AND STATE TRANSITION MODEL

TEC Condition Classes and Thresholds:

Table 1 in Conservation Advice (DCCEEW, 2023b)

Condition Class	Patch Size*	Features present
Class A Good quality understorey and mature overstorey both present.	0.1 ha (1,000 m ²) or larger	- The ground layer is predominantly native* and - the understorey contains at least 12 native, non-grass species (such as forbs, shrubs, ferns and sedges) and - at least one of the understorey species should be a species recognised as 'important' (e.g. grazing-sensitive, regionally significant, listed threatened or uncommon species) (see 'Important' column in plant species list at Appendix A – Species lists) and - the patch contains 10 or more mature trees* per hectare consistent with the key diagnostics for the ecological community
Class B Good quality understorey present. Characteristic trees may be absent.	0.1 ha (1,000 m ²) or larger	- The ground layer is predominantly native* and - the understorey contains at least 12 native, non-grass species (such as forbs, shrubs, ferns and sedges) and - at least one of the understorey species should be a species recognised as 'important' (e.g. grazing-sensitive, regionally significant, listed threatened or

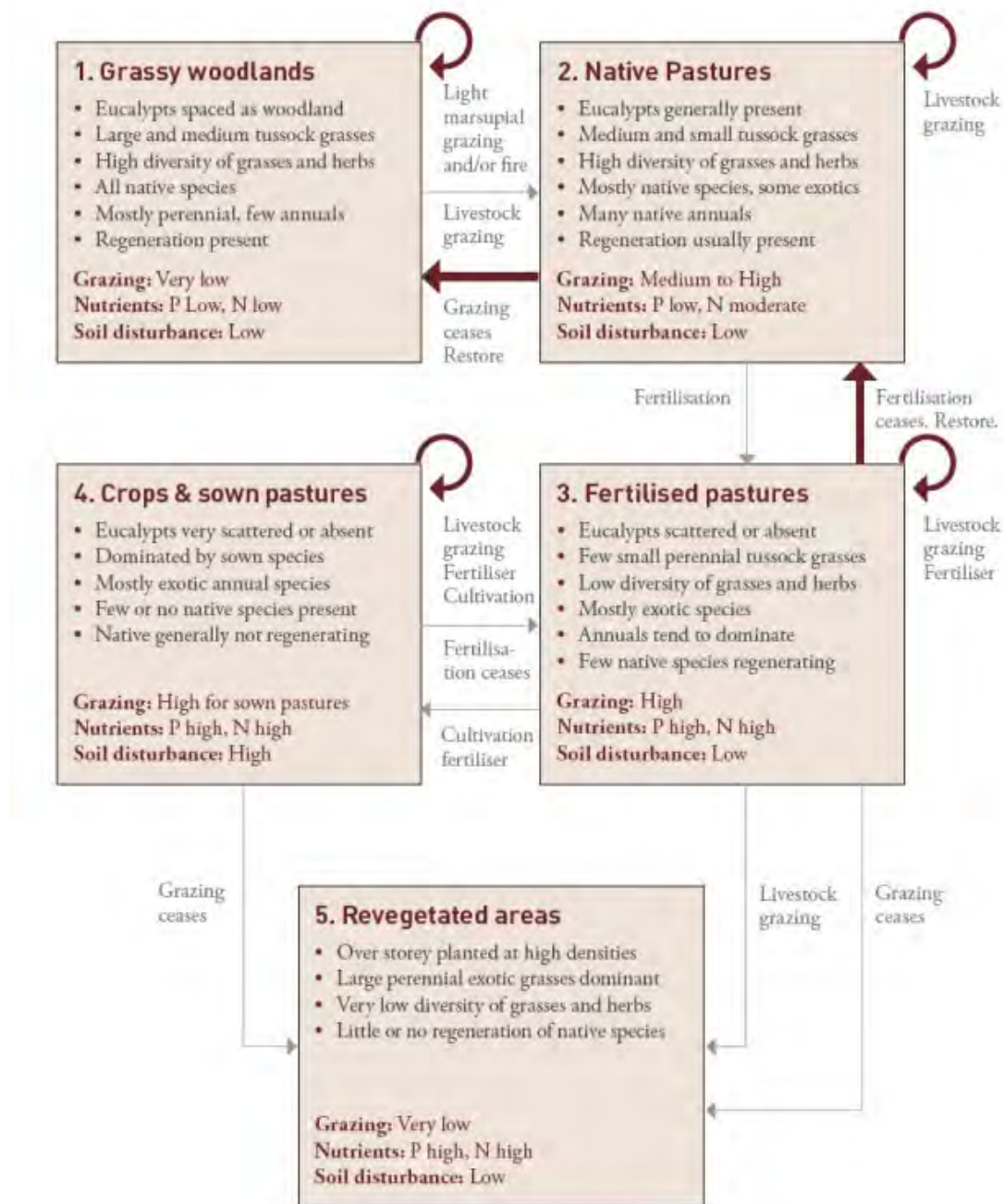
Threatened Species Scientific Committee
Page 19 of 121

White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland Conservation Advice

		uncommon species) (see 'Important' column in plant species list at Appendix A – Species lists)
Class C Allows for a lower diversity in the understorey in areas where there is regeneration and/or tree density may be relatively dense.	2 ha (20,000 m ²) or larger	- The ground layer is predominantly native* and - The patch contains 20 or more mature trees* per hectare and/or - The patch contains natural regeneration of dominant overstorey eucalypts*

State Transition Model:

Appendix 3 in National Recovery Plan (DECCW NSW, 2010)



Telstra / Nextgen cable realignment, Gowrie Junction

Protected Plant Survey Report

Prepared for Australian Rail Track Corporation

March 2024

Telstra / Nextgen cable realignment, Gowrie Junction

Protected Plant Survey Report

Australian Rail Track Corporation

E231240 RP1

March 2024

Version	Date	Prepared by	Reviewed by	Comments
V1	4 March 2024	Daniel Kelly	Berlinda Ezzy	Draft for client review
V2	7 March 2024	Daniel Kelly	Berlinda Ezzy	Final

Approved by

Berlinda Ezzy

Associate Director

7 March 2024

Level 1 87 Wickham Terrace

Spring Hill QLD 4000

This report has been prepared in accordance with the brief provided by Australian Rail Track Corporation and, in its preparation, EMM has relied upon the information collected at the times and under the conditions specified in this report. All findings, conclusions or recommendations contained in this report are based on those aforementioned circumstances. The contents of this report are private and confidential. This report is only for Australian Rail Track Corporation's use in accordance with its agreement with EMM and is not to be relied on by or made available to any other party without EMM's prior written consent. Except as permitted by the Copyright Act 1968 (Cth) and only to the extent incapable of exclusion, any other use (including use or reproduction of this report for resale or other commercial purposes) is prohibited without EMM's prior written consent. Except where expressly agreed to by EMM in writing, and to the extent permitted by law, EMM will have no liability (and assumes no duty of care) to any person in relation to this document, other than to Australian Rail Track Corporation (and subject to the terms of EMM's agreement with Australian Rail Track Corporation).

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1 Introduction

1.1 Project background

The Australian Rail Track Corporation (ARTC), in co-operation with InterlinkSQ, is seeking to relocate an existing network of Telstra/Nextgen optic fibre cables to an adjacent road easement associated with Krienkes Road, Gowrie Junction. The purpose of the relocation is to mitigate interaction during the construction phase of both ARTC's Gowrie to Helidon (G2H) rail section and InterlinkSQ developments in the locale. These cables are pivotal assets for both Telstra and Nextgen, particularly the Nextgen fibre serving as the main trunk fibre between Brisbane and Sydney, while the Telstra fibre plays a crucial role in interconnecting Gowrie Junction and Kingsthorpe.

As ecological assessments have been progressed for the G2H Environmental Impact Statement (EIS) associated with the Inland Rail project, ARTC have become aware threatened flora species are present near the proposed cable footprint. As such, with the addition of protected plant trigger mapping intersecting the impact area, and prior knowledge of threatened flora species in the area, it was considered necessary to undertake a protected plant survey.

1.2 Purpose and scope

Under the *Nature Conservation Act 1992*, a protected flora survey is to be completed where proposed works are to occur within areas mapped as a high-risk area on the flora survey trigger map, or where proposed works are located within 100 m of an existing record of a protected flora species. A suitably qualified person needs to undertake a protected plant survey across a 'clearing impact area' and then prepare a flora survey report. If threatened species are observed within the clearing impact area, a flora survey report (this report) summarising the survey findings is required to be submitted, in support of a protected plant clearing application.

This report summarises the results from two protected flora surveys undertaken on 18–19 December 2023 and on 22 February 2024 consistent with the Flora Survey Guidelines – Protected Plants (DES 2020). More specifically, this report will provide the information required to meet the requirements of the Protected Plants Assessment Guidelines (DES 2021).

1.3 Survey area location and description

The proposed cable relocation is 5.78 km in length and situated between Leeson's Road, Kingsthorpe and Gowrie Junction Road, Gowrie Junction (see Figure 1.3). The chosen route represents the most optimal solution, ensuring minimal disruption to critical telecommunication infrastructure while aligning as much as possible with environmental and logistical considerations.

Surveys were undertaken east of Leeson's Road, near Gowrie Creek south-east of Kingsthorpe, and west of and adjacent to Krienkes Road, Gowrie Junction. Kingsthorpe is located roughly 15 km north-west of Toowoomba, and Gowrie Junction is located roughly 10 km north-west of Toowoomba. Both townships lie within the Brigalow Belt Bioregion. The clearing impact area primarily consists of native grassland in paddocks interspersed with patches of *Eucalyptus orgadophila* (Mountain Coolibah) woodland, road verges, old homesteads, cattle yards, and exotic grasslands heavily disturbed by weeds. The elevation of the site sits between 400 and 500 m above sea level. There are some areas that are highly disturbed due to cropping/being regularly slashed, and bitumen roads.

Table 1.1 summarises the Lot/Plans that occur within the clearing impact area (proposed alignment and 100 m survey buffer) and those that could be accessed. Justification for properties that were not surveyed is provided in Section 2.5.

See Figure 1.2 for location of the disturbance footprint and clearing impact area.

Table 1.1 **Lot/Plans within the survey area and access**

Lot/Plan	Tenure	Access obtained Yes/No	Comment
61SP122171	Lands Lease	No	Active Queensland Rail corridor
2RP34933	Lands Lease	No	Active Queensland Rail corridor
157AG2455	Freehold	Yes	
478A34873	Freehold	Yes	
477A34873	Freehold	Yes	
472A34873	Freehold	Yes	
473A34873	Freehold	Yes	
476A34873	Freehold	Yes	
475A34873	Freehold	Yes	
474A34873	Freehold	Yes	
133A342650	Freehold	Yes	
485AG3377	Freehold	No	Landholder did not provide permission
479A34873	Freehold	Yes	
480A34873	Freehold	Yes	
4RP34885	Lands Lease	Yes	
1RL3652	Lands Lease	Yes	
100SP270462	Freehold	Yes	
BSP270462	Easement	Yes	
200SP312428	Freehold	Yes	
33SP312428	Freehold	Yes	
35AG4088	Freehold	Yes	
61AG3184	Freehold	No	Highly modified environment
154RP99736	Freehold	Yes	
482A34873	Freehold	Yes	
471A34873	Freehold	Yes	
470AG3378	Freehold	Yes	
466AG3378	Freehold	Yes	
1AG3345	Lands Lease	No	Inactive Queensland Rail corridor
301G1861	Freehold	No	Highly modified environment
305G1861	Freehold	No	Highly modified environment
117AG1535	Reserve	No	Highly modified environment

Table 1.1 Lot/Plans within the survey area and access

Lot/Plan	Tenure	Access obtained Yes/No	Comment
118AG1535	Reserve	No	Highly modified environment
469AG3378	Freehold	Yes	
468AG3378	Freehold	Yes	
467AG3378	Freehold	Yes	
3RP34912	Lands Lease	No	Inactive Queensland Rail corridor
1RL3625	Lands Lease	Yes	
1RL3652	Lands Lease	Yes	
481A34873	Freehold	Yes	
2SP169808	Freehold	No	Highly modified environment
3SP169808	Freehold	No	Highly modified environment
2RP55460	Freehold	No	Highly modified environment
26RP24609	Freehold	Yes	
33SP312428	Freehold	No	Highly modified environment
29SP294200	Freehold	No	Highly modified environment
Leesons / Leeson Rd	Road parcel	Yes	

1.3.1 Project description

The imperative need to relocate the existing Telstra and Nextgen cables arises from their susceptibility to the proposed Inland Rail and InterlinkSQ development works in the area. These cables are pivotal assets for both Telstra and Nextgen; the Telstra cable plays a crucial role in interconnecting the towns of Kingsthorpe and Gowrie Junction, and the Nextgen cable serves as part of the main trunk between Brisbane and Sydney.

Ground disturbance works associated with the Project will include two types of trenching layouts, as well as horizontal directional drilling (under-boring) and associated works. Horizontal directional drilling will involve two minor disturbance footprints (approximately 1 m x 4 m) at either end of the drill with no disturbance in between; the nominal depth of the 'tunnel' will be 1,200 mm to 1,500 mm. Figure 1.1 depicts disturbance footprint extents at each end of the directional drilling locations. Note that only the areas depicted in blue involve ground disturbance. Trenching layouts will have an approximate width of 500 mm and a depth between 900–1,200 mm. The main disturbance to the existing environment will be the stripping of grass and topsoil. Stockpiling of the excavated grass and soil will be immediately adjacent to where it was removed from the ground. As far as practicable, the trenching contractors will attempt to preserve the soil profile, and avoid mixing topsoil and subsoil, which will be stored on opposite sides of the trench while cable is being laid. A small amount of bedding material (sand) will be deposited in the bottom of the trench and infilled around the cables. This will then be buried with excavated subsoil, and the preserved topsoil and grasses will then be backfilled over the cable. Any extra subsoil material will be distributed evenly nearby, avoiding burial of existing ground vegetation.

1.4 Authority to conduct protected plant survey

Collection of plant specimens for submission to the Queensland Herbarium for the purpose of identification was required. Plant collection was undertaken in accordance with Division 3 of the *Nature Conservation (Plants) Regulation 2020*.

1.5 Statement of validation from suitably qualified personnel

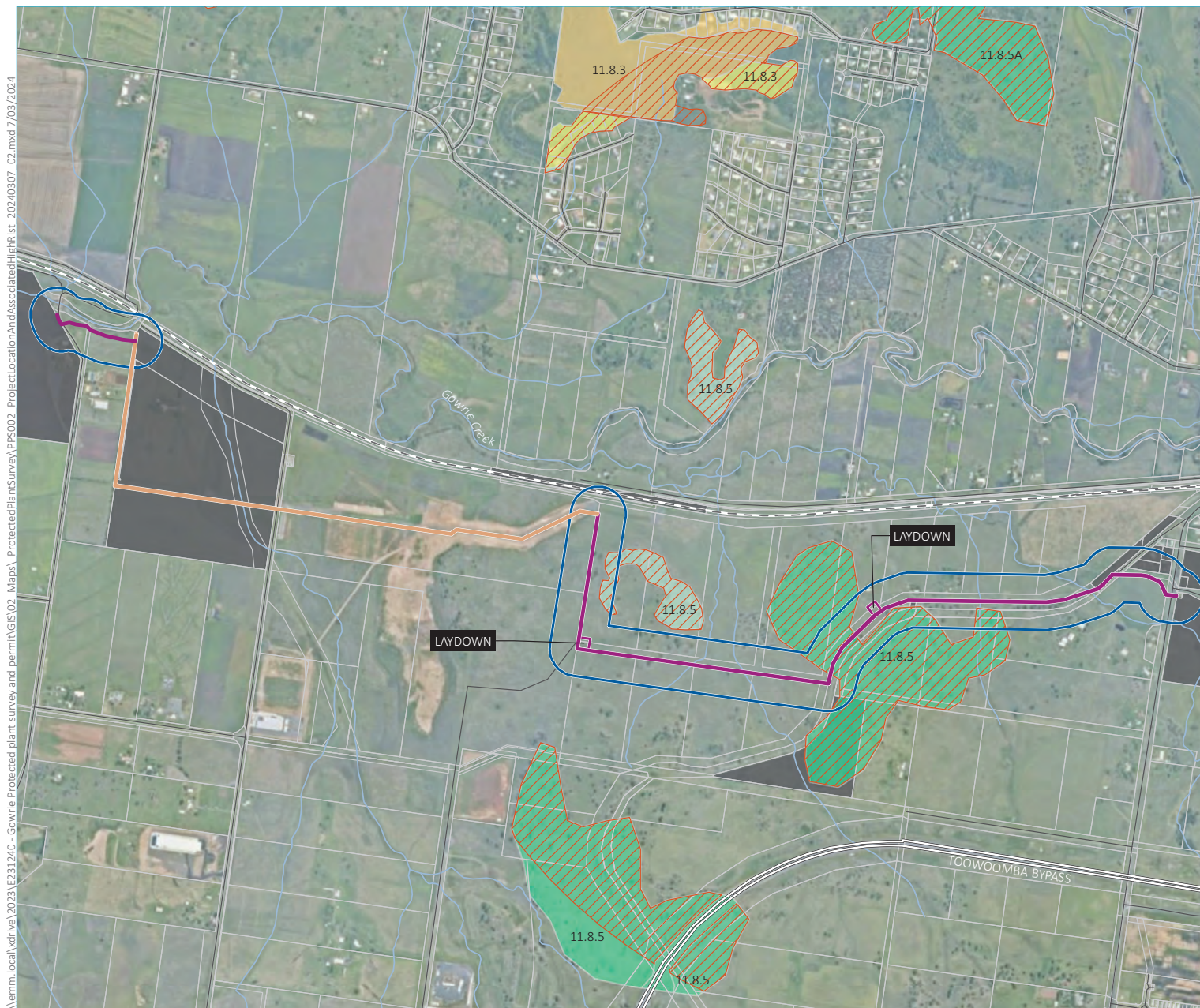
I certify that:

- a. I have adhered to all statutory requirements and flora survey guideline requirements; and
- b. In the area surveyed I, **Daniel Kelly**, found any plants that are currently listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable or near threatened in the *Nature Conservation (Plants) Regulation 2020*; and
- c. The flora survey report is an accurate and full account of the flora survey.



Date: 07/03/2024

Daniel Kelly - Ecologist



- KEY**
- Disturbance footprint
 - InterlinkSQ section
 - Clearing impact area (survey area)
 - Protected plant trigger mapping
 - Exempt area (no access)
 - Regulated vegetation (VM status)**
 - Remnant - of concern
 - High value regrowth - of concern
 - Remnant - least concern
 - High value regrowth - least concern
 - Existing environment**
 - Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Cadastral boundary

Project location and associated high-risk trigger mapping

Telstra/Nextgen Cable Realignment
Gowrie Junction
Protected Plant Survey Report
Figure 1.3



2 Methodology

2.1 Desktop assessment

A review of existing information was undertaken to assess ecological characteristics of the study area, including the potential presence of critically endangered, endangered, vulnerable and near threatened (CEEVNT) flora species under NC Act and potential habitat types.

As such, a 5 km buffer was used for the desktop searches to delineate a study area to assess ecological characteristics of the survey area. The following sources were consulted during the desktop assessment phase including the potential presence of CEEVNT flora species associated with the survey area:

- Department of Environment and Science (DES) Protected Plants Flora Survey Trigger Map
- Department of Science, Information Technology and Innovation (DSITI) Wildlife Online
- Department of Climate Change, Energy, the Environment and Water (DCEEEW) Protected Matters Search Tool (PMST)
- Department of Natural Resources, Mines and Energy (DNRME) Detailed Surface Geology – Queensland
- Department of Natural Resources and Mines (DNRM) Vegetation Management Regional Ecosystem (RE) spatial layer
- spatial imagery
- Atlas of Living Australia (ALA)
- Gowrie to Helidon Ecology Technical Report (EMM 2024) (draft)
- Redleaf Environmental protected plant survey data set (Redleaf Environmental 2022).

Desktop searches are provided in Appendix A.

2.2 Field survey methodology

A timed meander survey was conducted in the designated clearing impact area which included the disturbance footprint and a 100 m buffer, as outlined in the *Nature Conservation (Plants) Regulations 2020 – Protected Plants Assessment Guidelines* (the Guidelines). The clearing impact area, as seen in Figure 1.3, includes areas intersecting protected plant trigger mapping.

The clearing impact area, including all habitat types, was traversed by two ecologists, to obtain maximum coverage (refer Figure 1.2). The survey was conducted over three days, with a total estimated survey time of 18 hours. Where a CEEVNT plant, or possible CEEVNT plant was observed, the population extent within the clearing impact area was recorded and a specimen was taken for submission to the Queensland Herbarium to confirm identification. Coordinates for each potential CEEVNT individual or population was recorded.

Desktop search results were also used to identify potential CEEVNT flora species that may be present, and these are summarised in Section 3.1.3. Field ecologists looked for these threatened flora species during the survey. Access was restricted in small areas within the clearing impact area (see Figure 1.3) and justification as to why land access wasn't available is provided in Section 2.5.

2.3 Survey team

In accordance with Section 4.2.1 of the Flora Survey Guidelines – Protected Plants (DES 2020), the survey was led by Suitably Qualified Person (SQP), Ecologist Daniel Kelly, and assisted by ecologists Rachel Scott and Elliot Leach. Curricula Vitae are provided in Appendix B. Daniel's SQP self-assessment can be observed in Table 2.1 below.

Table 2.1 SQP self-assessment – Daniel Kelly

	Conditions	Maximum points allocated	Self-assessment	Rationale
Component 1: Qualification knowledge and ability				
A relevant qualification from a recognised institution (e.g., University, TAFE) that results in a thorough knowledge of plant identification and flora surveys.	General training (not Aust. or Qld focussed); OR	30	50	Bachelor of Environmental Science with honours (Ecology), University of Queensland. Relevant subjects include Rainforest Ecology, Desert Ecology and Plant Systematics and Identification.
	Australian focussed training; OR	40		
	Queensland focussed training	50		
Regional ecosystem training by a recognised and qualified institution, such as the Queensland Herbarium.	Nil	5	5	The QLD Regional Ecosystem Framework and Application (QLD Herbarium 2018)
Member of a recognised group/certificate program relevant to ecology/botany, where skills/knowledge are demonstrated to be granted membership e.g., Certified Environmental Practitioner (CEnvP) Program	Nil	5	0	N/A
Lead author of articles/papers published in peer-reviewed journals concerning Qld flora surveys, Qld plant identification, or Qld <i>threatened plants or near threatened plants</i>	10 points per paper to a maximum of 50 points	50	0	N/A
Component 2: Field experience				
Experience within the last 2 years and a total of at least 5 years at leading flora surveys in a field-based environment at a rate of no less than 5 comprehensive botanical surveys that focus on locating and identifying <i>threatened plant or near threatened plants</i> , per year.	General (not Aust. based); OR	40	60	Daniel has been conducting field-based flora surveys in Queensland and NSW for more than 5 years, beginning in November 2017. Daniel has led at least 5 comprehensive botanical surveys each year.
	Australian based survey experience; OR	50		
	Qld based field flora surveys experience	60		
Number of plant specimens you have collected that have been retained/incorporated into the Queensland Herbarium collection:	5 points per plant specimen retained/incorporated, to a maximum of 40 points	40	40	Daniel has submitted at least 15 specimens retained by the Queensland Herbarium.
TOTAL			155	

2.4 Survey timing

ARTC commissioned an initial reconnaissance survey to be undertaken by EMM on 8 March 2023, as a part of the broader G2H project. This survey was done to identify any possible constraints within the proposed disturbance footprint for the cabling. As a result of the surveys, the CEEVNT species *Digitaria porrecta* was observed within the proposed disturbance footprint and surrounding grasslands and a protected plants survey was advised. Surveys were then proposed to be undertaken in the warmer spring/summer survey period to ensure good survey conditions.

Protected plant surveys were conducted on 18 and 19 December 2023, and again on 22 February 2024. All surveys were led by Daniel Kelly. Inadequate rainfall in the Toowoomba area prior to November 2023 resulted in poor growing conditions for the target species within the survey area, particularly during the months of August, September and October where there was a combined 22 mm of rainfall (BOM 2024). During the month of November, a total of 115.2 mm of rain fell at the Toowoomba Airport weather station (station 041529). This allowed for optimal growing conditions for the rain-responsive target grass and forb species (BOM 2024). Conditions between November 2023 and February 2024 were excellent, with many native flora species flowering in the natural grasslands (EMM unpublished data). The likelihood of occurrence for threatened flora species and optimal survey timing for species is discussed in Section 3.1.3.

2.5 Land access

Access was permitted across most of the clearing impact area; however, access was restricted or not sought for the land parcels listed in Table 2.2, with justification.

Table 2.2 Land access

Lot/plan	Justification
485AG3377	This particular lot had not been previously contacted by the project team, leading to the absence of contact details for the landowners on file. Despite searches across various databases, attempts to retrieve their contact information proved unsuccessful. An ARTC land access representative visited this lot and nearby properties in an effort to gather information, although there was no residence on this lot. Information from neighbours indicated that the owner resides elsewhere in Queensland and rarely visits the property. Unfortunately, due to the time constraints of the survey, obtaining a Land Access Agreement for this lot proved to be unattainable.
61SP122171 2RP34933 1AG3345 3RP34912	These lots are situated in the west of the clearing impact area and are a part of an active Queensland Rail (QR) railway. QR require the correct safety inductions and a minimum 40 business days as notice before access can be granted. Finding a window of good growing conditions for the target species was difficult due to the poor rainfall prior to November 2023 (see Section 2.4) and the predicted dryer El Niño conditions. If EMM waited 40 minimum business days, survey conditions may not have been optimal.
61AG3184 117AG1535 118AG1535	EMM considered these land parcels highly modified environments as spatial imagery indicated slashing or cropping occurs. Therefore, access was not requested.
301G1861 305G1861 2SP169808 3SP169808	EMM considered these areas highly modified environments as they are private residencies which are regularly mown and maintained. Therefore, access was not requested for these land parcels.
2RP55460 33SP312428 29SP294200	Access was sought by ARTC representatives, but denied by landholders. EMM considered these land parcels highly modified environments as spatial imagery indicated slashing or cropping occurs. Therefore, access was not pursued further.

3 Results

3.1 Desktop survey results

3.1.1 High risk trigger mapping

Desktop assessments identified a small area of the disturbance footprint falls within high-risk trigger mapping (Figure 1.3 and Appendix A). The CEEVNT species, *Digitaria porrecta*, was known to occur in proximity to the clearing impact area based on knowledge from previous surveys in the area (Redleaf Environmental 2022; EMM 2023). Additionally, locations of the CEEVNT species *Leuzea australis*, *Picris evae* and *Thesium australe* were provided to EMM ecologists by Brad Jeffers (AusEcology), who had been conducting botanical surveys for ARTC in the local area (B. Jeffers pers. comm. 2024).

High-risk trigger mapping occurs in the lots shown in Table 1.1 with 8.31 ha in the clearing impact area and approximately 0.094 ha intersecting the disturbance footprint.

3.1.2 Regional ecosystems and habitats

Regulated vegetation mapping shows one least concern regional ecosystem (RE) occurring within the clearing impact area in two places:

- RE 11.8.5 *Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.

The extent of the two patches of RE 11.8.5 is shown in Figure 1.3 and Figure 3.1. One patch is mapped as high value regrowth, whilst the other is mapped as remnant. The remaining clearing impact area is currently mapped as non-remnant vegetation. EMM confirmed RE 11.8.5 was present on the hills whilst non-remnant native grassland was located on the lower gradient colluvial/alluvial areas of the survey area (as seen in Photograph 3.1).

It should be noted that additional assessments undertaken as a part of the Inland Rail G2H project by EMM Consulting have identified areas of the 'Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland' threatened ecological community (TEC). The TEC occurs as remnant patches of RE 11.3.21 and RE 11.8.11; potential impacts to the TEC have been assessed via a self-assessment process (EMM 2024). Due to the proponent agreeing to utilise horizontal directional drilling to tunnel beneath the TEC area, there are no significant impacts to the TEC expected.



Photograph 3.1 Native grassland habitat with RE 11.8.5 on the basaltic rises (EMM 2023)

3.1.3 Potentially occurring CEEVNT flora

Desktop searches (provided in Appendix A) identified 35 CEEVNT flora species. Four categories were used to assess the likelihood of habitat occurrence within the clearing impact area. The criteria used to assign each category are as follows:

- Known – the species is known to occur within the clearing impact area.
- Likely – the species was identified in database searches or through local expertise, records exist within the 5 km database study area, and suitable habitat is present within the clearing impact area.
- Potential – the species was identified in database searches or through local expertise, suitable habitat is present within the clearing impact area, but no records exist within the 5 km database search area.
- Unlikely – the species was identified in database searches, but no records are present within the survey area and no suitable habitat is present within the survey area.

Two species were assessed as known, three species were assessed as likely, and six species were assessed as having the potential to occur within the clearing impact area. These species are hereby referred to as the target species. Table 3.1 lists the 11 target species and includes their status under the EPBC Act and NC Act, the source of the database records, the likelihood of the habitat occurring within the clearing impact area, habitat requirements, and the optimal time of year for survey. Previous surveys undertaken by both Redleaf Environmental in 2022 and EMM Consulting in 2023 identified *Digitaria porrecta* within 100 m of the proposed impact area. This species was the primary target of the protected plant surveys.

Table 3.1 Target threatened flora species

Scientific name	Common name	Source	EPBC Act status ¹	NC Act status ²	Likelihood and habitat requirements	Target survey period
<i>Bothriochloa bunyensis</i>	Satin-top Grass	PMST & WildNet	VU	V	Potential - Satin-top Grass grows on fertile basaltic soils on the upper slopes and crests of hills at altitudes between 600–1,100 m above sea level (DEWHA 2008a). Although the soil is basaltic, the elevation of the site sits between 400–500 m above sea level.	Flowers January to May (Simon and Alfonso 2011).
<i>Clematis fawcettii</i>	Stream Clematis	PMST & WildNet	VU	V	Potential - This species is associated with dry rainforest, subtropical rainforests, the ecotone of dry rainforests and to a lesser extent eucalypt forests with rainforest species in the understorey. Stream Clematis can be found growing in basalt derived soils where there are suitable canopy gaps, or on the margins of SEVT (DEWHA 2008b).	Surveys for this species can be conducted any time of the year (DEWHA 2008b).
<i>Cyperus clarus</i>	A sedge	WildNet	-	V	Likely - <i>Cyperus clarus</i> inhabits open woodlands or grasslands in heavy soils derived from basalt (DES 2024a). This species has been previously recorded in the vicinity of Gowrie as a part of the G2H project.	Flowers over the spring and summer periods (DES 2024a).
<i>Dichanthium queenslandicum</i>	King Bluegrass	PMST	EN	V	Potential - This species is primarily associated with grassland communities (particularly those dominated by other blue grasses (<i>Dichanthium</i> spp. and <i>Bothriochloa</i> spp.) on black cracking soils (TSSC 2013a).	Flowers November to January (Simon and Alfonso 2011).
<i>Dichanthium setosum</i>	Bluegrass	PMST	V	-	Potential - The species is primarily restricted to heavy volcanics such as red-brown and heavy black soils. However, it can be found in a broad range of habitats from remnant woodlands to roadside vegetation and pasture (DEWHA 2008c).	Flowering occurs between November to June (Simon and Alfonso 2011). However, the species primarily flowers during summer (DEWHA 2008c).

Table 3.1 Target threatened flora species

Scientific name	Common name	Source	EPBC Act status ¹	NC Act status ²	Likelihood and habitat requirements	Target survey period
<i>Digitaria porrecta</i>	Finger Panic Grass	WildNet	-	NT	Known – Previously observed in proximity to the clearing impact area.	Flowers have been recorded from February to July (Simon and Alfonso 2011).
<i>Homopholis belsonii</i>	Belson's Panic	PMST	VU	E	Potential - <i>Homopholis belsonii</i> occurs in dry woodland habitats on a range of soil types at an altitudinal range between 200–520 metres. This species is generally found growing at the base trees and under the shade of branches and other shaded areas (DES 2024b).	Flowers February to May, feasibly also November to December (Simon and Alfonso 2011; Leigh et al. 1984).
<i>Lepidium peregrinum</i>	Wandering Peppergrass	PMST & WildNet	EN	-	Potential - This species has been recorded in a range of habitats but prefers riparian forests and the ecotones between rainforest and woodland in elevated areas (DoE 2014b).	Flowering from January to April (Scarlet 1999).
<i>Leuzea australis</i>	Austral Cornflower	PMST & WildNet	VU	V	Known – <i>Leuzea australis</i> grows in eucalypt open forest with a grassy understory and in grasslands on black clay soil. It is often found on roadsides and on road or rail reserves (DES 2024c). B. Jeffers provided a GPS location of individuals within the clearing impact area in early 2024 (B. Jeffers pers. comm. 2024).	Flowers Spring to Autumn (Marlow 1998).
<i>Picris evae</i>	Hawkweed	PMST	VU	V	Likely - Hawkweed primarily occurs in association with <i>Dichanthium</i> sp., on rich dark or reddish soils, in open Eucalypt woodland with a grassy understorey (DEWHA 2008d). B. Jeffers provided a GPS location of an individual approximately 100 m south of the clearing impact area in early 2024 (B. Jeffers pers. comm. 2024).	Flowers in spring and summer (Leiper et al 2017).
<i>Thesium australe</i>	Austral toadflax	PMST	VU	V	Likely - Austral Toadflax grows in moist areas of grassland or woodland on skeletal soils, or heavy alluvium and black cracking clays (DES 2024d). As the species exhibits broad habitat preferences, it was surveyed for throughout the disturbance footprint. B. Jeffers provided a GPS location of an individual some 200 m north of the clearing impact area in early 2024 (B. Jeffers pers. comm. 2024).	<i>Thesium australe</i> has been recorded flowering from October to April (DES 2024d).

Notes: 1. EPBC Act status: CE- critically endangered, E – endangered, V – vulnerable

2. NC Act status: CE – critically endangered, E – endangered, V – vulnerable, NT – near threatened

3.2 Field survey results

A timed meander was completed over two days within the eastern portion of the clearing impact area in December 2023; an additional timed meander was completed in the western portion of the clearing impact area in February 2024. In general, the clearing impact area in the west consisted of non-remnant grassland, with high levels of exotic weed cover. The clearing impact area was surveyed systematically to cover as much ground as possible. A small area of natural grassland, containing several *Digitaria porrecta*, was also identified, potentially representing RE 11.3.21. A large population of *Picris evae* was identified in the clearing impact area during the survey; advice was sought from the Queensland Herbarium while in the field and it was determined that representative counts of the species would be conducted in ten 1 x 1 m quadrats across a 50 m transect (J. Neldner pers. comm. 2024). An average density was then obtained and extrapolated to the entire area of occupancy that fell within the clearing impact area.

The clearing impact area in the east comprised primarily non-remnant grassland, though small areas of remnant native grasslands RE 11.3.21 and RE 11.8.5 (dominated by *Eucalyptus argadophila*) also occurred. As the ground layer was relatively contiguous in its species composition between the open woodland RE 11.8.5 and non-remnant areas, and the target species were predominantly groundcover species, the site was surveyed systematically to cover as much ground as possible. This was also done to ensure an accurate count of *Digitaria porrecta*, as it is known to occur across the site. Weed cover across the clearing impact area was generally quite low, with the most consistent weed species being *Glandularia aristigera* (Mayne's Pest). A species list consisting of the native and introduced species observed on site can be found in Appendix D.

A total of 105 flora species were identified during the protected plant surveys. Four CEEVNT species were observed in the clearing impact area:

- *Digitaria porrecta* (Near Threatened – NC Act) observed in both western and eastern sections
- *Eucalyptus argophloia* (Vulnerable – NC Act) observed in the eastern section
- *Leuzea australis* (Vulnerable – NC Act) observed in the eastern section
- *Picris evae* (Vulnerable – NC Act) observed in the western section.

Queensland Herbarium confirmations of CEEVNT species identifications can be found in Appendix E.

A spatial package with location data will be provided for all CEEVNT species records within the clearing impact area.

3.2.1 *Digitaria porrecta*

Two hundred and forty-six individual *Digitaria porrecta* were present within the clearing impact area, of which 21 were located within the 5 m-wide disturbance footprint. All recorded individuals were in the process of flowering and were in good health due to the optimal rainfall that occurred the month prior. The *Digitaria porrecta* (Photograph 3.2) were all situated in native grasslands with low weed cover where the dominant species included *Dichanthium sericeum*, *Panicum queenslandicum*, *Aristida leptopoda*, *Bothriochloa biloba*, *Digitaria divaricatissima* and *Themeda avenacea*.

The surface geology associated with *Digitaria porrecta* was represented by heavy, black, clay soils on a gradual slope (<5%). These areas generally had a northerly aspect, draining towards the floodplain associated with Gowrie Creek. The ground-truthed potential habitat areas and individual records can be observed in Figure 3.1.



Photograph 3.2 *Digitaria porrecta* found in the native grassland (EMM 2023)

3.2.2 *Eucalyptus argophloia*

A plantation of roughly 30 *Eucalyptus argophloia*, planted in rows, were observed on the northern edge of the clearing impact area (see Figure 3.1). Three individuals were present within the clearing impact area. As this species has been intentionally planted (i.e. not occurring 'in the wild') and is outside of its known natural distribution, it has not been considered further in this report.



Photograph 3.3 *Eucalyptus argophloia* planted in evenly spaced rows (EMM 2023).

3.2.3 *Leuzea australis*

A small patch of 15 *Leuzea australis* were observed within the clearing impact footprint, 6 of which were within the disturbance footprint. Different stages of maturity were present in the population, with several plants flowering (Photograph 3.4), several bearing seedheads, young plants growing flower spikes and old, senesced individuals all being present. All plants appeared to be in good health with minimal impacts from disease or insect attack. The individuals were growing on a grassy slope (roughly 10%) dominated by *Themeda triandra* and a patch of *Rubus parvifolius*. The soils were noted as being basalt derived with some large surface rocks present.

Habitat in the immediate surroundings of these records has been impacted by cropping to the east, grazing to the south on Lot 35 AG4088, roadside excavations along Krienkes Road and a weedy drainage line to the north. Therefore, the known habitat area for this patch of *Leuzea australis* as mapped in Figure 3.1 is quite small.

No specimens were submitted to the Queensland Herbarium for this species due to the small size of the population; diagnostic photographs were sent to A.R. Bean (Senior Botanist at the Queensland Herbarium) for confirmation (Appendix E).



Photograph 3.4 *Leuzea australis* growing within the disturbance footprint (EMM 2023).

3.2.4 *Picris evae*

A large population of *Picris evae* was found in the western portion of the clearing impact footprint, with at least 50 individuals, and approximately 0.17 ha of habitat for the species found within the disturbance footprint. As discussed above, the population size within the clearing impact area (approximately 500,000 plants – see Table 3.2) was estimated by calculating the average density from ten 1 x 1 m quadrats along a 50 m transect, approximately 15 m south of Drapers Road, and extrapolating to the area of occupancy (2.08 ha of habitat was present within the clearing impact area (shown on Figure 3.1)). Details from each quadrat are presented in Table 3.2. Different stages of maturity were present in the population, with many plants flowering and bearing seed (Photograph 3.4), younger plants approaching maturity and growing flowers, hundreds of seedlings and old, senesced individuals all being present. The individuals were growing in a relatively flat (<5% slope) area of disturbed grassland, with many exotic weeds present.



Photograph 3.5 **Mature *Picris evae* growing within the disturbance footprint**

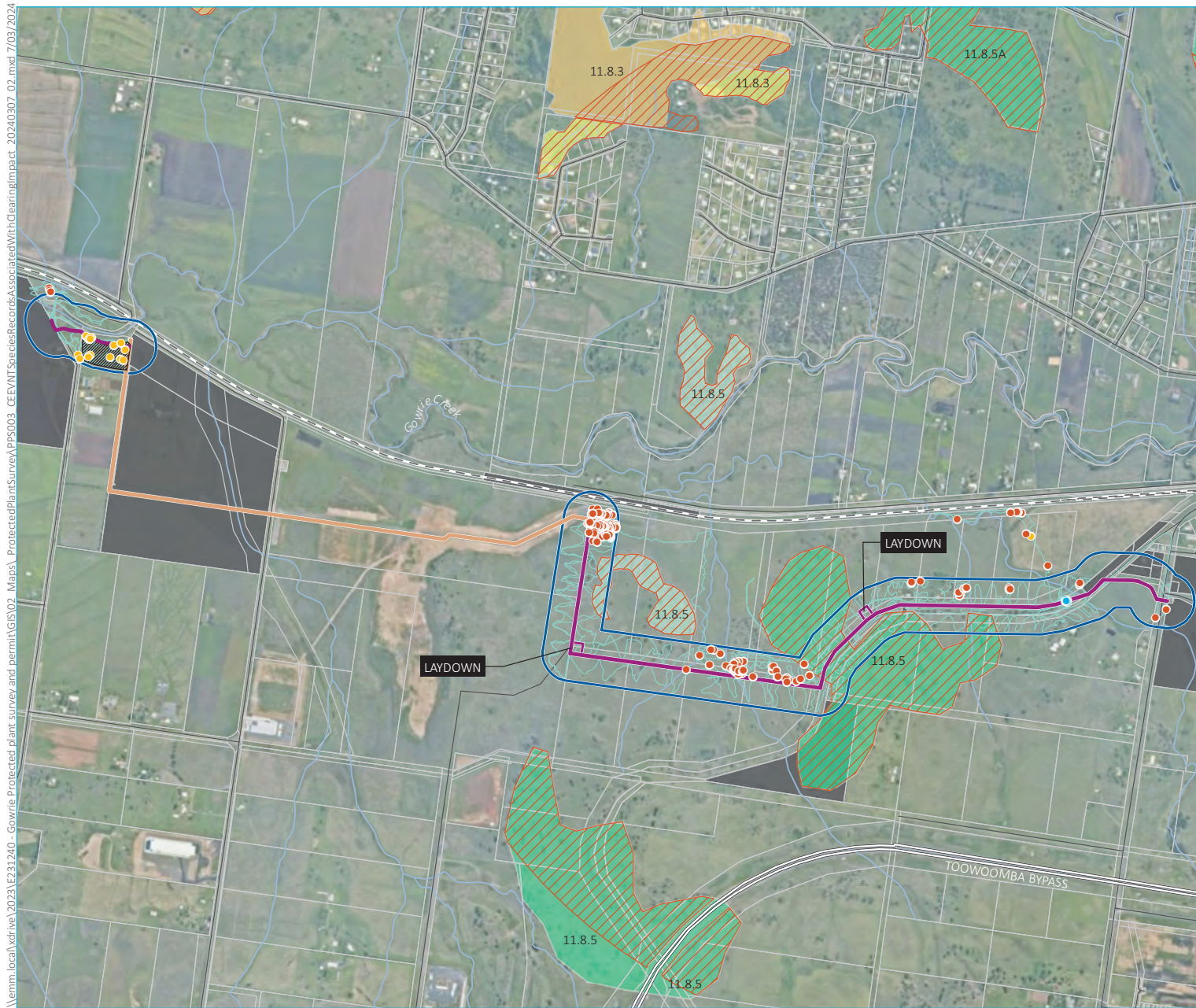
Table 3.2 **Representative density of *Picris evae* along a 50 m transect**

1 x 1 m Quadrat ID	Number of <i>Picris evae</i> per m ²	Notes
PICRIS 1	8	Mature flowering plants
PICRIS 2	16	Mature flowering plants
PICRIS 3	10	Mature flowering plants
PICRIS 4	26	Mature flowering plants and seedlings
PICRIS 5	30	Mature flowering plants and seedlings
PICRIS 6	25	Mature flowering plants and seedlings
PICRIS 7	80	Mature flowering plants, many seedlings
PICRIS 8	10	Mature flowering plants
PICRIS 9	16	Mature flowering plants
PICRIS 10	18	Mature flowering plants, some seedlings
Average number	23.9 individuals per m ²	Average density x extent of population in clearing impact area (20,947.3 m ²) = estimated population of ~500,000 individuals.

Habitat in the immediate surroundings of the population has been impacted by Drapers Road (which runs through the population), slashing of the roadside verge of Leeson's Road and extensive cropping to the west. The locations of individual plants recorded in spatial software, as well as the total extent of the population, is visible in Figure 3.1.

No specimens were submitted to the Queensland Herbarium for this species; diagnostic photographs were sent to A.R. Bean (Senior Botanist at the Queensland Herbarium) for confirmation (Appendix E).

\\vmm.local\vdriw\2023\E231240 - Gowrie Protected plant survey and permit\GIS\02 Maps\ ProtectedPlantSurvey\PP5003_CEEVNTSpeciesRecordsAssociatedWithClearingImpact_20240307_02.mxd 7/03/2024



- KEY**
- Disturbance footprint
 - InterlinkSQ section
 - Clearing impact area (survey area)
 - Protected plant trigger mapping
 - Exempt area (no access)
 - Picris evae* habitat
 - Protected plant meander
- CEEVNT species**
- Digitaria porrecta*
 - Leuzea australis*
 - Picris evae*
- Regulated vegetation (VM status)**
- Remnant - of concern
 - High value regrowth - of concern
 - Remnant - least concern
 - High value regrowth - least concern
- Existing environment**
- Rail line
 - Major road
 - Minor road
 - Watercourse/drainage line
 - Cadastral boundary

CEEVNT species records associated with the clearing impact area

Telstra/Nextgen Cable Realignment
Gowrie Junction
Protected Plant Survey Report
Figure 3.1



4 Species profiles

4.1 *Digitaria porrecta* – Finger Panic Grass

Digitaria porrecta occurs in four disjunct areas extending over 1,000 km. In Queensland, it occurs in the Nebo district, south-west of Mackay; the Central Highlands between Springsure and Rolleston; and from Jandowae south to Warwick. In NSW, it occurs from near Inverell south to the Liverpool Plains near Coonabarabran and Werris Creek (Figure 4.1). It is a perennial, erect grass growing to 70 cm tall with a compound inflorescence upwards of 27 cm in size. The inflorescence consists of a panicle of racemes each bearing 10–20 florets. Florets are generally paired with the spikelet consisting of a sterile basal floret (or rarely male) and a fertile floret. This species is closely related to both *Digitaria coenocloa* and *Digitaria divaricatissima*, however, differs by its rebranching inflorescence (Simon & Alfonso 2011).

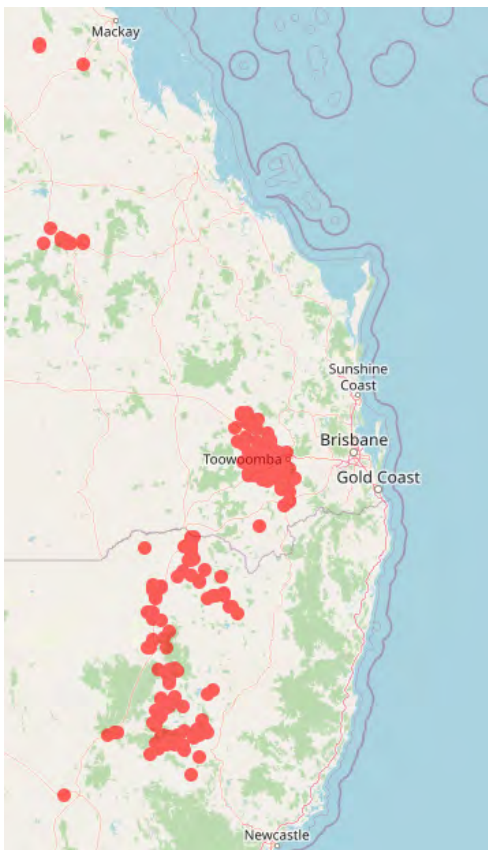


Figure 4.1 Public records indicating the distribution of *Digitaria porrecta* (ALA 2024)

4.1.1 Important populations

As this species is not listed as threatened under the EPBC Act there are no important populations listed for *Digitaria porrecta*.

4.1.2 Reproduction

Digitaria porrecta seeds from February to July but also reproduces vegetatively by dying back to the tussock base, from which it resprouts in summer. As the tussock ages, the central portion dies, and the resultant ring of plantlets eventually separate and become independent tussocks (Simon & Alfonso 2011; DES 2024e). EMM has recorded the species flowering in December.

4.1.3 Ecology and habitat

Digitaria porrecta occurs in several disjunct population centres with appropriate heavy soils. In Queensland these localities are all within the Brigalow Belt bioregion. The species occurs in tussock grassland or open woodland of *Eucalyptus populnea* or *E. tereticornis*, invariably on heavy, cracking clays, sometimes of alluvial origin. The climate is subtropical and seasonal, often with extended periods of drought (DES 2024e).

4.1.4 Threatening processes

The main identified threats to *Digitaria porrecta* are clearing and habitat fragmentation, fire, trampling and grazing by livestock, physical disturbance by machinery, and urban expansion. Competition from introduced grasses such as *Chloris gayana* and *Urochloa panicoides* also present potential threats (DES 2024e).

4.2 *Leuzea australis* – Austral Cornflower

Leuzea australis is listed as Vulnerable under the Federal EPBC Act and the Queensland NC Act. It is an erect, herbaceous perennial growing to 60 cm high. Stems are covered with woolly hairs. Leaves are toothed to deeply pinnatifid (cut about half the width of the leaf blade into lobes that are spaced out along the midrib), lower leaves are 18 cm long, 6 cm wide, reducing in size along the stem with the upper leaves few, smaller and nearly stalkless. Flowers are clustered into terminal heads, 36 cm in diameter, the outer and intermediate bracts are ovate and rough to touch (DEWHA 2008e).

4.2.1 Important populations

DCCEEW does not define locations of important populations for the species. The total population size and extent of occurrence of this species are unknown; there are historical records of the species from as far south as Victoria, but its current distribution appears to be limited to Queensland, from areas west of Gladstone to areas close to the Queensland-New South Wales border (Figure 4.2).

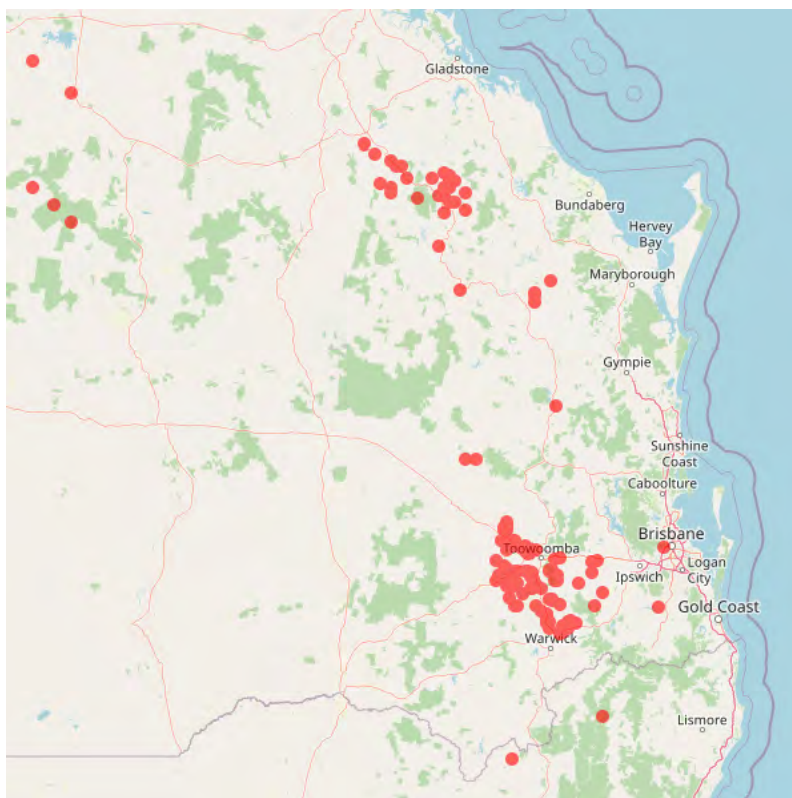


Figure 4.2 Public records indicating the distribution of *Leuzea australis* (ALA 2024)

4.2.2 Reproduction

Flowering occurs in February, October, November and December. Seedlings have been recorded in November (DEWHA 2008e).

4.2.3 Ecology and habitat

Leuzea australis grows in eucalypt open forest with grassy understory on roadsides and on road reserves with *Chloris gayana*, *Cirsium vulgare*, *Eucalyptus tereticornis* and *Angophora floribunda* on black clay soil (DEWHA 2008e).

4.2.4 Threatening processes

The main potential threats to *Leuzea australis* include broad-scale vegetation clearing, invasion by exotic weeds, grazing pressure and roadworks (DEWHA 2008e).

4.3 *Picris evae* - Hawkweed

Picris evae is listed as Vulnerable under the Federal EPBC Act and the Queensland NC Act. It is an erect annual herb growing 1.3–1.7 m high. Leaves are 2.5–15 cm long, 4–30 mm wide, margins entire to toothed, stalkless, sparsely covered with split-ended hairs, and mostly grow around the base of the plant. Flower heads are yellow, 8–10 mm wide, with hairs along the midrib of the bracts. The fruits are 5–8 mm long and the beak is long and mostly curved (DEWHA 2008d). The center of the species distribution appears to be located in the area around Toowoomba, in Queensland (Figure 4.3).

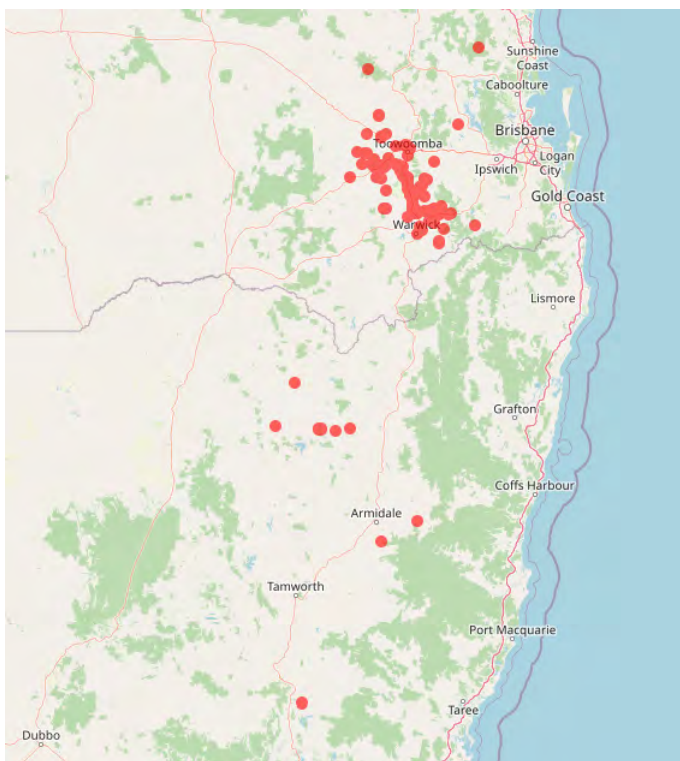


Figure 4.3 Public records indicating the distribution of *Picris evae* (ALA 2024)

4.3.1 Important populations

DCCEEW does not define locations of important populations for the species. The total population size and extent of occurrence of this species are unknown.

4.3.2 Reproduction

Flowering occurs in February, October, November and December. Seedlings have been recorded in November (DEWHA 2008e). EMM recorded flowering individuals and seedlings in February 2024.

4.3.3 Ecology and habitat

Picris evae occurs in Eucalyptus open woodland with a grassy understorey composed of *Dichanthium* spp. Upper stratum species include *Eucalyptus melliodora*, *E. crebra*, *E. populnea*, *E. albens*, *Angophora subvelutina*, *Allocasuarina torulosa*, and *Casuarina cunninghamiana*. Collections have been made along roadsides and in cultivated areas, such as paddocks, on black, dark grey or red-brown soils, reddish clay-loam or medium clay soils (DEWHA 2008d, and references therein).

4.3.4 Threatening processes

The main identified threats to *Picris evae* include weed invasion, inappropriate fire regimes, habitat fragmentation and clearing of vegetation for cropping and grazing (DEWHA 2008d).

5 Impact management plan

This section of the report has been prepared in accordance with Section 6.2 of the Assessment Guidelines (DES 2021), requiring the provision of an Impact Management Plan with a clearing permit application. The Impact Management Plan has been developed to demonstrate how avoidance and mitigation measures have been applied and assess potential for residual impacts to occur. The following information is included:

- the nature of the impacts
- avoidance and minimisation of impacts
- the proposed management of potential impacts
- justification for proposed management of impacts.

5.1 Nature of the proposed impact

Potential impacts associated with the Project include:

- disturbance of surface vegetation and excavation of the soil during trenching operations
- slashing of native vegetation, including grasses
- temporary stockpiling of soil adjacent to the trench
- vehicles and machinery driving along a 5 m wide corridor, and personnel moving on foot in the same area
- the introduction and/or spread of weeds.

Ground disturbance works will occur over an estimated 11-week period. The main disturbance relevant to the CEEVNT species will be the temporary removal of grasses and topsoil, and the excavation of the trench required to install the new cable. Stockpiling of the excavated grass and soil will be immediately adjacent to where it was removed from the ground, avoiding known locations of threatened species. As far as practicable, the trenching contractors will attempt to preserve the soil profile, and avoid mixing topsoil and subsoil, which will be stored on opposite sides of the trench while cables are being laid. A small amount of bedding material (sand) will be deposited in the bottom of the trench and infilled around the cables. This will then be buried with excavated subsoil, and the preserved topsoil and grasses will then be backfilled over the cable in such a way as to replicate the original conditions as closely as possible. Any extra subsoil material will be distributed evenly nearby, avoiding burial of existing ground vegetation. The trench will be progressively backfilled to ensure it isn't left open overnight.

The known populations of *Leuzea australis* and *Picris evae* will be avoided using horizontal directional drilling (HDD) to tunnel beneath the locations in which they occur. Contractors will be provided with GPS locations of CEEVNT species and also suitable entry and exit points for HDD works on site.

Given the temporary nature of the disturbance, it is not expected the CEEVNT species will have any long-term decline in population once the avoidance, minimisation and management of the impacts are undertaken.

Total maximum impacts are outlined in Table 5.1.

Table 5.1 **Maximum clearing impacts (excluding Interlink property section)**

Impact type	Clearing impact
Total disturbance footprint area (including all areas subject to horizontal directional drilling)	~1.72 ha
Total ground disturbance from trench excavation	~0.17 ha
Total area of disturbance footprint in known threatened species habitat (note disturbance to <i>Leuzea australis</i> and <i>Picris evae</i> habitat will be avoided using horizontal directional drilling)	<i>Digitaria porrecta</i> – 0.50 ha Total – 0.50 ha
Total disturbance from trench excavation in known threatened species habitat	<i>Digitaria porrecta</i> – 0.05 ha Total – 0.05 ha
Number of <i>Digitaria porrecta</i> in disturbance footprint	21
Number of <i>Leuzea australis</i> in disturbance footprint	9
Number of <i>Picris evae</i> in disturbance footprint	~50

5.2 Avoidance, minimisation and management of impacts

- The disturbance footprint will be clearly demarcated using high visibility tape, survey pegs or other appropriate methods.
- Exclusion zones will be clearly delineated prior to works starting to identify ecologically sensitive areas, and locations for horizontal directional drilling. Vegetation clearing (slashing) will be limited as much as possible, especially in ecologically sensitive areas.
- Excavated subsoil, topsoil and grasses will be retained whilst trenching, and topsoil and grasses kept separately from subsoil. Preserved subsoil, topsoil and grasses will be backfilled over the cable in such a way as to replicate the original on-site conditions as closely as possible. This will maximise the viability of the existing seedbank and allow for natural regeneration of the native vegetation. Direct seeding of suitable native grasses that occur in adjacent areas will be conducted; EMM will provide ARTC with a list of suitable species prior to construction.
- The disturbance footprint will be narrowed where possible to avoid *Digitaria porrecta* individuals. As the plants are widely dispersed both within the 5 m wide corridor and adjacent areas it will not be possible for all individuals to be avoided. Therefore, a permit is being sought for the maximum extent of 21 individuals.
- The population of *Leuzea australis* at the eastern end of the alignment will be avoided by HDD; the cable at their location will tunnel beneath the entire population. These plants will be clearly identified and fenced off to ensure both direct and indirect impacts do not occur.
- Similarly, the population of *Picris evae* at the western end of the alignment will be avoided by HDD; the cable at their location will tunnel beneath the entire population. These plants will be clearly identified and fenced off to ensure both direct and indirect impacts do not occur.
- EMM will provide Telstra contractors with a 'field guide' to the CEEVNT species (including photographs and a written description for each) they may encounter during construction operations. Telstra contractors will add this information to their construction methodology and discuss these matters during pre-start meetings (G Foelz, pers comm).

- Hygiene protocols (weed washdowns of vehicles and machinery) will be implemented to reduce the potential for introduction or spread of weeds. The number of vehicles entering the clearing impact area will be minimised as much as possible.
- Sediment and erosion control measures will be put in place to ensure no sediment runoff goes into adjacent waterways.
- Construction equipment is to be well maintained to minimise risk of chemical spill or leakage.
- Refuelling will not take place within 50 m of a watercourse or an ecologically sensitive area.
- Trenches will not be left open overnight and sections that are open during the day will be backfilled immediately after works are completed. Entry and exit holes for the bores will have fencing surrounding them whilst they are open. Any open excavations will be checked for wildlife first thing in the morning.
- Monitoring will occur one month and three months post backfilling and rehabilitation of the trench to check that the grasslands are re-establishing, and no erosion is occurring. If regeneration has not commenced, then more direct management will be required, such as further reseeding and watering.

5.2.1 Weed management

Disturbance of vegetation (including existing weeds) is required, therefore appropriate control measures will be put in place to avoid the spread of weeds occurring. Weeds will be managed under protocols set out under the *Queensland Biosecurity Act 2014*.

5.3 Justification of the impact

As stated in Section 1.3.1, the imperative need to relocate the existing Telstra and Nextgen cables arises from their susceptibility to the proposed Inland Rail and InterlinkSQ development works in the area. Given the critical nature of these networks, additional challenges such as cable length were encountered during the design and route selection. The efficiency of these cables is significantly impacted by any increase in length, prompting both Telstra and Nextgen to resist proposed routes that would add substantial length to their cables.

The proposed route for the Project underwent three revisions before finalisation. Alternative options were deemed to be unfeasible for various reasons, including:

- conflicts with the planned Inland Rail works and adjoining Interlink development future stages causing the majority of the route to be within private property if simply shifted to the south,
- substantial increases in cable length when following only road corridors to the north of the existing alignment, and
- clashes with the previously relocated native grasses from the Interlink site during water/sewer relocations.

The chosen route represents the most optimal solution, ensuring minimal disruption to critical telecommunication infrastructure while aligning with environmental and logistical considerations. As much as possible, the disturbance footprint avoids sensitive environmental areas, avoids the clearing of trees and follows existing road reserves.

As potential impacts to CEEVNT species are minor in scope and temporary in nature. If the proposed mitigation measures are followed, it is considered that the planned works will not have a significant impact on any CEEVNT flora species, and no net loss will occur.

6 Conclusion

Timed meanders were undertaken in December 2023 and February 2024 to cover all habitat types within the clearing impact area and survey for the presence of the target threatened flora species. 246 individual *Digitaria porrecta*, 15 *Leuzea australis* and a large population of *Picris evae* were observed in the clearing impact area. Therefore, this report has been prepared in support of a clearing application and measures to avoid and/or mitigate impacts on these threatened flora species have been presented above.

Based on a worst-case 5 m wide disturbance footprint that will include the trenching and associated activities, it is estimated up to 21 *D. porrecta* may be impacted. Avoidance measures for this species will include narrowing the corridor where possible to avoid the protected plants; a section of natural grassland in the eastern portion of the clearing impact area will also be avoided using horizontal directional drilling. Populations of *Leuzea australis* and *Picris evae* will be avoided using horizontal directional drilling; the cable in these locations will tunnel beneath the entire population. These plants will be clearly identified and fenced off to avoid both direct and indirect impacts to the populations.

Excavated subsoil, topsoil and grasses will be retained whilst trenching, and topsoil and grasses kept separately from subsoil. Preserved subsoil, topsoil and grasses will be backfilled over the cable in such a way as to replicate the original on-site conditions as closely as possible. This will maximise the viability of the existing seedbank and allow for natural regeneration of the native vegetation. Direct seeding of suitable native grasses that occur in adjacent areas will also be conducted to facilitate recovery post disturbance.

Monitoring will occur one month and then three months post the rehabilitation of the trench to confirm species are regenerating and the soil surface is stable with no erosion occurring.

Overall, no net loss of threatened flora species will occur as a result of the Project.

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Appendix A

Desktop searches



Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 21-Feb-2024

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[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

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Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	46
Listed Migratory Species:	14

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	12
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands)		[Resource Information]
Ramsar Site Name	Proximity	
Banrock station wetland complex	1300 - 1400km upstream from Ramsar site	
Narran lake nature reserve	400 - 500km upstream from Ramsar site	
Riverland	1200 - 1300km upstream from Ramsar site	
The coorong, and lakes alexandrina and albert wetland	1400 - 1500km upstream from Ramsar site	

Listed Threatened Ecological Communities	[Resource Information]
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For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat likely to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area
Erythrorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area
Turnix melanogaster Black-breasted Button-quail [923]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANT		
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
Bothriochloa bunyensis Satin-top Grass [15961]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat may occur within area
Clematis fawcettii Stream Clematis [4311]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat likely to occur within area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat likely to occur within area
Rhaponticum australe Austral Cornflower, Native Thistle [22647]	Vulnerable	Species or species habitat known to occur within area
Sarcochilus weinthalii Blotched Sarcochilus, Weinthals Sarcanth [12673]	Vulnerable	Species or species habitat may occur within area
Sophora fraseri [8836]	Vulnerable	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat likely to occur within area
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat likely to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area
Tympnocryptis condaminensis Condamine Earless Dragon [87888]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Migratory Terrestrial Species

Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat may occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

EPBC Act Referrals		[Resource Information]	
Title of referral	Reference	Referral Outcome	Assessment Status

Title of referral	Reference	Referral Outcome	Assessment Status
Toowoomba to Warwick Raw Water Pipeline	2023/09644		Assessment
Controlled action			
ARG Border Rail Project Moree to Toowoomba QLD	2013/7061	Controlled Action	Further Information Request
Gowrie-Grandchester Rail Corridor Upgrade Investigation	2001/349	Controlled Action	Completed
Gowrie to Grandchester Rail Corridor - Section A Gowrie to Helidon	2002/823	Controlled Action	Completed
Inland Rail Border to Gowrie Project, QLD	2018/8165	Controlled Action	Assessment Approach
Inland Rail Gowrie to Helidon Project, Qld	2017/7882	Controlled Action	Assessment Approach
Toowoomba Bypass Highway Corridor	2003/1143	Controlled Action	Post-Approval
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Inland Rail Border to Gowrie Geotechnical Investigations	2021/8911	Not Controlled Action	Completed
Inland Rail Gowrie to Kagaru Geotechnical Project, QLD	2018/8263	Not Controlled Action	Completed
Wetalla Recycled Water Pipeline - Acland Coal Mine	2008/4045	Not Controlled Action	Completed
Not controlled action (particular manner)			
Construction & Operation 275/330kV Transmission Line	2006/2820	Not Controlled Action (Particular Manner)	Post-Approval
Bioregional Assessments			
SubRegion	BioRegion	Website	
Maranoa-Balonne-Condamine	Northern Inland Catchments	BA website	

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact us](#) page.

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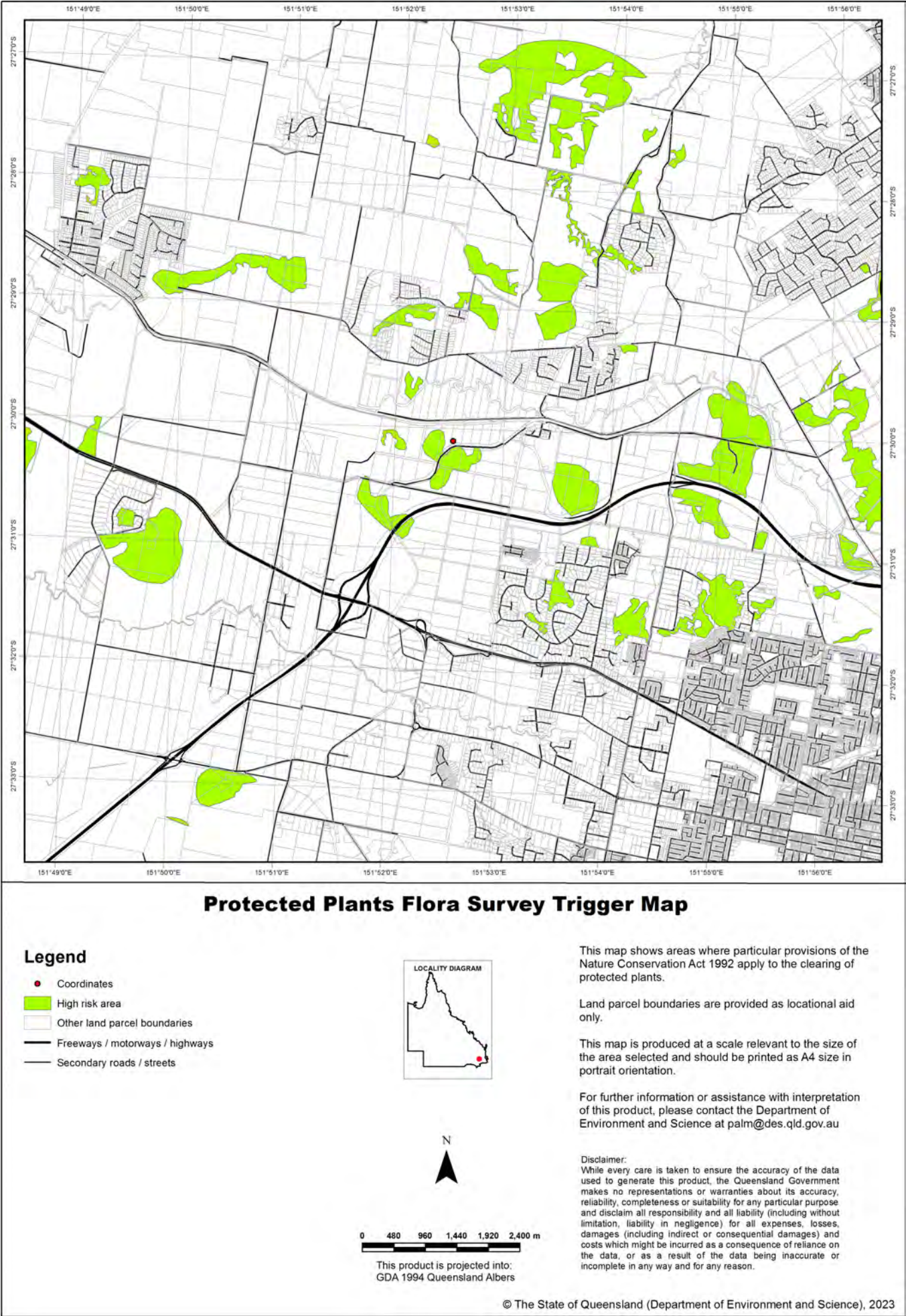
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A.2 Protected Plant trigger map



Protected plants flora survey trigger map

The protected plants flora survey trigger map identifies 'high risk areas' where threatened and near threatened plants are known to exist or are likely to exist. Under the *Nature Conservation Act 1992* (the Act) it is an offence to clear protected plants that are 'in the wild' unless you are authorised or the clearing is exempt, for more information see [section 89](#) of the Act.

Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the [Queensland Spatial Catalogue](#), the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the [clearing of protected plants](#) for more information.



Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point

Species: All

Type: All

Queensland status: All

Records: All

Date: All

Latitude: -27.5017

Longitude: 151.8756

Distance: 10

Email: kvercoe@emmconsulting.com.au

Date submitted: Friday 15 Dec 2023 07:50:56

Date extracted: Friday 15 Dec 2023 08:00:03

The number of records retrieved = 1629

Disclaimer

Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The State of Queensland disclaims all responsibility for information contained in this product and all liability (including liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Information about your Species lists request is logged for quality assurance, user support and product enhancement purposes only.

The information provided should be appropriately acknowledged as being derived from WildNet database when it is used. As the WildNet Program is still in a process of collating and vetting data, it is possible the information given is not complete. Go to the WildNet database webpage (<https://www.qld.gov.au/environment/plants-animals/species-information/wildnet>) to find out more about WildNet and where to access other WildNet information products approved for publication. Feedback about WildNet species lists should be emailed to wildlife.online@des.qld.gov.au.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	<i>Rhinella marina</i>	cane toad	Y			31
animals	amphibians	Hylidae	<i>Cyclorana alboguttata</i>	greenstripe frog		C		2
animals	amphibians	Hylidae	<i>Litoria balatus</i>	slender bleating treefrog		C		11
animals	amphibians	Hylidae	<i>Litoria caerulea</i>	common green treefrog		C		34
animals	amphibians	Hylidae	<i>Litoria chloris</i>	orange eyed treefrog		C		1
animals	amphibians	Hylidae	<i>Litoria fallax</i>	eastern sedgefrog		C		45
animals	amphibians	Hylidae	<i>Litoria gracilentia</i>	graceful treefrog		C		5
animals	amphibians	Hylidae	<i>Litoria latopalmata</i>	broad palmed rocketfrog		C		1
animals	amphibians	Hylidae	<i>Litoria peronii</i>	emerald spotted treefrog		C		13
animals	amphibians	Hylidae	<i>Litoria rubella</i>	ruddy treefrog		C		7
animals	amphibians	Hylidae	<i>Litoria wilcoxii</i>	eastern stony creek frog		C		2
animals	amphibians	Limnodynastidae	<i>Limnodynastes dumerilii</i>	grey bellied pobblebonk		C		4
animals	amphibians	Limnodynastidae	<i>Limnodynastes fletcheri</i>	barking frog		C		2
animals	amphibians	Limnodynastidae	<i>Limnodynastes peronii</i>	striped marshfrog		C		80
animals	amphibians	Limnodynastidae	<i>Limnodynastes salmini</i>	salmon striped frog		C		3
animals	amphibians	Limnodynastidae	<i>Limnodynastes tasmaniensis</i>	spotted grassfrog		C		12
animals	amphibians	Limnodynastidae	<i>Limnodynastes terraereginae</i>	scarlet sided pobblebonk		C		22/1
animals	amphibians	Limnodynastidae	<i>Platyplectrum ornatum</i>	ornate burrowing frog		C		4
animals	amphibians	Myobatrachidae	<i>Crinia signifera</i>	clicking froglet		C		11
animals	amphibians	Myobatrachidae	<i>Mixophyes fasciolatus</i>	great barred frog		C		1
animals	amphibians	Myobatrachidae	<i>Pseudophryne raveni</i>	copper backed broodfrog		C		1
animals	amphibians	Myobatrachidae	<i>Uperoleia fusca</i>	dusky gungan		C		3
animals	birds	Acanthizidae	<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill		C		673
animals	birds	Acanthizidae	<i>Acanthiza lineata</i>	striated thornbill		C		9
animals	birds	Acanthizidae	<i>Acanthiza nana</i>	yellow thornbill		C		308
animals	birds	Acanthizidae	<i>Acanthiza pusilla</i>	brown thornbill		C		395
animals	birds	Acanthizidae	<i>Acanthiza reguloides</i>	buff-rumped thornbill		C		15
animals	birds	Acanthizidae	<i>Acanthiza sp.</i>			C		2
animals	birds	Acanthizidae	<i>Gerygone fusca</i>	western gerygone		C		1
animals	birds	Acanthizidae	<i>Gerygone mouki</i>	brown gerygone		C		20
animals	birds	Acanthizidae	<i>Gerygone olivacea</i>	white-throated gerygone		C		406
animals	birds	Acanthizidae	<i>Pyrrholaemus sagittatus</i>	speckled warbler		C		20
animals	birds	Acanthizidae	<i>Sericornis frontalis</i>	white-browed scrubwren		C		330
animals	birds	Acanthizidae	<i>Sericornis magnirostra</i>	large-billed scrubwren		C		7
animals	birds	Acanthizidae	<i>Smicronis brevirostris</i>	weebill		C		155
animals	birds	Accipitridae	<i>Accipiter cirrocephalus</i>	collared sparrowhawk		C		15
animals	birds	Accipitridae	<i>Accipiter fasciatus</i>	brown goshawk		C		52
animals	birds	Accipitridae	<i>Accipiter novaehollandiae</i>	grey goshawk		C		24
animals	birds	Accipitridae	<i>Aquila audax</i>	wedge-tailed eagle		C		124
animals	birds	Accipitridae	<i>Aviceda subcristata</i>	Pacific baza		C		20
animals	birds	Accipitridae	<i>Circus assimilis</i>	spotted harrier		C		30
animals	birds	Accipitridae	<i>Elanus axillaris</i>	black-shouldered kite		C		297
animals	birds	Accipitridae	<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		C		22
animals	birds	Accipitridae	<i>Haliastur sphenurus</i>	whistling kite		C		40
animals	birds	Accipitridae	<i>Hieraaetus morphnoides</i>	little eagle		C		11
animals	birds	Accipitridae	<i>Lophoictinia isura</i>	square-tailed kite		C		24

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Accipitridae	<i>Milvus migrans</i>	black kite		C		38
animals	birds	Acrocephalidae	<i>Acrocephalus australis</i>	Australian reed-warbler		C		83
animals	birds	Aegothelidae	<i>Aegotheles cristatus</i>	Australian owl-nightjar		C		7/1
animals	birds	Alaudidae	<i>Mirafra javanica</i>	Horsfield's bushlark		C		68
animals	birds	Alcedinidae	<i>Ceyx azureus</i>	azure kingfisher		C		7
animals	birds	Alcedinidae	<i>Dacelo leachii</i>	blue-winged kookaburra		C		1
animals	birds	Alcedinidae	<i>Dacelo novaeguineae</i>	laughing kookaburra		C		879
animals	birds	Alcedinidae	<i>Todiramphus macleayii</i>	forest kingfisher		C		6
animals	birds	Alcedinidae	<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher		C		6
animals	birds	Alcedinidae	<i>Todiramphus sanctus</i>	sacred kingfisher		C		131
animals	birds	Anatidae	<i>Anas castanea</i>	chestnut teal		C		2
animals	birds	Anatidae	<i>Anas gracilis</i>	grey teal		C		125
animals	birds	Anatidae	<i>Anas platyrhynchos</i>	northern mallard	Y			13
animals	birds	Anatidae	<i>Anas sp.</i>			C		1
animals	birds	Anatidae	<i>Anas superciliosa</i>	Pacific black duck		C		566
animals	birds	Anatidae	<i>Aythya australis</i>	hardhead		C		61
animals	birds	Anatidae	<i>Biziura lobata</i>	musk duck		C		4
animals	birds	Anatidae	<i>Chenonetta jubata</i>	Australian wood duck		C		460
animals	birds	Anatidae	<i>Cygnus atratus</i>	black swan		C		56
animals	birds	Anatidae	<i>Dendrocygna eytoni</i>	plumed whistling-duck		C		34
animals	birds	Anatidae	<i>Malacorhynchus membranaceus</i>	pink-eared duck		C		2
animals	birds	Anatidae	<i>Spatula rhynchotis</i>	Australasian shoveler		C		1
animals	birds	Anatidae	<i>Stictonetta naevosa</i>	freckled duck		C		4
animals	birds	Anhingidae	<i>Anhinga novaehollandiae</i>	Australasian darter		C		55
animals	birds	Anseranatidae	<i>Anseranas semipalmata</i>	magpie goose		C		3
animals	birds	Apodidae	<i>Apus pacificus</i>	fork-tailed swift		SL		4
animals	birds	Apodidae	<i>Hirundapus caudacutus</i>	white-throated needletail		V	V	16
animals	birds	Ardeidae	<i>Ardea alba modesta</i>	eastern great egret		C		57
animals	birds	Ardeidae	<i>Ardea intermedia</i>	intermediate egret		C		19
animals	birds	Ardeidae	<i>Ardea pacifica</i>	white-necked heron		C		38
animals	birds	Ardeidae	<i>Bubulcus ibis</i>	cattle egret		C		140
animals	birds	Ardeidae	<i>Egretta garzetta</i>	little egret		C		13
animals	birds	Ardeidae	<i>Egretta novaehollandiae</i>	white-faced heron		C		280
animals	birds	Ardeidae	<i>Egretta sacra</i>	eastern reef egret		C		1
animals	birds	Ardeidae	<i>Ixobrychus dubius</i>	Australian little bittern		C		2
animals	birds	Ardeidae	<i>Nycticorax caledonicus</i>	nankeen night-heron		C		35
animals	birds	Artamidae	<i>Artamus cinereus</i>	black-faced woodswallow		C		1
animals	birds	Artamidae	<i>Artamus cyanopterus</i>	dusky woodswallow		C		4
animals	birds	Artamidae	<i>Artamus leucorhynchus</i>	white-breasted woodswallow		C		2
animals	birds	Artamidae	<i>Artamus personatus</i>	masked woodswallow		C		2
animals	birds	Artamidae	<i>Artamus superciliosus</i>	white-browed woodswallow		C		9
animals	birds	Artamidae	<i>Cracticus nigrogularis</i>	pied butcherbird		C		864
animals	birds	Artamidae	<i>Cracticus torquatus</i>	grey butcherbird		C		754
animals	birds	Artamidae	<i>Gymnorhina tibicen</i>	Australian magpie		C		1419
animals	birds	Artamidae	<i>Strepera graculina</i>	pied currawong		C		1082
animals	birds	Artamidae	<i>Strepera graculina graculina</i>	pied currawong (eastern Australia)		C		39

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Burhinidae	<i>Burhinus grallarius</i>	bush stone-curlew		C		7
animals	birds	Cacatuidae	<i>Cacatua galerita</i>	sulphur-crested cockatoo		C		372
animals	birds	Cacatuidae	<i>Cacatua leadbeateri leadbeateri</i>	Major Mitchell's cockatoo		E	E	2
animals	birds	Cacatuidae	<i>Cacatua sanguinea</i>	little corella		C		81
animals	birds	Cacatuidae	<i>Cacatua tenuirostris</i>	long-billed corella	Y	C		8
animals	birds	Cacatuidae	<i>Calyptorhynchus banksii</i>	red-tailed black-cockatoo		C		153
animals	birds	Cacatuidae	<i>Calyptorhynchus banksii banksii</i>	red-tailed black-cockatoo (Cape York & Eastern Aust)		C		1
animals	birds	Cacatuidae	<i>Calyptorhynchus lathamii</i>	glossy black-cockatoo		V		2
animals	birds	Cacatuidae	<i>Calyptorhynchus lathamii lathamii</i>	glossy black-cockatoo (eastern)		V	V	5
animals	birds	Cacatuidae	<i>Eolophus roseicapilla</i>	galah		C		1169
animals	birds	Cacatuidae	<i>Nymphicus hollandicus</i>	cockatiel		C		192
animals	birds	Cacatuidae	<i>Zanda funerea</i>	yellow-tailed black-cockatoo		C		61
animals	birds	Campephagidae	<i>Coracina lineata</i>	barred cuckoo-shrike		C		4
animals	birds	Campephagidae	<i>Coracina maxima</i>	ground cuckoo-shrike		C		5
animals	birds	Campephagidae	<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		C		924
animals	birds	Campephagidae	<i>Coracina papuensis</i>	white-bellied cuckoo-shrike		C		11
animals	birds	Campephagidae	<i>Edolisoma tenuirostre</i>	common cicadabird		C		59
animals	birds	Campephagidae	<i>Lalage leucomela</i>	varied triller		C		14
animals	birds	Campephagidae	<i>Lalage tricolor</i>	white-winged triller		C		44
animals	birds	Charadriidae	<i>Charadrius ruficapillus</i>	red-capped plover		C		1
animals	birds	Charadriidae	<i>Elseyornis melanops</i>	black-fronted dotterel		C		70
animals	birds	Charadriidae	<i>Erythronyx cinctus</i>	red-kneed dotterel		C		16
animals	birds	Charadriidae	<i>Vanellus miles</i>	masked lapwing		C		342
animals	birds	Charadriidae	<i>Vanellus miles novaehollandiae</i>	masked lapwing (southern subspecies)		C		450
animals	birds	Charadriidae	<i>Vanellus tricolor</i>	banded lapwing		C		9
animals	birds	Cisticolidae	<i>Cisticola exilis</i>	golden-headed cisticola		C		410
animals	birds	Climacteridae	<i>Climacteris picumnus</i>	brown treecreeper		C		2
animals	birds	Climacteridae	<i>Cormobates leucophaea</i>	white-throated treecreeper		C		7
animals	birds	Climacteridae	<i>Cormobates leucophaea metastasis</i>	white-throated treecreeper (southern)		C		33
animals	birds	Columbidae	<i>Chalcophaps longirostris</i>	Pacific emerald dove		C		6
animals	birds	Columbidae	<i>Columba leucomela</i>	white-headed pigeon		C		56
animals	birds	Columbidae	<i>Columba livia</i>	rock dove	Y			397
animals	birds	Columbidae	<i>Geopelia cuneata</i>	diamond dove		C		2
animals	birds	Columbidae	<i>Geopelia humeralis</i>	bar-shouldered dove		C		446
animals	birds	Columbidae	<i>Geopelia placida</i>	peaceful dove		C		73
animals	birds	Columbidae	<i>Leucosarcia melanoleuca</i>	wonga pigeon		C		14
animals	birds	Columbidae	<i>Lopholaimus antarcticus</i>	topknot pigeon		C		10
animals	birds	Columbidae	<i>Macropygia phasianella</i>	brown cuckoo-dove		C		46
animals	birds	Columbidae	<i>Ocyphaps lophotes</i>	crested pigeon		C		1152
animals	birds	Columbidae	<i>Phaps chalcoptera</i>	common bronzewing		C		27
animals	birds	Columbidae	<i>Ptilinopus magnificus</i>	wompoo fruit-dove		C		1
animals	birds	Columbidae	<i>Ptilinopus regina</i>	rose-crowned fruit-dove		C		4/1
animals	birds	Columbidae	<i>Ptilinopus superbus</i>	superb fruit-dove		C		3/1
animals	birds	Columbidae	<i>Spilopelia chinensis</i>	spotted dove	Y			798
animals	birds	Coraciidae	<i>Eurystomus orientalis</i>	dollarbird		C		254

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Corcoracidae	<i>Corcorax melanorhamphos</i>	white-winged chough		C		7
animals	birds	Corcoracidae	<i>Struthidea cinerea</i>	apostlebird		C		28
animals	birds	Corvidae	<i>Corvus bennetti</i>	little crow		C		6
animals	birds	Corvidae	<i>Corvus coronoides</i>	Australian raven		C		4
animals	birds	Corvidae	<i>Corvus orru</i>	Torresian crow		C		1202
animals	birds	Corvidae	<i>Corvus sp.</i>			C		1
animals	birds	Cuculidae	<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		C		54
animals	birds	Cuculidae	<i>Cacomantis pallidus</i>	pallid cuckoo		C		10
animals	birds	Cuculidae	<i>Cacomantis variolosus</i>	brush cuckoo		C		11
animals	birds	Cuculidae	<i>Centropus phasianinus</i>	pheasant coucal		C		339
animals	birds	Cuculidae	<i>Chalcites basalis</i>	Horsfield's bronze-cuckoo		C		46
animals	birds	Cuculidae	<i>Chalcites lucidus</i>	shining bronze-cuckoo		C		24/1
animals	birds	Cuculidae	<i>Chalcites minutillus barnardi</i>	Eastern little bronze-cuckoo		C		1
animals	birds	Cuculidae	<i>Chalcites osculans</i>	black-eared cuckoo		C		1
animals	birds	Cuculidae	<i>Cuculus optatus</i>	oriental cuckoo		SL		1
animals	birds	Cuculidae	<i>Eudynamys orientalis</i>	eastern koel		C		410
animals	birds	Cuculidae	<i>Scythrops novaehollandiae</i>	channel-billed cuckoo		C		255
animals	birds	Dicaeidae	<i>Dicaeum hirundinaceum</i>	mistletoebird		C		399
animals	birds	Dicruridae	<i>Dicrurus bracteatus</i>	spangled drongo		C		90
animals	birds	Dicruridae	<i>Dicrurus bracteatus bracteatus</i>	spangled drongo (eastern Australia)		C		2
animals	birds	Estrildidae	<i>Lonchura castaneothorax</i>	chestnut-breasted mannikin		C		124
animals	birds	Estrildidae	<i>Neochmia modesta</i>	plum-headed finch		C		14
animals	birds	Estrildidae	<i>Neochmia temporalis</i>	red-browed finch		C		107
animals	birds	Estrildidae	<i>Taeniopygia bichenovii</i>	double-barred finch		C		457
animals	birds	Estrildidae	<i>Taeniopygia guttata</i>	zebra finch		C		195
animals	birds	Eurostopodidae	<i>Eurostopodus mystacalis</i>	white-throated nightjar		C		5
animals	birds	Falconidae	<i>Falco berigora</i>	brown falcon		C		64
animals	birds	Falconidae	<i>Falco cenchroides</i>	nankeen kestrel		C		483
animals	birds	Falconidae	<i>Falco hypoleucos</i>	grey falcon		V	V	2
animals	birds	Falconidae	<i>Falco longipennis</i>	Australian hobby		C		57
animals	birds	Falconidae	<i>Falco peregrinus macropus</i>	Australian peregrine falcon		C		31
animals	birds	Falconidae	<i>Falco subniger</i>	black falcon		C		10
animals	birds	Falcunculidae	<i>Falcunculus frontatus</i>	crested shrike-tit		C		3
animals	birds	Hirundinidae	<i>Cheramoeca leucosterna</i>	white-backed swallow		C		10
animals	birds	Hirundinidae	<i>Hirundo neoxena</i>	welcome swallow		C		287
animals	birds	Hirundinidae	<i>Petrochelidon ariel</i>	fairy martin		C		75
animals	birds	Hirundinidae	<i>Petrochelidon nigricans</i>	tree martin		C		17
animals	birds	Laridae	<i>Chlidonias hybrida</i>	whiskered tern		C		3
animals	birds	Laridae	<i>Chroicocephalus novaehollandiae</i>	silver gull		C		6
animals	birds	Laridae	<i>Onychoprion fuscatus</i>	sooty tern		C		1
animals	birds	Laridae	<i>Thalasseus bergii</i>	crested tern		SL		1
animals	birds	Locustellidae	<i>Cincloramphus cruralis</i>	brown songlark		C		8
animals	birds	Locustellidae	<i>Cincloramphus mathewsi</i>	rufous songlark		C		7
animals	birds	Locustellidae	<i>Cincloramphus timoriensis</i>	tawny grassbird		C		10
animals	birds	Locustellidae	<i>Poodytes gramineus</i>	little grassbird		C		1
animals	birds	Maluridae	<i>Malurus cyaneus</i>	superb fairy-wren		C		752/1

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animals	birds	Maluridae	<i>Malurus lamberti</i>	variegated fairy-wren		C		10
animals	birds	Maluridae	<i>Malurus lamberti sensu lato</i>	variegated fairy-wren		C		125
animals	birds	Maluridae	<i>Malurus leucopterus</i>	white-winged fairy-wren		C		3
animals	birds	Maluridae	<i>Malurus melanocephalus</i>	red-backed fairy-wren		C		60
animals	birds	Maluridae	<i>Malurus sp.</i>			C		1
animals	birds	Megapodiidae	<i>Alectura lathamii</i>	Australian brush-turkey		C		52/1
animals	birds	Meliphagidae	<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater		C		366
animals	birds	Meliphagidae	<i>Acanthorhynchus tenuirostris</i>	eastern spinebill		C		127
animals	birds	Meliphagidae	<i>Anthochaera carunculata</i>	red wattlebird		C		163
animals	birds	Meliphagidae	<i>Anthochaera chrysoptera</i>	little wattlebird		C		3
animals	birds	Meliphagidae	<i>Caligavis chrysops</i>	yellow-faced honeyeater		C		174
animals	birds	Meliphagidae	<i>Entomyzon cyanotis</i>	blue-faced honeyeater		C		230
animals	birds	Meliphagidae	<i>Gavicalis virescens</i>	singing honeyeater		C		1
animals	birds	Meliphagidae	<i>Grantiella picta</i>	painted honeyeater		V	V	4
animals	birds	Meliphagidae	<i>Lichenostomus melanops</i>	yellow-tufted honeyeater		C		2
animals	birds	Meliphagidae	<i>Lichmera indistincta</i>	brown honeyeater		C		901
animals	birds	Meliphagidae	<i>Manorina flavigula</i>	yellow-throated miner		C		6
animals	birds	Meliphagidae	<i>Manorina melanocephala</i>	noisy miner		C		977
animals	birds	Meliphagidae	<i>Manorina melanophrys</i>	bell miner		C		6
animals	birds	Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's honeyeater		C		660
animals	birds	Meliphagidae	<i>Melithreptus albogularis</i>	white-throated honeyeater		C		7
animals	birds	Meliphagidae	<i>Melithreptus brevirostris</i>	brown-headed honeyeater		C		2
animals	birds	Meliphagidae	<i>Melithreptus lunatus</i>	white-naped honeyeater		C		33
animals	birds	Meliphagidae	<i>Myzomela sanguinolenta</i>	scarlet honeyeater		C		67
animals	birds	Meliphagidae	<i>Philemon citreogularis</i>	little friarbird		C		140
animals	birds	Meliphagidae	<i>Philemon corniculatus</i>	noisy friarbird		C		456
animals	birds	Meliphagidae	<i>Plectorhyncha lanceolata</i>	striped honeyeater		C		404
animals	birds	Meliphagidae	<i>Ptilotula fusca</i>	fuscous honeyeater		C		1
animals	birds	Meliphagidae	<i>Ptilotula penicillata</i>	white-plumed honeyeater		C		1
animals	birds	Meliphagidae	<i>Sugomel nigrum</i>	black honeyeater		C		2
animals	birds	Meropidae	<i>Merops ornatus</i>	rainbow bee-eater		C		55
animals	birds	Monarchidae	<i>Grallina cyanoleuca</i>	maggie-lark		C		1112
animals	birds	Monarchidae	<i>Monarcha melanopsis</i>	black-faced monarch		SL		29
animals	birds	Monarchidae	<i>Myiagra cyanoleuca</i>	satin flycatcher		SL		2
animals	birds	Monarchidae	<i>Myiagra inquieta</i>	restless flycatcher		C		95
animals	birds	Monarchidae	<i>Myiagra rubecula</i>	leaden flycatcher		C		102
animals	birds	Monarchidae	<i>Symphysia trivirgatus</i>	spectacled monarch		SL		7
animals	birds	Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian pipit		C		71
animals	birds	Neosittidae	<i>Daphoenositta chrysoptera</i>	varied sittella		C		8
animals	birds	Oriolidae	<i>Oriolus sagittatus</i>	olive-backed oriole		C		288
animals	birds	Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian figbird		C		544
animals	birds	Pachycephalidae	<i>Colluricincla harmonica</i>	grey shrike-thrush		C		160
animals	birds	Pachycephalidae	<i>Pachycephala pectoralis</i>	golden whistler		C		75
animals	birds	Pachycephalidae	<i>Pachycephala pectoralis youngi</i>	golden whistler (south-eastern Australia)		C		3
animals	birds	Pachycephalidae	<i>Pachycephala rufiventris</i>	rufous whistler		C		308

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animals	birds	Pandionidae	<i>Pandion haliaetus cristatus</i>	eastern osprey		SL		1
animals	birds	Pardalotidae	<i>Pardalotus punctatus</i>	spotted pardalote		C		103
animals	birds	Pardalotidae	<i>Pardalotus striatus</i>	striated pardalote		C		592
animals	birds	Passeridae	<i>Passer domesticus</i>	house sparrow	Y			506
animals	birds	Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian pelican		C		64
animals	birds	Petroicidae	<i>Eopsaltria australis</i>	eastern yellow robin		C		101
animals	birds	Petroicidae	<i>Melanodryas cucullata</i>	hooded robin		C		1
animals	birds	Petroicidae	<i>Microeca fascinans</i>	jacky winter		C		8
animals	birds	Petroicidae	<i>Petroica boodang</i>	scarlet robin		C		2
animals	birds	Petroicidae	<i>Petroica goodenovii</i>	red-capped robin		C		11
animals	birds	Petroicidae	<i>Petroica rosea</i>	rose robin		C		9
animals	birds	Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	little pied cormorant		C		244
animals	birds	Phalacrocoracidae	<i>Phalacrocorax carbo</i>	great cormorant		C		52
animals	birds	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	little black cormorant		C		130
animals	birds	Phalacrocoracidae	<i>Phalacrocorax varius</i>	pied cormorant		C		8
animals	birds	Phasianidae	<i>Coturnix pectoralis</i>	stubble quail		C		14
animals	birds	Phasianidae	<i>Pavo cristatus</i>	Indian peafowl	Y			1
animals	birds	Phasianidae	<i>Synoicus chinensis</i>	king quail		C		1
animals	birds	Phasianidae	<i>Synoicus ypsilophorus</i>	brown quail		C		395
animals	birds	Podargidae	<i>Podargus strigoides</i>	tawny frogmouth		C		416
animals	birds	Podicipedidae	<i>Podiceps cristatus</i>	great crested grebe		C		4
animals	birds	Podicipedidae	<i>Poliocephalus poliocephalus</i>	hoary-headed grebe		C		1
animals	birds	Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian grebe		C		82
animals	birds	Pomatostomidae	<i>Pomatostomus superciliosus</i>	white-browed babbler		C		1
animals	birds	Pomatostomidae	<i>Pomatostomus temporalis</i>	grey-crowned babbler		C		127
animals	birds	Pomatostomidae	<i>Pomatostomus temporalis temporalis</i>	grey-crowned babbler (eastern)		C		11
animals	birds	Psittaculidae	<i>Alisterus scapularis</i>	Australian king-parrot		C		275
animals	birds	Psittaculidae	<i>Aprosmictus erythropterus</i>	red-winged parrot		C		4
animals	birds	Psittaculidae	<i>Barnardius zonarius barnardi</i>	mallee ringneck		C		1
animals	birds	Psittaculidae	<i>Glossopsitta concinna</i>	musk lorikeet		C		83
animals	birds	Psittaculidae	<i>Lathamus discolor</i>	swift parrot		E	CE	5
animals	birds	Psittaculidae	<i>Melopsittacus undulatus</i>	budgerigar		C		12
animals	birds	Psittaculidae	<i>Neophema pulchella</i>	turquoise parrot		C		1
animals	birds	Psittaculidae	<i>Northiella haematogaster</i>	blue bonnet		C		7
animals	birds	Psittaculidae	<i>Northiella haematogaster haematorrhoa</i>	blue bonnet (red-vented)		C		5/1
animals	birds	Psittaculidae	<i>Parvipsitta pusilla</i>	little lorikeet		C		88
animals	birds	Psittaculidae	<i>Platycercus adscitus</i>	pale-headed rosella		C		1057
animals	birds	Psittaculidae	<i>Platycercus adscitus palliceps</i>	pale-headed rosella (southern form)		C		33
animals	birds	Psittaculidae	<i>Platycercus elegans</i>	crimson rosella		C		9
animals	birds	Psittaculidae	<i>Platycercus eximius</i>	eastern rosella		C		15
animals	birds	Psittaculidae	<i>Psephotus haematonotus</i>	red-rumped parrot		C		261
animals	birds	Psittaculidae	<i>Trichoglossus chlorolepidotus</i>	scaly-breasted lorikeet		C		882
animals	birds	Psittaculidae	<i>Trichoglossus moluccanus</i>	rainbow lorikeet		C		878
animals	birds	Psophodidae	<i>Psophodes olivaceus</i>	eastern whipbird		C		291
animals	birds	Ptilonorhynchidae	<i>Chlamydera maculata</i>	spotted bowerbird		C		1
animals	birds	Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	satin bowerbird		C		139

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animals	birds	Ptilonorhynchidae	<i>Sericulus chrysocephalus</i>	regent bowerbird		C		7
animals	birds	Rallidae	<i>Amaurornis moluccana</i>	pale-vented bush-hen		C		1
animals	birds	Rallidae	<i>Fulica atra</i>	Eurasian coot		C		91
animals	birds	Rallidae	<i>Gallinula tenebrosa</i>	dusky moorhen		C		109
animals	birds	Rallidae	<i>Gallirallus philippensis</i>	buff-banded rail		C		23
animals	birds	Rallidae	<i>Porphyrio melanotus</i>	purple swamphen		C		110
animals	birds	Rallidae	<i>Zapornia pusilla</i>	Baillon's crane		C		1
animals	birds	Rallidae	<i>Zapornia tabuensis</i>	spotless crane		C		1
animals	birds	Recurvirostridae	<i>Cladorhynchus leucocephalus</i>	banded stilt		C		1
animals	birds	Recurvirostridae	<i>Himantopus leucocephalus</i>	pied stilt		C		43
animals	birds	Recurvirostridae	<i>Recurvirostra novaehollandiae</i>	red-necked avocet		C		2
animals	birds	Rhipiduridae	<i>Rhipidura albiscapa</i>	grey fantail		C		348
animals	birds	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail		C		724
animals	birds	Rhipiduridae	<i>Rhipidura leucophrys leucophrys</i>	willie wagtail (southern)		C		19
animals	birds	Rhipiduridae	<i>Rhipidura rufifrons</i>	rufous fantail		SL		55
animals	birds	Scolopacidae	<i>Calidris acuminata</i>	sharp-tailed sandpiper		SL		14
animals	birds	Scolopacidae	<i>Calidris ferruginea</i>	curlew sandpiper		CR	CE	2
animals	birds	Scolopacidae	<i>Gallinago hardwickii</i>	Latham's snipe		SL		16
animals	birds	Scolopacidae	<i>Gallinago sp.</i>			C		1
animals	birds	Scolopacidae	<i>Numenius minutus</i>	little curlew		SL		2
animals	birds	Scolopacidae	<i>Tringa nebularia</i>	common greenshank		SL		1
animals	birds	Scolopacidae	<i>Tringa stagnatilis</i>	marsh sandpiper		SL		20
animals	birds	Strigidae	<i>Ninox boobook</i>	southern boobook		C		337
animals	birds	Strigidae	<i>Ninox connivens</i>	barking owl		C		1
animals	birds	Strigidae	<i>Ninox strenua</i>	powerful owl		V		33
animals	birds	Sturnidae	<i>Acridotheres tristis</i>	common myna	Y			952
animals	birds	Sturnidae	<i>Sturnus vulgaris</i>	common starling	Y			693
animals	birds	Threskiornithidae	<i>Platalea flavipes</i>	yellow-billed spoonbill		C		11
animals	birds	Threskiornithidae	<i>Platalea regia</i>	royal spoonbill		C		39
animals	birds	Threskiornithidae	<i>Plegadis falcinellus</i>	glossy ibis		SL		3
animals	birds	Threskiornithidae	<i>Threskiornis molucca</i>	Australian white ibis		C		328
animals	birds	Threskiornithidae	<i>Threskiornis spinicollis</i>	straw-necked ibis		C		477
animals	birds	Turdidae	<i>Turdus merula</i>	common blackbird	Y			24
animals	birds	Turdidae	<i>Zoothera heinei</i>	russet-tailed thrush		C		5
animals	birds	Turnicidae	<i>Turnix maculosus</i>	red-backed button-quail		C		4/2
animals	birds	Turnicidae	<i>Turnix melanogaster</i>	black-breasted button-quail		V	V	12/2
animals	birds	Turnicidae	<i>Turnix varius</i>	painted button-quail		C		8/1
animals	birds	Tytonidae	<i>Tyto javanica</i>	eastern barn owl		C		24
animals	birds	Tytonidae	<i>Tyto novaehollandiae</i>	masked owl		C		1
animals	birds	Tytonidae	<i>Tyto novaehollandiae novaehollandiae</i>	masked owl (southern subspecies)		C		1
animals	birds	Tytonidae	<i>Tyto tenebricosa tenebricosa</i>	sooty owl		C		9
animals	birds	Zosteropidae	<i>Zosterops lateralis</i>	silveryeye		C		699
animals	birds	Zosteropidae	<i>Zosterops lateralis cornwalli</i>	silveryeye (eastern)		C		4
animals	insects	Aeshnidae	<i>Adversaeschna brevistyla</i>	blue-spotted hawk				10
animals	insects	Aeshnidae	<i>Anax papuensis</i>	Australian Emperor				57
animals	insects	Aeshnidae	<i>Austrogynacantha heterogena</i>	Australian duskhawker				9

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animals	insects	Coenagrionidae	<i>Austroagrion watsoni</i>	eastern billabongfly				1
animals	insects	Coenagrionidae	<i>Ischnura aurora</i>	aurora bluetail				3
animals	insects	Coenagrionidae	<i>Ischnura heterosticta heterosticta</i>	common bluetail				29
animals	insects	Coenagrionidae	<i>Pseudagrion aureofrons</i>	gold-fronted riverdamsel				28
animals	insects	Coenagrionidae	<i>Pseudagrion microcephalum</i>	blue riverdamsel				2
animals	insects	Coenagrionidae	<i>Xanthagrion erythroneurum</i>	red & blue damsel				29
animals	insects	Corduliidae	<i>Hemicordulia australiae</i>	Australian emerald				45
animals	insects	Corduliidae	<i>Hemicordulia intermedia</i>	yellow-spotted emerald				2
animals	insects	Corduliidae	<i>Hemicordulia tau</i>	tau emerald				27
animals	insects	Diphlebiidae	<i>Diphlebia coerulescens</i>	sapphire rockmaster				5
animals	insects	Diphlebiidae	<i>Diphlebia nymphoides</i>	arrowhead rockmaster				2
animals	insects	Formicidae	<i>Iridomyrmex purpureus</i>					1
animals	insects	Formicidae	<i>Ochetellus glaber group</i>					1
animals	insects	Formicidae	<i>Pheidole megacephala</i>	African big-headed ant	Y			1
animals	insects	Formicidae	<i>Solenopsis invicta</i>	red imported fire ant	Y			1
animals	insects	Gomphidae	<i>Austrogomphus amphilitus</i>	pale hunter				1
animals	insects	Gomphidae	<i>Austrogomphus cornutus</i>	unicorn hunter				6
animals	insects	Gomphidae	<i>Austrogomphus ochraceus</i>	jade hunter				1
animals	insects	Gomphidae	<i>Hemigomphus heteroclytus</i>	stout vicetail				5
animals	insects	Hesperiidae	<i>Cephrenes augiades sperthias</i>	orange palm-dart				3
animals	insects	Hesperiidae	<i>Chaetocneme beata</i>	eastern dusk-flat				1
animals	insects	Hesperiidae	<i>Hasora khoda haslia</i>	narrow-banded awl				1
animals	insects	Hesperiidae	<i>Netrocoryne repanda</i>					1
animals	insects	Hesperiidae	<i>Ocybadistes walkeri sothis</i>	green grass-dart				5
animals	insects	Hesperiidae	<i>Suniana sunias reactivitta</i>	wide-brand grass-dart				1
animals	insects	Hesperiidae	<i>Telicota colon argea</i>	pale-orange darter				1
animals	insects	Hesperiidae	<i>Toxidia doubledayi</i>	lilac grass-skipper				1
animals	insects	Isostictidae	<i>Rhadinosticta simplex</i>	powdered wiretail				1
animals	insects	Lestidae	<i>Austrolestes aridus</i>	inland ringtail				1
animals	insects	Lestidae	<i>Austrolestes leda</i>	wandering ringtail				22
animals	insects	Libellulidae	<i>Crocothemis nigrifrons</i>	black-headed skimmer				2
animals	insects	Libellulidae	<i>Diplacodes bipunctata</i>	wandering percher				26
animals	insects	Libellulidae	<i>Diplacodes haematodes</i>	scarlet percher				45
animals	insects	Libellulidae	<i>Orthetrum caledonicum</i>	blue skimmer				63
animals	insects	Libellulidae	<i>Orthetrum villosovitatum</i>	fiery skimmer				24
animals	insects	Libellulidae	<i>Pantala flavescens</i>	wandering glider				16
animals	insects	Libellulidae	<i>Rhyothemis graphiptera</i>	graphic flutterer				3
animals	insects	Libellulidae	<i>Tramea loewii</i>	common glider				7
animals	insects	Libellulidae	<i>Zyxomma elgneri</i>	short-tailed duskdarter				4
animals	insects	Lindenidae	<i>Ictinogomphus australis</i>	Australian tiger				8
animals	insects	Lycaenidae	<i>Acrodipsas illidgei</i>	Illidge's ant-blue			V	1
animals	insects	Lycaenidae	<i>Candalides absimilis</i>	common pencilled-blue				2
animals	insects	Lycaenidae	<i>Candalides xanthospilos</i>	yellow-spotted blue				1
animals	insects	Lycaenidae	<i>Erysichton lineatus lineatus</i>	hairy line-blue				1
animals	insects	Lycaenidae	<i>Erysichton sp.</i>					1
animals	insects	Lycaenidae	<i>Jalmenus evagoras</i>	imperial hairstreak				8

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animals	insects	Lycaenidae	<i>Lampides boeticus</i>	long-tailed pea-blue				3
animals	insects	Lycaenidae	<i>Leptotes plinius pseudocassius</i>	plumbago blue				14
animals	insects	Lycaenidae	<i>Lucia limbaria</i>	chequered copper				3
animals	insects	Lycaenidae	<i>Neolucia agricola agricola</i>	fringed heath-blue				1
animals	insects	Lycaenidae	<i>Psychonotis caelius taygetus</i>	small green-banded blue				4
animals	insects	Lycaenidae	<i>Theclinesthes onycha</i>					1
animals	insects	Lycaenidae	<i>Theclinesthes onycha capricornia</i>	cycad blue (northern subspecies)				26
animals	insects	Lycaenidae	<i>Zizina otis labradus</i>	common grass-blue (Australian subspecies)				53
animals	insects	Megapodagrionidae	<i>Austroargiolestes icteromelas</i>	common flatwing				23
animals	insects	Megapodagrionidae	<i>Austroargiolestes icteromelas icteromelas</i>	pale-mouth common flatwing				6
animals	insects	Nymphalidae	<i>Acraea andromacha andromacha</i>	glasswing				43
animals	insects	Nymphalidae	<i>Charaxes sempronius sempronius</i>	tailed emperor				15
animals	insects	Nymphalidae	<i>Danaus petilia</i>	lesser wanderer				50
animals	insects	Nymphalidae	<i>Danaus plexippus</i>	monarch	Y			69
animals	insects	Nymphalidae	<i>Euploea corinna</i>	common crow				55
animals	insects	Nymphalidae	<i>Heteronympha merope merope</i>	common brown				7
animals	insects	Nymphalidae	<i>Hypolimnias bolina nerina</i>	varied eggfly				15
animals	insects	Nymphalidae	<i>Junonia villida villida</i>	meadow argus				99
animals	insects	Nymphalidae	<i>Melanitis leda bankia</i>	evening brown				4
animals	insects	Nymphalidae	<i>Phaedyma shepherdii shepherdii</i>	white-banded plane (southern subspecies)				11
animals	insects	Nymphalidae	<i>Tirumala hamata hamata</i>	blue tiger				38
animals	insects	Nymphalidae	<i>Vanessa itea</i>	yellow admiral				19
animals	insects	Nymphalidae	<i>Vanessa kershawi</i>	Australian painted lady				15
animals	insects	Nymphalidae	<i>Ypthima arctous arctous</i>	dusky knight				1
animals	insects	Papilionidae	<i>Cressida cressida cressida</i>	clearwing swallowtail				6
animals	insects	Papilionidae	<i>Graphium choredon</i>	blue triangle				57
animals	insects	Papilionidae	<i>Graphium eurypylus lycaon</i>	pale triangle				2
animals	insects	Papilionidae	<i>Graphium macleayanum macleayanum</i>	Macleay's swordtail				8
animals	insects	Papilionidae	<i>Papilio aegeus</i>					5
animals	insects	Papilionidae	<i>Papilio aegeus aegeus</i>	orchard swallowtail (Australian subspecies)				47
animals	insects	Papilionidae	<i>Papilio anactus</i>	dainty swallowtail				38
animals	insects	Papilionidae	<i>Papilio demoleus sthenelus</i>	chequered swallowtail				7
animals	insects	Papilionidae	<i>Papilio fuscus</i>					2
animals	insects	Papilionidae	<i>Papilio fuscus capaneus</i>	fuscous swallowtail (Australian subspecies)				3
animals	insects	Papilionidae	<i>Protographium leosthenes leosthenes</i>	four-barred swordtail				2
animals	insects	Pieridae	<i>Appias paulina ega</i>	yellow albatross				1
animals	insects	Pieridae	<i>Belenois java teutonia</i>	caper white				63
animals	insects	Pieridae	<i>Catopsilia gorgophone gorgophone</i>	yellow migrant				8
animals	insects	Pieridae	<i>Catopsilia pomona</i>	lemon migrant				17
animals	insects	Pieridae	<i>Catopsilia pyranthe crokera</i>	white migrant				15
animals	insects	Pieridae	<i>Catopsilia scylla etesia</i>	orange migrant				1
animals	insects	Pieridae	<i>Cepora perimale</i>					3

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animals	insects	Pieridae	<i>Delias aganippe</i>	spotted jezebel				4
animals	insects	Pieridae	<i>Delias argenthona argenthona</i>	scarlet jezebel				22
animals	insects	Pieridae	<i>Delias harpalyce</i>	imperial jezebel				1
animals	insects	Pieridae	<i>Delias nigrina</i>	black jezebel				10
animals	insects	Pieridae	<i>Delias nysa nysa</i>	yellow-spotted jezebel (Australian subspecies)				1
animals	insects	Pieridae	<i>Elodina angulipennis</i>	southern pearl-white				1
animals	insects	Pieridae	<i>Elodina padusa</i>	narrow-winged pearl-white				1
animals	insects	Pieridae	<i>Elodina parthia</i>	striated pearl-white				1
animals	insects	Pieridae	<i>Eurema hecabe</i>	large grass-yellow				10
animals	insects	Pieridae	<i>Eurema smilax</i>	small grass-yellow				5
animals	insects	Pieridae	<i>Eurema sp.</i>					1
animals	insects	Pieridae	<i>Pieris rapae</i>	cabbage white	Y			62
animals	insects	Platycnemididae	<i>Nososticta solida</i>	orange threadtail				11
animals	insects	Synlestidae	<i>Synlestes selysi</i>	forest needle				4
animals	insects	Synthemistidae	<i>Choristhemis flavoterminalata</i>	yellow-tipped tigertail				18
animals	insects	Synthemistidae	<i>Eusynthemis nigra xanthosticta</i>	black tigertail				2
animals	insects	Synthemistidae	<i>Parasyntemis regina</i>	royal tigertail				1
animals	insects	Telephlebiidae	<i>Austroaeschna sigma</i>	sigma darner				1
animals	insects	Telephlebiidae	<i>Austroaeschna unicornis</i>	unicorn darner				2
animals	malacostracans	Parastacidae	<i>Cherax destructor</i>	common yabbie				13
animals	mammals	Acrobatidae	<i>Acrobates pygmaeus</i>	feathertail glider			C	1
animals	mammals	Canidae	<i>Canis familiaris</i>	dog	Y			1
animals	mammals	Canidae	<i>Canis familiaris (dingo)</i>	dingo				3
animals	mammals	Canidae	<i>Vulpes vulpes</i>	red fox	Y			8
animals	mammals	Cervidae	<i>Axis axis</i>	chital	Y			1
animals	mammals	Dasyuridae	<i>Antechinus flavipes flavipes</i>	yellow-footed antechinus (south-east Queensland)			C	3/1
animals	mammals	Dasyuridae	<i>Antechinus flavipes sensu lato</i>	yellow-footed antechinus			C	1
animals	mammals	Dasyuridae	<i>Phascogale tapoatafa tapoatafa</i>	brush-tailed phascogale			C	2
animals	mammals	Dasyuridae	<i>Planigale maculata</i>	common planigale			C	8/1
animals	mammals	Dasyuridae	<i>Sminthopsis murina</i>	common dunnart			C	5
animals	mammals	Emballonuridae	<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat			C	1
animals	mammals	Felidae	<i>Felis catus</i>	cat	Y			3
animals	mammals	Leporidae	<i>Lepus europaeus</i>	European brown hare	Y			89
animals	mammals	Leporidae	<i>Oryctolagus cuniculus</i>	rabbit	Y			19
animals	mammals	Macropodidae	<i>Macropus giganteus</i>	eastern grey kangaroo			C	22
animals	mammals	Macropodidae	<i>Notamacropus parryi</i>	whiptail wallaby			C	4
animals	mammals	Macropodidae	<i>Notamacropus rufogriseus</i>	red-necked wallaby			C	16
animals	mammals	Macropodidae	<i>Petrogale penicillata</i>	brush-tailed rock-wallaby			V	1
animals	mammals	Macropodidae	<i>Wallabia bicolor</i>	swamp wallaby			C	9
animals	mammals	Miniopteridae	<i>Miniopterus australis</i>	little bent-wing bat			C	2
animals	mammals	Miniopteridae	<i>Miniopterus schreibersii oceanensis</i>	eastern bent-wing bat			C	10
animals	mammals	Molossidae	<i>Austronomus australis</i>	white-striped freetail bat			C	3
animals	mammals	Molossidae	<i>Mormopterus ridei</i>	eastern free-tailed bat			C	3
animals	mammals	Molossidae	<i>Mormopterus sp.</i>				C	1

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animals	mammals	Muridae	<i>Hydromys chrysogaster</i>	water rat		C		1
animals	mammals	Muridae	<i>Mus musculus</i>	house mouse	Y			12
animals	mammals	Muridae	<i>Pseudomys gracilicaudatus</i>	eastern chestnut mouse		C		6
animals	mammals	Muridae	<i>Rattus norvegicus</i>	brown rat	Y			1
animals	mammals	Muridae	<i>Rattus rattus</i>	black rat	Y			56
animals	mammals	Muridae	<i>Rattus tunneyi</i>	pale field-rat		C		1
animals	mammals	Ornithorhynchidae	<i>Ornithorhynchus anatinus</i>	platypus		SL		2
animals	mammals	Peramelidae	<i>Isoodon macrourus</i>	northern brown bandicoot		C		11
animals	mammals	Peramelidae	<i>Perameles nasuta</i>	long-nosed bandicoot		C		7
animals	mammals	Petauridae	<i>Petaurus norfolcensis</i>	squirrel glider		C		5
animals	mammals	Petauridae	<i>Petaurus notatus</i>	Kreff's glider		C		8
animals	mammals	Phalangeridae	<i>Trichosurus caninus</i>	short-eared possum		C		2
animals	mammals	Phalangeridae	<i>Trichosurus sp.</i>			C		1
animals	mammals	Phalangeridae	<i>Trichosurus vulpecula</i>	common brushtail possum		C		96
animals	mammals	Phascolarctidae	<i>Phascolarctos cinereus</i>	koala		E	E	62
animals	mammals	Potoroidae	<i>Aepyprymnus rufescens</i>	rufous bettong		C		1
animals	mammals	Pseudocheiridae	<i>Petauroides volans volans</i>	southern greater glider		E	E	1
animals	mammals	Pseudocheiridae	<i>Pseudocheirus peregrinus</i>	common ringtail possum		C		33
animals	mammals	Pteropodidae	<i>Pteropus alecto</i>	black flying-fox		C		14
animals	mammals	Pteropodidae	<i>Pteropus poliocephalus</i>	grey-headed flying-fox		C	V	26
animals	mammals	Pteropodidae	<i>Pteropus scapulatus</i>	little red flying-fox		C		3
animals	mammals	Suidae	<i>Sus scrofa</i>	pig	Y			1
animals	mammals	Tachyglossidae	<i>Tachyglossus aculeatus</i>	short-beaked echidna		SL		19
animals	mammals	Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's wattled bat		C		9
animals	mammals	Vespertilionidae	<i>Chalinolobus picatus</i>	little pied bat		C		2
animals	mammals	Vespertilionidae	<i>Nyctophilus gouldi</i>	Gould's long-eared bat		C		2
animals	mammals	Vespertilionidae	<i>Nyctophilus sp.</i>			C		1
animals	mammals	Vespertilionidae	<i>Scoteanax rueppellii</i>	greater broad-nosed bat		C		1
animals	mammals	Vespertilionidae	<i>Scotorepens greyii</i>	little broad-nosed bat		C		2
animals	mammals	Vespertilionidae	<i>Scotorepens orion</i>	south-eastern broad-nosed bat		C		3
animals	mammals	Vespertilionidae	<i>Vespadelus vulturnus</i>	little forest bat		C		2
animals	ray-finned fishes	Anguillidae	<i>Anguilla reinhardtii</i>	longfin eel				2
animals	ray-finned fishes	Cyprinidae	<i>Carassius auratus</i>	goldfish	Y			1
animals	ray-finned fishes	Eleotridae	<i>Hypseleotris klunzingeri</i>	western carp gudgeon				1
animals	ray-finned fishes	Eleotridae	<i>Hypseleotris sp.</i>					3
animals	ray-finned fishes	Eleotridae	<i>Hypseleotris species 1</i>	Midgley's carp gudgeon				5
animals	ray-finned fishes	Eleotridae	<i>Mogurnda adspersa</i>	southern purplespotted gudgeon				7
animals	ray-finned fishes	Melanotaeniidae	<i>Melanotaenia fluviatilis</i>	Murray River rainbowfish				9
animals	ray-finned fishes	Percichthyidae	<i>Maccullochella peelii</i>	Murray cod			V	2
animals	ray-finned fishes	Percichthyidae	<i>Macquaria novemaculeata</i>	Australian bass				2
animals	ray-finned fishes	Plotosidae	<i>Tandanus tandanus</i>	freshwater catfish				32
animals	ray-finned fishes	Poeciliidae	<i>Gambusia holbrooki</i>	mosquitofish	Y			31
animals	ray-finned fishes	Terapontidae	<i>Bidyanus bidyanus</i>	silver perch			CE	2
animals	ray-finned fishes	Terapontidae	<i>Leiopotherapon unicolor</i>	spangled perch				34
animals	reptiles	Agamidae	<i>Amphibolurus muricatus</i>	jacky lizard		C		1
animals	reptiles	Agamidae	<i>Intellagama lesueurii</i>	eastern water dragon		C		75

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animals	reptiles	Agamidae	<i>Pogona barbata</i>	bearded dragon		C		30
animals	reptiles	Boidae	<i>Antaresia maculosa</i>	spotted python		C		1
animals	reptiles	Boidae	<i>Morelia spilota</i>	carpet python		C		15
animals	reptiles	Carphodactylidae	<i>Underwoodisaurus milii</i>	thick-tailed gecko		C		6
animals	reptiles	Chelidae	<i>Chelodina expansa</i>	broad-shelled river turtle		C		23
animals	reptiles	Chelidae	<i>Chelodina longicollis</i>	eastern snake-necked turtle		C		31
animals	reptiles	Chelidae	<i>Elseya albagula</i>	white-throated snapping turtle		CR	CE	2
animals	reptiles	Chelidae	<i>Elseya irwini</i>	Irwin's turtle		C		1
animals	reptiles	Chelidae	<i>Emydura macquarii krefftii</i>	Krefft's river turtle		C		10
animals	reptiles	Chelidae	<i>Emydura macquarii macquarii</i>	Murray turtle		C		118
animals	reptiles	Chelidae	<i>Wollumbinia latisternum</i>	saw-shelled turtle		C		26
animals	reptiles	Colubridae	<i>Boiga irregularis</i>	brown tree snake		C		1
animals	reptiles	Colubridae	<i>Dendrelaphis punctulatus</i>	green tree snake		C		2
animals	reptiles	Diplodactylidae	<i>Amalosia jacovae</i>	clouded gecko		C		2
animals	reptiles	Diplodactylidae	<i>Amalosia robusta</i>	robust velvet gecko		C		7
animals	reptiles	Diplodactylidae	<i>Oedura tryoni</i>	southern spotted velvet gecko		C		1
animals	reptiles	Elapidae	<i>Cacophis harriettae</i>	white-crowned snake		C		10
animals	reptiles	Elapidae	<i>Cacophis squamulosus</i>	golden crowned snake		C		14
animals	reptiles	Elapidae	<i>Cryptophis boschmai</i>	Carpentaria whip snake		C		1
animals	reptiles	Elapidae	<i>Cryptophis nigrescens</i>	eastern small-eyed snake		C		2
animals	reptiles	Elapidae	<i>Demansia psammophis</i>	yellow-faced whipsnake		C		19
animals	reptiles	Elapidae	<i>Furina diadema</i>	red-naped snake		C		1/1
animals	reptiles	Elapidae	<i>Hemiaspis signata</i>	black-bellied swamp snake		C		4
animals	reptiles	Elapidae	<i>Hoplocephalus bitorquatus</i>	pale-headed snake		C		5/2
animals	reptiles	Elapidae	<i>Pseudechis guttatus</i>	spotted black snake		C		8
animals	reptiles	Elapidae	<i>Pseudechis porphyriacus</i>	red-bellied black snake		C		8
animals	reptiles	Elapidae	<i>Pseudonaja textilis</i>	eastern brown snake		C		23/3
animals	reptiles	Elapidae	<i>Suta dwyeri</i>	Dwyer's snake		C		1
animals	reptiles	Elapidae	<i>Vermicella annulata</i>	bandy-bandy		C		1
animals	reptiles	Gekkonidae	<i>Gehyra dubia</i>	dubious dtella		C		2
animals	reptiles	Gekkonidae	<i>Hemidactylus frenatus</i>	house gecko	Y			32
animals	reptiles	Gekkonidae	<i>Heteronotia binoei</i>	Bynoe's gecko		C		1
animals	reptiles	Pygopodidae	<i>Delma plebeia</i>	common delma		C		3
animals	reptiles	Pygopodidae	<i>Delma tincta</i>	excitable delma		C		4
animals	reptiles	Pygopodidae	<i>Delma torquata</i>	collared delma		V	V	30
animals	reptiles	Pygopodidae	<i>Lialis burtonis</i>	Burton's legless lizard		C		4
animals	reptiles	Scincidae	<i>Anomalopus leuckartii</i>	two-clawed worm-skink		C		1
animals	reptiles	Scincidae	<i>Anomalopus verreauxii</i>	three-clawed worm-skink		C		21
animals	reptiles	Scincidae	<i>Bellatorias frerei</i>	major skink		C		2
animals	reptiles	Scincidae	<i>Calyptotis scutirostrum</i>	scute-snouted calyptotis		C		45
animals	reptiles	Scincidae	<i>Carlia schmeltzii</i>	robust rainbow-skink		C		1
animals	reptiles	Scincidae	<i>Carlia tetradactyla</i>	southern rainbow-skink		C		6
animals	reptiles	Scincidae	<i>Carlia vivax</i>	tussock rainbow-skink		C		1
animals	reptiles	Scincidae	<i>Concinnia martini</i>	dark bar-sided skink		C		1
animals	reptiles	Scincidae	<i>Concinnia tenuis</i>	bar-sided skink		C		6
animals	reptiles	Scincidae	<i>Cryptoblepharus pulcher pulcher</i>	elegant snake-eyed skink		C		82

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animals	reptiles	Scincidae	<i>Ctenotus spaldingi</i>	straight-browed ctenotus		C		11
animals	reptiles	Scincidae	<i>Egernia cunninghami</i>	Cunningham's skink		C		16/1
animals	reptiles	Scincidae	<i>Egernia mcphreei</i>	eastern crevice-skink		C		1
animals	reptiles	Scincidae	<i>Egernia striolata</i>	tree skink		C		1
animals	reptiles	Scincidae	<i>Eulamprus quoyii</i>	eastern water skink		C		1
animals	reptiles	Scincidae	<i>Lampropholis delicata</i>	dark-flecked garden sunskink		C		60
animals	reptiles	Scincidae	<i>Lampropholis guichenoti</i>	pale-flecked garden sunskink		C		4
animals	reptiles	Scincidae	<i>Lygisaurus foliorum</i>	tree-base litter-skink		C		2
animals	reptiles	Scincidae	<i>Menetia greyii</i>	common dwarf skink		C		2
animals	reptiles	Scincidae	<i>Morethia taeniopleura</i>	fire-tailed skink		C		2
animals	reptiles	Scincidae	<i>Saiphos equalis</i>	three-toed skink		C		6
animals	reptiles	Scincidae	<i>Saproscincus rosei</i>	Rose's shadeskink		C		8
animals	reptiles	Scincidae	<i>Tiliqua rugosa</i>	shingle-back		C		1
animals	reptiles	Scincidae	<i>Tiliqua scincoides scincoides</i>	eastern bluetongue		C		50
animals	reptiles	Typhlopidae	<i>Anilius ligatus</i>	robust blind snake		C		3
animals	reptiles	Typhlopidae	<i>Anilius nigrescens</i>	blackish blind snake		C		3
animals	reptiles	Typhlopidae	<i>Anilius proximus</i>	proximus blind snake		C		1
animals	reptiles	Typhlopidae	<i>Anilius sp.</i>			C		1
animals	reptiles	Typhlopidae	<i>Anilius wiedii</i>	brown-snouted blind snake		C		4/1
animals	reptiles	Varanidae	<i>Varanus varius</i>	lace monitor		C		5
animals	uncertain	Indeterminate	<i>Indeterminate</i>	Unknown or Code Pending				423/4
fungi	Agaricomycetes	Agaricaceae	<i>Agaricus</i>					2/2
fungi	Agaricomycetes	Agaricaceae	<i>Agaricus austrovinaceus</i>			C		1
fungi	Agaricomycetes	Agaricaceae	<i>Agaricus campestris var. campestris</i>			C		2
fungi	Agaricomycetes	Agaricaceae	<i>Calvatia lilacina</i>			C		2
fungi	Agaricomycetes	Agaricaceae	<i>Calvatia rugosa</i>			C		7
fungi	Agaricomycetes	Agaricaceae	<i>Chlorophyllum hortense</i>			C		1
fungi	Agaricomycetes	Agaricaceae	<i>Chlorophyllum molybdites</i>	green-spored parasol		C		8
fungi	Agaricomycetes	Agaricaceae	<i>Coprinus atramentarius</i>			C		9
fungi	Agaricomycetes	Agaricaceae	<i>Coprinus comatus</i>			C		1
fungi	Agaricomycetes	Agaricaceae	<i>Coprinus truncorum</i>			C		3
fungi	Agaricomycetes	Agaricaceae	<i>Cyathus stercoreus</i>			C		2/1
fungi	Agaricomycetes	Agaricaceae	<i>Cyathus striatus</i>			C		1
fungi	Agaricomycetes	Agaricaceae	<i>Leucocoprinus birnbaumii</i>			C		1/1
fungi	Agaricomycetes	Agaricaceae	<i>Lycoperdon pyriforme</i>			C		2
fungi	Agaricomycetes	Agaricaceae	<i>Macrolepiota</i>					1/1
fungi	Agaricomycetes	Agaricaceae	<i>Macrolepiota clelandii</i>			C		1
fungi	Agaricomycetes	Agaricaceae	<i>Macrolepiota dolichaula</i>			C		2
fungi	Agaricomycetes	Amanitaceae	<i>Amanita farinacea</i>			C		2
fungi	Agaricomycetes	Amanitaceae	<i>Amanita muscaria</i>		Y			1/1
fungi	Agaricomycetes	Amanitaceae	<i>Amanita punctata</i>			C		2
fungi	Agaricomycetes	Amanitaceae	<i>Amanita pyramidifera</i>			C		1
fungi	Agaricomycetes	Amanitaceae	<i>Amanita xanthocephala</i>			C		1
fungi	Agaricomycetes	Auriculariaceae	<i>Auricularia cornea</i>			C		3/1
fungi	Agaricomycetes	Bolbitiaceae	<i>Bolbitius titubans</i>			C		2
fungi	Agaricomycetes	Boletaceae	<i>Phylloporus</i>					1/1

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fungi	Agaricomycetes	Corticaceae	<i>Corticium</i>			C		2/2
fungi	Agaricomycetes	Cortinariaceae	<i>Cortinarius australiensis</i>			C		1
fungi	Agaricomycetes	Cortinariaceae	<i>Gymnopilus</i>					1/1
fungi	Agaricomycetes	Geastraceae	<i>Geastrum minimum</i>			C		1
fungi	Agaricomycetes	Geastraceae	<i>Geastrum pectinatum</i>			C		5/1
fungi	Agaricomycetes	Geastraceae	<i>Geastrum saccatum</i>			C		2
fungi	Agaricomycetes	Geastraceae	<i>Geastrum triplex</i>			C		4
fungi	Agaricomycetes	Hymenochaetaceae	<i>Hymenochaete</i>					1/1
fungi	Agaricomycetes	Marasmiaceae	<i>Armillaria fumosa</i>			C		1
fungi	Agaricomycetes	Marasmiaceae	<i>Campanella olivaceonigra</i>			C		1
fungi	Agaricomycetes	Marasmiaceae	<i>Gerronema</i>					2/2
fungi	Agaricomycetes	Marasmiaceae	<i>Marasmius</i>					6/6
fungi	Agaricomycetes	Marasmiaceae	<i>Marasmius elegans</i>			C		1
fungi	Agaricomycetes	Mycenaceae	<i>Cruentomyces viscidocruentus</i>			C		1
fungi	Agaricomycetes	Omphalotaceae	<i>Marasmiellus</i>					1/1
fungi	Agaricomycetes	Panaeolaceae	<i>Panaeolina foenicisii</i>			C		2
fungi	Agaricomycetes	Panaeolaceae	<i>Panaeolus</i>					1/1
fungi	Agaricomycetes	Panaeolaceae	<i>Panaeolus antillarum</i>			C		1/1
fungi	Agaricomycetes	Phallaceae	<i>Aseroe rubra</i>			C		15
fungi	Agaricomycetes	Phallaceae	<i>Colus pusillus</i>			C		2
fungi	Agaricomycetes	Phallaceae	<i>Ileodictyon gracile</i>			C		1
fungi	Agaricomycetes	Phallaceae	<i>Lysurus mokusin</i>			C		6
fungi	Agaricomycetes	Phallaceae	<i>Phallus rubicundus</i>			C		12
fungi	Agaricomycetes	Phallaceae	<i>Pseudocolus fusiformis</i>			C		1
fungi	Agaricomycetes	Physalacriaceae	<i>Armillaria luteobubalina</i>			C		1/1
fungi	Agaricomycetes	Pluteaceae	<i>Pluteus</i>					2/2
fungi	Agaricomycetes	Polyporaceae	<i>Laetiporus portentosus</i>			C		3
fungi	Agaricomycetes	Polyporaceae	<i>Lentinus sajor-caju</i>			C		1
fungi	Agaricomycetes	Polyporaceae	<i>Lenzites</i>					1/1
fungi	Agaricomycetes	Polyporaceae	<i>Pycnoporus coccineus</i>			C		1
fungi	Agaricomycetes	Polyporaceae	<i>Trametes</i>					1/1
fungi	Agaricomycetes	Psathyrellaceae	<i>Coprinellus disseminatus</i>			C		2
fungi	Agaricomycetes	Psathyrellaceae	<i>Psathyrella</i>					1/1
fungi	Agaricomycetes	Russulaceae	<i>Russula</i>			C		1/1
fungi	Agaricomycetes	Russulaceae	<i>Russula persanguinea</i>			C		1
fungi	Agaricomycetes	Schizophyllaceae	<i>Schizophyllum commune</i>			C		2
fungi	Agaricomycetes	Sclerodermataceae	<i>Astraeus hygrometricus</i>			C		1/1
fungi	Agaricomycetes	Sclerodermataceae	<i>Pisolithus albus</i>			C		2
fungi	Agaricomycetes	Sclerodermataceae	<i>Pisolithus marmoratus</i>			C		3
fungi	Agaricomycetes	Sclerodermataceae	<i>Scleroderma cepa</i>			C		3
fungi	Agaricomycetes	Sclerodermataceae	<i>Scleroderma polyrhizum</i>			C		1
fungi	Agaricomycetes	Serpulaceae	<i>Serpula lacrymans</i>			C		1/1
fungi	Agaricomycetes	Stereaceae	<i>Stereum ostrea</i>			C		1/1
fungi	Agaricomycetes	Strophariaceae	<i>Leratiomyces ceres</i>			C		7
fungi	Agaricomycetes	Strophariaceae	<i>Psilocybe cubensis</i>			C		2/1
fungi	Agaricomycetes	Tricholomataceae	<i>Lepista sublilacina</i>			C		1

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fungi	Dacrymycetes	Dacrymycetaceae	<i>Dacryopinax spathularia</i>			C		4
fungi	Pezizomycetes	Morchellaceae	<i>Morchella</i>					1
fungi	Pezizomycetes	Morchellaceae	<i>Morchella esculenta</i>			C		2
fungi	Pezizomycetes	Pyronemataceae	<i>Scutellinia scutellata</i>			C		1/1
fungi	eurotiomycetes	Pyrenulaceae	<i>Anthracothecium gregale</i>			C		1/1
fungi	eurotiomycetes	Thermoascaceae	<i>Paecilomyces</i>					1/1
fungi	lecanoromycetes	Acarosporaceae	<i>Piccolia conspersa</i>			C		1/1
fungi	lecanoromycetes	Caliciaceae	<i>Buellia demutans</i>			C		1/1
fungi	lecanoromycetes	Caliciaceae	<i>Dirinaria applanata</i>			C		2/2
fungi	lecanoromycetes	Caliciaceae	<i>Dirinaria confluens</i>			C		2/2
fungi	lecanoromycetes	Caliciaceae	<i>Pyxine</i>					1
fungi	lecanoromycetes	Cladoniaceae	<i>Cladia aggregata</i>			C		1/1
fungi	lecanoromycetes	Cladoniaceae	<i>Cladia muelleri</i>			C		1/1
fungi	lecanoromycetes	Cladoniaceae	<i>Cladonia cervicornis subsp. verticillata</i>			C		1/1
fungi	lecanoromycetes	Cladoniaceae	<i>Cladonia floerkeana</i>			C		1/1
fungi	lecanoromycetes	Cladoniaceae	<i>Pulchrocladia retipora</i>			C		1/1
fungi	lecanoromycetes	Collemaataceae	<i>Collema</i>					2/2
fungi	lecanoromycetes	Lecanoraceae	<i>Lecanora</i>					1/1
fungi	lecanoromycetes	Lecanoraceae	<i>Lecanora helva</i>			C		1/1
fungi	lecanoromycetes	Letrouitiaceae	<i>Letrouitia coralloidea</i>			C		1/1
fungi	lecanoromycetes	Lobariaceae	<i>Crocodia aurata</i>			C		1/1
fungi	lecanoromycetes	Lobariaceae	<i>Pseudocyphellaria neglecta</i>			C		1/1
fungi	lecanoromycetes	Lobariaceae	<i>Pseudocyphellaria rubrina</i>			C		1/1
fungi	lecanoromycetes	Ochrolechiaceae	<i>Ochrolechia</i>					1/1
fungi	lecanoromycetes	Ochrolechiaceae	<i>Ochrolechia africana</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Canoparmelia texana</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema</i>					1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema austrosinense</i>			C		2/2
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema crinitum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema perlatum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema praesorediosum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema reparatum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema reticulatum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema saccatilobum</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Parmotrema tinctorum</i>			C		3/2
fungi	lecanoromycetes	Parmeliaceae	<i>Punctelia subflava</i>			C		2/2
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea angulata</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea dasaea</i>			C		5/5
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea molliuscula subsp. queenslandica</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea scabrida</i>			C		1
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea scabrida subsp. elegans</i>			C		8/7
fungi	lecanoromycetes	Parmeliaceae	<i>Xanthoparmelia pulla</i>			C		1/1
fungi	lecanoromycetes	Physciaceae	<i>Heterodermia angustiloba</i>			C		1/1
fungi	lecanoromycetes	Physciaceae	<i>Heterodermia obscurata</i>			C		1/1
fungi	lecanoromycetes	Physciaceae	<i>Heterodermia speciosa</i>			C		1/1
fungi	lecanoromycetes	Physciaceae	<i>Physcia jackii</i>			C		1/1

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fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina</i>					2/2
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina celastri</i> subsp. <i>celastri</i>			C		6/6
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina inflata</i> subsp. <i>inflata</i>			C		1/1
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina inflata</i> subsp. <i>perpusilla</i>			C		10/10
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina peruviana</i>			C		3/3
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina subfraxinea</i>			C		1/1
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina subfraxinea</i> var. <i>subfraxinea</i>			C		1
fungi	lecanoromycetes	Teloschistaceae	<i>Teloschistes sieberianus</i>			C		2/1
fungi	lecanoromycetes	Teloschistaceae	<i>Teloschistes xanthoroides</i>			C		1/1
fungi	sordariomycetes	Xylariaceae	<i>Xylaria polymorpha</i>			C		1
plants	Charophyceae	Characeae	<i>Nitella cristata</i>			C		1/1
plants	land plants	Acanthaceae	<i>Brunoniella australis</i>	blue trumpet		C		2
plants	land plants	Acanthaceae	<i>Hypoestes floribunda</i>			C		2/2
plants	land plants	Acanthaceae	<i>Hypoestes phyllostachya</i>		Y			1
plants	land plants	Acanthaceae	<i>Pseuderanthemum variabile</i>	pastel flower		C		1
plants	land plants	Acanthaceae	<i>Rostellularia adscendens</i>			C		3
plants	land plants	Acanthaceae	<i>Rostellularia adscendens</i> var. <i>adscendens</i>			C		1/1
plants	land plants	Acanthaceae	<i>Rostellularia obtusa</i>			C		1/1
plants	land plants	Acanthaceae	<i>Ruellia simplex</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Ruellia squarrosa</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Thunbergia alata</i>	black-eyed Susan	Y			5/1
plants	land plants	Agavaceae	<i>Agave americana</i> var. <i>americana</i>		Y			2/1
plants	land plants	Agavaceae	<i>Furcraea foetida</i>		Y			1
plants	land plants	Agavaceae	<i>Yucca aloifolia</i>		Y			2/2
plants	land plants	Aizoaceae	<i>Mesembryanthemum cordifolium</i>		Y			2
plants	land plants	Aizoaceae	<i>Tetragonia tetragonoides</i>	New Zealand spinach			C	8
plants	land plants	Aizoaceae	<i>Trianthema portulacastrum</i>	black pigweed	Y			3
plants	land plants	Aizoaceae	<i>Zaleya galericulata</i> subsp. <i>galericulata</i>				C	1
plants	land plants	Alismataceae	<i>Alisma plantago-aquatica</i>		Y			4/1
plants	land plants	Alismataceae	<i>Sagittaria platyphylla</i>	sagittaria	Y			1
plants	land plants	Alliaceae	<i>Nothoscordum borbonicum</i>		Y			5
plants	land plants	Amaranthaceae	<i>Alternanthera nana</i>	hairy joyweed			C	3/1
plants	land plants	Amaranthaceae	<i>Alternanthera pungens</i>	khaki weed	Y			5
plants	land plants	Amaranthaceae	<i>Alternanthera sessilis</i>		Y			1/1
plants	land plants	Amaranthaceae	<i>Amaranthus hybridus</i>	redshank	Y			3/3
plants	land plants	Amaranthaceae	<i>Amaranthus viridis</i>	green amaranth	Y			2
plants	land plants	Amaranthaceae	<i>Deeringia amaranthoides</i>	redberry			C	1/1
plants	land plants	Amaranthaceae	<i>Gomphrena celosioides</i>	gomphrena weed	Y			6
plants	land plants	Amaranthaceae	<i>Guilleminea densa</i>	small matweed	Y			3/1
plants	land plants	Amaranthaceae	<i>Nyssanthes diffusa</i>	barbed-wire weed			C	3/2
plants	land plants	Amaryllidaceae	<i>Proiphys cunninghamii</i>	Moreton Bay lily			SL	1
plants	land plants	Anacardiaceae	<i>Euroschinus falcatus</i>				C	1
plants	land plants	Anacardiaceae	<i>Euroschinus falcatus</i> var. <i>falcatus</i>				C	1/1
plants	land plants	Anacardiaceae	<i>Rhodosphaera rhodanthema</i>	tulip satinwood			C	2/1
plants	land plants	Anacardiaceae	<i>Schinus molle</i>		Y			1
plants	land plants	Anacardiaceae	<i>Schinus molle</i> var. <i>areira</i>	pepper tree	Y			2/1

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plants	land plants	Aphanopetalaceae	<i>Aphanopetalum resinosum</i>	gumvine		C		1
plants	land plants	Apiaceae	<i>Berula erecta</i>	water parsnip	Y			2/1
plants	land plants	Apiaceae	<i>Centella asiatica</i>			C		2
plants	land plants	Apiaceae	<i>Conium maculatum</i>	poison hemlock	Y			2/2
plants	land plants	Apiaceae	<i>Cyclospermum leptophyllum</i>		Y			4/1
plants	land plants	Apiaceae	<i>Daucus carota</i>	wild carrot	Y			2
plants	land plants	Apiaceae	<i>Daucus glochidiatus</i>	Australian carrot		C		1
plants	land plants	Apiaceae	<i>Foeniculum vulgare</i>	fennel	Y			10/2
plants	land plants	Apocynaceae	<i>Alstonia constricta</i>	bitterbark		C		4/1
plants	land plants	Apocynaceae	<i>Alyxia ruscifolia</i>			C		2/1
plants	land plants	Apocynaceae	<i>Araujia sericifera</i>	white moth vine	Y			18/2
plants	land plants	Apocynaceae	<i>Asclepias curassavica</i>	red-head cottonbush	Y			2
plants	land plants	Apocynaceae	<i>Carissa ovata</i>	currantbush		C		2/1
plants	land plants	Apocynaceae	<i>Gomphocarpus physocarpus</i>	balloon cottonbush	Y			12/1
plants	land plants	Apocynaceae	<i>Gymnema pleiadenium</i>			C		1/1
plants	land plants	Apocynaceae	<i>Hoya australis</i>			C		1
plants	land plants	Apocynaceae	<i>Leichhardtia coronata</i>			V		1/1
plants	land plants	Apocynaceae	<i>Leichhardtia viridiflora</i> subsp. <i>viridiflora</i>			C		1/1
plants	land plants	Apocynaceae	<i>Parsonsia leichhardtii</i>	black silkpod		C		2/2
plants	land plants	Apocynaceae	<i>Parsonsia straminea</i>	monkey rope		C		3
plants	land plants	Apocynaceae	<i>Vincetoxicum grandiflorum</i>			C		1/1
plants	land plants	Apocynaceae	<i>Vincetoxicum ovatum</i>			C		2
plants	land plants	Araceae	<i>Gymnostachys anceps</i>	settler's flax		C		2
plants	land plants	Araceae	<i>Lemna aequinoctialis</i>	common duckweed		C		1
plants	land plants	Araceae	<i>Typhonium brownii</i>	black arum lily		C		2
plants	land plants	Araliaceae	<i>Heptapleurum actinophyllum</i>			C		1
plants	land plants	Araliaceae	<i>Hydrocotyle acutiloba</i>			C		2
plants	land plants	Araliaceae	<i>Hydrocotyle laxiflora</i>	stinking pennywort		C		10/5
plants	land plants	Araliaceae	<i>Hydrocotyle verticillata</i>	shield pennywort		C		1/1
plants	land plants	Araliaceae	<i>Polyscias elegans</i>	celery wood		C		2/1
plants	land plants	Asparagaceae	<i>Asparagus africanus</i>	ornamental asparagus	Y			3/2
plants	land plants	Asparagaceae	<i>Asparagus asparagoides</i>	bridal creeper	Y			2/2
plants	land plants	Asphodelaceae	<i>Aloe arborescens</i>		Y			1
plants	land plants	Asphodelaceae	<i>Asphodelus fistulosus</i>	asphodel	Y			3/1
plants	land plants	Asphodelaceae	<i>Bulbine bulbosa</i>	golden lily		C		1
plants	land plants	Asphodelaceae	<i>Bulbine fraseri</i>			C		1/1
plants	land plants	Aspleniaceae	<i>Asplenium australasicum</i>			C		4
plants	land plants	Aspleniaceae	<i>Asplenium subglandulosum</i> subsp. <i>subglandulosum</i>			C		1/1
plants	land plants	Asteraceae	<i>Apowollastonia spilanthes</i>			C		4/1
plants	land plants	Asteraceae	<i>Arctotheca calendula</i>	Cape weed	Y			7/2
plants	land plants	Asteraceae	<i>Artemisia verlotiorum</i>		Y			2
plants	land plants	Asteraceae	<i>Baccharis halimifolia</i>	groundsel bush	Y			2
plants	land plants	Asteraceae	<i>Bidens bipinnata</i>	bipinnate beggar's ticks	Y			15
plants	land plants	Asteraceae	<i>Bidens pilosa</i>		Y			6/1
plants	land plants	Asteraceae	<i>Brachyscome</i>					2/1
plants	land plants	Asteraceae	<i>Brachyscome dentata</i>			C		3/3

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plants	land plants	Asteraceae	<i>Brachyscome microcarpa</i> subsp. <i>microcarpa</i>			C		1/1
plants	land plants	Asteraceae	<i>Calotis dentex</i>	white burr daisy		C		2/2
plants	land plants	Asteraceae	<i>Calotis lappulacea</i>	yellow burr daisy		C		10/1
plants	land plants	Asteraceae	<i>Calyptocarpus vialis</i>	creeping cinderella weed	Y			2
plants	land plants	Asteraceae	<i>Carduus pycnocephalus</i>		Y			4/2
plants	land plants	Asteraceae	<i>Carduus thoermeri</i>	nodding thistle	Y			2/2
plants	land plants	Asteraceae	<i>Carthamus lanatus</i>	saffron thistle	Y			3/2
plants	land plants	Asteraceae	<i>Cassinia laevis</i>			C		2
plants	land plants	Asteraceae	<i>Centaurea melitensis</i>	Maltese cockspur	Y			4/4
plants	land plants	Asteraceae	<i>Chondrilla juncea</i>	skeleton weed	Y			1/1
plants	land plants	Asteraceae	<i>Chrysocephalum apiculatum</i>	yellow buttons		C		12/1
plants	land plants	Asteraceae	<i>Chrysocephalum apiculatum</i> subsp. <i>exile</i>			C		2
plants	land plants	Asteraceae	<i>Cichorium intybus</i>	chicory	Y			2
plants	land plants	Asteraceae	<i>Cirsium vulgare</i>	spear thistle	Y			20
plants	land plants	Asteraceae	<i>Coreopsis lanceolata</i>		Y			2
plants	land plants	Asteraceae	<i>Crassocephalum crepidioides</i>	thickhead	Y			2/1
plants	land plants	Asteraceae	<i>Cyanthillium cinereum</i>			C		3/1
plants	land plants	Asteraceae	<i>Dimorphotheca ecklonis</i>		Y			3/2
plants	land plants	Asteraceae	<i>Emilia sonchifolia</i> var. <i>javanica</i>		Y			1/1
plants	land plants	Asteraceae	<i>Erigeron bonariensis</i>		Y			14/1
plants	land plants	Asteraceae	<i>Erigeron karvinskianus</i>		Y			2/1
plants	land plants	Asteraceae	<i>Erigeron pusillus</i>		Y			1/1
plants	land plants	Asteraceae	<i>Erigeron sumatrensis</i>		Y			4/1
plants	land plants	Asteraceae	<i>Euchiton involucratus</i>			C		1
plants	land plants	Asteraceae	<i>Euchiton sphaericus</i>			C		3/1
plants	land plants	Asteraceae	<i>Gamochaeta americana</i>		Y			1
plants	land plants	Asteraceae	<i>Gamochaeta pensylvanica</i>		Y			3/1
plants	land plants	Asteraceae	<i>Glossocardia bidens</i>	native cobbler's pegs		C		2/1
plants	land plants	Asteraceae	<i>Guizotia abyssinica</i>	niger seed	Y			1/1
plants	land plants	Asteraceae	<i>Hypochaeris albiflora</i>		Y			3
plants	land plants	Asteraceae	<i>Hypochaeris glabra</i>	smooth catsear	Y			4
plants	land plants	Asteraceae	<i>Hypochaeris radicata</i>	catsear	Y			9/1
plants	land plants	Asteraceae	<i>Lactuca saligna</i>	wild lettuce	Y			1
plants	land plants	Asteraceae	<i>Lactuca serriola</i> forma <i>serriola</i>		Y			10
plants	land plants	Asteraceae	<i>Leiocarpa brevicompta</i>			C		8/2
plants	land plants	Asteraceae	<i>Leiocarpa leptolepis</i>			C		1
plants	land plants	Asteraceae	<i>Leiocarpa websteri</i>			C		2/1
plants	land plants	Asteraceae	<i>Leuzea australis</i>			V	V	17/5
plants	land plants	Asteraceae	<i>Olearia elliptica</i>			C		2
plants	land plants	Asteraceae	<i>Olearia fulgens</i>			C		2/2
plants	land plants	Asteraceae	<i>Ozothamnus cassinioides</i>			C		1/1
plants	land plants	Asteraceae	<i>Picris angustifolia</i>			C		1
plants	land plants	Asteraceae	<i>Picris angustifolia</i> subsp. <i>carolorum-henricorum</i>			C		1
plants	land plants	Asteraceae	<i>Picris evae</i>			V	V	5/1
plants	land plants	Asteraceae	<i>Schkuhria pinnata</i>		Y			2
plants	land plants	Asteraceae	<i>Senecio bipinnatisectus</i>	Commonwealth weed		C		1

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plants	land plants	Asteraceae	<i>Senecio brignalowensis</i>			C		3/2
plants	land plants	Asteraceae	<i>Senecio daltonii</i>	dalton weed		C		1/1
plants	land plants	Asteraceae	<i>Senecio hispidulus</i>			C		2/1
plants	land plants	Asteraceae	<i>Senecio madagascariensis</i>	fireweed	Y			14/3
plants	land plants	Asteraceae	<i>Senecio minimus</i>			C		1
plants	land plants	Asteraceae	<i>Senecio pinnatifolius</i>			C		1
plants	land plants	Asteraceae	<i>Senecio pinnatifolius</i> var. <i>pinnatifolius</i>			C		19/4
plants	land plants	Asteraceae	<i>Senecio quadridentatus</i>	cotton fireweed		C		4
plants	land plants	Asteraceae	<i>Senecio tenuiflorus</i>			C		1/1
plants	land plants	Asteraceae	<i>Sigesbeckia orientalis</i>	Indian weed		C		1/1
plants	land plants	Asteraceae	<i>Silybum marianum</i>	variegated thistle	Y			3
plants	land plants	Asteraceae	<i>Soliva sessilis</i>		Y			4
plants	land plants	Asteraceae	<i>Sonchus asper</i>	rough sowthistle	Y			9/2
plants	land plants	Asteraceae	<i>Sonchus oleraceus</i>	common sowthistle	Y			11/1
plants	land plants	Asteraceae	<i>Sphagneticola trilobata</i>		Y			1
plants	land plants	Asteraceae	<i>Tagetes minuta</i>	stinking roger	Y			8/2
plants	land plants	Asteraceae	<i>Tanacetum vulgare</i>	tansy	Y			1/1
plants	land plants	Asteraceae	<i>Taraxacum officinale</i>	dandelion	Y			13/1
plants	land plants	Asteraceae	<i>Tragopogon porrifolius</i>	salsify	Y			4/1
plants	land plants	Asteraceae	<i>Tridax procumbens</i>	tridax daisy	Y			2
plants	land plants	Asteraceae	<i>Vittadinia</i>					1
plants	land plants	Asteraceae	<i>Vittadinia cuneata</i> var. <i>hirsuta</i>			C		1
plants	land plants	Asteraceae	<i>Vittadinia dissecta</i> var. <i>hirta</i>			C		1/1
plants	land plants	Asteraceae	<i>Vittadinia pterochaeta</i>	rough fuzzweed		C		2/1
plants	land plants	Asteraceae	<i>Vittadinia pustulata</i>			C		1
plants	land plants	Asteraceae	<i>Vittadinia sulcata</i>	native daisy		C		3
plants	land plants	Asteraceae	<i>Xerochrysum</i>					1
plants	land plants	Asteraceae	<i>Xerochrysum bracteatum</i>	golden everlasting daisy		C		2
plants	land plants	Asteraceae	<i>Youngia japonica</i>			C		1/1
plants	land plants	Asteraceae	<i>Zinnia peruviana</i>	wild zinnia	Y			13/2
plants	land plants	Aulacomniaceae	<i>Mesochaete undulata</i>			C		1/1
plants	land plants	Aytoniaceae	<i>Asterella drummondii</i>			C		2/1
plants	land plants	Basellaceae	<i>Anredera cordifolia</i>	Madeira vine	Y			2/1
plants	land plants	Bignoniaceae	<i>Dolichandra unguis-cati</i>	cat's claw creeper	Y			1
plants	land plants	Bignoniaceae	<i>Jacaranda mimosifolia</i>	jacaranda	Y			3/1
plants	land plants	Bignoniaceae	<i>Pandorea pandorana</i>	wonga vine		C		4
plants	land plants	Bignoniaceae	<i>Tecomaria capensis</i> subsp. <i>capensis</i>		Y			1
plants	land plants	Blechnaceae	<i>Blechnum neohollandicum</i>			C		3
plants	land plants	Blechnaceae	<i>Blechnum spinulosum</i>			SL		1
plants	land plants	Boraginaceae	<i>Buglossoides arvensis</i>	corn cromwell	Y			2/1
plants	land plants	Boraginaceae	<i>Cynoglossum torvum</i>			C		2/2
plants	land plants	Boraginaceae	<i>Echium plantagineum</i>	Paterson's curse	Y			3/1
plants	land plants	Boraginaceae	<i>Ehretia membranifolia</i>	weeping koda		C		1
plants	land plants	Boraginaceae	<i>Hackelia suaveolens</i>			C		2
plants	land plants	Boraginaceae	<i>Heliotropium amplexicaule</i>	blue heliotrope	Y			9/1
plants	land plants	Brassicaceae	<i>Brassica rapa</i> subsp. <i>campestris</i>		Y			1

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plants	land plants	Brassicaceae	<i>Capsella bursa-pastoris</i>	shepherd's purse	Y			8/1
plants	land plants	Brassicaceae	<i>Erucastrum austroafricanum</i>		Y			2
plants	land plants	Brassicaceae	<i>Hirschfeldia incana</i>	buchan weed	Y			2/1
plants	land plants	Brassicaceae	<i>Lepidium bonariense</i>	Argentine peppergrass	Y			1/1
plants	land plants	Brassicaceae	<i>Lepidium didymum</i>		Y			1
plants	land plants	Brassicaceae	<i>Lepidium peregrinum</i>			C	E	2/2
plants	land plants	Brassicaceae	<i>Lepidium virginicum</i>	Virginian peppergrass	Y			1
plants	land plants	Brassicaceae	<i>Raphanus raphanistrum</i>	wild radish	Y			7/3
plants	land plants	Brassicaceae	<i>Rapistrum rugosum</i>		Y			7/2
plants	land plants	Brassicaceae	<i>Rorippa dietrichiana</i>			C		1/1
plants	land plants	Brassicaceae	<i>Rorippa nasturtium-aquaticum</i>	watercress	Y			6/1
plants	land plants	Brassicaceae	<i>Sisymbrium irio</i>	london rocket	Y			1
plants	land plants	Brassicaceae	<i>Sisymbrium officinale</i>	hedge mustard	Y			1/1
plants	land plants	Brassicaceae	<i>Sisymbrium orientale</i>	Indian hedge mustard	Y			2/1
plants	land plants	Bryaceae	<i>Bryum</i>					1/1
plants	land plants	Bryaceae	<i>Plagiobryoides cellularis</i>			C		1/1
plants	land plants	Cactaceae	<i>Cereus uruguayanus</i>		Y			1
plants	land plants	Cactaceae	<i>Opuntia ficus-indica</i>	Indian fig	Y			2
plants	land plants	Cactaceae	<i>Opuntia monacantha</i>		Y			1
plants	land plants	Cactaceae	<i>Opuntia stricta</i>		Y			7
plants	land plants	Cactaceae	<i>Opuntia tomentosa</i>	velvety tree pear	Y			41
plants	land plants	Campanulaceae	<i>Lobelia concolor</i>			SL		1
plants	land plants	Campanulaceae	<i>Lobelia purpurascens</i>	white root		SL		4/1
plants	land plants	Campanulaceae	<i>Wahlenbergia capillaris</i>			SL		6
plants	land plants	Campanulaceae	<i>Wahlenbergia glabra</i>	native bluebell		SL		1/1
plants	land plants	Campanulaceae	<i>Wahlenbergia gracilis</i>	spawling bluebell		SL		3/1
plants	land plants	Campanulaceae	<i>Wahlenbergia stricta</i>			SL		1
plants	land plants	Cannabaceae	<i>Aphananthe philippinensis</i>			C		1
plants	land plants	Cannabaceae	<i>Celtis sinensis</i>	Chinese elm	Y			5
plants	land plants	Cannabaceae	<i>Trema tomentosa</i>			C		2
plants	land plants	Cannaceae	<i>Canna indica</i>	Indian shot	Y			1
plants	land plants	Capparaceae	<i>Capparis anomala</i>			C		1
plants	land plants	Capparaceae	<i>Capparis arborea</i>	brush caper berry		C		3/1
plants	land plants	Capparaceae	<i>Capparis mitchellii</i>			C		1
plants	land plants	Capparaceae	<i>Capparis sarmentosa</i>	scrambling caper		C		1
plants	land plants	Caprifoliaceae	<i>Lonicera japonica</i>	Japanese honeysuckle	Y			1
plants	land plants	Caryophyllaceae	<i>Gypsophila australis</i>			C		1/1
plants	land plants	Caryophyllaceae	<i>Petrorhagia nanteuillii</i>	proliferous pink	Y			2/1
plants	land plants	Caryophyllaceae	<i>Spergularia levis</i>		Y			1/1
plants	land plants	Caryophyllaceae	<i>Stellaria media</i>	chickweed	Y			5/2
plants	land plants	Casuarinaceae	<i>Allocasuarina torulosa</i>			C		5/1
plants	land plants	Casuarinaceae	<i>Casuarina cunninghamiana</i>			C		1
plants	land plants	Casuarinaceae	<i>Casuarina cunninghamiana subsp. cunninghamiana</i>			C		1
plants	land plants	Celastraceae	<i>Celastrus subspicata</i>	large-leaved staffvine		C		4/4
plants	land plants	Celastraceae	<i>Denhamia bilocularis</i>			C		2/1
plants	land plants	Celastraceae	<i>Denhamia celastroides</i>	broad-leaved boxwood		C		1

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plants	land plants	Celastraceae	<i>Denhamia pittosporoides</i> subsp. <i>pittosporoides</i>			C		1/1
plants	land plants	Celastraceae	<i>Elaeodendron australe</i> var. <i>integrifolium</i>			C		2/2
plants	land plants	Celastraceae	<i>Siphonodon australis</i>	ivorywood		C		2/2
plants	land plants	Chenopodiaceae	<i>Atriplex muelleri</i>	lagoon saltbush		C		1/1
plants	land plants	Chenopodiaceae	<i>Atriplex semibaccata</i>	creeping saltbush		C		1/1
plants	land plants	Chenopodiaceae	<i>Chenopodium album</i>	fat-hen	Y			3/3
plants	land plants	Chenopodiaceae	<i>Dysphania carinata</i>			C		3/1
plants	land plants	Chenopodiaceae	<i>Dysphania pumilio</i>			C		1
plants	land plants	Chenopodiaceae	<i>Einadia hastata</i>			C		3/1
plants	land plants	Chenopodiaceae	<i>Einadia polygonoides</i>	knotweed goosefoot		C		10
plants	land plants	Chenopodiaceae	<i>Einadia trigonos</i> subsp. <i>stellulata</i>			C		1
plants	land plants	Chenopodiaceae	<i>Maireana microphylla</i>			C		2
plants	land plants	Chenopodiaceae	<i>Salsola australis</i>			C		3
plants	land plants	Chenopodiaceae	<i>Sclerolaena birchii</i>	galvanised burr		C		1
plants	land plants	Chenopodiaceae	<i>Sclerolaena muricata</i>			C		5
plants	land plants	Chenopodiaceae	<i>Sclerolaena muricata</i> var. <i>villosa</i>			C		1/1
plants	land plants	Colchicaceae	<i>Iphigenia indica</i>			C		1
plants	land plants	Colchicaceae	<i>Wurmbea biglandulosa</i> subsp. <i>biglandulosa</i>			C		1/1
plants	land plants	Commelinaceae	<i>Aneilema acuminatum</i>			C		1
plants	land plants	Commelinaceae	<i>Callisia repens</i>		Y			2
plants	land plants	Commelinaceae	<i>Commelina</i>					1
plants	land plants	Commelinaceae	<i>Commelina diffusa</i>			C		5/1
plants	land plants	Commelinaceae	<i>Commelina ensifolia</i>	scurvy grass		C		5
plants	land plants	Commelinaceae	<i>Commelina lanceolata</i>			C		6
plants	land plants	Commelinaceae	<i>Murdannia graminea</i>	murdannia		C		1
plants	land plants	Commelinaceae	<i>Tradescantia fluminensis</i>		Y			2/1
plants	land plants	Commelinaceae	<i>Tradescantia zebrina</i>		Y			1
plants	land plants	Convolvulaceae	<i>Calystegia marginata</i>	forest bindweed		C		1
plants	land plants	Convolvulaceae	<i>Convolvulus arvensis</i>		Y			5
plants	land plants	Convolvulaceae	<i>Convolvulus graminetinus</i>			C		10
plants	land plants	Convolvulaceae	<i>Cuscuta campestris</i>	dodder	Y			2/1
plants	land plants	Convolvulaceae	<i>Dichondra repens</i>	kidney weed		C		19/1
plants	land plants	Convolvulaceae	<i>Evolvulus alsinoides</i>			C		1
plants	land plants	Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>			C		4
plants	land plants	Convolvulaceae	<i>Ipomoea alba</i>	moon flower	Y			1
plants	land plants	Convolvulaceae	<i>Ipomoea indica</i>	blue morning-glory	Y			3
plants	land plants	Convolvulaceae	<i>Ipomoea lonchophylla</i>			C		2/1
plants	land plants	Convolvulaceae	<i>Ipomoea purpurea</i>	common morning glory	Y			5/4
plants	land plants	Convolvulaceae	<i>Polymeria</i>					1
plants	land plants	Convolvulaceae	<i>Polymeria pusilla</i>			C		1/1
plants	land plants	Crassulaceae	<i>Bryophyllum daigremontianum</i>		Y			1/1
plants	land plants	Crassulaceae	<i>Bryophyllum proliferum</i>		Y			1/1
plants	land plants	Crassulaceae	<i>Crassula sieberiana</i>			C		2
plants	land plants	Cucurbitaceae	<i>Cucumis myriocarpus</i> subsp. <i>myriocarpus</i>	prickly pademelon	Y			1
plants	land plants	Cucurbitaceae	<i>Diplocyclos palmatus</i>			C		1
plants	land plants	Cucurbitaceae	<i>Diplocyclos palmatus</i> subsp. <i>palmatus</i>			C		2/1

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plants	land plants	Cucurbitaceae	<i>Sicyos australis</i>	star cucumber		C		1
plants	land plants	Cucurbitaceae	<i>Zehneria cunninghamii</i>	slender cucumber		C		1/1
plants	land plants	Cupressaceae	<i>Callitris baileyi</i>	Bailey's cypress		NT		1/1
plants	land plants	Cupressaceae	<i>Callitris glaucophylla</i>	white cypress pine		C		1/1
plants	land plants	Cyatheaceae	<i>Sphaeropteris cooperi</i>			C		4/1
plants	land plants	Cyperaceae	<i>Carex breviculmis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Carex declinata</i>			C		2/2
plants	land plants	Cyperaceae	<i>Carex inversa</i>	knob sedge		C		2/1
plants	land plants	Cyperaceae	<i>Cyperus</i>					1
plants	land plants	Cyperaceae	<i>Cyperus clarus</i>			V		1/1
plants	land plants	Cyperaceae	<i>Cyperus eragrostis</i>		Y			5/2
plants	land plants	Cyperaceae	<i>Cyperus flavescens</i>		Y			2/2
plants	land plants	Cyperaceae	<i>Cyperus flavidus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus fulvus</i>			C		1
plants	land plants	Cyperaceae	<i>Cyperus gracilis</i>			C		7/1
plants	land plants	Cyperaceae	<i>Cyperus imbecillis</i>			C		1
plants	land plants	Cyperaceae	<i>Cyperus involucratus</i>		Y			3
plants	land plants	Cyperaceae	<i>Cyperus laevis</i>			C		3/3
plants	land plants	Cyperaceae	<i>Cyperus nutans</i> var. <i>eleusinoides</i>	flatsedge		C		1/1
plants	land plants	Cyperaceae	<i>Cyperus rigidellus</i>			C		1
plants	land plants	Cyperaceae	<i>Cyperus rotundus</i>	nutgrass	Y			18
plants	land plants	Cyperaceae	<i>Cyperus rotundus</i> var. <i>carinalis</i>			C		2
plants	land plants	Cyperaceae	<i>Cyperus sesquiflorus</i>		Y			1
plants	land plants	Cyperaceae	<i>Cyperus sphaeroideus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus tetraphyllus</i>			C		2/2
plants	land plants	Cyperaceae	<i>Cyperus vaginatus</i>			C		1
plants	land plants	Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-rush		C		1
plants	land plants	Cyperaceae	<i>Gahnia aspera</i>			C		4/2
plants	land plants	Cyperaceae	<i>Lepidosperma laterale</i>			C		4/2
plants	land plants	Cyperaceae	<i>Scleria mackaviensis</i>			C		1/1
plants	land plants	Davalliaceae	<i>Davallia pyxidata</i>			C		3
plants	land plants	Dennstaedtiaceae	<i>Pteridium esculentum</i>	common bracken		C		5
plants	land plants	Dilleniaceae	<i>Hibbertia linearis</i>			C		1
plants	land plants	Dioscoreaceae	<i>Dioscorea transversa</i>	native yam		C		2/1
plants	land plants	Dryopteridaceae	<i>Parapolystichum acuminatum</i>			SL		1
plants	land plants	Ebenaceae	<i>Diospyros geminata</i>	scaly ebony		C		1
plants	land plants	Ebenaceae	<i>Diospyros humilis</i>	small-leaved ebony		C		1/1
plants	land plants	Elaeocarpaceae	<i>Elaeocarpus obovatus</i> subsp. <i>obovatus</i>			C		3/3
plants	land plants	Elatinaceae	<i>Elatine gratioloides</i>	waterwort		C		1/1
plants	land plants	Ericaceae	<i>Melichrus urceolatus</i>	honey gorse		C		1/1
plants	land plants	Ericaceae	<i>Monotoca scoparia</i>	prickly broom heath		C		1/1
plants	land plants	Ericaceae	<i>Styphelia sieberi</i>			C		1
plants	land plants	Erythroxylaceae	<i>Erythroxylum</i> sp. (Splityard Creek L.Pedley 5360)			C		3/3
plants	land plants	Euphorbiaceae	<i>Acalypha capillipes</i>	small-leaved acalypha		C		3/2
plants	land plants	Euphorbiaceae	<i>Croton insularis</i>	Queensland cascarilla		C		2/2
plants	land plants	Euphorbiaceae	<i>Croton phebaloides</i>	narrow-leaved croton		C		1/1

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plants	land plants	Euphorbiaceae	<i>Euphorbia</i>					11
plants	land plants	Euphorbiaceae	<i>Euphorbia davidii</i>		Y			10/1
plants	land plants	Euphorbiaceae	<i>Euphorbia drummondii</i>			C		1
plants	land plants	Euphorbiaceae	<i>Euphorbia hirta</i>		Y			3
plants	land plants	Euphorbiaceae	<i>Euphorbia hyssopifolia</i>		Y			1
plants	land plants	Euphorbiaceae	<i>Euphorbia prostrata</i>		Y			2
plants	land plants	Euphorbiaceae	<i>Euphorbiaceae</i>					1/1
plants	land plants	Euphorbiaceae	<i>Excoecaria dallachyana</i>	scrub poison tree		C		3/3
plants	land plants	Euphorbiaceae	<i>Homalanthus</i>			C		1
plants	land plants	Euphorbiaceae	<i>Homalanthus populifolius</i>			C		1
plants	land plants	Euphorbiaceae	<i>Mallotus philippensis</i>	red kamala		C		1
plants	land plants	Euphorbiaceae	<i>Manihot grahamii</i>		Y			1/1
plants	land plants	Euphorbiaceae	<i>Ricinocarpos ledifolius</i>	scrub wedding bush		C		1/1
plants	land plants	Euphorbiaceae	<i>Ricinus communis</i>	castor oil bush	Y			3
plants	land plants	Fabroniaceae	<i>Fabronia</i> sp. (Brisbane F.M.Bailey 296)			C		1/1
plants	land plants	Frullaniaceae	<i>Frullania rubella</i>			C		1/1
plants	land plants	Funariaceae	<i>Entosthodon radians</i>			C		1/1
plants	land plants	Gentianaceae	<i>Centaurium erythraea</i>	common centaury	Y			3/1
plants	land plants	Geraniaceae	<i>Erodium crinitum</i>	blue crowfoot		C		2/1
plants	land plants	Geraniaceae	<i>Geranium homeanum</i>			C		2/1
plants	land plants	Geraniaceae	<i>Geranium solanderi</i>			C		1
plants	land plants	Geraniaceae	<i>Geranium solanderi</i> var. <i>solanderi</i>	native geranium		C		12
plants	land plants	Goodeniaceae	<i>Goodenia</i>					1
plants	land plants	Goodeniaceae	<i>Goodenia bellidifolia</i> subsp. <i>argentea</i>			C		1/1
plants	land plants	Goodeniaceae	<i>Goodenia delicata</i>			C		1/1
plants	land plants	Gyrostemonaceae	<i>Codonocarpus attenuatus</i>			C		1
plants	land plants	Haloragaceae	<i>Haloragis heterophylla</i>	rough raspweed		C		1
plants	land plants	Hemerocallidaceae	<i>Caesia parviflora</i>			C		2/1
plants	land plants	Hemerocallidaceae	<i>Caesia parviflora</i> var. <i>vittata</i>			C		1
plants	land plants	Hemerocallidaceae	<i>Dianella brevipedunculata</i>			C		1
plants	land plants	Hemerocallidaceae	<i>Dianella caerulea</i>			C		3/2
plants	land plants	Hemerocallidaceae	<i>Dianella longifolia</i>			C		3/1
plants	land plants	Hemerocallidaceae	<i>Dianella revoluta</i>			C		1/1
plants	land plants	Hemerocallidaceae	<i>Geitonoplesium cymosum</i>	scrambling lily		C		2
plants	land plants	Hemerocallidaceae	<i>Geitonoplesium cymosum</i> forma <i>album</i>			C		4
plants	land plants	Hydrocharitaceae	<i>Egeria densa</i>	dense waterweed	Y			4/2
plants	land plants	Hydrocharitaceae	<i>Hydrilla verticillata</i>	hydrilla		SL		1
plants	land plants	Hydrocharitaceae	<i>Limnobium laevigatum</i>		Y			2/1
plants	land plants	Hypericaceae	<i>Hypericum gramineum</i>			C		1
plants	land plants	Hypoxidaceae	<i>Hypoxis pratensis</i>			C		1
plants	land plants	Iridaceae	<i>Iridaceae</i>					1/1
plants	land plants	Iridaceae	<i>Moraea setifolia</i>		Y			1/1
plants	land plants	Juncaceae	<i>Juncus articulatus</i>	jointed rush	Y			2/2
plants	land plants	Juncaceae	<i>Juncus bufonius</i>	toad rush	Y			1/1
plants	land plants	Lamiaceae	<i>Ajuga australis</i>	Australian bugle		C		5/1
plants	land plants	Lamiaceae	<i>Ajuga sinuata</i>			C		2/2

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plants	land plants	Lamiaceae	<i>Clerodendrum floribundum</i>			C		2
plants	land plants	Lamiaceae	<i>Coleus australis</i>			C		4/2
plants	land plants	Lamiaceae	<i>Lamium amplexicaule</i>	deadnettle	Y			5/1
plants	land plants	Lamiaceae	<i>Marrubium vulgare</i>	white horehound	Y			3
plants	land plants	Lamiaceae	<i>Mentha australis</i>	river mint		C		1
plants	land plants	Lamiaceae	<i>Mentha satureioides</i>	native pennyroyal		C		7/3
plants	land plants	Lamiaceae	<i>Prunella vulgaris</i>	self heal	Y			2/1
plants	land plants	Lamiaceae	<i>Salvia reflexa</i>		Y			9
plants	land plants	Lamiaceae	<i>Salvia verbenaca</i>	wild sage	Y			3/2
plants	land plants	Lamiaceae	<i>Teucrium argutum</i>			C		3/1
plants	land plants	Lamiaceae	<i>Teucrium junceum</i>			C		1/1
plants	land plants	Lauraceae	<i>Cinnamomum camphora</i>	camphor laurel	Y			1
plants	land plants	Laxmanniaceae	<i>Arthropodium fimbriatum</i>			C		1
plants	land plants	Laxmanniaceae	<i>Arthropodium milleflorum</i>	vanilla lily		C		2
plants	land plants	Laxmanniaceae	<i>Arthropodium paniculatum</i>			C		1/1
plants	land plants	Laxmanniaceae	<i>Cordyline petiolaris</i>	large-leaved palm lily		C		1
plants	land plants	Laxmanniaceae	<i>Eustrephus latifolius</i>	wombat berry		C		6/3
plants	land plants	Laxmanniaceae	<i>Eustrephus latifolius subforma fimbriatus</i>			C		1
plants	land plants	Laxmanniaceae	<i>Lomandra filiformis</i>			C		2
plants	land plants	Laxmanniaceae	<i>Lomandra longifolia</i>			C		5
plants	land plants	Laxmanniaceae	<i>Lomandra multiflora</i>			C		2
plants	land plants	Laxmanniaceae	<i>Lomandra multiflora subsp. multiflora</i>			C		1
plants	land plants	Laxmanniaceae	<i>Thysanotus tuberosus</i>			C		3
plants	land plants	Leguminosae	<i>Acacia burrowii</i>			C		1
plants	land plants	Leguminosae	<i>Acacia complanata</i>	flatstem wattle		C		1/1
plants	land plants	Leguminosae	<i>Acacia decora</i>	pretty wattle		C		2/1
plants	land plants	Leguminosae	<i>Acacia excelsa subsp. excelsa</i>			C		4
plants	land plants	Leguminosae	<i>Acacia falcata</i>	sickle wattle		C		1
plants	land plants	Leguminosae	<i>Acacia fimbriata</i>	Brisbane golden wattle		C		2
plants	land plants	Leguminosae	<i>Acacia glaucocarpa</i>	hickory wattle		C		1
plants	land plants	Leguminosae	<i>Acacia implexa</i>	lightwood		C		4
plants	land plants	Leguminosae	<i>Acacia irrorata subsp. irrorata</i>			C		1/1
plants	land plants	Leguminosae	<i>Acacia maidenii</i>	Maiden's wattle		C		1
plants	land plants	Leguminosae	<i>Acacia melanoxylon</i>	blackwood		C		2/1
plants	land plants	Leguminosae	<i>Acacia neriifolia</i>	pechey wattle		C		1/1
plants	land plants	Leguminosae	<i>Acacia podalyriifolia</i>	Queensland silver wattle		C		2/1
plants	land plants	Leguminosae	<i>Acacia pustula</i>			C		1/1
plants	land plants	Leguminosae	<i>Acacia salicina</i>	doolan		C		10/1
plants	land plants	Leguminosae	<i>Acacia sertiformis</i>			C		1/1
plants	land plants	Leguminosae	<i>Biancaea decapetala</i>		Y			1/1
plants	land plants	Leguminosae	<i>Chamaecrista mimosoides</i>	dwarf cassia		C		1/1
plants	land plants	Leguminosae	<i>Crotalaria brevis</i>			C		1/1
plants	land plants	Leguminosae	<i>Crotalaria mitchellii</i>			C		3
plants	land plants	Leguminosae	<i>Crotalaria montana</i>			C		2
plants	land plants	Leguminosae	<i>Cullen tenax</i>	emu-foot		C		10/1
plants	land plants	Leguminosae	<i>Daviesia wyattiana</i>	long-leaved bitter pea		C		1/1

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plants	land plants	Leguminosae	<i>Desmanthus pernambucanus</i>		Y			1/1
plants	land plants	Leguminosae	<i>Desmodium brachypodium</i>	large ticktrefoil		C		1/1
plants	land plants	Leguminosae	<i>Desmodium gunnii</i>			C		1/1
plants	land plants	Leguminosae	<i>Desmodium rhytidophyllum</i>			C		2
plants	land plants	Leguminosae	<i>Desmodium varians</i>	slender tick trefoil		C		1
plants	land plants	Leguminosae	<i>Erythrina vespertilio</i>			C		1
plants	land plants	Leguminosae	<i>Erythrina vespertilio subsp. vespertilio</i>			C		1
plants	land plants	Leguminosae	<i>Erythrostemon gilliesii</i>		Y			1/1
plants	land plants	Leguminosae	<i>Galactia tenuiflora var. lucida</i>			C		3/1
plants	land plants	Leguminosae	<i>Genista monspessulana</i>	Montpellier broom	Y			2/2
plants	land plants	Leguminosae	<i>Gleditsia triacanthos</i>	honey locust	Y			3/1
plants	land plants	Leguminosae	<i>Glycine clandestina</i>			C		7
plants	land plants	Leguminosae	<i>Glycine microphylla</i>			C		1/1
plants	land plants	Leguminosae	<i>Glycine tabacina</i>	glycine pea		C		8/1
plants	land plants	Leguminosae	<i>Glycine tomentella</i>	woolly glycine		C		11
plants	land plants	Leguminosae	<i>Hardenbergia violacea</i>			C		3/1
plants	land plants	Leguminosae	<i>Hovea longipes</i>	brush hovea		C		1/1
plants	land plants	Leguminosae	<i>Hovea lorata</i>			C		1/1
plants	land plants	Leguminosae	<i>Indigofera arrecta</i>		Y			2/2
plants	land plants	Leguminosae	<i>Indigofera australis</i>			C		2
plants	land plants	Leguminosae	<i>Indigofera hirsuta</i>	hairy indigo		C		1
plants	land plants	Leguminosae	<i>Lathyrus latifolius</i>	perennial pea	Y			1/1
plants	land plants	Leguminosae	<i>Lespedeza juncea</i>			C		2
plants	land plants	Leguminosae	<i>Lespedeza juncea subsp. sericea</i>	perennial lespedeza		C		2/1
plants	land plants	Leguminosae	<i>Lysiphyllum</i>					2
plants	land plants	Leguminosae	<i>Macroptilium atropurpureum</i>	siratiro	Y			7/1
plants	land plants	Leguminosae	<i>Medicago minima var. minima</i>		Y			2
plants	land plants	Leguminosae	<i>Medicago polymorpha</i>	burr medic	Y			6/2
plants	land plants	Leguminosae	<i>Medicago sativa</i>	lucerne	Y			2
plants	land plants	Leguminosae	<i>Medicago sativa subsp. sativa</i>		Y			13/1
plants	land plants	Leguminosae	<i>Medicago scutellata</i>	snail medic	Y			1
plants	land plants	Leguminosae	<i>Melilotus albus</i>	sweet clover	Y			18/1
plants	land plants	Leguminosae	<i>Melilotus indicus</i>	hexham scent	Y			3/1
plants	land plants	Leguminosae	<i>Neptunia gracilis</i>			C		4
plants	land plants	Leguminosae	<i>Pararchidendron pruinosum</i>			C		1/1
plants	land plants	Leguminosae	<i>Rhynchosia</i>					1
plants	land plants	Leguminosae	<i>Rhynchosia minima</i>			C		12
plants	land plants	Leguminosae	<i>Senna acclinis</i>			C		1/1
plants	land plants	Leguminosae	<i>Senna barclayana</i>			C		7
plants	land plants	Leguminosae	<i>Senna coronilloides</i>			C		1/1
plants	land plants	Leguminosae	<i>Senna pendula var. glabrata</i>	Easter cassia	Y			2/2
plants	land plants	Leguminosae	<i>Senna sophera var. (40Mile Scrub J.R.Clarkson+ 6908)</i>			C		1/1
plants	land plants	Leguminosae	<i>Senna sophera var. sophera</i>			C		1/1
plants	land plants	Leguminosae	<i>Sesbania cannabina var. cannabina</i>			C		1
plants	land plants	Leguminosae	<i>Sophora fraseri</i>	brush sophora		V	V	3/2

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plants	land plants	Leguminosae	<i>Swainsona brachycarpa</i>			C		2/2
plants	land plants	Leguminosae	<i>Swainsona queenslandica</i>			C		6/1
plants	land plants	Leguminosae	<i>Swainsona reticulata</i>			C		1/1
plants	land plants	Leguminosae	<i>Tephrosia rufula</i>			C		1
plants	land plants	Leguminosae	<i>Trifolium campestre</i>		Y			1
plants	land plants	Leguminosae	<i>Trifolium campestre</i> var. <i>campestre</i>		Y			1/1
plants	land plants	Leguminosae	<i>Trifolium repens</i> var. <i>repens</i>	white clover	Y			6
plants	land plants	Leguminosae	<i>Vachellia farnesiana</i>		Y			10
plants	land plants	Leguminosae	<i>Vicia monantha</i> subsp. <i>monantha</i>		Y			2
plants	land plants	Leguminosae	<i>Vicia sativa</i> subsp. <i>nigra</i>		Y			1
plants	land plants	Leguminosae	<i>Vigna suberecta</i>			C		2
plants	land plants	Leguminosae	<i>Zornia dyctiocarpa</i>			C		1
plants	land plants	Leguminosae	<i>Zornia dyctiocarpa</i> var. <i>dyctiocarpa</i>			C		1
plants	land plants	Lejeuneaceae	<i>Lejeunea aloba</i>			C		1/1
plants	land plants	Lentibulariaceae	<i>Utricularia gibba</i>	floating bladderwort		SL		1/1
plants	land plants	Linaceae	<i>Linum marginale</i>	native flax		C		1/1
plants	land plants	Loranthaceae	<i>Amyema congener</i> subsp. <i>rotundifolia</i>			C		2/2
plants	land plants	Loranthaceae	<i>Amyema lucasii</i>			C		4/3
plants	land plants	Loranthaceae	<i>Amyema miquelii</i>			C		2
plants	land plants	Loranthaceae	<i>Amyema pendula</i> subsp. <i>longifolia</i>			C		1
plants	land plants	Loranthaceae	<i>Amylothea dictyophleba</i>			C		10
plants	land plants	Loranthaceae	<i>Dendrophthoe glabrescens</i>			C		2/1
plants	land plants	Loranthaceae	<i>Lysiana subfalcata</i>			C		2/1
plants	land plants	Loranthaceae	<i>Muellerina eucalyptoides</i>			C		2/1
plants	land plants	Lunulariaceae	<i>Lunularia</i>					1/1
plants	land plants	Lythraceae	<i>Lythrum salicaria</i>	purple loosestrife		C		2/1
plants	land plants	Malvaceae	<i>Abutilon oxycarpum</i>			C		2
plants	land plants	Malvaceae	<i>Anoda cristata</i>	anoda weed	Y			10/1
plants	land plants	Malvaceae	<i>Hibiscus</i>					2
plants	land plants	Malvaceae	<i>Hibiscus tridactylites</i>			C		14/2
plants	land plants	Malvaceae	<i>Malva parviflora</i>	small-flowered mallow	Y			6
plants	land plants	Malvaceae	<i>Malvastrum americanum</i>		Y			10
plants	land plants	Malvaceae	<i>Malvastrum coromandelianum</i> subsp. <i>coromandelianum</i>		Y			2/1
plants	land plants	Malvaceae	<i>Modiola caroliniana</i>	red-flowered mallow	Y			16
plants	land plants	Malvaceae	<i>Pavonia hastata</i>	pink pavonia	Y			12/1
plants	land plants	Malvaceae	<i>Sida</i>					2/2
plants	land plants	Malvaceae	<i>Sida hackettiana</i>			C		2/1
plants	land plants	Malvaceae	<i>Sida hackettiana</i> subsp. (Gayndah P.Grimshaw+ PG2388)			C		12
plants	land plants	Malvaceae	<i>Sida rhombifolia</i>		Y			17/2
plants	land plants	Malvaceae	<i>Sida spinosa</i>	spiny sida	Y			4
plants	land plants	Malvaceae	<i>Sida trichopoda</i>			C		1
plants	land plants	Marchantiaceae	<i>Marchantia foliacea</i>			C		2/2
plants	land plants	Martyniaceae	<i>Proboscidea louisianica</i> subsp. <i>fragrans</i>		Y			1/1
plants	land plants	Meliaceae	<i>Melia azedarach</i>	white cedar		C		2/1
plants	land plants	Meliaceae	<i>Toona ciliata</i>	red cedar		C		1/1

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plants	land plants	Meliaceae	<i>Turraea pubescens</i>	native honeysuckle		C		4/4
plants	land plants	Menispermaceae	<i>Legnephora moorei</i>			C		2/1
plants	land plants	Menispermaceae	<i>Stephania japonica</i>			C		1
plants	land plants	Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>			C		1
plants	land plants	Menispermaceae	<i>Tinospora smilacina</i>	snakevine		C		1
plants	land plants	Menyanthaceae	<i>Nymphoides indica</i>	water snowflake		SL		1
plants	land plants	Metzgeriaceae	<i>Metzgeria</i>					1/1
plants	land plants	Moraceae	<i>Ficus coronata</i>	creek sandpaper fig		C		2/1
plants	land plants	Moraceae	<i>Ficus henneana</i>			C		1
plants	land plants	Moraceae	<i>Ficus rubiginosa</i> forma <i>glabrescens</i>			C		1/1
plants	land plants	Moraceae	<i>Ficus rubiginosa</i> forma <i>rubiginosa</i>			C		1/1
plants	land plants	Moraceae	<i>Maclura cochinchinensis</i>	cockspur thorn		C		2
plants	land plants	Moraceae	<i>Streblus brunonianus</i>	whalebone tree		C		2
plants	land plants	Myrsinaceae	<i>Lysimachia arvensis</i>		Y			1
plants	land plants	Myrsinaceae	<i>Myrsine variabilis</i>			C		3/3
plants	land plants	Myrtaceae	<i>Angophora floribunda</i>	rough-barked apple		C		3/1
plants	land plants	Myrtaceae	<i>Angophora leiocarpa</i>	rusty gum		C		1/1
plants	land plants	Myrtaceae	<i>Corymbia</i>					1
plants	land plants	Myrtaceae	<i>Corymbia clarksoniana</i>			C		1/1
plants	land plants	Myrtaceae	<i>Corymbia intermedia</i>	pink bloodwood		C		1
plants	land plants	Myrtaceae	<i>Eucalyptus</i>					1
plants	land plants	Myrtaceae	<i>Eucalyptus biturbinata</i>			C		2/1
plants	land plants	Myrtaceae	<i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i>			C		1
plants	land plants	Myrtaceae	<i>Eucalyptus crebra</i>	narrow-leaved red ironbark		C		1
plants	land plants	Myrtaceae	<i>Eucalyptus eugenioides</i>			C		2
plants	land plants	Myrtaceae	<i>Eucalyptus major</i>	mountain grey gum		C		2/1
plants	land plants	Myrtaceae	<i>Eucalyptus melliodora</i>	yellow box		C		4/1
plants	land plants	Myrtaceae	<i>Eucalyptus montivaga</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus nobilis</i>	manna gum		C		2/2
plants	land plants	Myrtaceae	<i>Eucalyptus orgadophila</i>	mountain coolibah		C		10/7
plants	land plants	Myrtaceae	<i>Eucalyptus pilularis</i>	blackbutt		C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus tereticornis</i>			C		4
plants	land plants	Myrtaceae	<i>Eucalyptus tereticornis</i> subsp. <i>basaltica</i>			C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus tereticornis</i> subsp. <i>tereticornis</i>			C		1/1
plants	land plants	Myrtaceae	<i>Gossia bidwillii</i>			C		1/1
plants	land plants	Myrtaceae	<i>Leptospermum polygalifolium</i>	tantoon		C		1/1
plants	land plants	Myrtaceae	<i>Lophostemon confertus</i>	brush box		C		2
plants	land plants	Myrtaceae	<i>Melaleuca bracteata</i>			C		2
plants	land plants	Myrtaceae	<i>Melaleuca viminalis</i>			C		1
plants	land plants	Myrtaceae	<i>Rhodamnia dumicola</i>	rib-fruited malletwood		E		1/1
plants	land plants	Nephrolepidaceae	<i>Nephrolepis cordifolia</i>	fishbone fern		C		6
plants	land plants	Notothyladaceae	<i>Phaeoceros carolinianus</i>			C		1
plants	land plants	Nyctaginaceae	<i>Boerhavia dominii</i>			C		10
plants	land plants	Nyctaginaceae	<i>Mirabilis jalapa</i>	four o'clock	Y			1/1
plants	land plants	Nymphaeaceae	<i>Nymphaea caerulea</i>		Y			1
plants	land plants	Ochnaceae	<i>Ochna serrulata</i>	ochna	Y			2

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plants	land plants	Oleaceae	<i>Jasminum</i>					1
plants	land plants	Oleaceae	<i>Jasminum dianthifolium</i>			C		5/1
plants	land plants	Oleaceae	<i>Jasminum dianthifolium</i> x <i>Jasminum simplicifolium</i>			C		1/1
			<i>subsp. australiense</i>					
plants	land plants	Oleaceae	<i>Jasminum didymum</i> subsp. <i>racemosum</i>			C		1/1
plants	land plants	Oleaceae	<i>Jasminum simplicifolium</i> subsp. <i>australiense</i>			C		2/2
plants	land plants	Oleaceae	<i>Ligustrum lucidum</i>	large-leaved privet	Y			7/1
plants	land plants	Oleaceae	<i>Notelaea linearis</i>			C		1/1
plants	land plants	Oleaceae	<i>Notelaea microcarpa</i>			C		2
plants	land plants	Oleaceae	<i>Olea europaea</i> subsp. <i>cuspidata</i>		Y			3/3
plants	land plants	Onagraceae	<i>Epilobium billardierianum</i>			C		1
plants	land plants	Onagraceae	<i>Epilobium hirtigerum</i>			C		1/1
plants	land plants	Onagraceae	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>			C		3
plants	land plants	Onagraceae	<i>Oenothera affinis</i>	long-flowered evening primrose	Y			1/1
plants	land plants	Onagraceae	<i>Oenothera curtiflora</i>		Y			6/1
plants	land plants	Onagraceae	<i>Oenothera stricta</i> subsp. <i>stricta</i>		Y			2/2
plants	land plants	Onagraceae	<i>Oenothera tetraptera</i>	four-winged evening primrose	Y			1/1
plants	land plants	Ophioglossaceae	<i>Ophioglossum lusitanicum</i>	adder's tongue		C		2
plants	land plants	Ophioglossaceae	<i>Ophioglossum reticulatum</i>			C		2/2
plants	land plants	Orchidaceae	<i>Acianthus fornicatus</i>	pixie caps		SL		2
plants	land plants	Orchidaceae	<i>Calochilus campestris</i>	copper beard orchid		SL		1/1
plants	land plants	Orchidaceae	<i>Corybas</i>					1
plants	land plants	Orchidaceae	<i>Cymbidium canaliculatum</i>			SL		1
plants	land plants	Orchidaceae	<i>Cymbidium suave</i>			SL		1
plants	land plants	Orchidaceae	<i>Dendrobium monophyllum</i>			SL		1
plants	land plants	Orchidaceae	<i>Dendrobium speciosum</i>			SL		2
plants	land plants	Orchidaceae	<i>Dendrobium speciosum</i> subsp. <i>hillii</i>			SL		1
plants	land plants	Orchidaceae	<i>Dendrobium</i> x <i>delicatum</i>			SL		1/1
plants	land plants	Orchidaceae	<i>Diuris abbreviata</i>	lemon doubletail		SL		1
plants	land plants	Orchidaceae	<i>Diuris sulphurea</i>	tiger orchid		SL		5/1
plants	land plants	Orchidaceae	<i>Dockrillia bowmanii</i>	scrub pencil orchid		SL		2/1
plants	land plants	Orchidaceae	<i>Dockrillia cucumerina</i>			SL		2
plants	land plants	Orchidaceae	<i>Dockrillia linguiformis</i>	tongue orchid		SL		3
plants	land plants	Orchidaceae	<i>Dockrillia pugioniformis</i>	dagger orchid		SL		1
plants	land plants	Orchidaceae	<i>Dockrillia teretifolia</i>	rat's tail orchid		SL		1
plants	land plants	Orchidaceae	<i>Microtis parviflora</i>	slender onion orchid		SL		1/1
plants	land plants	Orchidaceae	<i>Pterostylis acuminata</i>	sharp greenhood		SL		1
plants	land plants	Orchidaceae	<i>Pterostylis baptistii</i>	king greenhood		SL		1
plants	land plants	Orchidaceae	<i>Pterostylis curta</i>	blunt greenhood		SL		2/1
plants	land plants	Orchidaceae	<i>Pterostylis erecta</i>			SL		1
plants	land plants	Orchidaceae	<i>Pterostylis grandiflora</i>			SL		2/1
plants	land plants	Orchidaceae	<i>Sarcochilus ceciliae</i>	fairy bells		SL		2/1
plants	land plants	Orchidaceae	<i>Sarcochilus falcatus</i>	orange blossom orchid		SL		1/1
plants	land plants	Orchidaceae	<i>Sarcochilus weinthalii</i>	blotched sarcochilus		E	V	2/2
plants	land plants	Orobanchaceae	<i>Orobanche minor</i>	lesser broomrape	Y			2/2
plants	land plants	Oxalidaceae	<i>Oxalis</i>					1

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plants	land plants	Oxalidaceae	<i>Oxalis articulata</i>	shamrock oxalis	Y			1/1
plants	land plants	Oxalidaceae	<i>Oxalis chnoodes</i>			C		9
plants	land plants	Oxalidaceae	<i>Oxalis corniculata</i>		Y			5
plants	land plants	Oxalidaceae	<i>Oxalis debilis</i> var. <i>corymbosa</i>	pink shamrock	Y			1
plants	land plants	Oxalidaceae	<i>Oxalis latifolia</i>	fishtail oxalis	Y			1/1
plants	land plants	Oxalidaceae	<i>Oxalis perennans</i>			C		4/2
plants	land plants	Papaveraceae	<i>Argemone ochroleuca</i>		Y			1
plants	land plants	Papaveraceae	<i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i>	Mexican poppy	Y			2
plants	land plants	Papaveraceae	<i>Fumaria bastardii</i>	bastard fumitory	Y			1/1
plants	land plants	Papaveraceae	<i>Fumaria densiflora</i>	dense-flowered fumitory	Y			1/1
plants	land plants	Papaveraceae	<i>Fumaria muralis</i> subsp. <i>muralis</i>	wall fumitory	Y			1/1
plants	land plants	Papaveraceae	<i>Papaver aculeatum</i>	bristle poppy	Y			3
plants	land plants	Papaveraceae	<i>Papaver hybridum</i>	rough poppy	Y			1/1
plants	land plants	Papaveraceae	<i>Papaver somniferum</i>	opium poppy	Y			3
plants	land plants	Papaveraceae	<i>Papaver somniferum</i> subsp. <i>setigerum</i>		Y			4/1
plants	land plants	Papaveraceae	<i>Papaver somniferum</i> subsp. <i>somniferum</i>		Y			2/1
plants	land plants	Passifloraceae	<i>Passiflora aurantia</i>			C		2
plants	land plants	Passifloraceae	<i>Passiflora edulis</i>		Y			1
plants	land plants	Passifloraceae	<i>Passiflora herbertiana</i> subsp. <i>herbertiana</i>	native passionfruit		C		2
plants	land plants	Passifloraceae	<i>Passiflora suberosa</i> subsp. <i>litoralis</i>		Y			5/2
plants	land plants	Passifloraceae	<i>Passiflora subpeltata</i>	white passion flower	Y			1/1
plants	land plants	Phyllanthaceae	<i>Breynia oblongifolia</i>			C		4/1
plants	land plants	Phyllanthaceae	<i>Bridelia exaltata</i>			C		1
plants	land plants	Phyllanthaceae	<i>Bridelia leichhardtii</i>			C		4/4
plants	land plants	Phyllanthaceae	<i>Phyllanthus</i>					2/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus gunnii</i>			C		2
plants	land plants	Phyllanthaceae	<i>Phyllanthus similis</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus virgatus</i>			C		2
plants	land plants	Phytolaccaceae	<i>Phytolacca octandra</i>	inkweed	Y			3/1
plants	land plants	Pinaceae	<i>Pinus</i>					2
plants	land plants	Pittosporaceae	<i>Auranticarpa rhombifolia</i>			C		1
plants	land plants	Pittosporaceae	<i>Bursaria incana</i>			C		3/2
plants	land plants	Pittosporaceae	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>			C		2
plants	land plants	Pittosporaceae	<i>Pittosporum angustifolium</i>			C		3/1
plants	land plants	Pittosporaceae	<i>Pittosporum undulatum</i>	sweet pittosporum		C		2
plants	land plants	Plantaginaceae	<i>Linaria texana</i>		Y			1/1
plants	land plants	Plantaginaceae	<i>Plantago cunninghamii</i>	sago weed		C		1
plants	land plants	Plantaginaceae	<i>Plantago debilis</i>	shade plantain		C		8/1
plants	land plants	Plantaginaceae	<i>Plantago lanceolata</i>		Y			29/2
plants	land plants	Plantaginaceae	<i>Plantago major</i>	greater plantain	Y			12
plants	land plants	Plantaginaceae	<i>Veronica plebeia</i>	trailing speedwell		C		3/1
plants	land plants	Plumbaginaceae	<i>Plumbago zeylanica</i>	native plumbago		C		3/3
plants	land plants	Poaceae	<i>Anthosachne plurinervis</i>			C		4
plants	land plants	Poaceae	<i>Anthosachne scabra</i>			C		2/2
plants	land plants	Poaceae	<i>Aristida calycina</i>			C		1
plants	land plants	Poaceae	<i>Aristida caput-medusae</i>			C		1

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plants	land plants	Poaceae	<i>Aristida gracilipes</i>			C		1
plants	land plants	Poaceae	<i>Aristida lazaridis</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida leptopoda</i>	white speargrass		C		16
plants	land plants	Poaceae	<i>Aristida personata</i>			C		1/1
plants	land plants	Poaceae	<i>Aristida queenslandica</i> var. <i>dissimilis</i>			C		1/1
plants	land plants	Poaceae	<i>Arthraxon hispidus</i>			V	V	5
plants	land plants	Poaceae	<i>Arthraxon hispidus</i> var. <i>hispidus</i>			V		2/1
plants	land plants	Poaceae	<i>Austrostipa aristiglumis</i>	plains grass		C		11/1
plants	land plants	Poaceae	<i>Austrostipa ramosissima</i>	bamboo grass		C		2/1
plants	land plants	Poaceae	<i>Austrostipa rudis</i> subsp. <i>rudis</i>			C		1/1
plants	land plants	Poaceae	<i>Austrostipa scabra</i> subsp. <i>scabra</i>			C		1/1
plants	land plants	Poaceae	<i>Austrostipa verticillata</i>	slender bamboo grass		C		9/1
plants	land plants	Poaceae	<i>Avena fatua</i>	wild oats	Y			2
plants	land plants	Poaceae	<i>Avena fatua</i> x <i>Avena sativa</i>		Y			1/1
plants	land plants	Poaceae	<i>Avena sativa</i>	common oats	Y			1
plants	land plants	Poaceae	<i>Bothriochloa biloba</i>			C		10
plants	land plants	Poaceae	<i>Bothriochloa bladhii</i>			C		6
plants	land plants	Poaceae	<i>Bothriochloa bladhii</i> subsp. <i>bladhii</i>			C		1/1
plants	land plants	Poaceae	<i>Bothriochloa bunyensis</i>	Bunya Mountains bluegrass		V	V	3/3
plants	land plants	Poaceae	<i>Bothriochloa decipiens</i>			C		4
plants	land plants	Poaceae	<i>Bothriochloa decipiens</i> var. <i>decipiens</i>			C		1/1
plants	land plants	Poaceae	<i>Bothriochloa erianthoides</i>	satintop grass		C		8
plants	land plants	Poaceae	<i>Bothriochloa macra</i>	redleg grass		C		2/2
plants	land plants	Poaceae	<i>Bromus catharticus</i>	prairie grass	Y			6/1
plants	land plants	Poaceae	<i>Capillipedium parviflorum</i>	scented top		C		1
plants	land plants	Poaceae	<i>Capillipedium spicigerum</i>	spicytop		C		1
plants	land plants	Poaceae	<i>Cenchrus ciliaris</i>		Y			7
plants	land plants	Poaceae	<i>Cenchrus clandestinus</i>		Y			6
plants	land plants	Poaceae	<i>Cenchrus longisetus</i>		Y			8/5
plants	land plants	Poaceae	<i>Cenchrus purpurascens</i>			C		1/1
plants	land plants	Poaceae	<i>Chloris divaricata</i> var. <i>divaricata</i>	slender chloris		C		1
plants	land plants	Poaceae	<i>Chloris gayana</i>	rhodes grass	Y			18/1
plants	land plants	Poaceae	<i>Chloris ventricosa</i>	tall chloris		C		5/2
plants	land plants	Poaceae	<i>Chloris virgata</i>	feathertop rhodes grass	Y			6
plants	land plants	Poaceae	<i>Cortaderia selloana</i>	pampas grass	Y			1
plants	land plants	Poaceae	<i>Cymbopogon refractus</i>	barbed-wire grass		C		5/2
plants	land plants	Poaceae	<i>Cynodon dactylon</i>		Y			5
plants	land plants	Poaceae	<i>Cynodon dactylon</i> var. <i>dactylon</i>		Y			4/1
plants	land plants	Poaceae	<i>Dactyloctenium radulans</i>	button grass		C		2
plants	land plants	Poaceae	<i>Dichanthium annulatum</i>	sheda grass	Y			1/1
plants	land plants	Poaceae	<i>Dichanthium aristatum</i>	angleton grass	Y			2/1
plants	land plants	Poaceae	<i>Dichanthium sericeum</i>			C		16
plants	land plants	Poaceae	<i>Dichanthium sericeum</i> subsp. <i>humilius</i>			C		1/1
plants	land plants	Poaceae	<i>Dichanthium sericeum</i> subsp. <i>polystachyum</i>			C		1/1
plants	land plants	Poaceae	<i>Dichelachne crinita</i>	longhair plumegrass		C		14/4
plants	land plants	Poaceae	<i>Dichelachne micrantha</i>	shorthair plumegrass		C		4/1

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plants	land plants	Poaceae	<i>Dichelachne montana</i>			C		1/1
plants	land plants	Poaceae	<i>Digitaria abyssinica</i>		Y			1/1
plants	land plants	Poaceae	<i>Digitaria brownii</i>			C		2
plants	land plants	Poaceae	<i>Digitaria ciliaris</i>	summer grass	Y			1/1
plants	land plants	Poaceae	<i>Digitaria diffusa</i>			C		1/1
plants	land plants	Poaceae	<i>Digitaria divaricatissima</i>	spreading umbrella grass		C		7
plants	land plants	Poaceae	<i>Digitaria divaricatissima</i> var. <i>divaricatissima</i>			C		1/1
plants	land plants	Poaceae	<i>Digitaria eriantha</i> 'Pangola'		Y			8/1
plants	land plants	Poaceae	<i>Digitaria parviflora</i>			C		1/1
plants	land plants	Poaceae	<i>Digitaria porrecta</i>			NT		81/9
plants	land plants	Poaceae	<i>Digitaria ramularis</i>			C		1
plants	land plants	Poaceae	<i>Echinochloa colona</i>	awnless barnyard grass	Y			2/1
plants	land plants	Poaceae	<i>Echinopogon nutans</i>			C		1
plants	land plants	Poaceae	<i>Echinopogon nutans</i> var. <i>nutans</i>			C		2/2
plants	land plants	Poaceae	<i>Echinopogon ovatus</i>			C		1
plants	land plants	Poaceae	<i>Ehrharta erecta</i> var. <i>erecta</i>		Y			2/2
plants	land plants	Poaceae	<i>Eleusine indica</i>	crowsfoot grass	Y			2/1
plants	land plants	Poaceae	<i>Eleusine tristachya</i>	goose grass	Y			2
plants	land plants	Poaceae	<i>Enneapogon gracilis</i>	slender nineawn		C		1/1
plants	land plants	Poaceae	<i>Enteropogon acicularis</i>	curly windmill grass		C		9
plants	land plants	Poaceae	<i>Enteropogon unispiceus</i>			C		1/1
plants	land plants	Poaceae	<i>Entolasia marginata</i>	bordered panic		C		1/1
plants	land plants	Poaceae	<i>Entolasia whiteana</i>			C		1/1
plants	land plants	Poaceae	<i>Eragrostis alveiformis</i>			C		1
plants	land plants	Poaceae	<i>Eragrostis brownii</i>	Brown's lovegrass		C		2/1
plants	land plants	Poaceae	<i>Eragrostis brownii</i> var. <i>pubescens</i>			C		2
plants	land plants	Poaceae	<i>Eragrostis cilianensis</i>		Y			4
plants	land plants	Poaceae	<i>Eragrostis curvula</i>		Y			12/1
plants	land plants	Poaceae	<i>Eragrostis leptostachya</i>			C		3/2
plants	land plants	Poaceae	<i>Eragrostis tenuifolia</i>	elastic grass	Y			5/1
plants	land plants	Poaceae	<i>Eriochloa crebra</i>	spring grass		C		2/1
plants	land plants	Poaceae	<i>Eriochloa procera</i>	slender cupgrass		C		3
plants	land plants	Poaceae	<i>Eulalia aurea</i>	silky browntop		C		6
plants	land plants	Poaceae	<i>Heteropogon contortus</i>	black speargrass		C		4/1
plants	land plants	Poaceae	<i>Hordeum vulgare</i>		Y			1
plants	land plants	Poaceae	<i>Hyparrhenia hirta</i>	coolati grass	Y			12/2
plants	land plants	Poaceae	<i>Imperata cylindrica</i>	blady grass		C		4
plants	land plants	Poaceae	<i>Lachnagrostis filiformis</i>			C		1/1
plants	land plants	Poaceae	<i>Lolium multiflorum</i>	italian ryegrass	Y			1
plants	land plants	Poaceae	<i>Lolium perenne</i>	perennial ryegrass	Y			8
plants	land plants	Poaceae	<i>Megathyrsus maximus</i>		Y			1
plants	land plants	Poaceae	<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>		Y			12/1
plants	land plants	Poaceae	<i>Melinis repens</i>	red natal grass	Y			7/1
plants	land plants	Poaceae	<i>Microlaena stipoides</i>			C		1
plants	land plants	Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>			C		1/1
plants	land plants	Poaceae	<i>Oplismenus aemulus</i>	creeping shade grass		C		3/1

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plants	land plants	Poaceae	<i>Oplismenus aemulus</i> var. <i>lasiorhachis</i>			C		2
plants	land plants	Poaceae	<i>Oplismenus imbecillis</i>			C		1/1
plants	land plants	Poaceae	<i>Panicum bisulcatum</i>	blackseed panic		C		1/1
plants	land plants	Poaceae	<i>Panicum coloratum</i>		Y			3/1
plants	land plants	Poaceae	<i>Panicum decompositum</i>			C		10
plants	land plants	Poaceae	<i>Panicum decompositum</i> var. <i>decompositum</i>			C		3/2
plants	land plants	Poaceae	<i>Panicum effusum</i>			C		2/1
plants	land plants	Poaceae	<i>Panicum queenslandicum</i> var. <i>queenslandicum</i>			C		13/1
plants	land plants	Poaceae	<i>Panicum simile</i>			C		1/1
plants	land plants	Poaceae	<i>Paspalidium aversum</i>			C		1
plants	land plants	Poaceae	<i>Paspalidium distans</i>	shotgrass		C		6/2
plants	land plants	Poaceae	<i>Paspalidium globoideum</i>	sago grass		C		1
plants	land plants	Poaceae	<i>Paspalum dilatatum</i>	paspalum	Y			9/1
plants	land plants	Poaceae	<i>Phyllostachys aurea</i>	fishpole bamboo	Y			1/1
plants	land plants	Poaceae	<i>Poa labillardierei</i> var. <i>labillardierei</i>	tussock grass		C		1/1
plants	land plants	Poaceae	<i>Polypogon monspeliensis</i>	annual beardgrass	Y			1/1
plants	land plants	Poaceae	<i>Polypogon monspeliensis</i> var. <i>rosei</i>			C		1
plants	land plants	Poaceae	<i>Rytidosperma longifolium</i>			C		3/3
plants	land plants	Poaceae	<i>Rytidosperma racemosum</i> var. <i>racemosum</i>			C		4/4
plants	land plants	Poaceae	<i>Rytidosperma tenuius</i>			C		4/1
plants	land plants	Poaceae	<i>Sarga leiocladum</i>			C		2
plants	land plants	Poaceae	<i>Setaria pumila</i>		Y			1
plants	land plants	Poaceae	<i>Setaria pumila</i> subsp. <i>pumila</i>		Y			1/1
plants	land plants	Poaceae	<i>Setaria sphacelata</i>		Y			6
plants	land plants	Poaceae	<i>Setaria surgens</i>			C		2
plants	land plants	Poaceae	<i>Sorghum bicolor</i>	forage sorghum	Y			1/1
plants	land plants	Poaceae	<i>Sorghum halepense</i>	Johnson grass	Y			14
plants	land plants	Poaceae	<i>Sorghum nitidum</i>			C		4
plants	land plants	Poaceae	<i>Sporobolus africanus</i>	Parramatta grass	Y			2/1
plants	land plants	Poaceae	<i>Sporobolus creber</i>			C		1
plants	land plants	Poaceae	<i>Sporobolus elongatus</i>			C		1/1
plants	land plants	Poaceae	<i>Sporobolus pyramidalis</i>		Y			1/1
plants	land plants	Poaceae	<i>Stenotaphrum secundatum</i>	buffalo grass	Y			1
plants	land plants	Poaceae	<i>Themeda avenacea</i>			C		10
plants	land plants	Poaceae	<i>Themeda triandra</i>	kangaroo grass		C		15/1
plants	land plants	Poaceae	<i>Tragus australianus</i>	small burr grass		C		1
plants	land plants	Poaceae	<i>Tripogon loliiformis</i>	five minute grass		C		1/1
plants	land plants	Poaceae	<i>Urochloa fusca</i>		Y			1/1
plants	land plants	Poaceae	<i>Urochloa mosambicensis</i>	sabi grass	Y			9
plants	land plants	Poaceae	<i>Urochloa panicoides</i> var. <i>panicoides</i>		Y			12
plants	land plants	Poaceae	<i>Vulpia muralis</i>		Y			1/1
plants	land plants	Poaceae	<i>Walwhalleya proluta</i>			C		1
plants	land plants	Polygonaceae	<i>Fallopia convolvulus</i>	black bindweed	Y			2/1
plants	land plants	Polygonaceae	<i>Muehlenbeckia gracillima</i>			C		1
plants	land plants	Polygonaceae	<i>Persicaria attenuata</i>			C		2
plants	land plants	Polygonaceae	<i>Persicaria capitata</i>		Y			2

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plants	land plants	Polygonaceae	<i>Persicaria decipiens</i>	slender knotweed		C		1
plants	land plants	Polygonaceae	<i>Persicaria hydropiper</i>	water pepper		C		7/2
plants	land plants	Polygonaceae	<i>Persicaria lapathifolia</i>	pale knotweed		C		1
plants	land plants	Polygonaceae	<i>Rumex brownii</i>	swamp dock		C		19
plants	land plants	Polygonaceae	<i>Rumex crispus</i>	curled dock	Y			10
plants	land plants	Polygonaceae	<i>Rumex hypogaeus</i>		Y			1
plants	land plants	Polypodiaceae	<i>Dendroconche scandens</i>			SL		2
plants	land plants	Polypodiaceae	<i>Dictymia brownii</i>	strap fern		SL		1
plants	land plants	Polypodiaceae	<i>Drynaria rigidula</i>			SL		1
plants	land plants	Polypodiaceae	<i>Platyserium bifurcatum</i>			SL		5
plants	land plants	Polypodiaceae	<i>Platyserium superbum</i>	staghorn fern		SL		2
plants	land plants	Polypodiaceae	<i>Pyrrosia confluens</i>			SL		3/1
plants	land plants	Polypodiaceae	<i>Pyrrosia confluens</i> var. <i>confluens</i>			SL		4/1
plants	land plants	Polypodiaceae	<i>Pyrrosia rupestris</i>	rock felt fern		SL		4/1
plants	land plants	Portulacaceae	<i>Calandrinia eremaea</i>			C		1/1
plants	land plants	Portulacaceae	<i>Portulaca bicolor</i>			C		4/1
plants	land plants	Portulacaceae	<i>Portulaca oleracea</i>	pigweed	Y			12
plants	land plants	Portulacaceae	<i>Portulaca pilosa</i>		Y			3
plants	land plants	Potamogetonaceae	<i>Potamogeton ochreateus</i>	blunt pondweed		SL		1
plants	land plants	Pottiaceae	<i>Weissia</i> sp. (Victoria Park H. Tryon AQ645533)			C		1/1
plants	land plants	Proteaceae	<i>Banksia spinulosa</i> var. <i>collina</i>			C		1/1
plants	land plants	Proteaceae	<i>Grevillea robusta</i>			C		3
plants	land plants	Proteaceae	<i>Hakea eriantha</i>			C		1/1
plants	land plants	Proteaceae	<i>Petrophile canescens</i>			C		1/1
plants	land plants	Pteridaceae	<i>Adiantum aethiopicum</i>			SL		2
plants	land plants	Pteridaceae	<i>Adiantum atroviride</i>			SL		5/1
plants	land plants	Pteridaceae	<i>Adiantum formosum</i>			C		2
plants	land plants	Pteridaceae	<i>Adiantum hispidulum</i>			SL		5
plants	land plants	Pteridaceae	<i>Adiantum hispidulum</i> var. <i>whitei</i>			SL		1
plants	land plants	Pteridaceae	<i>Adiantum silvaticum</i>			SL		2
plants	land plants	Pteridaceae	<i>Cheilanthes distans</i>	bristly cloak fern		C		3
plants	land plants	Pteridaceae	<i>Cheilanthes sieberi</i>			C		1
plants	land plants	Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>			C		3
plants	land plants	Pteridaceae	<i>Pellaea</i>					1/1
plants	land plants	Pteridaceae	<i>Pellaea nana</i>			SL		1
plants	land plants	Pteridaceae	<i>Pellaea paradoxa</i>	heart fern		SL		1
plants	land plants	Pteridaceae	<i>Pteris vittata</i>	Chinese bracken		SL		1
plants	land plants	Ptychomitriaceae	<i>Ptychomitrium australe</i>			C		2/2
plants	land plants	Racopilaceae	<i>Racopilum cuspidigerum</i> var. <i>cuspidigerum</i>			C		1/1
plants	land plants	Ranunculaceae	<i>Clematis fawcettii</i>			V	V	1
plants	land plants	Ranunculaceae	<i>Clematis glycinoides</i>			C		3/1
plants	land plants	Ranunculaceae	<i>Clematis pickeringii</i>			C		1/1
plants	land plants	Ranunculaceae	<i>Ranunculus inundatus</i>	river buttercup		C		2
plants	land plants	Ranunculaceae	<i>Ranunculus lappaceus</i>	common buttercup		C		2
plants	land plants	Ranunculaceae	<i>Ranunculus meristus</i>			C		3/1
plants	land plants	Ranunculaceae	<i>Ranunculus muricatus</i>	sharp buttercup	Y			1/1

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plants	land plants	Ranunculaceae	<i>Ranunculus sessiliflorus</i>			C		1
plants	land plants	Rhamnaceae	<i>Alphitonia excelsa</i>	soap tree		C		3/1
plants	land plants	Ricciaceae	<i>Riccia lamellosa</i>			C		1
plants	land plants	Rosaceae	<i>Acaena ovina</i>			C		1
plants	land plants	Rosaceae	<i>Cotoneaster coriaceus</i>		Y			1/1
plants	land plants	Rosaceae	<i>Potentilla indica</i>		Y			7/1
plants	land plants	Rosaceae	<i>Prunus persica</i> var. <i>persica</i>		Y			2/1
plants	land plants	Rosaceae	<i>Prunus rivularis</i>		Y			2
plants	land plants	Rosaceae	<i>Pyracantha angustifolia</i>		Y			1/1
plants	land plants	Rosaceae	<i>Rosa bracteata</i>	Macartney rose	Y			1/1
plants	land plants	Rosaceae	<i>Rubus moluccanus</i>			C		1
plants	land plants	Rosaceae	<i>Rubus parvifolius</i>	pink-flowered native raspberry		C		2
plants	land plants	Rubiaceae	<i>Asperula conferta</i>			C		5
plants	land plants	Rubiaceae	<i>Galium aparine</i>	cleavers	Y			2/1
plants	land plants	Rubiaceae	<i>Galium leptogonium</i>			C		4/2
plants	land plants	Rubiaceae	<i>Galium terrae-reginae</i>			C		1/1
plants	land plants	Rubiaceae	<i>Pavetta australiensis</i>			C		1
plants	land plants	Rubiaceae	<i>Pomax umbellata</i>			C		1/1
plants	land plants	Rubiaceae	<i>Psydrax odorata</i> forma <i>buxifolia</i>			C		4/2
plants	land plants	Rubiaceae	<i>Triflorensia cameronii</i>			C		4/4
plants	land plants	Rutaceae	<i>Boronia glabra</i>			C		1/1
plants	land plants	Rutaceae	<i>Dinosperma erythrococcum</i>			C		3/3
plants	land plants	Rutaceae	<i>Flindersia australis</i>	crow's ash		C		2/1
plants	land plants	Rutaceae	<i>Flindersia collina</i>	broad-leaved leopard tree		C		4/3
plants	land plants	Rutaceae	<i>Geijera salicifolia</i>	brush wilga		C		3/3
plants	land plants	Rutaceae	<i>Melicope micrococca</i>	white evodia		C		1/1
plants	land plants	Rutaceae	<i>Murraya paniculata</i> 'Exotica'		Y			1
plants	land plants	Rutaceae	<i>Sarcomelicope simplicifolia</i> subsp. <i>simplicifolia</i>	yellow aspen		C		1/1
plants	land plants	Rutaceae	<i>Zanthoxylum brachyacanthum</i>			C		1/1
plants	land plants	Rutaceae	<i>Zieria smithii</i>			C		1/1
plants	land plants	Salicaceae	<i>Casearia multinervosa</i>	casearia		C		1/1
plants	land plants	Salicaceae	<i>Populus nigra</i>	Lombardy poplar	Y			1
plants	land plants	Salicaceae	<i>Salix babylonica</i>	weeping willow	Y			3/1
plants	land plants	Salviniaceae	<i>Azolla rubra</i>			C		1
plants	land plants	Santalaceae	<i>Choretrum candollei</i>	white sour bush		C		1/1
plants	land plants	Santalaceae	<i>Exocarpos cupressiformis</i>	native cherry		C		2
plants	land plants	Santalaceae	<i>Korthalsella breviarticulata</i>			C		2/2
plants	land plants	Santalaceae	<i>Leptomeria acida</i>	sour currant bush		C		1
plants	land plants	Santalaceae	<i>Notothixos subaureus</i>	golden mistletoe		C		1/1
plants	land plants	Santalaceae	<i>Santalum lanceolatum</i>			SL		4/4
plants	land plants	Santalaceae	<i>Viscum articulatum</i>	flat mistletoe		C		4/3
plants	land plants	Sapindaceae	<i>Alectryon diversifolius</i>	scrub boonaree		C		1
plants	land plants	Sapindaceae	<i>Alectryon pubescens</i>			C		5/5
plants	land plants	Sapindaceae	<i>Alectryon subdentatus</i>			C		2
plants	land plants	Sapindaceae	<i>Atalaya salicifolia</i>			C		1
plants	land plants	Sapindaceae	<i>Cupaniopsis parvifolia</i>	small-leaved tuckeroo		C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Sapindaceae	<i>Dodonaea triquetra</i>	large-leaved hop bush		C		1
plants	land plants	Sapindaceae	<i>Dodonaea viscosa</i>			C		1
plants	land plants	Sapindaceae	<i>Dodonaea viscosa subsp. burmanniana</i>			C		1/1
plants	land plants	Sapindaceae	<i>Elaeagnus argentea</i>	white tamarind		C		3/2
plants	land plants	Sapotaceae	<i>Planchonella cotinifolia</i> var. <i>cotinifolia</i>			C		1/1
plants	land plants	Sapotaceae	<i>Pleoloma macrocarpa</i>			C		1
plants	land plants	Scrophulariaceae	<i>Eremophila debilis</i>	winter apple		C		3
plants	land plants	Scrophulariaceae	<i>Verbascum virgatum</i>	twiggy mullein	Y			13
plants	land plants	Smilacaceae	<i>Smilax australis</i>	barbed-wire vine		C		3/1
plants	land plants	Solanaceae	<i>Cestrum parqui</i>	green cestrum	Y			1
plants	land plants	Solanaceae	<i>Datura ferox</i>	fierce thornapple	Y			2/1
plants	land plants	Solanaceae	<i>Datura stramonium</i>	common thornapple	Y			8
plants	land plants	Solanaceae	<i>Lycium ferocissimum</i>	African boxthorn	Y			10
plants	land plants	Solanaceae	<i>Nicotiana</i>					1
plants	land plants	Solanaceae	<i>Physalis lanceifolia</i>		Y			1/1
plants	land plants	Solanaceae	<i>Physalis peruviana</i>		Y			2/1
plants	land plants	Solanaceae	<i>Solanum</i>					1/1
plants	land plants	Solanaceae	<i>Solanum americanum</i>		Y			6/2
plants	land plants	Solanaceae	<i>Solanum capsicoides</i>	devil's apple	Y			1
plants	land plants	Solanaceae	<i>Solanum chenopodioides</i>	whitewort nightshade	Y			2/2
plants	land plants	Solanaceae	<i>Solanum mauritianum</i>	wild tobacco	Y			8
plants	land plants	Solanaceae	<i>Solanum mitchellianum</i>			C		3/3
plants	land plants	Solanaceae	<i>Solanum nemophilum</i>			C		3/1
plants	land plants	Solanaceae	<i>Solanum nigrum</i>		Y			8
plants	land plants	Solanaceae	<i>Solanum parvifolium</i>			C		1
plants	land plants	Solanaceae	<i>Solanum pseudocapsicum</i>	Madeira winter cherry	Y			1
plants	land plants	Solanaceae	<i>Solanum seaforthianum</i>	Brazilian nightshade	Y			2
plants	land plants	Solanaceae	<i>Solanum sisymbriifolium</i>		Y			1/1
plants	land plants	Solanaceae	<i>Solanum stelligerum</i>	devil's needles		C		2/2
plants	land plants	Solanaceae	<i>Solanum stupefactum</i>			C		2/2
plants	land plants	Stackhousiaceae	<i>Stackhousia viminea</i>	slender stackhousia		C		1
plants	land plants	Sterculiaceae	<i>Brachychiton discolor</i>			SL		1/1
plants	land plants	Sterculiaceae	<i>Brachychiton populneus</i>			C		1
plants	land plants	Sterculiaceae	<i>Brachychiton rupestris</i>			SL		2/1
plants	land plants	Tamaricaceae	<i>Tamarix aphylla</i>	athel pine	Y			3
plants	land plants	Thelypteridaceae	<i>Christella dentata</i>	creek fern		SL		2/1
plants	land plants	Thelypteridaceae	<i>Christella hispidula</i>			SL		2
plants	land plants	Thymelaeaceae	<i>Pimelea curviflora</i>			C		3
plants	land plants	Thymelaeaceae	<i>Pimelea curviflora subsp. divergens</i>			C		1/1
plants	land plants	Thymelaeaceae	<i>Pimelea neoanglica</i>	poison pimelea		C		18/6
plants	land plants	Thymelaeaceae	<i>Wikstroemia indica</i>	tie bush		C		1
plants	land plants	Typhaceae	<i>Typha domingensis</i>			C		1
plants	land plants	Typhaceae	<i>Typha orientalis</i>	broad-leaved cumbungi		C		2
plants	land plants	Urticaceae	<i>Dendrocnide</i>					1
plants	land plants	Urticaceae	<i>Elatostema reticulatum</i>	rainforest spinach		C		1/1
plants	land plants	Urticaceae	<i>Urtica incisa</i>	stinging nettle		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Urticaceae	<i>Urtica urens</i>	small nettle	Y			1
plants	land plants	Verbenaceae	<i>Glandularia aristigera</i>		Y			23
plants	land plants	Verbenaceae	<i>Lantana camara</i>	lantana	Y			16/2
plants	land plants	Verbenaceae	<i>Lantana montevidensis</i>	creeping lantana	Y			3/1
plants	land plants	Verbenaceae	<i>Phyla nodiflora</i>	carpetweed		C		1
plants	land plants	Verbenaceae	<i>Verbena</i>					1
plants	land plants	Verbenaceae	<i>Verbena africana</i>			C		2/2
plants	land plants	Verbenaceae	<i>Verbena bonariensis</i>	purpletop	Y			4
plants	land plants	Verbenaceae	<i>Verbena gaudichaudii</i>			C		6
plants	land plants	Verbenaceae	<i>Verbena halei</i>		Y			1/1
plants	land plants	Verbenaceae	<i>Verbena incompta</i>		Y			1/1
plants	land plants	Verbenaceae	<i>Verbena litoralis</i>	verbena	Y			4
plants	land plants	Verbenaceae	<i>Verbena litoralis var. brevibracteata</i>		Y			1
plants	land plants	Verbenaceae	<i>Verbena litoralis var. litoralis</i>		Y			5/1
plants	land plants	Verbenaceae	<i>Verbena rigida</i>		Y			15/2
plants	land plants	Viburnaceae	<i>Viburnum odoratissimum var. awabuki</i>	sweet viburnum 'emerald lustre'	Y			1/1
plants	land plants	Violaceae	<i>Pigea enneasperma</i>			C		1
plants	land plants	Violaceae	<i>Pigea stellarioides</i>			C		1/1
plants	land plants	Violaceae	<i>Viola betonicifolia</i>			C		1
plants	land plants	Vitaceae	<i>Apocissus antarctica</i>			C		2
plants	land plants	Vitaceae	<i>Apocissus sterculiifolia</i>			C		1
plants	land plants	Vitaceae	<i>Causonis clematidea</i>			C		5/3
plants	land plants	Vitaceae	<i>Cayratia acris</i>	hairy grape		C		1
plants	land plants	Vitaceae	<i>Tetrastigma nitens</i>	shining grape		C		1
plants	land plants	Xanthorrhoeaceae	<i>Xanthorrhoea glauca subsp. glauca</i>			SL		1
plants	land plants	Zygophyllaceae	<i>Roepera apiculata</i>			C		1/1
plants	land plants	Zygophyllaceae	<i>Tribulus micrococcus</i>	yellow vine		C		9
plants	land plants	Zygophyllaceae	<i>Tribulus terrestris</i>	caltrop		C		10
plants	uncertain	Indet.	<i>Indet.</i>			C		3
protozoans	slime molds	Physaraceae	<i>Fuligo septica</i>			C		5

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*.

The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*.

The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).

This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.

This number is output as 999 if it equals or exceeds this value.

Appendix B

Curricula vitae



Daniel Kelly

Ecologist

EMM Consulting Pty Limited

Professional Overview

Daniel is an Ecologist who finished an honours project on Koala habitat use across different vegetation communities in 2015. Since joining EMM in 2017, Daniel has developed a varied skillset by working on several large infrastructure projects on the east coast of Australia from Kosciuszko National Park to Townsville. Throughout his work and studies Daniel has developed a keen interest in native flora and has a strong botanical knowledge across the east-coast of Australia.

Qualifications and licences

Bachelor of Environmental Science (Hons) Ecology, University of Queensland, 2015

Introduction to Regional Ecosystems and BioConditioning, 2018

Biodiversity Offset Scheme Accredited Assessors Course, 2018

Advanced Plant Identification Skills for Research and Environmental Assessment, 2019

Associate Member Environmental Institute of Australia and New Zealand, 2018

4WD and Defensive Driving, 2018

White Card – Work Safely in the Construction Industry, 2015

Specialisation

Botanical field assessments.

Threatened species surveys.

Data analysis.

Desktop and field-based biodiversity assessments.

Technical reporting.

Representative experience

Queensland

- Carmichael mine and rail project (September 2017 – December 2017), regional ecosystem ground truthing surveys, pest, weed and contaminated land surveys, breeding place surveys, targeted threatened flora surveys and fauna surveys, Central Queensland (Carmichael Rail Network Pty Ltd).
- Carmichael mine and rail project (July 2019), Pest, weed and contaminated land surveys & reporting, pre-clearance surveys & reporting, Central Queensland (Carmichael Rail Network Pty Ltd).
- Carmichael mine and rail project (July – October 2019), Species Management Plans (MCU1, MCU2 & MCU3) (Carmichael Rail Network Pty Ltd).
- Inland Rail Geotechnical support - Gowrie to Kagaru (March 2018 – August 2019), Protected plant surveys & reporting, pre-clearance surveys & reporting, landholder liaison and access planning, Species Management Plan (Australian Rail Track Corporation).
- Karreman Quarries Expansion (October 2018), offset site BioCondition assessments (Karreman Quarries).
- ARTC G2K Inland Rail Geotechnical Support (2018/2019), protected plant reports, pre-clearance reporting, SMP, and MNES reports. South-East Queensland, (Australian Rail Track Corporation).
- Karreman Quarries Expansion (February 2020), hollow bearing tree assessments (Karreman Quarries).

- Razorback Windfarm Development Approval (April/May 2020), fieldwork planning, vegetation Assessments (Ground-truthing Regional Ecosystem mapping), key findings report (flora). Mount Morgan Ranges, (Epuron).
- Specimen Hill Windfarm Development Approval (April/May 2020), fieldwork planning, vegetation Assessments, key findings report (flora). Callide Range (Epuron).
- Crush Creek exploratory works (2020) – EPBC self-assessment. (Evolution Mining).
- Townsville Energy Chemicals Hub (March 2021), Terrestrial Ecology Tech Report (QPM).
- Inland Rail B2G Geotechnical Investigations (May - June 2021) – Protected plants survey (non-SQ) and Protected Plants survey report (ARTC).
- Bravis Great Artesian Basin Strategy Implementation (August/September 2021) – Bubbling Bore, Bow Park Bore and Culberrnie Station Bore desktop ecological reviews (Bravis).
- ARTC Inland Rail G2K Ecological Assessments (September 2020 – May 2023), fieldwork planning and logistics, BioCondition assessments, frog surveys, reptile active searches, bird surveys, RE verification, habitat assessments (Australian Rail Track Corporation).
- G2H Inland Rail Collared Delma surveys (May/June 2021) Collared Delma active searches and habitat mapping (ARTC).
- Specimen Hill Wind Farm (January 2021), MSE SRI assessments as a part of the Ecological Assessment Report (Epuron Pty Ltd).
- QPM Pipeline flora surveys (December 2021 and March 2022), RE verification, RE mapping, trapping lines for Ornamental Snake and habitat assessments (Queensland Pacific Metals Ltd).
- Olive Downs Impact and Offset sites (February 2022 – March 2023) Impact site protected plant surveys, pre-clear spotlighting and offset site BioCondition assessments (Pembroke Resources).
- Inland Rail Geotechnical survey (July 2022) EPBC referral (ARTC).
- Boulder Creek Offset Delivery (May – July 2023) *Cycas megacarpa* relocation plan surveys and management plan updates (Zenviron Pty Ltd).

New South Wales

- Mole River (February 2020) Koala surveys (WaterNSW).
- NSW Offset Advice (February 2020), Assisting in Grassland TEC field assessments (Dorado).

- HMAS Creswell (March 2021), Gap Analysis (Defence).
- Inland Rail North Star to Border and Border to Gowrie (November 2022 – June 2023) due diligence assessments, pre-clearance surveys (*Digitaria porrecta*) and reports (Laing O'Rourke).

Pumped hydro and dam projects

- Snowy 2.0 (Jan 2018 – January 2020), targeted threatened flora surveys, BAM plots in addition to targeted threatened reptile, amphibian, mammal, diurnal bird and owl surveys, Kosciuszko National Park NSW (Snowy Hydro Limited).
- Snowy 2.0 (March 2019 – February 2020), Biodiversity Monitoring Program, smoky mouse trapping/chipping/habitat monitoring, weed monitoring, feral predator monitoring, feral herbivore monitoring, Booroolong Frog monitoring (Snowy Hydro Limited).
- Burrawang to Avon Tunnel (November 2019), Amphibian and Avifauna surveys (WaterNSW).
- Burrawang to Avon Tunnel (February 2020), Threatened Flora surveys (WaterNSW).
- OMPS (May 2022) Threatened Flora surveys using the two-phase method (Oven Mountain Pumped Hydro Storage).
- OMPS (June 2022) Camera trap deployment for threatened fauna species (Oven Mountain Pumped Hydro Storage).
- OMPS (July 2022) Owl and Glossy Black-cockatoo surveys (Oven Mountain Pumped Hydro Storage).
- OMPS (October 2022) Small Snake Orchid and Barrington Tops Ant Orchid surveys (Oven Mountain Pumped Hydro Storage).
- Dungowan Dam Biodiversity Assessments (February 2023) Threatened Flora surveys (WaterNSW).
- OMPS (November 2023) *Pultenaea rubescens* distribution and abundance surveys outside footprint (Oven Mountain Pumped Hydro Storage).
- CHDR (November 2023) Targeted threatened flora surveys – wet sclerophyll and lowland rainforest species (Clarrie Hall Dam Raising – Tweed Shire Council).

Volunteering

- National Parks Association Queensland Council & Advocacy Committee (August 2016 – January 2018).
- National Parks Association (January – August 2016) internship.
- University of Queensland School of Geography and Planning (May and October 2015) Volunteer Research Assistant (PhD fieldwork support).
- Bulimba Creek Catchment Co-ordinating Committee (November 2015) Volunteer.
- The Wilderness Society (January – December 2017) Volunteer assisting/advising campaign managers with conservation research and GIS tasks.



Rachel Scott

Ecologist

EMM Consulting Pty Limited

Professional Overview

Rachel is an Ecologist with over 4 years' experience within varying environmental sectors including: the resource and development industry, fauna rescue and rehabilitation, human-wildlife conflict, and wildlife tourism. Rachel has completed work in various South-east Asian locations, ranging from marine habitat surveys to anti-poaching wildlife programs. Additionally, Rachel has experience conducting extensive field work in remote locations in Australia such as the Northern Territory, far-north Queensland and west New South Wales. During her time at EMM, Rachel has contributed to MNES and MSES management plans and self-assessments, species management plans, offset management plans, project proposals and responses to EPBC approvals. Rachel has experience conducting a range flora surveys such as BioCondition assessments, quaternary assessments, protected plant surveys and targeted threatened flora species surveys. Fauna surveys that Rachel has conducted include baseline surveys (with a range of trapping methods applied e.g. pitfall, Elliot, camera and funnel trapping), breeding place surveys and targeted threatened fauna species surveys.

Qualifications and licences

Bachelor of Environmental Science (Wildlife and Conservation Biology), Deakin University, 2021

GI, G8, G9 Mining Supervisor

Standard S11 Course (including Coal Board Medical)

Provide First Aid and Cardiopulmonary Resuscitation

Operate and Maintain a 4WD Vehicle

Queensland White Card

Working at Heights

Queensland Class C Driver's Licence

Specialisation

Targeted fauna surveys

Habitat quality surveys

Flora and fauna baseline surveys

Rescue and rehabilitation

Representative experience

- MNES independent peer review (AGL Pty Ltd)
- Olive Downs Impact, greater glider nest box utilisation analysis (Pembroke Resources, QLD)
- Olive Downs Impact, feral animal monitoring surveys and analysis (Pembroke Resources, QLD)
- North Star to Border, EPBC self-assessment (Inland Rail)
- Cape Flattery Silica Mine Expansion, gap analysis (Cape Flattery Silica Pty Ltd)
- North Queensland Bulk Ports, EPBC self-assessment (North Queensland Bulk Ports Corporation Limited)
- Aurukun Bauxite offset delivery and ecological ground truthing, ecology surveys and habitat quality analysis (Glencore Bauxite Resource Pty Ltd)
- Eva Copper, baseline ecology surveys (Harmony Gold Pty Ltd)
- Eva Copper, baseline report, MSES and MNES assessments (Harmony Gold Pty Ltd)
- North Star to Border, ecological ground truthing (Inland Rail)
- Boulder Creek Wind Farm offset delivery, field surveys (Macquarie Corporate Holdings Pty Ltd)
- Boulder Creek Wind Farm Cycad Translocation Plan, targeted threatened flora surveys (Macquarie Corporate Holdings Pty Ltd)
- Olive Downs Impact, targeted species MNES field surveys (Pembroke Resources, QLD)
- Olive Downs Offset Area, habitat quality surveys (Pembroke Resources, QLD)
- QPM Offset Area Management Plan, habitat quality impact assessment (Queensland Pacific Metals)
- QPM Energy Powerline Project, ecology fieldwork (Queensland Pacific Metals)
- Blackwater Northern Lease Expansion, MNES Assessments (BHP)
- Solquartz Silicon Smelter, ecological survey (Solquartz)
- Baseline fauna surveys (National Parks and Wildlife Service, NSW)
- Data consolidation and review (Victorian National Parks Association, VIC)
- Animal rehabilitation (Free the Bears, Cambodia)
- Animal rehabilitation (Elephant Nature Park, Thailand)
- Habitat surveys, PhD Assistant (Charles Darwin University, NT)
- Rescue and rehabilitation (Crystal Ocean Wildlife Shelter, VIC)
- Marine fauna guide (Watermaarq, VIC)
- Environmental guide (Kimberly Wild Expeditions, WA)



Dr Elliot Leach

Senior Ecologist
EMM Consulting Pty Limited

Professional Overview

Elliot is a Senior Ecologist who completed a PhD on Australian rainforest birds in 2018. He has extensive field experience in eastern Australia, working on a wide range of biodiversity surveys and threatened species surveys, including several in national parks.

Since joining EMM in 2018, Elliot has carried out threatened species surveys in New South Wales (primarily for Snowy 2.0), the Australian Capital Territory and Queensland. He has also played a key role in the preparation of technical reports, as well as conducting desktop and field-based biodiversity assessments and threatened species surveys for many projects across Queensland.

Qualifications and licences

Doctor of Philosophy "Monitoring the effects of climate change on the rainforest birds of eastern Australia" Griffith University, 2018.

Bachelor of Science (Hons I) Ecology and Conservation Biology, Griffith University, 2013.

Specialisation

Threatened species surveys.

Technical reporting.

Desktop and field-based biodiversity assessments.

Data analysis.

Representative experience

Resource industries

- Eva Copper Project, threatened species surveys, habitat mapping, vegetation surveys ,technical reporting. Cloncurry, North-west Qld (Copper Mountain Mining Corporation).
- Olive Downs Coking Coal Project, threatened species surveys, vegetation surveys, pre-clearance ecology surveys, habitat assessment and preparation of an offset area management plan (OAMP). Central Qld (Pembroke Resources).
- QPM Moranbah gas pipeline, threatened species surveys, habitat assessment, technical reporting. Central Qld (Queensland Pacific Metals).
- QPM Tech project, threatened species surveys, habitat assessment, habitat quality scoring, technical reporting. North QLD (Queensland Pacific Metals).
- Karreman Quarries Offset Project, vegetation surveys and pre-clearance ecology surveys. South-east QLD (Karreman Quarries).
- Hall Quarry overburden, threatened species surveys. Central NSW (Boral).

Infrastructure

- Snowy 2.0, threatened species surveys, Kosciuszko National Park. Southern NSW (Snowy Hydro Limited).
- Inland Rail (Gowrie to Kagaru Project), project management, desktop biodiversity assessment, planning of ecological surveys, ecological fieldwork, technical reporting, habitat assessment and habitat quality scoring. South-east QLD (ARTC).
- North Queensland Bulk Ports, flora surveys, habitat assessments, preparation of species management program

(SMP). Ports of Weipa, Mackay, Hay Point and Abbot Point QLD (North Queensland Bulk Ports).

- Gladstone Ports Corporation, migratory shorebird monitoring surveys and preparation of 2020 annual report. Central QLD (Gladstone Ports Corporation) **note: work completed for Wildlife Unlimited.*
- Mona Vale Road upgrade, targeted threatened species surveys for Red-crowned Broodfrog (*Pseudophryne australis*) within Ku-ring-gai Chase National Park. Sydney NSW (NSW Roads & Maritime Services).
- Moreton Bay Rail Link project, design, construction and installation of wildlife telemetry equipment to monitor movement and behaviour of Koalas. South-east QLD (QLD Transport & Main Roads).
- SEQ Koala retrofit works, koala surveys and monitoring. South-east QLD (QLD Transport & Main Roads).

Renewable energy

- Green Poly, threatened fauna and flora surveys, technical reporting, habitat quality scoring. North Queensland (Solquartz).
- Specimen Hill Windfarm, bird utilisation surveys, threatened fauna and flora surveys, technical reporting, preparation of bird and bat management plan (BBMP). Central QLD (Epuron).
- Boulder Creek windfarm, bird utilisation surveys, technical reporting, preparation of BBMP. Central QLD (Epuron).
- Ti-tree Bioenergy, bird of prey surveys and mitigation strategy. South-east QLD (Veolia).

Scientific Research

- Lamington National Park, IBISCA Project, arthropod biodiversity surveys. South-east QLD (Hong Kong University).
- Eungella National Park, Eungella Biodiversity Study, multidisciplinary biodiversity surveys. Central QLD (Griffith University).
- Mt Tamborine BioBlitz, multidisciplinary biodiversity surveys. South-east QLD (Griffith University, Queensland Museum and Scenic Rim Council).
- Border Ranges National Park, community level avifauna surveys. North-east NSW (Griffith University).
- Mt Lewis National Park, multidisciplinary biodiversity surveys. Far north QLD (Griffith University).

Publications

- Barlow, B., Ashton, L., Boyle, M., Leach, E., Stone, M., Dem, F., Kitching, R.L. & Stork, N. in review. Moth, beetle, and bug assemblages are shaped differently across a tropical rainforest vertical gradient.
- Boyle, M., Amaral, V., Leach, E., Kitching, R.L., Burwell, C. & Ashton, L. in prep. Fifteen years of change in the arthropod community of a primary rainforest: repeating the IBISCA Qld survey.
- Leach, E. & Burwell C. J. 2021. *Birds*. In: Eungella: Land of Clouds (eds B. Mitchell & R. Ridgway). Queensland Museum, Brisbane.
- Leach, E., Daly, G. & Burwell, C. J. 2020. The avifauna of the Eungella Region, central coastal Queensland, Australia. *Proceedings of the Royal Society of Queensland – Special Issue on Eungella*, 125, 117-138.
- Ashton, L. A., Leach, E. C., Odell, E. H., McDonald, W. J. F., Arvidsson, D. & Kitching, R. L. 2020. The Eungella Biodiversity Study: filling the knowledge gap. *Proceedings of the Royal Society of Queensland – Special Issue on Eungella*, 135, 11-21
- Burwell, C. J., Theischinger, G., Leach, E. & Burwell-Rodriguez, A. I. 2020. Dragonflies and Damselflies (Odonata) of the Eungella region, central coastal Queensland, Australia. *Proceedings of the Royal Society of Queensland – Special Issue on Eungella*, 135, 33-42.
- Leach, E., Burwell, C., Jones, D. & Kitching, R. 2018. Estimating the population sizes of rainforest birds of the Tweed Caldera. *Australian Field Ornithology*, 35, 119-125.
- Leach, E., Burwell, C., Jones, D. & Kitching, R. 2018. Identifying avian indicators of elevation in the Gondwanan Rainforests of Australia. *Pacific Conservation Biology*, doi.org/10.1071/PC18039
- Leach, E., Burwell, C., Jones, D. & Kitching, R. 2018. Modelling the responses of Australian subtropical rainforest birds to changes in environmental conditions along elevational gradients. *Austral Ecology*, 43, 490-501.
- Leach, E. 2016. Notes on the Zoothera thrushes in the Tweed Range of north-eastern New South Wales. *Australian Field Ornithology*, 33, 240-243.
- Leach, E., Burwell, C., Ashton, L., Jones, D. & Kitching, R. 2016. Comparison of point counts and automated acoustic monitoring: detecting birds in a rainforest biodiversity survey. *Emu*, 116, 305-309.
- Leach, E., Jones, D., Mcbroom, J. & Appleby, R. 2015. Diet of Nankeen Kestrels *Falco cenchroides* at Brisbane Airport. *Australian Field Ornithology*, 32, 15-25.
- Leach, E. 2014. Dust bathing behaviour in a young male Australian brush-turkey (*Alectura lathami*). *The Sunbird*, 44, 24-25.
- Leach, E., Nakamura, A., Turco, F., Burwell, C. J., Catterall, C. P. & Kitching, R. L. 2013. Potential of ants and beetles as indicators of rainforest restoration: characterising pasture and rainforest remnants as reference habitats. *Ecological Management & Restoration*, 14, 202-209.

Volunteering

- Monthly monitoring of migratory shorebird populations at Luggage Point Advanced Water Treatment Plant. South-east Queensland (Queensland Wader Studies Group).
- Woodford Folk Festival Dawn Chorus Bird Walk (with Roy Sonnenburg). South-east Queensland (Woodford Folk Festival).
- Woodford Folk Festival Kids Nature Walk (with Jess Mackie). South-east Queensland (Woodford Folk Festival).
- Birds and Binoculars for Kids. South-east Queensland (The Planting Festival).
- Weeding and habitat restoration for various Habitat Brisbane groups and / or catchment committees including sites at Moorhen Flats, Whites Hill Reserve and Arnwood Place Park. South-east Queensland (Habitat Brisbane).

Appendix C

Likelihood of occurrence table

Table C.1 **Likelihood of occurrence - CEEVNT flora species**

Scientific name	Common name	Source	EPBC Act status	NC Act status	Likelihood and habitat requirements
<i>Arthraxon hispidus</i>	Hairy-joint Grass	WildNet	VU	V	Unlikely - The species occurs in a range of habitats including wet eucalypt forest, rainforest and alluvial woodlands, often in association with water sources such as creeks or swamps (Leiper et al 2017).
<i>Bertya opposens</i>	-	PMST	VU	-	Unlikely – Grows in a variety of vegetation communities generally associated with shallow soils derived from sandstone and other well-draining substrates (Halford and Henderson 2002).
<i>Bosistoa transversa</i>	Three-leaved Bosistoa	PMST	VU	-	Unlikely - No records of this species exist within the study area and the preferred habitat of subtropical rainforest are not known to occur in the locale.
<i>Bothriochloa bunyensis</i>	Satin-top Grass	PMST & WildNet	VU	V	Potential - Satin-top Grass grows on fertile basaltic soils on the upper slopes and crests of hills at altitudes between 600-1100 m above sea level (DEWHA 2008a). Although the soil is basaltic, the elevation of the site sits between 400-500 m above sea level.
<i>Bulbophyllum globuliforme</i>	Miniature Moss-orchid	PMST	VU	NT	Unlikely - This species is only known to occur on the upper branches of mature Hoop Pines (<i>Araucaria cunninghamii</i>) (Jones 2021).
<i>Cadellia pentastylis</i>	Ooline	PMST	VU	V	Unlikely - This species is not known to occur within the study area. It primarily occurs in association with semi-evergreen vine thicket and Brigalow communities of the Brigalow Belt bioregion, west of the Great Dividing Range (DEWHA 2008f).
<i>Callitris baileyi</i>	Bailey's Cypress	WildNet	-	NT	Unlikely - Grows in mountainous terrain in rocky, basalt derived soils in Eucalypt woodlands (DES 2024f). It also has a preference for the ecotones of dry rainforest (Harden et al. 2014).
<i>Clematis fawcettii</i>	Stream Clematis	PMST & WildNet	VU	V	Potential - This species is associated with dry rainforest, subtropical rainforests, the ecotone of dry rainforests and to a lesser extent eucalypt forests with rainforest species in the understorey. Stream Clematis can be found growing in basalt derived soils where there are suitable canopy gaps, or on the margins of SEVT (DEWHA 2008b).
<i>Coleus omissus</i>	-	PMST	EN	E	Unlikely – Only known from four sites between Gympie and Gayndah. Grows on rocky outcrops in Eucalypt forest adjacent to vine thicket (DES 2024g).
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	PMST	VU	-	Unlikely - In Queensland, this species is primarily associated with sandy coastal heath (DEWHA 2008g).
<i>Cyperus clarus</i>	A sedge	WildNet		V	Likely - <i>Cyperus clarus</i> inhabits open woodlands or grasslands in heavy soils derived from basalt (DES 2024a). This species has been previously recorded in the vicinity of Gowrie as a part of the G2H project.

Table C.1 **Likelihood of occurrence - CEEVNT flora species**

Scientific name	Common name	Source	EPBC Act status	NC Act status	Likelihood and habitat requirements
<i>Dichanthium queenslandicum</i>	King Bluegrass	PMST	EN	V	Potential - This species is primarily associated with grassland communities (particularly those dominated by other blue grasses (<i>Dichanthium</i> spp. and <i>Bothriochloa</i> spp.) on black cracking soils (TSSC 2013a).
<i>Dichanthium setosum</i>	Bluegrass	PMST	V	-	Potential - The species is primarily restricted to heavy volcanics such as red-brown and heavy black soils. However, it can be found in a broad range of habitats from remnant woodlands to roadside vegetation and pasture (DEWHA 2008c).
<i>Digitaria porrecta</i>	Finger Panic Grass			NT	Known – Previously observed within the clearing impact area.
<i>Eucalyptus taurina</i>	Helidon Ironbark	PMST	EN	E	Unlikely - grows on ridges in shallow sandy soils (Leiper et al 2017).
<i>Grevillea quadricauda</i>	Four-tailed Grevillea	PMST	VU	V	Unlikely - This species occurs in eucalypt woodlands on gravelly and sandy soils in the Helidon Hills and Murphy's Creek area. It occurs primarily near watercourses and drainage lines (Leiper et al 2017; DEWHA 2008h).
<i>Haloragis exalata</i> subsp. <i>velutina</i>	Tall Velvet Sea-berry	PMST	VU	V	Unlikely - The subspecies occurs in a range of habitats including eucalypt forests, rainforest ecotones and grasslands (DEWHA 2008i). However, there are no records in or near the study area.
<i>Homopholis belsonii</i>	Belson's Panic	PMST	VU	E	Potential - <i>Homopholis belsonii</i> occurs in dry woodland habitats on a range of soil types at an altitudinal range between 200 - 520 metres. This species is generally found growing at the base trees and under the shade of branches and other shaded areas (DES 2024b).
<i>Leichhardtia coronata</i>	Slender Milkvine	WildNet	-	V	Unlikely - Slender Milkvine grows most commonly in moist areas of open forest or rainforest (Borsboom and Wang 1996). This species distribution is primarily east of the Great Dividing Range.
<i>Leionema obtusifolium</i>	-	PMST	VU	V	Unlikely - This species is largely restricted to the Helidon Hills area growing on sandy or rocky soils (Leiper et al 2017).
<i>Lepidium monoplacoides</i>	Winged Pepper-cress	PMST	EN	-	Unlikely - This semi-arid species is not known from the region with the nearest records approximately 150 km south-west of the study area (Leigh et al. 1984).
<i>Lepidium peregrinum</i>	Wandering Peppercress	PMST & WildNet	EN	-	Potential - This species has been recorded in a range of habitats but prefers riparian forests and the ecotones between rainforest and woodland in elevated areas (DoE 2014b).
<i>Leuzea australis</i>	Austral Cornflower	PMST & WildNet	VU	V	Likely – <i>Leuzea australis</i> grows in eucalypt open forest with a grassy understory and in grasslands on black clay soil. It is often found on roadsides and on road or rail reserves (DES 2024c).
<i>Macadamia integrifolia</i>	Macadamia Nut	PMST	VU	V	Unlikely - Rainforest habitats required for this species do not occur and no confirmed records exist in the study area (DEWHA 2008j).

Table C.1 **Likelihood of occurrence - CEEVNT flora species**

Scientific name	Common name	Source	EPBC Act status	NC Act status	Likelihood and habitat requirements
<i>Notelaea lloydii</i>	Lloyd's Olive	PMST	VU	V	Unlikely - The species primarily occurs in open eucalypt woodland with vine forest associations including ecotones and understorey species (Guymer 1987).
<i>Paspalidium grandispiculatum</i>	A Grass	PMST	VU	V	Unlikely - This species is primarily associated with eucalypt woodlands on sedimentary substrates but can also be found in disturbed environments (DAWE 2021).
<i>Phebalium distans</i>	Mt Berryman Phebalium	PMST	EN	E	Unlikely - There are no records of this species within the study area. Although volcanic soils are present within the disturbance footprint, the closest records are more than 50 km to the south-east near Mt. Berryman.
<i>Picris evae</i>	Hawkweed	PMST	VU	V	Likely - Hawkweed primarily occurs in association with <i>Dichanthium</i> sp., on rich dark or reddish soils, in open Eucalypt woodland with a grassy understorey (DEWHA 2008i).
<i>Rhodamnia dumicola</i>	Rib-fruited Malletwood	WildNet	-	E	Unlikely - The species occurs in dry rainforests and vine thickets (Leiper et al 2017).
<i>Rhodamnia rubescens</i>	Scrub Turpentine	PMST & WildNet	CE	CR	Unlikely - Records of this species are not known within the study area. This species has the potential to inhabit most forms of rainforest, in both volcanic and sedimentary soils, except cool temperate rainforest (Floyd 1989).
<i>Rhodomyrtus psidioides</i>	Native Guava	PMST	CE	CR	Unlikely - Records of this species are not known within the study area. This species is generally observed in wet sclerophyll forest or along the fringes of littoral rainforest (Floyd 1989).
<i>Samadera bidwillii</i>	Quassia	PMST	VU	V	Unlikely - Records of this species are not known within the study area. The species usually occurs in dry rainforest north of Gympie (Leiper et al 2017).
<i>Sarcophilus weinthalii</i>	Blotched Sarcophilus	PMST & WildNet	VU	E	Unlikely - grows epiphytically on the upper branches of rainforest trees between the altitudinal range of 400 to 700 m above sea level (Barker and Borsboom 1998).
<i>Sophora fraseri</i>	Brush Sophora	PMST & WildNet	VU	V	Unlikely - Brush Sophora grows in moist habitat and is typically associated with hilly terrain in shallow soils derived from basalt or sandstone (DES 2019h).
<i>Thesium australe</i>	Austral toadflax	PMST	VU	V	Potential - Austral Toadflax grows in moist areas of grassland or woodland on skeletal soils, or heavy alluvium and black cracking clays (DES 2024d). As the species exhibits broad habitat preferences, it was surveyed for throughout the disturbance footprint.

Appendix D

Flora list

Table D.1 **Flora species list**

Scientific name	
<i>Acacia salicina</i>	<i>Hypochaeria albiflora</i>
<i>Alectryon diversifolius</i>	<i>Jasminum</i> sp.
<i>Alternanthera denticulata</i>	<i>Lactuca serriola</i>
<i>Anthosachne scabra</i>	<i>Lantana camara</i>
<i>Aristida leptopoda</i>	<i>Leiocarpa brevicompta</i>
<i>Asperula conferta</i>	<i>Lepidium bonariense</i>
<i>Aster subulatus</i>	<i>Leuzea australis</i>
<i>Austrostipa</i> sp.	<i>Lolium</i> sp.
<i>Bidens pilosa</i>	<i>Lycium ferocissimum</i>
<i>Boerhavia dominii</i>	<i>Melilotus albus</i>
<i>Bothriochloa biloba</i>	<i>Melinis repens</i>
<i>Bothriochloa erianthoides</i>	<i>Mentha satpureioides</i>
<i>Brunoniella australis</i>	<i>Neptunia gracilis</i>
<i>Calotis lappulacea</i>	<i>Notelaea microcarpa</i>
<i>Chloris gayana</i>	<i>Oenothera curtiflora</i>
<i>Chloris</i> sp.	<i>Opuntia stricta</i>
<i>Cirsium vulgare</i>	<i>Opuntia tomentosa</i>
<i>Convolvulus graminetus</i>	<i>Panicum decompositum</i>
<i>Corymbia tessellaris</i>	<i>Panicum queenslandicum</i>
<i>Cullen tenax</i>	<i>Peripluera</i> sp.
<i>Cyclospermum leptophyllum</i>	<i>Picris evae</i>
<i>Cyperus bifax</i>	<i>Pimelia neo-anglica</i>
<i>Cyperus eragrostis</i>	<i>Plantago lanceolata</i>
<i>Cyperus esculentus</i>	<i>Plantago</i> sp.
<i>Cyperus fulvus</i>	<i>Portulaca oleracea</i>
<i>Cyperus rotundus</i>	<i>Rhynchosia minima</i>
<i>Dianella</i> sp.	<i>Rubus parvifolius</i>
<i>Dichanthium sericeum</i>	<i>Rumex brownii</i>
<i>Dichondra repens</i>	<i>Rumex crispus</i>
<i>Digitaria ciliaris</i>	<i>Rytidosperma tenuius</i>
<i>Digitaria divaricatissima</i>	<i>Salsola australis</i>
<i>Digitaria porrecta</i>	<i>Salvia reflexa</i>

Table D.1 **Flora species list**

Scientific name	
<i>Digitaria</i> sp.	<i>Santalum lanceolatum</i>
<i>Dysphania</i> sp.	<i>Sclerolaena</i> sp.
<i>Ehretia membranifolia</i>	<i>Senecio bipinnatisectus</i>
<i>Einadia</i> sp.	<i>Senecio pinnatifolius</i>
<i>Enneapogon truncatus</i>	<i>Senecio quadridentatus</i>
<i>Enteropogon ramosus</i>	<i>Setaria globoidea</i>
<i>Eremophila debilis</i>	<i>Sida hackettiana</i>
<i>Erigeron</i> sp.	<i>Sida spinosa</i>
<i>Eriochloa pseudoacrotricha</i>	<i>Solanum nigrum</i>
<i>Erodium crinitum</i>	<i>Sonchus oleraceus</i>
<i>Eucalyptus argophloia</i>	<i>Sorghum halepense</i>
<i>Eucalyptus orgadophila</i>	<i>Themeda avenacea</i>
<i>Euphorbia davidii</i>	<i>Themeda triandra</i>
<i>Geranium solanderi</i>	<i>Tribulus</i> sp.
<i>Glandularia aristigera</i>	<i>Urochloa panicoides</i>
<i>Glycine</i> sp.	<i>Verbascum</i> sp.
<i>Gomphocarpus physocarpus</i>	<i>Verbena bonariensis</i>
<i>Hackelia suaveolens</i>	<i>Verbena gaudichaudii</i>
<i>Haloragis</i> sp.	<i>Wahlenbergia</i> sp.
<i>Heliotropium amplexicaule</i>	<i>Zinnia peruviana</i>
<i>Hibiscus tridactylites</i>	

Appendix E

Queensland Herbarium specimen identifications



Queensland
Government

Department of
Environment, Science,
and Innovation

Queensland Herbarium and Biodiversity Science

Brisbane Botanic Gardens Mt Coot-tha • Toowong Qld 4066 • Australia

Telephone +61 7 3199 7699

e-mail Queensland.Herbarium@qld.gov.au

<http://www.qld.gov.au/herbarium>

Enquiries
Telephone
Your reference
Our reference

Lorna Ngugi
07 3199 7666

LN 23/24

25 January 2024

Daniel Kelly
6/32 Cottell Street
NORMAN PARK QLD 4170
dankelly87@gmail.com

Dear Daniel,

The botanical specimens received by the Queensland Herbarium on 15 January 2024 have been identified as:

CYPE1	<i>Cyperus gracilis</i>
DIPO1	<i>Digitaria porrecta</i>
ELNE	<i>Elattostachys nervosa</i>
EUAR1	<i>Eucalyptus argophloia</i>

You can contribute to Queensland's biodiversity information by submitting these plant identifications and associated information to the Atlas of Living Australia using the 'Report a sighting' template at (<https://www.ala.org.au/>).

The amount of \$128.30 (GST inclusive) has been paid for this identification. Thank you for your payment.

Yours sincerely

Lorna B. Ngugi

For Dr G. Brown
Director, QHBS

Elliot Leach

From: Advisory Services <advisory.services@des.qld.gov.au>
Sent: Thursday, 29 February 2024 1:07 PM
To: Elliot Leach
Cc: Daniel Kelly
Subject: RE: Identification of protected plants Leuzea australis and Picris evae from photographs

CAUTION: This email originated outside of the Organisation.

Hi Elliot,
Yes, that link worked.
I can confirm that all of the images show Picris evae.
Regards,
Tony Bean

Biodiversity Information and Advisory Services
Telephone: (07) 3199 7666 Facsimile: 07 3876 1278
Email: advisory.services@des.qld.gov.au
<http://www.qld.gov.au/environment/plants-animals/herbarium/>

Queensland Herbarium
Brisbane Botanic Gardens Mt Coot-tha
Mt Coot-tha Rd
TOOWONG, Qld 4066
Australia
Email: queensland.herbarium@qld.gov.au

From: Elliot Leach <eleach@emmconsulting.com.au>
Sent: Thursday, February 29, 2024 12:35 PM
To: Advisory Services
Cc: Daniel Kelly
Subject: RE: Identification of protected plants Leuzea australis and Picris evae from photographs

Thanks for that Tony, fantastic!

Does this link work? If not I can send a series of emails – the photos are quite large so there might be a few, that's all.

 [Picris evae](#)

Thanks again,

elliot

From: Advisory Services <advisory.services@des.qld.gov.au>
Sent: Thursday, February 29, 2024 12:21 PM

To: Elliot Leach <eleach@emmconsulting.com.au>

Cc: Daniel Kelly <dkelly@emmconsulting.com.au>

Subject: RE: Identification of protected plants *Leuzea australis* and *Picris evae* from photographs

CAUTION: This email originated outside of the Organisation.

Dear Elliot,

I was able to access the images for *Leuzea australis*, and I can confirm that all images are of that species.

I was not able to access the images for *Picris evae*. Not sure why.

Regards,

Tony Bean

Biodiversity Information and Advisory Services

Telephone: (07) 3199 7666 Facsimile: 07 3876 1278

Email: advisory.services@des.qld.gov.au

<http://www.qld.gov.au/environment/plants-animals/herbarium/>

Queensland Herbarium

Brisbane Botanic Gardens Mt Coot-tha

Mt Coot-tha Rd

TOOWONG, Qld 4066

Australia

Email: queensland.herbarium@qld.gov.au

From: Elliot Leach <eleach@emmconsulting.com.au>

Sent: Wednesday, February 28, 2024 5:09 PM

To: Advisory Services

Cc: Daniel Kelly

Subject: Identification of protected plants *Leuzea australis* and *Picris evae* from photographs

Good afternoon,

My colleague and I were out in the field last week conducting formal Protected Plant surveys (timed meanders) west of Gowrie Junction. We identified *Leuzea australis* and *Picris evae* in the field.

Daniel spoke on the phone earlier today with Tony Bean regarding whether we would be able to get confirmation of our identifications from the Herbarium by using photographs.

Unfortunately Dan (our SQP) has knocked off early today with a bad headache so I am following up!

There were only 15 *Leuzea* present in a small area, and Dan decided not to collect a plant for submission as he didn't want to compromise the population. Dan was very confident on his identification, and photographs of a number of plants are provided in the following linked folder:  [Leuzea australis](#)

The population of *Picris* was very large, but Dan did not take a specimen for submission. He may be able to clarify why tomorrow if necessary – his email address has been CC'd.

Again Dan was confident of his identification, and we are providing a number of photographs at the following link for your examination:  [Picris evae](#)

Incidentally, Dan and I would like to talk to someone at the herbarium about this population of *Picris* and other interesting findings in the area. We may try to set up a meeting later this week.

Thanks for your help!

Dr. Elliot Leach

Senior Ecologist



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BRISBANE | Yuggera/Turrbal Country, Level 1, 87 Wickham Terrace, Spring Hill QLD 4000



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APPENDIX

L

Terrestrial and Aquatic Ecology Technical Report

Appendix B Likelihood of occurrence

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

THREATENED SPECIES LIKELIHOOD OF OCCURRENCE

This likelihood of occurrence has been prepared according to the methods detailed in Appendix L, Section 3.2.4 and in conjunction with the species profiles and habitat definitions in Appendix A.

TABLE 1 LIKELIHOOD OF OCCURRENCE CRITERIA

	Preferred habitat exists ⁴	General habitat exists ⁵	Habitat does not exist ⁶
Recent ¹ records within the Project footprint ²	Known	Known	Known
Recent records in the Locality ³	Likely	Potential	Unlikely
No recent records within the Locality, but the Project footprint is within known distribution ⁷	Potential	Unlikely	Unlikely
No recent records in the Locality, and the Project Area is outside of distribution	Unlikely	Unlikely	Unlikely

¹Recent records are those that have been recorded in the last 20 years.
²'Project footprint' is the land required to accommodate all permanent and temporary components of the Project as described in EIS Chapter 5: Project Description.
³'Locality' refers to a 10 km buffer around the Project footprint and is inclusive of the Project footprint.
⁴Preferred habitat includes breeding, denning, roosting, and/or foraging habitats for fauna species; and habitat containing associated floristic species, vegetation communities, suitable substrates, and/or landforms for flora species.
⁵General habitat includes dispersal habitat and other areas where the species may occasionally be found, but do not contain all required habitat features to constitute preferred habitat.
⁶Based on sources reviewed and/or field survey results.
⁷Known distribution is defined as the may/likely distribution as per the SPRAT profile.

TABLE 2 MSSES LIKELIHOOD OF OCCURRENCE

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
Threatened Flora									
<i>Acacia argyrotricha</i>	Bracker wattle	V	-	The Bracker Wattle is native to a small area of Queensland in the Darling Downs district, primarily within Yelarbon State Forest south of Inglewood. The species has been found growing in quaternary sand (orangy-brown sandy loam) soils on flat undulating terrain, as a part of Eucalyptus woodland communities, including very tall <i>Eucalyptus crebra</i>, <i>E. pilligaensis</i> woodland and tall open heath of <i>Melaleuca uncinata</i> and <i>Calytrix tetragona</i> with emergent <i>Eucalyptus moluccana</i> and <i>E. sideroxylon</i> (Pedley 2018; ALA 2022). The presence of <i>Triodia</i> spp., <i>Allocasuarina luehmannii</i> and <i>Melaleuca</i> and <i>Acacia</i> spp. shrubs is noted in several occurrence record notes (ALA 2022). Habitat is supplied as “Flat undulating terrain, quaternary sand and soil.” Distribution in relation to the Project: There is no official distribution for the species, however it is only known from Yelarbon State Forest south of Inglewood. Species records: There are multiple records in Yelarbon State Forest (15 – 20 km from Project footprint) recorded between 1989 and 1994 (ALA, 2023). There is also an isolated record by Grimshaw approximately 5.5 km south southeast of Inglewood on Texas-Inglewood Rd in 1997 (~9 km from Project footprint). Records in the Project footprint: No Records in the locality: Yes, however they are historic records (20+ year old records).	WildNet Publications ALA	Potential	No	Habitat for the species, as described in the literature, was detected within the Project footprint although the species was not detected during targeted surveys in potential habitat. Suitable flat undulating landforms are present throughout the project footprint. Suitable quaternary sand soils are present within the project footprint, particularly on land zone 5. Associate floristic assemblage species, such as <i>Eucalyptus crebra</i>, <i>Allocasuarina luehmannii</i> and <i>Triodia</i> spp. occur within the project footprint. REs with suitable landform, soil and associated species were recorded within the project footprint between Yelarbon and Inglewood, including RE 11.5.1, 11.5.14 and 11.5.20. The bracker wattle has serval historical records within the Project Area (older than 20 years), all within the Yelarbon State Forest. This area is the only known area in which the species inhabits. The Project alignment is proposed to miss the Yelarbon State Forest entirely. Due to the Projects close proximity to the Yelarbon State Forest it has been assessed as being potential to occur within the southern sections of the Project Area, however, field surveys did not detect the species, thus its potential likelihood of occurring within the Project Area.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Acacia calantha</i>	Dawson River wattle	NT	-	Until recently, <i>Acacia calantha</i> was considered restricted to the Dawson River basin near Cracow, Queensland. However, new records have recently been found in the Coominglah State Forest, west of Monto; 35 km south-west of Mundubbera; Koko State Forest, 50 km south-west of Mundubbera; 6 km south-west of Brovinia and two populations 42 km north-east of Injune (one within Expedition National Park) (ALA, 2024b). At most sites, the species is restricted but locally common (Queensland Herbarium 2011). <i>Acacia calantha</i> grows in sand to sandy-clay soil on the lower slopes of steep sandstone hills and ridges in dry sclerophyll forest and open forest. The species has also been recorded growing in alluvial sands on an alluvial terrace adjacent to an ephemeral watercourse in Low open eucalypt forest with a shrubby understorey (ALA 2022). Associated with <i>Corymbia trachyphloia</i>, <i>C. maculata</i>, <i>Eucalyptus cloeziana</i>, <i>E. tenuipes</i>, <i>E. crebra</i>, <i>E. corynodes</i>, <i>C. citriodora</i>, <i>C. tessellaris</i>, <i>E. fibrosa</i>, <i>C. watsoniana</i>, <i>Lysicarpus angustifolius</i>, <i>Angophora leiocarpa</i>, <i>Acacia podalyriifolia</i>, <i>Acacia crassa</i>, <i>Acacia juncifolia</i>, <i>A. caroleae</i> and <i>Astrotricha biddulphiana</i> (Queensland Herbarium 2011). Distribution in relation to the Project: The Project footprint is outside the distributional limits of the species. Species records: Records only occur north of Chinchilla, approximately 150 km north of the Project footprint (ALA, 2023; DES, 2024). Records in the Project footprint: No Records in the locality: No	WildNet DES Species Profile ALA	Unlikely	No	Habitat for the species, as described in the literature, was detected within the Project footprint. Suitable sand to sandy-clay soil on the lower slopes of sandstone hills and ridges are not present. However, alluvial sands adjacent to watercourses are present within land zone 3 within the project footprint. No individuals were detected during targeted surveys in potential habitat. Suitable vegetation structural types, including open eucalypt forest are present within the project footprint. Several associate floristic assemblage species, specifically <i>Eucalyptus crebra</i> and <i>Angophora leiocarpa</i> were recorded within the project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Acacia curranii</i>	Curly-bark wattle	V	V	<i>Acacia curranii</i> has a disjunct distribution and is known from three separate areas: Lake Cargelligo and Gunderbooka Range near Bourke in NSW, and Gurulmundi in Queensland. These three locations are separated by several hundred kilometres. Within these areas there are approximately twenty populations of the species found in ten broad localities comprising a total of <5,000 individual plants. Two populations consisting of several hundred plants occur in the vicinity of Gurulmundi, Queensland. Preferred habitat for <i>Acacia curranii</i> is located in dry sclerophyll forests and semi-arid woodlands. Where found in parts of south-eastern Queensland in the Darling Downs area around Gurulmundi, it grows on deeply weathered sandstone forming poorly-drained red sandy soils (Pickard. J, 1995a). The soil is stony, containing patches of deep sand and little evidence of rock outcrop near the patches (Pickard. J, 1995a). In this Queensland location, the species occurs in widely scattered thickets within patches of diverse heath scrub containing emergent trees, with associated species including <i>Hakea purpurea</i>, <i>Kunzea opposita</i>, <i>Baeckea</i> spp. (Pickard. J, 1995b; Queensland Herbarium, 2011). Vegetation communities supporting this species include <i>Eucalyptus dwyeri</i>, <i>Acacia triptera</i>, <i>A. doratoxylon</i> mallee/shrubland, <i>E. intertexta</i> - <i>Callitris glaucophylla</i>, <i>E. microcarpa</i> woodland and <i>E. morrisii</i> - <i>C. glaucophylla</i> woodland (Ayers et al., 1996). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species' habitat is likely to and may occur. Species records: The nearest record of the species is located halfway between Oakey and Toowoomba Wellcamp Airport (approximately 4.5 km from the Project footprint). However, this record has a very high spatial uncertainty/inaccuracy of 75 km and the specimen was collected in 1973 (ALA, 2023). The next nearest record is approximately 185 km to the north-west of the Project, in Miles. Records in the Project footprint: No Records in the locality: Yes, but high spatial uncertainty	SPRAT WildNet DES Species Profile Publications	Unlikely	No	Preferred or general habitat for the species was not detected within the Project footprint as no suitable substrates described as deeply weathered sandstone forming poorly drained red sandy soils were detected. Of the described associated floristic species assemblages, only <i>Kunzea opposita</i> and <i>Callitris glaucophylla</i> were detected in the alignment, this is considered weak evidence of suitability as far as floristic indicators are concerned. Vegetation communities identified in the habitat requirements, dry sclerophyll forests and semi-arid woodlands, were abundant within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Acacia lauta</i>	Tara wattle	V	V	Occurs within south-east Queensland, in a small region of the Darling Downs between Inglewood and Tara. In this region, the species is known to occur on freehold land that has been previously cleared of vegetation and cultivated and within the road reserve, including road verges. Generally, the species is found on gently undulating to flat landforms with sandy soils in open forest to low woodland with a moderately dense shrub layer (Maslin, 2005). Preferred habitat for the species is located in moderately deep and hard setting soil with a weakly acidic to neutral sandy loam surface, grading into alkaline sandy clay subsoil (Halford, 1995). <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i> occur across all sites. SPRAT profile distribution in relation to the Project: The area around Inglewood is in the mapped distribution where the species or species' habitat is likely to or may occur. Species records: The nearest record of <i>Acacia lauta</i> is from 1989 and is located approximately 16 km south of the Project footprint near Coolmunda Dam, Inglewood. The remaining records are >100 km from the Project footprint, with the most recent being from 1994 (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT EIS WildNet	Potential	No	Both general and preferred habitat for the species occurs within the Project footprint near Inglewood and was targeted during surveys. Although this species has not been detected within the Project footprint, it was recently recorded during affiliated surveys by USC approximately 11 km from the alignment near Coolmunda Dam. The associate species <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i> are abundant throughout the alignment. Suitable landforms described as gently undulating to flat landforms are common throughout the potential habitat areas identified. Suitable sandy soil substrates are common throughout the alignment from Goondiwindi to Millmerran, particularly on Landzone 5 and 3 (REs 11.5.1, 11.5.4, 11.3.18, 11.3.7). Vegetation structural types open forest to low woodland are common. However, those with a moderately dense shrub layer are scarce.	Potential
<i>Androcalva procumbens</i>	-	-	V	<i>Androcalva procumbens</i> (synonyms: <i>Commersonia procumbens</i>) grows in sandy sites, often alongside roads and is endemic to NSW - mainly confined to the Dubbo-Mendooran-Gilgandra region, but also recorded in the Pilliga, Mount Kaputar National Park (NP), north-east of Gulgong, near Denmen and in Goonoo State Conservation Area (Harden and Orme, 2020; NSW OEH, 2021). This species produces persistent seeds which remain viable for some time. Large numbers of seedlings are known to germinate after fires at sites where no live specimens were evident above ground before the fires. Clusters of individuals may be clonal. It is often a pioneer species of disturbed habitats, being recorded colonising disturbed areas such as roadsides, quarry edges and gravel stockpiles and a recently cleared easement under power lines (NSW OEH, 2021). Preferred habitat for this rare species is recorded growing in <i>Eucalyptus dealbata</i> and <i>Eucalyptus sideroxylon</i> communities, <i>Melaleuca uncinata</i> scrub, under mallee eucalypts with a <i>Calytrix tetragona</i> understorey, and in a recently burnt Ironbark and <i>Callitris</i> area. Also recorded in <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i>, <i>Eucalyptus dealbata</i>, <i>Eucalyptus albens</i> and <i>Callitris glaucophylla</i> woodlands north of Dubbo. Other associated species include <i>Acacia triptera</i>, <i>Callitris endlicheri</i>, <i>Eucalyptus melliodora</i>, <i>Allocasuarina diminuta</i>, <i>Philotheca salsolifolia</i>, <i>Xanthorrhoea</i> species, <i>Exocarpos cupressiformis</i>, <i>Leptospermum parvifolium</i> and <i>Kunzea parvifolia</i> (NSW OEH, 2021). SPRAT profile distribution in relation to the Project: The area between Inglewood and Yelarbon in the mapped distribution where the species or species' habitat is likely to or may occur. Species records: All known records restricted to central and western NSW. The closest record is approximately 170 km away from the very western point of the Project footprint (ALA, 2023).	WildNet	Unlikely	No	Potentially suitable sandy soil substrates are common throughout the alignment from Goondiwindi to Millmerran, particularly on Landzone 5 and 3 (REs 11.5.1, 11.5.4, 11.3.18, 11.3.7). Surveys targeting these areas did not identify the species however many of the associate floristic assemblage species occur in the project footprint, including: <i>Eucalyptus dealbata</i> (likely to be present but misidentification as <i>E. chloroclada</i>), <i>Calytrix tetragona</i>, <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i>, <i>Eucalyptus albens</i> <i>Callitris glaucophylla</i>, <i>Callitris endlicheri</i>, <i>Eucalyptus melliodora</i>, and <i>Exocarpos cupressiformis</i>, are present in the alignment. Vegetation communities detected, include: woodlands and scrubs.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Records in the Project footprint: No Records in the locality: No					
<i>Aristida forsteri</i>	-	E	-	<i>Aristida forsteri</i> is a native grass that is restricted to a single locality. Found on low open heath on shallow soil over sandstone, and flowers and fruits in April. There is little information published about this species due to its restricted distribution. The species has been noted as growing in association with <i>Triodia vella</i>. Distribution in relation to the Project: The species is only known to occur in Bringalily State Forest, adjacent to the Project footprint. Species records: There are four records within 10 km of the Project footprint, with all four records located within Bringalily State Forest, towards the west of the footprint, recorded in 1992, 1995, 2006 and 2023 (ALA, 2023; DES, 2023). Records in the Project footprint: No Records in the locality: Yes, two records are within the past 20 years.	AusGrass ALA Wildnet	Potential	No	Habitat for the species, as described in the literature, was not detected within the Project footprint. Habitat typical of the species includes low open heathland on shallow soil, commonly associated with <i>Triodia vella</i>. This habitat type was not detected within the Project footprint, nor were any <i>Triodia vella</i> specimens detected during survey efforts. There have been several historical records of the species within the Project locality, being within the Bringalily State Forest and Wondul Range National Park. The areas surrounding the Project footprint have seen immense disturbance in the form of agricultural clearing, cropping and grazing. Due to the species not being detected during surveys, nor any habitat identified, the species has been assessed as unlikely to occur within the Project footprint	Unlikely
<i>Arthraxon hispidus</i>	Hairy-joint grass	V	V	Occurs in scattered locations throughout south-east Queensland. However, most occurrences are from Noosa southwards. Preferred habitat for hairy-joint grass is found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps. In south-east Queensland, hairy-joint grass has also been recorded growing in shaded small gullies, on creek banks, and on sandy alluvium in creek beds in open forests. White et al (2019) found that, in NSW, cover of the species was highest in moisture-associated assemblages in and around wetlands, drainage lines and groundwater seepages, often in association with native grasses, sedges and herbs. <i>A. hispidus</i> also occurred widely among introduced pastures and weeds in previously forested areas, demonstrating the species' potential to exploit derived habitat (White et al. 2019). SPRAT profile distribution in relation to the Project: The area around Toowoomba, Oakey and Pittsworth is in the mapped distribution where the species or species' habitat is likely to or may occur. The species or species' habitat likely to occur distribution is mapped to the north and east of the Project footprint between Kingsthorpe and Gowrie and around Southbrook (north-east of Pittsworth) where it is closest to the Project. Species records:	SPRAT WildNet Publications	Potential	No	General habitat for the species occurs within the Project footprint. Suitable landforms including moist areas in and around creeks, swamps, wetlands, drainage lines and groundwater seepages, are present throughout the Project footprint. The literature mentions sandy alluvium, which is present at many creeks and waterways throughout the alignment, particularly on Landzone 3. No particular associate floristic assemblages were identified in the literature to define habitat suitable for the species; as it occurs generally amongst native and introduced grasses, forbs and sedges.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				There are multiple recent records of <i>Arthraxon hispidus</i> within Toowoomba, from approximately 12 km from the Project footprint (ALA, 2023; DES 2023). Records in the Project footprint: No Records in the locality: No					
<i>Bertya opposens</i>	Coolabah bertya	-	V	In Queensland the species is widely distributed and has been recorded in the Brigalow Belt South and SEQ Bioregions. <i>Bertya opposens</i> preferred habitat occurs mainly in shallow sandy loams and red earth mixed with sandstone. The species is also found with rhyolite, shale, and metasediments. All soils are rocky and well-drained. Common community types include: shrubland, lance woodland, mallee woodland, eucalypt/acacia open forests and <i>Eucalyptus/Callitris</i> open woodland and semi-evergreen vine-thicket (Halford and Henderson, 2002; Queensland Herbarium, 2012). SPRAT profile distribution in relation to the Project: An area approximately 12 km east of Inglewood is mapped as where the species or species habitat is likely to occur, however this does not overlap with the railway alignment. Species records: The nearest records of the species are relatively recent (between 1994 and 2006) and are located within Devine State Forest, approximately 13 km east of the Project footprint north-east of Inglewood (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Potential	No	General habitat for the species occurs within the Project footprint and was targeted during surveys, that being present mixed shrublands, and open eucalypt/acacia woodlands. No individuals were detected during targeted surveys within general habitat. It should be noted that the species requires fire to germinate, then relies upon wind dispersal to pollinate, however frequent fire can actually be fatal to the species. Suitable landforms described in the literature include ridges and gullies, however this is not defined as an explicit list of suitable landforms. Ridges and gullies are present throughout hilly sections of the project. Preferred soils and substrate characteristics including shallow, rocky, and well-drained sandy loams, rhyolite, shale, and metasediments, red earths mixed with sandstone, are present in certain areas of the alignment, particularly on Landzone 7 (REs 11.7.7, 11.7.4, 11.7.5,) occurring between chainage 46500 - 64000. Many of the associate floristic assemblage species occur in the project footprint, including <i>Acacia shirleyi</i>, <i>Corymbia citriodora</i>, <i>C. trachyphloia</i>, <i>Gahnia aspera</i>, <i>Callitris endlicheri</i>, and <i>E. crebra</i>, however the likely/may distribution does not overlap with the Project footprint. The historical distribution of the species, based upon records and distribution mapping from DCCEEW, is very scattered and does not have large areas of preferred or general habitat. The species is additionally heavily reliant on fire for germination; however, fire is additionally its largest threat. The threat of fire and the amount of disturbed land (cropping and grazing land) is considered a large contributor to its relative absence within the Project footprint.	Unlikely
<i>Bertya pedicellata</i>	-	NT	-	<i>Bertya pedicellata</i> is confined to central and south-east Queensland, from near Aramac eastwards to Rockhampton and south to near Biggenden, with an isolated record from the Warwick district. The species has been recorded in Peak Range National Park and Allies Creek State Forest (Halford and Henderson 2002; Queensland Herbarium 2012). <i>Bertya pedicellata</i> has been recorded growing on rocky hillsides in eucalypt forest or woodland, Acacia woodland or shrubland and open heathland or vine thicket communities. Soils are predominantly skeletal to shallow sandy, sandy clay or clay loams overlaying rhyolite, trachyte or sandstone substrates. Associated species communities include <i>Corymbia trachyphloia</i>, <i>Dodonaea filifolia</i>, <i>Acacia catenulata</i>, <i>A. curvinervia</i>, <i>A. shirleyi</i>, <i>A. rhodoxylon</i>, <i>A. sparsiflora</i>, <i>E. crebra</i>, <i>Acacia harpophylla</i> and <i>E. decorticans</i> (Queensland Herbarium, 2012). Distribution in relation to the Project: The Project footprint is outside the distributional limits of the species.	WildNet DES Species Profile Publications	Unlikely	No	Suitable eucalypt forest (RE 11.7.7) on mid to upper slopes with sandy soil was recorded within the Project footprint. Associated species recorded within the RE included, <i>Corymbia trachyphloia</i>, <i>Eucalyptus crebra</i>, <i>Acacia shirleyi</i> and <i>Acacia sparsiflora</i>. One survey site contained rocky outcrops. No individuals were detected during targeted surveys in potential habitat.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Species records: There are no records of the species within the footprint or within 10 km of the Project footprint. The nearest record is located approximately 78 km east of the Project, recorded in 1995 and 1996 (DES, 2023). All other records occur within central Queensland. Records in the Project footprint: No Records in the locality: No					
<i>Bothriochloa bunyensis</i>	Satin-top grass	V	V	<i>Bothriochloa bunyensis</i> is endemic to south-east Queensland, where populations are only known to occur along the Great Dividing Range in Bunya Mountains NP, Toowoomba, Crows Nest and Main Range NP (Halford, 1998). <i>Bothriochloa bunyensis</i> is known to grow in relatively fertile krasnozem soils derived from basalt on upper slopes and hillcrests at altitudes of 600 to 1100 m. The species preferred habitat occurs in tussock grasslands and woodlands with a grassy understorey (Halford, 1998). SPRAT profile distribution in relation to the Project: An area north of Toowoomba is mapped within the mapped distribution where the species or species habitat is likely to occur, however this does not overlap with the Project footprint. Species records: All records are restricted to south-eastern Queensland. Two records exist in close proximity to Project footprint, both in Blue Mountain Heights (8.8 km and 9.3 km distant). Additional records occur in Toowoomba (<13 km distant) and the Lockyer Resources Reserve (<25 km distant) (ALA, 2023). The three closest records are recent (2004-2022). Majority of other records occur in Bunya Mountains and Main Range NPs. Although the nearest records are <10 km from the alignment (Blue Mountain Heights), no southerly records occur west of the Great Dividing Range (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes, but none south of Toowoomba west of the Great Dividing Range	SPRAT WildNet	Unlikely	No	General habitat for the species was observed within the Project footprint, in the form of general grasslands. During surveys in grasslands and/or grassy understory woodlands, no specimens were observed. Suitable landforms for the species are described as upper slopes and hillcrests at altitudes of 600 to 1100 m, which are uncommon throughout Project footprint. The species is commonly found in proximity to larger remnant patches of vegetation close to Main Range and Bunya Mountains National Parks. The species is largely threatened from encroachment of woody open forest and invasive weeds, this is thought to be induced from changes in fire regimes after European settlement. Suitable relatively fertile krasnozem soils derived from basalt are common throughout the alignment from Pittsworth to Gowrie, particularly on Landzone 8 (RES 11.8.5,11.8.11). Vegetation communities detected within the Project footprint include tussock grasslands and woodlands with a grassy understorey. As a result of the limited suitable landforms, lack of individuals identified, and prevalence of major threats to the species it is considered that this species is unlikely to occur.	Unlikely
<i>Bulbophyllum globuliforme</i>	Miniature moss-orchid	NT	V	<i>Bulbophyllum globuliforme</i> grows exclusively on the wrinkled bark of hoop pines (<i>Araucaria cunninghamii</i>) (Harrison, 2002), and can be considered preferred habitat for the species. The species is known from only four locations: Puzzle Creek near Paluma (north-east Queensland), Kroombit Tops near Calliope (Central Queensland), Cainbable Creek in Lamington NP (south-east Queensland) and Levers Plateau (north-east NSW) (Jones and Clements, 2001). SPRAT profile distribution in relation to the Project: Toowoomba is mapped within the mapped distribution where the species or species habitat is likely to occur, however this does not overlap with the Project footprint. Species records: The nearest record of the species is from 1946 and is located within Border Ranges NP, approximately 175 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	Preferred and general habitat for the species includes rainforests and vine thicket with emergent hoop pine, which is not present within the Project footprint. This is an epiphytic plant, and the substrate is the bark of hoop pine trees, which were not detected in the alignment.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Cadellia pentastylis</i>	Ooline	V	V	In Queensland, <i>Cadellia pentastylis</i> occurs from Balcomba (west of Rockhampton) south to the NSW border and west to near Blackall. All post-1984 records of the species within the Darling Downs are from north of 27° S (i.e., the northern part of Darling Downs). <i>Cadellia pentastylis</i> grows as a canopy or emergent species, often locally dominant, within semi-evergreen vine thicket, brigalow-belah, poplar box and bendee vegetation communities, and persists in cleared paddocks. The species has been recorded on undulating clay plains and low hills (Benson 1993), including sandstone, conglomerate, claystone, and basalt as underlying geology types (Harden 1991). Altitude ranges found in the literature range from 200 m to 600 m above sea level, with 300 m to 460 m considered typical. Soils mentioned in the literature include low to moderately fertile soils, of sandy clay or clayey consistencies (Pollock 1999). This can be considered preferred habitat for the species, which forms a closed or open canopy, with an open understorey and dense leaf litter dominating the forest floor. SPRAT profile distribution in relation to the Project: The entire alignment is inside of the mapped distribution where the species or species habitat is likely to or may occur. A very small section the alignment intersects with the species or species' habitat likely to occur distribution south of Millmerran. Species records: The closest records are two historic records (from 1919 and 1938) located approximately 42 km north-east of the Project footprint from Wyaga and Kindon Station, respectively (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT	Potential	No	General habitat for the species is present within the Project footprint however the species was not observed within the Project footprint. Suitable landforms occurring in the Project footprint, include: undulating terrain, upper and mid-slopes, and, to a lesser extent, confined areas which may loosely meet the description of edges of sandstone and basalt escarpments (Gowrie). Suitable underlying geology occurring in the Project footprint, includes: sandstone, conglomerate, claystone, and basalt. Suitable soil substrates occurring in the Project footprint, includes: sandy clay or clayey, low to moderately fertile soils, which are present throughout much of the alignment, particularly on Landzone 3, 4, 8 and 9. Associate floristic species detected in the Project footprint include: <i>Acacia harpophylla</i>, <i>Casuarina cristata</i>, <i>Eucalyptus populnea</i>, White Box (<i>Eucalyptus albens</i>), White Cypress Pine (<i>Callitris glaucophylla</i>), Bitterbark (<i>Alstonia constricta</i>), Wilga (<i>Geijera parviflora</i>), Berry Saltbush (<i>Einadia hastata</i>), <i>Stipa</i> spp. and <i>Aristida</i> spp. Suitable vegetation communities detected within the Project footprint include: brigalow woodland and poplar box woodland. The Project footprint does contain general habitat for the species, however, no specimens were identified during targeted surveys. Additionally, the closest record of the species is approximately 42 km north-east of the Project footprint from Wyaga and Kindon Station. It is considered that the species is unlikely to occur within the Projects footprint due to the lack of records. Additionally, the area in which the Project footprint is located has seen many of the species' main threats occur (i.e., previous clearing for agriculture, grazing, invasive species introduction, and change in microclimate potentially affecting recruitment) (DEWHA, 2008) which would likely preclude it from occurring locally.	Unlikely
<i>Camptacra perdita</i>	-	E	-	<i>Camptacra perdita</i> was named in 2020 following a taxonomic revision of the genus Camptacra. Camptacra perdita is currently known from four collections in southern Queensland (two from near Oakey, one near St George and one near Roma), and from a single location in NSW (Bean 2020). The species has been recorded growing in grassland on heavy black soil on alluvium. Two of the known sites were dominated by <i>Dichanthium sericeum</i>. Distribution in relation to the Project: There is no official distribution for the species. Species records: There are no records of the species within the Project footprint, however there are two records from 2001 (ALA, 2023) are found within approximately ~9 km north-west of the Project footprint near Oakey. An additional record from 2013 exists ~17 km from the Project footprint, north-west of Oakey. Records in the Project footprint: No Records in the locality: Yes, however they are over 20 years old.	WildNet	Potential	No	Habitat for the species, as described in the literature, was detected within the Project footprint although targeted surveys did not detect the species. Suitable grassland habitat (RE 11.3.21) on heavy black soil on alluvium was recorded within the project footprint. An associated species, <i>Dichanthium sericeum</i>, was recorded at multiple survey sites. There are no records of the species within the Project footprint, however there are two records from 2001 within the locality, ~9 km north-west of the Project footprint near Oakey and an additional record from 2013 exists ~17 km from the Project footprint, north-west of Oakey. Due to habitat for the species being present within the Project footprint and serval historical records being present within the locality the species has been assessed as being potential to occur within the Project footprint.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Clematis fawcettii</i>	Stream clematis	V	V	Preferred habitat for stream clematis contains canopy gaps and is often found near streams. The literature describes suitable soils as variable, but particularly mentions loam soils derived from basalt and mixed volcanic rock, and fertile clays (Queensland Herbarium,2009; Harden, 1990; Queensland CRA/RFA Steering Committee, 1998; NSW DECCW, 2005bl (Internet)). It is generally found in the following community types: semi-evergreen vine thicket, araucarian microphyll vine forest, complex notophyll vine forest, and eucalypt open forest with scattered vine forest species. Altitudes described in the literature range from 500 m to 980 m above sea level (Halford 1998; Harden 1990; Queensland Herbarium 2009). No particular floristic assemblages or associations are described in the literature. The literature describes the species as particularly hard to detect due to its nature as a vine with adult foliage confined to the tree canopies where it is difficult to spot (Bean 2009 pers. comm. cited in DEWHA 2009bd). Juveniles with foliage at ground level are reportedly more easily, and therefore more often, detected (DECCW, 2005bl (Internet)). SPRAT profile distribution in relation to the Project: Two small areas around Gowrie and Pittsworth are located within the mapped distribution where the species or species habitat may occur. Species records: Three recent records of the species are 1.3 km to 5 km north of the project in Kingsthorpe and Gowrie Junction (from 2020-2023) (ALA 2023). Another close record of the species is from 2011, approximately 6 km north of the Project footprint in the Mount Tyson area north of Pittsworth. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Potential	No	Preferred habitat for the species, as described in the literature, occurs however the species was not observed within the Project footprint. Suitable landforms described in the literature and occurring in the Project footprint, includes creeks and streams. Suitable underlying geology described in the literature and occurring in the Project footprint, includes basalt and mixed volcanic rock. Suitable soil substrates described in the literature occurring in the Project footprint, includes loam soils derived from basalt and mixed volcanic rock, and fertile clays. Suitable Landzones occurring in the Project footprint are considered to include: 3, 8. Suitable vegetation communities described in the literature and detected within the Project footprint include: eucalypt woodland communities that are close to vine thicket or rainforest (potential small patches of 11.8.5 with vine forest species on two small hills, ch.164500 and 165000 near Pittsworth).	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Coleus insularis</i>	Millmerran mint bush	CE	-	The Millmerran mint bush has a very limited distribution, being limited to a small, isolated area in the southeastern sector of Queensland. It is locally common within the Millmerran State Forest but is very restricted in region or district. Species is known from a single population with a very restricted area of occupancy (<20 km²). The species commonly occurs amongst boulders and between rock pavements on granite monolith with tall shrubland and open woodland (Forster, 2011). An outlier of granite (with pavements and outcrops) supporting low eucalypt woodland or shrubland surrounded by dissimilar geology (mainly heavy clay soils) that used to support brigalow open forest prior to conversion to agricultural land. The granite geology of the Millmerran State Forest is also unique within the context of the local Millmerran area. Millmerran mint bush is locally very common on pavement areas within the State Forest, particularly at the western end. Distribution in relation to the project: Small area adjacent to the alignment is within known records/mapped distribution where the species' habitat is likely to and may occur. Species records: There are multiple records in Millmerran State Forest (2 – 3 km east from Project Footprint) recorded between 1995 and 2021. There is also an isolated record at Mount Domville approximately 1.5 km east of the Project Footprint, 2005. Records in the Project footprint: No Records in the locality: Yes	ALA WildNet Publications	Potential	No	Preferred or general habitat for the species was not detected within the Project footprint. The Millmerran mint bush prefers environments with granite structures within tall shrubland and open woodland. These niche requirements were detected via desktop analysis in the Millmerran State Forest. This particular State Forest demonstrates a unique granite geology in comparison to surrounding areas. This specific environment found in the Millmerran State Forest demonstrates goldilocks conditions for the species. It can be deemed that preferred habitat exist for the species within the Project locality, however recent and old records are secluded to Millmerran State Forest. Due to its close proximity to the alignment, it is recommended that there is a potential for this species to occur within the alignment.	Potential
<i>Commersonia ingelewoodensis</i>	-	CE	-	<i>Commersonia ingelewoodensis</i> (formerly <i>Androcalva ingelewoodensis</i>) is known only from a single population in the Inglewood area of south-eastern Queensland (Guymer, 2006). It is a ground-hugging shrub that can grow 100 mm in height with trailing stems and branchlets about 90 mm long (Hobson 2015). It flowers a small white-flower, with globular seed capsules in February – March and October – November. The species occurs in low heathland and shrubland communities on flat-topped rises. It grows on deeply weathered sedimentary rocks and shallow red sandy loam (Guymer 2006). Associated species include, <i>Calytrix spp.</i>, <i>Micromyrtus sessilis</i>, <i>Babingtonia densifolia</i> and <i>Boronia</i> spp. The species has also been recorded in adjacent eucalypt woodland on Inglewood sandstone with associated species, including <i>Acacia conferta</i>, <i>A. crassa</i> subsp. <i>crassa</i>, <i>Angophora leiocarpa</i>, <i>Callitris endlicheri</i>, <i>Chrysocephalum apiculatum</i>, <i>Jacksonia scoparia</i>, <i>Allocasuarina luehmannii</i> and <i>Melinis repens</i>. Distribution in relation to the Project: There is no official distribution for the species, however it is only known from Bringalily State Forest north of Inglewood. Species records: All Queensland records are restricted to Bringalily State Forest, 14 of which are located within 10 km west of the	WildNet DES Species Profile ALA Publications	Potential	No	No habitat for the species, as described in the literature, was detected within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Project footprint. The records range between 2003 and 2017 (ALA, 2023), in a habitat supplied as “Small flat-topped rise, shallow red sandy loam, on edge of vehicle track” (record in 2006) and “Eucalypt woodland. Steady rise on sedimentary geology. Orange pebbly sand soil. Land used in forestry” (record in 2017). Records in the Project footprint: No Records in the locality: Yes					
<i>Cymbonotus maidenii</i>	-	E	-	<i>Cymbonotus maidenii</i> is found in isolated patches in inland southern Queensland; west to Mitchell and north to Emerald. It is also found in northern NSW, north of the Darling and Barwon Rivers. (Holland and Funk 2006; Herbrechs 2008). <i>Cymbonotus maidenii</i> occurs in open grassland, along roadsides or beside watercourses or waterholes. It grows on black, brown or grey heavy, cracking clay soils (Holland and Funk, 2006). The species commonly flowers yearly, from September to November. Distribution in relation to the Project: There is no official distribution for this species. Species records: The nearest records are from Toowoomba (~11 km from Project footprint from 1940 and 1953) and around Cecil Plains (~19 km from Project footprint) (ALA, 2023; DES, 2023). Records in the Project footprint: No Records in the locality: No	WildNet ALA DES Species Profile Publications	Potential	No	Habitat for the species, as described in the literature, was detected within the Project footprint. No individuals were detected during targeted surveys in potential habitat. Suitable grassland habitat (RE 11.3.21 and 11.8.11) on heavy black, brown and/or grey cracking clay soil was recorded within the Project footprint. Suitable non-remnant habitat with cracking clay was also present along roadsides and grazing paddocks. There were no records within either the Project footprint or the locality. However, the nearest records were approximately 11 km from the Project footprint from 1940 /1953 and around Cecil Plains 19 km from the Project footprint. Field surveys did observe appropriate habitat for the species. Resulting from present habitat within the Project footprint and the species germinating behaviour, dispersing / flowers in response to rain, leads to the potential for the species to occur. Therefore the species has been assessed as potential to occur within the Project footprint.	Potential
<i>Cyperus clarus</i>	-	V	-	<i>Cyperus clarus</i> is found from near Emerald in central Queensland to near Delungra on the NSW north-west slopes (Queensland Herbarium 2012). The species grows in grassland (in particular Dichanthium grassland) or open woodland, in brown clay soils and heavy soils derived from basalt (Wilson, 1991; Wilson, 2008). The species is associated with grasslands where <i>Aristida leptopoda</i> and <i>Panicum queenslandicum</i> occur on deep alluvial black clay; in <i>Eucalyptus melanophloia</i> woodland with mid-dense ground stratum of <i>Chrysopogon fallax</i>; growing with <i>Stemmacantha australis</i> in mountain coolibah woodland on basalt ridges; and in Dichanthium grassland with <i>Cyperus bifax</i> and <i>Fimbristylis</i> spp. (Queensland Herbarium 2012). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are records at multiple sites surrounding the Project footprint (west of Pittsworth and around Southbrook and Gowrie Mountain) between the years 1974 and 2021 predominantly within RE 11.8.4 and 11.8.5 (ALA, 2023). A single record from 2021 appears to be within the Project footprint. Despite the low accuracy of the record location (2 km), the description of “ca. 0.16km north of Murlaggan Road, 7km west of Pittsworth” places it within the footprint. Records in the Project footprint: Yes Records in the locality: Yes	ALA WildNet DES Species Profile Publications	Known	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. The species was detected during surveys of habitat (predominantly RE 11.8.4 and 11.8.5) between Brookstead and Gowrie. Suitable grassland habitat (RE 11.8.11) on heavy soils was recorded within the project footprint. Associated species included <i>Dichanthium sericeum</i>. Suitable open woodland habitat on heavy soils (RE 11.3.2, 11.7.7, 11.8.4 and 11.8.5) was recorded within the Project footprint. Associated species included <i>Eucalyptus melanophloia</i>.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Dichanthium queenslandicum</i>	King bluegrass	V	E	<i>Dichanthium queenslandicum</i> occurs in three disjunct populations: 1) Hughenden district; 2) from Nebo to Monto and west to Clermont and Rolleston; and 3) Dalby district, Darling Downs (DSEWPAC, 2013). This species preferred habitat is confined to natural grassland on the black cracking clay soils (basalt downs, basalt cracking clay, open downs) on undulating plains (Simon, 1982; Fletcher, 2001). The literature also lists travelling stock routes, road reserves and unploughed grasslands as general habitat where the species is commonly found. It has been observed in paddocks grazed by cattle, but where the grazing pressure is very irregular and/or low, and where native grasses dominate (natural grasslands) (pers. comm. Jeffers, 2022). Other communities where <i>Dichanthium queenslandicum</i> can be found include <i>Acacia salicina</i> thickets in grassland and eucalypt woodlands (i.e. <i>Corymbia dallachiana</i>, <i>C. erythrophloia</i>, <i>E. orgadophila</i>). The literature lists species associations as: other species of blue grasses (<i>Dichanthium</i> spp. And <i>Bothriochloa</i> spp.), and other grasses restricted to black cracking clay soils. SPRAT profile distribution in relation to the Project: Areas of the alignment between Gowrie and Pampas (south-west of Pittsworth) are within the mapped distribution where the species or species habitat is likely to or may occur. The areas around Pittsworth are within the species' likely to occur distribution. This area appears to be an extension in a southeast direction, of the Dalby district, Darling Downs population mentioned in the literature. Species records: Five recent records exist very close to the Project footprint (30 – 850 m) near Pittsworth around the intersection of the Gore Highway and Toowoomba Road (dated 2014-2021) (ALA, 2023). Records in the Project footprint: No but are located very close to the edge of the footprint. Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes – close to the edge of the footprint near Pittsworth	Preferred habitat for the species, as described in the literature, is present within the Project footprint. The closest detection was located 0.8m from the edge of the alignment. Surveys detected the species in open woodland (RE 11.8.5) on low hills near Pittsworth. Suitable landforms described in the literature and occurring in the Project footprint include: undulating plains, low hills, basalt downs, and open downs. The <i>D. queenslandicum</i> plants found near the alignment, including previous records, occur on low hills characteristic of the Pittsworth to Gowrie section of the Project alignment (approximately 39 km). Suitable underlying geology described in the literature and occurring in the Project footprint includes basalt. Suitable soil substrates described in the literature occurring in the Project footprint includes black cracking clay soils. Suitable Landzones occurring in the Project footprint are considered to include: 8 Associate floristic species described in the literature and detected in the Project footprint include: <i>Dichanthium</i> spp., <i>Bothriochloa</i> spp., and other grasses restricted to black cracking clay soils. Suitable vegetation communities described in the literature and detected within the Project footprint includes natural grasslands (RE 11.8.11) and <i>Eucalyptus orgadophila</i> open grassy woodland (RE 11.8.5).	Known
<i>Dichanthium setosum</i>	Bluegrass	-	V	The literature describes <i>Dichanthium setosum</i> as occurring in soils generally described as heavy soils (predominantly cracking clays or alluvium, often in gilgai), and including more specific soils including heavy basaltic black soil, stony red-brown hard-setting loam with a clay subsoil (Booth, 2012; DEH, 2022). Vegetation communities forming general habitat for the species are described in the literature as woodland or open woodland usually dominated by <i>Acacia harpophylla</i> (brigalow) and/or <i>Eucalyptus</i> spp. (Booth, 2012). It is also described as often being found in moderately disturbed areas such as cleared woodland, disturbed open grassy woodlands, grassy roadside remnants, and highly disturbed pasture. Such areas include habitat that has been variously grazed, nutrient-enriched and water-enriched (DE, 2022b). Flora species associated with preferred habitat mentioned in the literature include <i>Eucalyptus albens</i>, <i>Eucalyptus melanophloia</i>, <i>Eucalyptus melliodora</i>, <i>Eucalyptus viminalis</i>, <i>Myoporum debile</i>, <i>Aristida ramosa</i>, <i>Themeda triandra</i>, <i>Poa sieberiana</i>, <i>Bothriochloa ambigua</i>, <i>Medicago minima</i>, <i>Leptorhynchos squamatus</i>, <i>Lomandra aff. Longifolia</i>, <i>Ajuga australis</i>, <i>Calotis hispidula</i> and <i>Austrodanthonia</i>, <i>Dichopogon</i>, <i>Brachyscome</i>, <i>Vittadinia</i>, <i>Wahlenbergia</i> and <i>Psoralea</i> species (Ayers et al., 1996; DE, 2022b; OEH, 2022a). The extent to which the species can tolerate disturbance is not known. However, it is commonly found in disturbed areas such as cleared woodland, roadside remnants,	SPRAT WildNet Publications	Potential	No	Both general and preferred habitat for the species, as described in the literature, occurs within the Project footprint however the species was not observed within the Project footprint. Suitable soil substrates described in the literature occurring in the Project footprint, include cracking clays, alluvium, heavy basaltic black soils. Suitable Landzones occurring in the Project footprint are considered to include: 3, 4, 8. Associate floristic species described in the literature, and detected in the Project footprint, includes <i>Eucalyptus albens</i> , <i>Eucalyptus melanophloia</i> , <i>Myoporum debile</i> , <i>Aristida ramosa</i> , <i>Themeda triandra</i> , <i>Ajuga australis</i> , <i>Calotis</i> spp., <i>Vittadinia</i> spp., and <i>Wahlenbergia</i> spp. Suitable vegetation communities described in the literature and detected within the Project footprint, includes woodland, open woodland, <i>Acacia harpophylla</i> (brigalow) woodland, cleared woodland, disturbed open grassy woodlands, grassy roadside remnants, and highly disturbed pasture.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				grazed land and highly disturbed pasture. It is also found on variously grazed pasture where the soil is nutrient-enriched and water-enriched (Ayers et al., 1996). SPRAT profile distribution in relation to the Project: The entire alignment is inside of the mapped distribution where the species or species habitat is likely to and may occur, mostly within the likely to occur distribution. Species records: The nearest records of the species are from 10 km south of the Project footprint in NSW and from 15 km east and north-east of the Project footprint within the Toowoomba Range. Three out of four of these records are recent (between 2004 to 2018) (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes, one record					
<i>Digitaria porrecta</i>	Finger panic grass	NT	-	<i>Digitaria porrecta</i> is endemic to eastern Australia where it occurs in several disjunct populations. In Queensland, these localities are all within the Brigalow Belt bioregion. The species generally occurs in tussock grassland or open woodland of poplar box or forest red gum on heavy, alluvium, cracking clay soils (Leigh et al., 1984; Halford, 1995). The species has also been recorded in disturbed habitats, such as fallow paddocks and grazed grasslands (Halford, 1995). Distribution in relation to the Project: The Project footprint is within DES's modelled distribution for the species. Species records: Multiple records (30+) are within the Project footprint and surrounds, predominately in the Toowoomba region, down to north of Millmerran, with some distribution south of Goondiwindi (ALA, 2023; DES, 2023). These records range between 1984 and 2023. Three records (1995-2022, three being recent) appear within the Project footprint. Records in the Project footprint: Yes Records in the locality: Yes	SPRAT ALA WildNet Publications	Known	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. The species was recorded within the Project footprint, predominately between Brookstead and Gowrie, with two records south of Millmerran. Suitable soil i.e., heavy, cracking clay soils, occurs within the Project footprint. Suitable vegetation communities described in the literature and detected within the Project footprint, include tussock grassland (RE 11.3.21 and 11.8.11), poplar box woodland (RE 11.3.2) and red gum woodland (RE 11.3.25 and 11.3.4). The species was recorded within additional vegetation communities, RE 11.4.3, 11.8.4, 11.8.5 and 11.9.5.	Known
<i>Eucalyptus curtisii</i>	Plunkett mallee	NT	-	<i>Eucalyptus curtisii</i> occurs in a rather wide but very scattered distribution in south-east Queensland, extending 80 km north and south of Brisbane, and inland >300 km north-west to the Dalby and Miles district. <i>E. curtisii</i> occurs on poorly-drained sandy podsoils, shallow stony soils, clay loams and stony clays with a surface layer of loose stones (Brooker and Kleinig, 1994; Wang, 1996; Queensland Herbarium, 2012). The species exhibits two growth forms when occurring in different habitats. The shorter mallee form is more likely to occur as the only eucalypt species on poorly drained lowland sites in banksia-dominated shrubland, with an understorey of heath plants, and sometimes <i>E. conglomerata</i>. The larger growth form occurs scattered on better drained soils in more open areas of mixed eucalypt forests. Common species associations include <i>Corymbia citriodora subsp. variegata</i>, <i>C. trachyphloia</i> and <i>Callitris endlicheri</i>, less commonly associated with <i>E. fibrosa</i>, <i>E. planchoniana</i> and <i>E. acmenoides</i>. Distribution in relation to the Project: Yes, based on records. Species records:	WildNet ALA Publications DES Species Profile	Potential	No	Habitat for the species, as described in the literature, was detected within the Project footprint, although targeted surveys did not detect the species. Habitat was limited to small patches of RE 11.7.7, which contained sandy-loam soil with scattered loose rock cover and associated floristic species, including: <i>Corymbia trachyphloia</i> and <i>Eucalyptus fibrosa</i>, but it is expected that the species is restricted to localised areas in the vicinity of the previous records, several kilometres from the Project footprint.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				There are several records within Bringalily, Devine and Western Creek State Forests that are within 15 km of the Project footprint, ranging between 1958 and 2006 (ALA, 2023). The records in Bringalily State Forest are the only records within 10 km of the Project area and are dated between 1993 and 1998. Records in the Project footprint: No Records in the locality: Yes, however they are over 20 years old.					
<i>Eucalyptus infera</i>	Durikai mallee	V	V	<i>Eucalyptus infera</i> is currently known from Durikai State Forest south-west of Warwick, on a land area approximately 40 to 50 ha in size (Bean, 1990; The Royal Botanic Gardens & Domain Trust, 2021). The species grows in sandy duplex soils (podsoles, grey sandy-clay sometimes with a gravelly surface layer, grey clay loam) derived from metamorphosed sediments (Bean, 1990; DEWHA, 2008). The underlying landzone in the areas of known records are broadly mapped as Landzone 11, metamorphic and may include minor areas of landzone (LZ) 3, potentially at a scale that has not been mapped. General habitat, based on descriptions of vegetation types in the literature includes tall dry sclerophyll forest (Hill, 1997), open forest (Bean, 1990) in which <i>E. infera</i>, a mallee, occurs in the understorey. Positions in the landscape mentioned in the literature include growing in or next to often-dry watercourses or small drainage lines, and adjacent low rises (Bean, 1990). Species associated with preferred habitat include <i>Eucalyptus moluccana</i>, <i>E. fibrosa</i> subsp. <i>fibrosa</i>, <i>E. melliodora</i>, <i>E. tereticornis</i>, <i>Corymbia citriodora</i> subsp. <i>variegata</i>, <i>Melaleuca decora</i>, <i>Jacksonia scoparia</i>, and <i>Melichrus urceolatus</i> (Bean, 1990). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: The closest recent records are located 40 to 50 km east of the Project footprint in Talgai and Durikai State Forests. The Project footprint is outside the species current known distribution (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	Both general and preferred habitat for the species, as described in the literature, is not considered present within the Project footprint, due to absence of metamorphic sedimentary geology, which appears to be a habitat requirement. Suitable landforms are not described in the literature, but through examination of topographic maps of the locations of specimens, is considered to be gentle slopes on low hills, similar landscapes are present in the Project footprint, though not those derived from metamorphic sediments. It is not known whether suitable soil substrates described in the literature occur in the Project footprint. Landzone 11, inferred to be suitable for the species, is not mapped in the Project footprint on the Queensland Herbarium Pre-clearing Regional Ecosystems (RE) map V 12.1, and landzone 11 Res were not detected during the surveys. There are no areas of the Project footprint that fall within mapped or known distribution of the species. Associate floristic species described in the literature and detected in the Project footprint includes <i>E. tereticornis</i>, <i>Melaleuca decora</i>, <i>Jacksonia scoparia</i>, and <i>Melichrus urceolatus</i>. Suitable vegetation communities described in the literature and detected within the Project footprint includes open forest.	Unlikely
<i>Eucalyptus virens</i>	Shiny-leaved ironbark	V	V	<i>Eucalyptus virens</i> is endemic to south-east Queensland. There are five recorded sites, as far south as Inglewood and as far west as Mt Moffatt (Queensland Herbarium, 2008). The species occurs within areas of dynamic topography such as on undulating hills, hillslopes, sandstone escarpments, gentle rises, and scree slopes and has a limited distribution in southern Queensland (Halford, 1997). Soils mentioned in literature and specimen labels include white sand over sandstone (Brooker, M.I.H., 1993), grey sandy loam over sandstone (Briggs, J.D. and Keith, D, 1988), sandy (Bean, A.R., 1993); and grey sandy loam (Hill, K.D., 1984). General habitat, based on vegetation communities recorded in the literature includes <i>Eucalyptus</i> woodland (Bean, A.R., 1993), and dense scleromorphic woodland (Hill, K.D., 1984). Floristic species assemblages recorded in the literature include <i>Eucalyptus exserta</i> and <i>E. panda</i> (Brooker, M.I.H., 1993); <i>Angophora costata</i>, <i>Eucalyptus umbellata</i>, <i>Corymbia trachyphloia</i> (Bean, 1993); and <i>C. trachyphloia</i>, <i>E. umbellata</i>, and <i>Callitris glaucophylla</i> (Hill, K.D., 1984). SPRAT profile distribution in relation to the Project:	SPRAT WildNet Publications	Potential	No	General habitat for the species, as described in the literature, occurs within the Project footprint however the species was not observed during targeted surveys of this habitat. Suitable landforms described in the literature and occurring in the Project footprint includes undulating hills, gentle rises, and hill slopes. However, the proposed alignment is generally situated on more level ground at the bottom of the undulating hill sections. Suitable underlying geology described in the literature and occurring in the Project footprint includes sandstone. It is not known if suitable soil substrates, including those described in the literature, occur in the Project footprint. Associate floristic species described in the literature and detected in the Project footprint include: <i>Callitris glaucophylla</i>. Suitable vegetation communities described in the literature and detected within the Project footprint includes <i>Eucalyptus</i> spp. woodlands. While general habitat typical of the species occurs within the Project footprint, shiny-leaved ironbark was not detected during targeted surveys. The area	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Areas of the Project footprint from Inglewood to Bringalily are within the mapped distribution where the species or species habitat is likely to occur. Species records: The nearest records of the species are from Bringalily State Forest and Coolmunda, located 11 km and 15 km distant from the Project footprint, respectively (ALA, 2023; DES, 2023). The record in Bringalily SF is from 1988, whereas the most recent of the records around Coolmunda is from 2008. Records in the Project footprint: No Records in the locality: No				surrounding the Project footprint has seen immense historical clearing and as a result has fragmented habitat. It can be concluded that the species is unlikely to occur within the Project footprint, due to its lack of presence, historical habitat loss, and no records within the locality.	
<i>Fimbristylis vagans</i>	-	E	-	<i>Fimbristylis vagans</i> is a species of plant in the family Cyperaceae, a sedge family of monocotyledonous flowering plants. The species is a wetland indicator (WetlandInfo 2019). The species is associated with clay pans, open sedge land and sparse-tussock grasslands on shallow alluvial sand plains but may also occur in other ecosystems (other species of <i>Fimbristylis</i> are common in pastures of central Queensland). <i>F. vagans</i> is also found near ephemeral lagoons on wet sandy soils, and within <i>Eucalyptus camaldulensis</i> communities (Menkins 2018). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species within 10 km of the Project footprint. The nearest records are located 50 km east of the footprint, recorded in 1984 (ALA, 2023; DES, 2023). All other records occur north of Chinchilla. Records in the Project footprint: No Records in the locality: No	ALA Wildnet Publications WetlandInfo	Unlikely	No	Habitat for the species was detected within the Project footprint, although surveys did not detect the species. Habitat was limited to RE 11.3.27i with associated floristic species, including <i>Eucalyptus camaldulensis</i> .	Unlikely
<i>Haloragis exalata</i> subsp. <i>velutina</i>	Tall velvet sea-berry	V	V	<i>Haloragis exalata</i> subsp. <i>velutina</i> occurs on the north coast of NSW and in south-east Queensland. It occurs from near Kempsey, north to Carnarvon NP (NSW DECC, 2005; Queensland Herbarium, 2008). In Queensland this species is conserved in Carnarvon NP, Bunya Mountains NP, and Mt Moffat NP (NSW DECC, 2005; Queensland Herbarium, 2008). In Queensland, preferred habitat for <i>Haloragis exalata</i> subsp. <i>velutina</i> occurs in rainforest, rainforest margins, adjacent grassland and open grassy woodland >500 m above sea level (the grassland balds of Bunya Mountain NP) (Queensland CRA/RFA Steering Committee, 1998; Queensland Herbarium, 2008). The species has been recorded growing on brown heavy clay, shallow rock loam and basaltic soils. It was formerly known from swamp vegetation beside the Brisbane River near Hamilton at low elevation (Queensland Herbarium, 2012). Microhabitat noted in the literature includes damp places near watercourses; and in woodland on the steep rocky slopes of gorges (NSW OEH, 2022). Associated species includes broad-leaved apple (<i>Angophora subvelutina</i>), forest redgum (<i>Eucalyptus tereticornis</i>), green wattle (<i>Acacia irrorata</i>), and <i>Scutellaria humilis</i> (Queensland Herbarium, 2008). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: Nearest recent record is within Bunya Mountains NP (approximately 68 km from the Project footprint) from	SPRAT WildNet Publications	Unlikely	No	Preferred habitat for the species was not identified within the Project footprint. No suitable vegetation communities, described in the literature as rainforest, or in proximity to rainforest occur within the Project footprint. Limited general habitat for the species, as described in the literature, was observed within the Project footprint although the species was not detected during targeted surveys. Suitable soil substrates described in the literature occurring in the Project footprint includes brown heavy clay, shallow rock loam and basaltic soils. Associate floristic species described in the literature and detected in the Project footprint includes <i>Eucalyptus tereticornis</i> .	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				2008. Another record exists from 2001 near Oakey, approximately 10 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes, but the record is 22 years old					
<i>Homopholis belsonii</i>	Belson's panic	E	V	This species occurs at elevations ranging from 200 m to 520 m above sea level. Preferred habitat includes a range of dry woodland habitats and soil types including, brigalow and Belah forest and woodlands, temperate sub-humid woodlands, woodland on rocky hills supporting white box (<i>Eucalyptus albens</i>) and wilga (<i>Geijera parviflora</i>); flat to gently undulating alluvial areas supporting belah (<i>Casuarina cristata</i>), <i>Acacia harpophylla</i> (Brigalow) or G.parviflora (Wilga); poplar box (<i>Eucalyptus populnea</i>) woodlands, mountain coolibah (<i>Eucalyptus orgadophila</i>) communities, and roadsides (Trémont and Whalley, 1993a; AusGrass, 2022; Queensland Department of Environment and Science, 2022). Microhabitat features often associated with this grass includes growing beside or supported by, fallen logs, sub-shrubs and tree trunks and low hanging branches. SPRAT profile distribution in relation to the Project: Areas of the Project footprint including most of the alignment from the border to Pittsworth are within the mapped distribution where the species or species habitat may occur. Species records: In proximity to the Project alignment, <i>Homopholis belsonii</i> records are present from Pittsworth to Goondiwindi, with a particularly high density around Millmerran (Queensland Herbarium, 2008; ALA, 2023). Two recent records from 2021 and 2023 are present at the southern end alignment (ALA, 2023; DES, 2023). Records in the Project footprint: Yes Records in the locality: Yes	SPRAT WildNet	Known	Yes	Preferred habitat for the species, as described in the literature, occurs within the Project footprint and was confirmed during surveys. The species was recorded across the Project footprint during surveys, including multiple records near Yelarbon, Inglewood, Tummaville, Millmerran and Yandilla. Habitat is located sporadically, generally in small patches between Pittsworth and the border (approximately 180 km). Suitable landforms described as gently undulating to flat landforms are common throughout the Project footprint. Suitable soil substrates described in the literature occurring in the Project footprint, includes clay and loam. Suitable Landzones occurring in the Project footprint are considered to include: 3, 4, 8 Associate floristic species described in the literature and detected in the Project footprint, includes <i>Eucalyptus albens</i>, <i>E. populnea</i>, <i>Geijera parviflora</i>, <i>Casuarina cristata</i>, and <i>Acacia harpophylla</i>. Suitable vegetation communities described in the literature and detected within the Project footprint, includes poplar box (<i>Eucalyptus populnea</i>) woodlands, belah woodlands, brigalow woodlands and Whitebox woodlands.	Known
<i>Homoranthus vagans</i>	-	CE	-	This species is currently known from two populations northwest of the Project footprint approximately 12 km from the alignment in remnant vegetation within the Wondul Range National Park. These plants are found here to grow in deep sandy soil derived from sandstone, and found in shallow riparian, heath and woodland (Donatiu & Phillips, 2013). There is currently very little literature, and this shrub is endemic only to this property and it is estimated that only 250 individuals exist in the wild. Distribution in relation to the Project: There is no official distribution for the species, however it is only known from Wondul Range National Park west of Millwood. Species records: There are no records of the species within 10 km of the Project footprint. All substantiated and accurate records for this species are located within Wondul Range National Park or near its border with Bringalily State Forest, approximately 15 km west of the footprint. The earliest recorded date was from 1992, and most recently recorded in 2013 (ALA, 2023; DES, 2023). Records in the Project footprint: No Records in the locality: No	Wildnet ALA Publications	Unlikely	No	Although there may be some potential suitable eucalypt forest (RE 11.7.7) on mid to upper slopes with sandy soil as recorded within the Project footprint these areas of landzone 7 are patchy and disturbed from grazing and located where edge effects and disturbance from adjacent agriculture are likely to limit the viability of this ground shrub which is known to grow to 0.2 m height by 2 m wide. All substantiated and accurate records for this species are located within Wondul Range National Park or near its border with Bringalily State Forest. All records are within approximately 5 km of each other.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Lepidium monoplocoides</i>	Winged peppercress	-	E	The winged peppercress is known from arid to semi-arid areas with an average rainfall of 200 to 450 mm per year. The species generally occurs in ephemeral habitats, such as areas that are seasonally flooded or prone to waterlogging, on heavy clay or clay-loam soils (Mavromihalis, 2010). The species is associated with a number of vegetation communities, including grasslands, wetlands and floodplain woodlands dominated by <i>Eucalyptus coolabah</i> and <i>Eucalyptus largiflorens</i>, and chenopod shrublands dominated by <i>Atriplex</i>, <i>Maireana</i> and/or <i>Nitraria</i> species (Mavromihalis, 2010). This has been considered as preferred habitat. It has also been recorded from samphire communities dominated by <i>Halosarcia</i> species and temperate woodlands with <i>Eucalyptus microcarpa</i> and <i>Allocasuarina luehmannii</i> on the southern margins of its range. SPRAT profile distribution in relation to the Project: Areas of the Project footprint from the border to Pittsworth are within the mapped distribution where the species or species habitat may occur. Two small areas around Yelarbon and Inglewood are located within the mapped distribution where the species or species' habitat is likely to occur. Species records: The species has two recent records very close to the alignment at Yelarbon from 2005 and 2011 (ALA, 2023), however one of these records has a low accuracy of 10 km. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	Preferred habitat for the species, as described in the literature, occurs within the Project footprint and was confirmed during surveys. Habitat is restricted to approximately 8 km of the alignment west from Yelarbon. Suitable soil substrates, including heavy clay and clay-loam occur in the Project footprint. Suitable Landzones occurring in the Project footprint are considered to include: 3, 4, and 5. Vegetation communities described in the literature, including grasslands, wetlands and floodplains were detected in the Project footprint. Populations detected during the Project surveys occur in, or on the edges of, and along fences and cleared tracks in <i>E. woollsi</i> open forest, and <i>Triodia scabra</i>/<i>Melaleuca densispicata</i> grassland/shrubland.	Known
<i>Lepidium peregrinum</i>	Wandering peppercress	-	E	The wandering peppercress occurs from Bunya Mountains in SEQ to Tenterfield in northern NSW, with known populations occurring in closest proximity to the Project near Toowoomba (Queensland Herbarium, 2009a; ALA, 2022). The species has not been well studied. Descriptions of vegetation communities described in the herbarium samples include: riparian open forest dominated by <i>Eucalyptus camaldulensis</i> and <i>Casuarina cunninghamiana</i> (Scarlett, 1999); creek terrace in cleared <i>Allocasuarina cunninghamiana</i> open forest with a grassy ground stratum, on red brown alluvial loam (Qld Herbarium, 2019 BRI AQ0553298); edge of walking tracks in wet sclerophyll forest on red brown volcanics with some basalt rock present (National Herbarium of Victoria, MEL 2316492A, 2007); irregularly mowed area in a sheltered gully under tall wet sclerophyll forest (Queensland Herbarium, BRI AQ0736630, 2007). These habitat attributes can be regarded as general habitat. The species has also been recorded along walking tracks and road edges, in native pine plantations, irregularly mown areas, sheltered area in paddock seldom grazed by cattle, a travelling stock route, edge of cultivation area, on granite sand (National Herbarium of Victoria, 2006); and car parks, suggesting this species may respond well to disturbance (Queensland Herbarium, 2009; OEH, 2022; N.C.W. Beadle Herbarium, NE 87834, 2005)). SPRAT profile distribution in relation to the Project: Areas of the Project footprint from Gowrie to Pittsworth are within the mapped distribution where the species or species habitat may occur. A small area south-west of Millmerran is also mapped as where the species or species' habitat may occur; the Project footprint overlaps with this area slightly.	SPRAT WildNet Publications	Potential	No	Limited general habitat for the species, as described in the literature, was observed within the Project footprint although the species was not detected during targeted surveys. The distribution mapping for the species (as per DCCEEW) delineates only a small patch of habitat that may occur on the northern sections of the alignment near Pittsworth and Toowoomba. Again, no specimens were observed during multiple targeted surveys in these areas. Associated floristic species described in the literature and detected in the Project footprint, includes <i>Eucalyptus camaldulensis</i>. Suitable vegetation communities described in the literature and detected within the Project footprint, includes riparian open forest, paddocks, roadsides and grasslands.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Species records: The nearest record of the species is from Highfield Falls north of Toowoomba in 2007, approximately 10 km east of the Project footprint. Another recent record from 2022 in Harlaxton is approximately 12 km east of the Project (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Macadamia integrifolia</i>	Macadamia nut	V	V	<i>Macadamia integrifolia</i> occupies remnant rainforest along the south-east coast of Qld, within 5 to 600 m elevation (Gross 1995; Stanley & Ross 1986). This is regarded as preferred habitat, however the species occupies all topographic positions including ridges, scree slopes, foot slopes, gullies, benches, and riverine terraces, these differing topographic positions are regarded as general habitat. Soils are predominantly alluvial or volcanic, well drained, and often with significant surface exposure of rock fragments (Costello et al. 2009). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: There is one recent record from Mount Lofty in 2023, approximately 12 km from the Project footprint (ALA, 2023). The next nearest recent record of the species is from near Toogoolawah in 2019, approximately 60 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	No preferred and general habitat for the species, that is, suitable vegetation communities described in the literature, specifically rainforest or rainforest margins occur within the Project footprint. Suitable soil substrates described in the literature occurring in the Project footprint includes alluvial and rocky soils. Suitable landforms described as slopes in the literature occur in the Project footprint.	Unlikely
<i>Macrozamia conferta</i>	-	V	V	<i>Macrozamia conferta</i> has three known populations located within or adjacent to Bringalily State Forest, Durikai State Forest and Talgai State Forest (Queensland Herbarium, 2008). The species general habitat can be found in ash-grey to white silty loam soils in flat undulating terrain and in skeletal, grey to white soils on steep slopes between 600 to 750 m altitude (Borsboom et al. 1998). The species occurs in open forest and is associated with spotted gum (<i>Corymbia citriodora</i> var. <i>variegata</i>), broad-leaved red ironbark (<i>Eucalyptus fibrosa</i>), yellow box (<i>E. melliodora</i>), narrow-leaved ironbark (<i>E. crebra</i>) and grey box (<i>E. moluccana</i>). The species has also been recorded in 'Woodland of <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i>, <i>E. pillagaensis</i> and <i>Corymbia citriodora</i> var. <i>variegata</i>, with an understorey of <i>Acacia semilunata</i>, <i>Olearia elliptica</i> on pale reddish-white stony clay soil on a rise (ALA, 2022). SPRAT profile distribution in relation to the Project: A portion of the Project footprint from Inglewood to Clontarf is within the mapped distribution where the species or species habitat is likely to or may occur. An area of northern Bringalily State Forest is within the mapped distribution where the species or species' habitat is likely to occur. Species records: The nearest record of <i>Macrozamia conferta</i> is located approximately 10 km east of the Project footprint near the north-east corner of Bringalily State Forest. All records are located outside the eastern boundary of Bringalily State	SPRAT WildNet Publications	Potential	No	Limited general habitat for the species, as described in the literature and the conservation advice (DEWHA, 2008), was observed within the Project footprint. Suitable landforms described as flat and undulating terrain are common throughout the Project footprint. Associate floristic species described in the literature and detected in the Project footprint includes <i>Eucalyptus fibrosa</i> , <i>E. melliodora</i> , and <i>E. crebra</i> . However, no specimens were identified within the Project footprint during surveys. The closet records are 10 km east of the Project footprint at the north-east corner of Bringalily State Forest. It is regarded that the species is unlikely to occur, due to limited habitat.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Forest, within or surrounding Durikai State Forest (ALA, 2023). However, due to potential poaching concerns, all records have an imposed spatial uncertainty of 2 km, meaning in actuality a number of these records may occur in proximity to the Project footprint (Bösenberg, J.D., 2010). Records in the Project footprint: No Records in the locality: Possibly; records are close to 10 km from the Project footprint but locations have an uncertainty of 2 km.					
<i>Macrozamia machinii</i>	Machin's macrozamia	V	V	<i>Macrozamia machinii</i> occurs on the Darling Downs in Queensland between Texas and Wondul Range NP. When described, there were eight populations near Inglewood (Jones & Forster 1994). Three of the sites are in state forests, while the remaining sites are on leasehold land. The species general habitat occurs in deep sandy soils, in flat areas of open forest that are dominated by <i>Angophora leiocarpa</i> , <i>Allocasuarina inophloia</i> , <i>Callitris glaucophylla</i> , <i>Lysicarpus angustifolius</i> , and <i>Acacia conferta</i> (Jones & Forster 1994; Hill 1999a; Jones, 2002). SPRAT profile distribution in relation to the Project: Areas of the Project footprint from Inglewood to Clontarf are within the mapped distribution where the species or species habitat is likely to occur. Species records: Multiple records of the species north and south of Inglewood (mostly from the 1990s), particularly within Yelarbon and Bringalily State Forests (ALA, 2023). The only recent record is approximately 21 km west of the alignment, north of Bulli State Forest. Records in the Project footprint: No Records in the locality: Yes, however all are over 20 years old	SPRAT WildNet Publications	Potential	No	General habitat for the species was observed within the Project footprint. Suitable landforms described in the literature and occurring in the Project footprint includes flat terrain. Suitable soil substrates described in the literature, observed in the Project footprint: deep sandy soils. Suitable Landzones occurring in the Project footprint are considered to include: 5. Associate floristic species described in the literature and detected in the Project footprint includes <i>Angophora leiocarpa</i> , <i>Callitris glaucophylla</i> and <i>Acacia conferta</i> . Although general habitat was observed in the Project footprint, it is considered unlikely that the species is present. The Project footprint primarily occurs through cleared areas adjacent to the Yelarbon and Bringalily State Forests. Records of the species occur west of the Project alignment.	Unlikely
<i>Melaleuca formosa</i>	Cliff bottlebrush	NT	-	<i>Melaleuca formosa</i> (superseded by <i>Callistemon formosus</i>) occurs in near coastal districts in south-east Queensland, recorded growing in vine forest or as an understorey plant beneath eucalypts in loam or sandy soil over trachyte (Brophy et al. 2013). Distribution in relation to the Project: There is no official distribution for this species. Species records: The nearest records of the species are located within and around Long Grass Nature Refuge (30 km east of the footprint) (ALA, 2023; DES, 2023). Other records dispersed throughout southern and central Queensland. Records in the Project footprint: No Records in the locality: No	WildNet ALA Publications	Potential	No	No preferred habitat for the species, as described in the literature, was detected within the Project footprint. Potential habitat located within Landzone 8 was found to be disturbed from grazing and agricultural practices. No individuals were detected during targeted surveys in potential habitat.	Unlikely
<i>Microcarpaea agonis</i>	-	E	E	Until recently <i>Microcarpaea agonis</i> was known only from its type locality within Boondandilla State Forest west of Millmerran, where it was found in what is considered the general habitat of the species on the margins of an <i>Eleocharis-Cyperus</i> dominated seasonal swamp fringed by <i>Eucalyptus chloroclada</i> . However, the species has since been recorded in Bladensburg National Park (NP) and Idalia NP much further north-west of the type locality. In these localities, the species has been recorded in a damp gully shaded by Acacias and bloodwood and in a spring fed wetland. Therefore, <i>Microcarpaea agonis</i> is likely to occur	SPRAT WildNet Publications	Unlikely	No	Small areas of general habitat for the species were observed within the Project footprint, notably <i>Eleocharis</i> spp. Dominated wetlands and larger gilgai, and wetlands fringed with <i>Eucalyptus</i> spp. However, the species was not found during targeted surveys. Associate floristic species described in the literature, detected in the Project footprint include: <i>Eucalyptus chloroclada</i> , <i>Eleocharis</i> spp. and <i>Cyperus</i> spp. Suitable vegetation communities described in the literature and detected within the Project footprint include: 11.3.27, 11.3.27b and 11.3.27i.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				more widely and, in more habitats, than are currently listed in the species Conservation Advice. SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: The nearest records are from 1996 at the type locality within Boondandilla State Forest, approximately 52 km west of the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No				Although general habitat was observed in the Project footprint, it is considered unlikely that the species is present within the Project footprint. The Project footprint primarily occurs through cleared areas adjacent to the Yelarbon and Bringalily State Forests. The records of the species additionally occur west of the Project alignment.	
<i>Phebalium distans</i>	Mt Berryman phebalium	E	E (CE at time of the referral) (downlisted from CE, effective 22 April 2022, after controlled action date)	<i>Phebalium distans</i> is endemic to south-east Queensland, where ten extant populations are known from three locations: Mt Berryman, Mt Jones Plateau near Kingaroy and Mt Walla near Coalstoun Lakes (Forster, 2003). This species is most commonly found in the general habitat of semi-evergreen vine thicket or adjacent community types, 200 m+ above sea level (Queensland Herbarium, 2012). It also occurs within microphyll and notophyll vine forests and low microphyll vine forest. The terrain tends to be undulating to hilly and it grows on a variety of soil types including: red volcanic soil, red-brown earth, brown clay, dark brown loam (from lithosols to shallow, gravelly krasnozems). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: The nearest records of <i>Phebalium distans</i> are from Mt Berryman, approximately 54 km east of the Project footprint (ALA, 2023). These records span from 1985 to 2016. Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	Limited general habitat for the species, as described in the literature, was observed within the Project footprint. Suitable landforms described as undulating terrain is common throughout the Project footprint. Suitable vegetation communities described in the literature do not occur within the Project footprint.	Unlikely
<i>Philotheca sporadica</i>	Kogan waxflower	NT	-	<i>Philotheca sporadica</i> occurs from near Kogan to Tara in the Darling Downs region of Queensland, in open shrubland to closed shrubland to closed woodland on shallow soils derived from low fertility laterised Cretaceous sandstones (Kumbarilla Beds; HLA-Envirosciences Pty Ltd, 2005). Soils are shallow uniform sandy loams to clay loams or shallow texture contrast soils with loamy surfaces and medium clay subsoils (Threatened Species Scientific Committee, 2020). Some sites have duricrust surfaces (Powerlink QLD, 2005). Topography of these areas is undulating to flat with low dissected flat top or rounded hills (Dawson, 1972; Halford, 1995p). The distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities; brigalow (<i>Acacia harpophylla</i> dominant and co-dominant); and White box-yellow box-Blakely's red gum grassy woodland and derived native grassland (Threatened Species Scientific Committee 2020). The species distribution is largely located in the Braemar State Forest, 30 km west of Dalby. Note, the species was listed in the ToR as a species that required an assessment. At the time the ToR was issued, the species was listed under the EPBC Act in the	SPRAT WildNet ALA TSSC DES Species Profile	Unlikely	No	Habitat for the species, as described in the literature, was found within the Project footprint. Suitable vegetation communities (RE 11.3.1, 11.4.3, 11.9.5 (eastern) and 11.9.9a) described in the literature and detected within the Project footprint include: brigalow (<i>Acacia harpophylla</i> dominant and co-dominant) and White box-yellow box-Blakely's red gum grassy woodland and derived native grassland. Associate floristic species described in the literature and detected in the Project footprint include: <i>Eucalyptus crebra</i>, <i>E. fibrosa</i> and <i>Callitris glaucophylla</i>. No individuals were detected during targeted surveys in potential habitat.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Vulnerable category. However, in 2020 (after the ToR was issued), it was determined that the species was no longer eligible for inclusion. The likelihood of occurrence assessment for the species has been retained to show that the species was considered. Distribution in relation to the Project: This species known distribution is outside the Project footprint and is restricted to the area between Kogan and Tara on laterised Cretaceous sandstones. Species records: The nearest record is from 2008 in Dunmore, located approximately 46 km north-west of the Project footprint (ALA, 2023). The nearest WildNet record is located approximately 70 km east of the Project, within Lake Broadwater Conservation Park, recorded in 1984 (DES, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Picris barbarorum</i>	-	V	-	<i>Picris barbarorum</i> has been recorded in the Eastern Darling Downs from west of Brookstead to Pittsworth along the Gore Highway. A plant species of riverbanks and floodplains on heavier alluvial and clay soils. The species has been recorded in non-remnant grassland dominated by <i>Chloris gayana</i> and <i>Sorghum</i> spp. (Queensland Herbarium, 2017). Distribution in relation to the Project: Areas of the Project footprint that fall within modelled or known distribution of the species include multiple locations near Brookstead, Pittsworth, and between Yandilla and Pampas. Species records: The are seven records within the Project Footprint between Pittsworth and Brookstead, most recently in 2020 (ALA, 2023; DES, 2023). Records in the Project footprint: Yes Records in the locality: Yes	WildNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was found within the Project footprint. <i>Picris barbarorum</i> was recorded within the Project footprint in RE 11.3.2, 11.3.21, 11.3.25/11.3.4/11.3.27b, 11.8.5 and also in non-remnant vegetation. Suitable heavy soils are present within the project footprint, particularly within land zone 3. Suitable microhabitat features recorded within the Project footprint included riverbanks and floodplains on heavy alluvial soils.	Known
<i>Picris evae</i>	Hawkweed	V	V	<i>Picris evae</i> has been recorded in the Eastern Darling Downs from Toowoomba to west of Brookstead along the Gore Highway (DEWHA, 2008). The literature describes suitable soils as variable, but particularly mentions black, dark grey or red-brown soils, reddish clay-loam or medium clay soils (DEWHA, 2008a). The species general habitat is: <i>Eucalyptus</i> open woodland with a grassy understorey composed of <i>Dichanthium</i> spp. although it is mentioned that recent collections appear to come from modified (including non-remnant) habitats such as weedy roadside vegetation and paddocks (DEH, 2022a). The species preferred habitat is <i>Eucalyptus</i> open woodland, the typical upper stratum species include <i>Eucalyptus melliodora</i>, <i>E. crebra</i>, <i>E. populnea</i>, <i>E. albens</i>, <i>Angophora subvelutina</i>, <i>Allocasuarina torulosa</i>, and <i>Casuarina cunninghamiana</i> (Holzapfel, 1994). SPRAT profile distribution in relation to the Project: Approximately half of the railway alignment (from Gowrie to ~22 km south of Millmerran) is within the mapped distribution where the species or species habitat is likely to or may occur. The area from Gowrie to Yandilla is within the mapped distribution where the species or species habitat is likely to occur. Species records:	SPRAT WildNet Publications	Known	Yes	Preferred and general habitat for the species is patchily located from just south of Clontarf to Gowrie (approximately 95 km of the alignment). Suitable vegetation structural types forming preferred and general habitat, including remnant and regrowth <i>Eucalyptus</i> open woodland, <i>Dichanthium</i> spp. grassland, as well as areas of non-remnant vegetation (weedy roadside vegetation and paddocks) were common across the Project footprint. Additionally, suitable black, dark grey or red-brown soils, reddish clay-loam or medium clay soils are distributed primarily in the northeast sections of the alignment around the Pittsworth area, particularly on alluvial plains and sediments. During field surveys, the species was recorded within the Project footprint south of Brookstead, north of Pittsworth and at the northern extent of the footprint near Gowrie Mountain. It was also recorded at multiple locations within the study area but outside of the Project footprint east of Pittsworth. More recently, during a survey for another project, a large population of the species were recorded within the Project footprint near Gowrie Mountain by EMM. This large population is assumed to have grown from	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				The species has numerous records in close proximity to the north-east section of the Project footprint, mostly from the early 2000s to as recent as 2021 (ALA, 2023). One record from 2002 in Brookstead appears within the Project footprint (along the Gore Highway at Elsdon Road), while many other close records are within 5 km of the alignment. Records in the Project footprint: Yes, however, the record is over 20 years old. Records in the locality: Yes				the records during ecological surveys. From EMM's surveys, the population extent within the Project footprint is 14,281.67 m ² , with an average plant density of 23.9 individuals per square metre. This results in an estimated population of 341,332 individuals within the footprint near Gowrie Mountain.	
<i>Pomaderris coomingalensis</i>	-	E	-	<i>Pomaderris coomingalensis</i> has been recorded near Kingaroy, Proston and Dalby where it is described as locally common, in Braemar State Forest, Coomingleh State Forest, Devine State Forest and Durikai State Forest and in the Coomingleh State Forest between Monto and Theodore (Queensland Herbarium, 2012). The species is found in <i>Eucalyptus decorticans</i>, and <i>Corymbia citriodora subsp. variegata</i> open forest on red soil; and <i>E. crebra/Eucalyptus fibrosa subsp. nubila</i> woodland on stony brown clay loam (Walsh, 1997; Queensland Herbarium, 2012). The species is known to survive extremely dry conditions (Forster, 2006). Distribution in relation to the Project: Yes, based on records. Species records: The nearest species records are located within Devine State Forest (~8 km east of Project footprint) (ALA, 2023; DES, 2023) from 2006. Other records of this species are dispersed throughout southern central Queensland. Records in the Project footprint: No Records in the locality: Yes	WildNet ALA DES Species Profile Publications	Potential	No	Habitat for the species, as described in the literature, was found within the Project footprint. Suitable microhabitat features recorded within the Project footprint included heavy clay/clay-loam. Associate floristic species described in the literature and detected in the Project footprint include <i>Eucalyptus crebra</i> and <i>E. fibrosa</i>. Suitable open woodland habitat for the species, as described in the literature, was found within the Project footprint; RE 11.7.4, 11.7.7. No individuals were detected during targeted surveys in potential habitat.	Potential
<i>Prostanthera</i> spp. Dunmore (D.M.Gordon 8A)	-	V	V	<i>Prostanthera</i> spp. (Dunmore (D.M.Gordon 8A)) is known from four locations in a small area west of Millmerran in southern Queensland. Its extent of occurrence is less than 100 km². One population occurs on private land and three in state forest, including one on the border with Wondul Range NP (DEWHA, 2008b). The species general habitat features <i>Eucalyptus</i> and <i>Callitris</i> woodland in shallow sandy soil or <i>Eucalyptus</i> woodland on hard sandstone ridge tops (DEWHA, 2008b). The three populations in state forest occur in remnant vegetation. SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: The closest record is in Wondul Range NP which is approximately 20 km west of the alignment from 1994 (Australian Virtual Herbarium, 2023; DES, 2023). The only other database records are located in Western Creek and Boondandilla State Forests, approximately 45 km and 50 km west of the Project footprint respectively. Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	General habitat for the species, as described in the literature and the conservation advice (DEWHA, 2008), is very limited within the Project footprint. Flora surveys along the alignment did not detect the species. Suitable soil substrates described in the literature occurring in the Project footprint include shallow sandy soils, which may occur in the central project footprint area. The species is also known to occur on hard sandstone ridge tops – a geological feature that does not occur across the Project footprint. All known records of the species are approximately 45 km and 50 km west of the Project footprint respectively in Western Creek and Boondandilla State Forests. Due to limited general habitat, limited suitable geological features, and no sightings of the species within the Project footprint, it is considered that the species is unlikely to be present.	Unlikely
<i>Rhaponticum australe</i>	Austral cornflower	V ⁱ	V	<i>Rhaponticum australe</i> is known from locations near Mt Moffatt and Biloela in central Queensland, and from the eastern Darling Downs to Gatton in southeast Queensland (DES, 2022a). According to DAWE the most significant extant population of <i>Rhaponticum australe</i> occurs at upper	SPRAT WildNet	Likely	Yes	Preferred and general habitat for the species, as described in the literature, and present within the Project footprint include grasslands, eucalypt woodlands with grassy understory, grassy roadsides and on road reserves. Flora surveys along the alignment detected the species within and directly	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Glengallan Creek, just north of the Cunningham Highway, in the Toowoomba-Aubigny region. The species general habitat features heavy black or red-brown clay, or clay loams derived from basalt (DEWHA, 2008c). Populations are often confined to roadsides and cultivation headlands (DEWHA, 2008c). Locations where the species have been observed range in altitude up to 480 m above sea level. The species preferred habitat is considered to be in woodland and grassland and in association with <i>Eucalyptus crebra</i>, <i>E. orgadophila</i>, <i>E. populnea</i>, <i>E. tereticornis</i>, <i>E. melanophloia</i>, <i>Angophora subvelutina</i>, <i>A. floribunda</i>, <i>Cirsium vulgare</i> (introduced), <i>Dichanthium sericeum</i> and <i>Themeda triandra</i> (DEWHA, 2008c). It is considered to be a poor competitor and prefers habitat where grass competition has been reduced by fire or other forms of disturbance. However, the species is unlikely to benefit from disturbance that allows the development of a dense cover of exotic grasses such as <i>Chloris gayana</i> (DEWHA, 2008c). SPRAT profile distribution in relation to the Project: Approximately half of the railway alignment (from Gowrie to ~22 km south of Millmerran) is within the mapped distribution where the species or species habitat is likely to or may occur. The area from Gowrie to Yaranlea (west of Pittsworth) is within the mapped distribution where the species or species habitat is likely to occur. Species records: There are many records in proximity to the Project footprint between Pittsworth and Gowrie, including multiple records from 2021 that are within 3 km of the alignment near Pittsworth and Southbrook (ALA, 2023). Other close recent records exist around Kingsthorpe and Gowrie. Records in the Project footprint: No Records in the locality: Yes				adjacent to the Project footprint, between 20 m to 1 km from the alignment, at multiple locations near Pittsworth and north-east of Southbrook. Furthermore, the significant population recorded by DAWE at upper Glengallan Creek is in close proximity to the north-east end of the alignment. Habitat for the species is located from Yarrenlea to Southbrook (approximately 21 km of the alignment). Suitable soil substrates described in the literature include heavy black or red-brown clay, or clay loams derived from basalt, which occur in the north-eastern areas of the Project footprint. Suitable vegetation communities described in the literature align with several that have been recorded within the Project footprint.	
<i>Rutidosia glandulosa</i>	-	NT	-	<i>Rutidosia glandulosa</i> is known from approximately 15 populations across six distinct localities. The species occurs as far north as the Blackdown Tableland National Park, where five populations have been recorded. There is also one population just south on the Planet Downs Pastoral Holding. Other locations include Carnarvon Gorge National Park (one population) and just south on the Carnarvon Range (*Saddler Springs) (one population); Gwambagwine (2 populations); Barakula State Forest (near Chinchilla) (three populations) and Thulimbah (near Stanthorpe) (one population). The Thulimbah population has not been relocated and has probably been destroyed (Barker, 1997; Holland, 1999 as sited on DES, 2022). <i>Rutidosia glandulosa</i> generally occurs on sandy or gravelly well drained soil in grassy open eucalypt woodland. Around Blackdown National Park, it was observed growing in open forest dominated by <i>Eucalyptus interstans</i>, <i>E. sphaerocarpa</i> and <i>Angophora leiocarpa</i>. In Carnarvon Gorge National Park the species was recorded within a very dense woodland dominated by <i>Corymbia clarksoniana</i>, <i>Eucalyptus crebra</i> and <i>Callitris glaucophylla</i> with a dense understorey composed of eucalypt saplings, <i>Petalostigma pubescens</i>, <i>Cassinia laevis</i>, <i>Acacia pustula</i>, <i>A. leiocalyx</i> and ground layer dominated by grasses and <i>Vittadinia</i> spp. At Gwambagwine it was recorded within spinifex heathland with scattered trees of <i>Angophora leiocarpa</i>, <i>Corymbia bunites</i>, <i>Allocasuarina inophloia</i>, <i>Lysicarpus</i> spp. and <i>Xylomelum</i> spp. overlying sandstone, skeletal soil. The Barakula State Forest <i>R. glandulosa</i> populations were recorded in open forest dominated by <i>Corymbia citriodora</i>,	WildNet ALA DES Species Profile Publications	Potential	No	Habitat for the species, as described in the literature, was found within the Project footprint however targeted surveys did not detect the species in the footprint. Suitable woodland habitat for the species, as described in the literature, was located within the Project footprint (RE 11.3.1, 11.3.2, 11.3.18, 11.3.14, 11.3.17, 11.3.25, 11.3.27i, 11.3.4, 11.5.1, 11.5.1a, 11.5.4, 11.5.20, 11.7.4, 11.7.5, 11.7.7, 11.8.4, 11.8.5, 11.9.7, 11.9.5, 11.9.9a, 11.9.10). Associate floristic species described in the literature and detected in the Project footprint include <i>Acacia leiocalyx</i>, <i>Angophora leiocarpa</i>, <i>Allocasuarina inophloia</i>, <i>Callitris glaucophylla</i>, <i>Corymbia clarksoniana</i> and <i>Eucalyptus crebra</i>.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				<i>Eucalyptus crebra</i> and <i>Allocasuarina luehmannii</i> with herb understorey on fine sandy-silty loam over clay (Queensland Herbarium, 2011). Distribution in relation to the Project: There is no official distribution for this species, however the known populations are outside of the Project footprint, with the closest being in Kumbarilla State Forest. Species records: Records restricted to south-east and central Queensland, with the closest records ~46 km north-east from Project footprint, in Kumbarilla State Forest from 2021 and Western Creek State Forest from 2008 (ALA 2023, DES, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Sarcochilus hartmannii</i>	Waxy sarcochilus	V	V	<i>Sarcochilus hartmannii</i> is known from the Richmond River in northern NSW to Main Range NP in south-eastern Queensland (DEWHA, 2008d). The species preferred habitat is typically located on volcanic rocks, shallow soils and exposed cliffs in sclerophyll forests, rainforest margins or open areas at 500–1000 m altitude (DEWHA, 2008d). It is also found occasionally at the base of fibrous trunks of trees, including cycads and grasstrees. It prefers basalt substrate and exposed sunny locations, although occasionally it has been found growing near creeks in rather shady conditions (DEWHA, 2008d). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to and may occur. Species records: The nearest record of <i>Sarcochilus hartmannii</i> is located to the east of Toowoomba, approximately 18 km from the alignment (ALA, 2023). The record is not dated; however, the specimen was loaned to the Sydney Herbarium in 1965 indicating it is at least 56 years old. The record location has also been generalised to a 2 km area in an effort to protect the species from illegal collecting. All other records are located >50 km from the Project footprint, predominantly east of Warwick. Records in the Project footprint: No Records in the locality: No	SPRAT WildNet	Unlikely	No	Both general and preferred habitat, landform and vegetation types for the species, as described in the literature, do not occur within the Project footprint and the Project footprint occurs outside of the mapped distribution. Flora surveys along the alignment did not result in detection of the species.	Unlikely
<i>Sarcochilus weinthalii</i>	Blotched sarcochilus	E	V	<i>Sarcochilus weinthalii</i> is known from the east coast of Australia from the north of the Richmond River to the Bunya Mountains and the Gallangowan area, including several records near Toowoomba (DoE, 2014). The species general habitat occurs in rainforest, dry rainforest and drier scrub of sub-coastal ranges and associated foothills inland from the coast at altitudes of 400 to 700 m above sea level (DoE, 2014). In south-east Queensland, it typically grows in a number of microphyll and notophyll rainforest types and patches of isolated scrub (Barker and Borsboom 1997). <i>Sarcochilus weinthalii</i> occurs as small, single plants on the upper branches of rainforest trees. In dry rainforest habitats it may occur as a twig epiphyte and has been recorded growing on rocks (DEH, 2018). SPRAT profile distribution in relation to the Project: A small area of the Project footprint between Gowrie and Southbrook is within the mapped distribution where the species or species habitat may occur.	SPRAT WildNet Publications	Unlikely	No	General habitat, landform and vegetation types for the species, as described in the literature, do not occur within the Project footprint. Flora surveys along the alignment did not result in detection of the species.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Species records: The nearest records of this species are from pre-1990s and are located within the Toowoomba range (approximately 15 km from the Project footprint) (ALA, 2023). However, the location of the records have been generalised to a 2 km area in an effort to protect the species from illegal collecting, so the exact distance to the Project footprint is not known. Records in the Project footprint: No Records in the locality: No					
<i>Solanum papaverifolium</i>	-	E	-	The <i>Solanum papaverifolium</i> has a known distribution in the south eastern sector of Queensland which extends southwards into the north eastern sector of New South Wales. Literature has stated that the species predominantly occurred in the Darling Downs District and Northern slopes District of NSW, commonly on heavy clay soils in eucalypt woodland and grassland (Electronic Flora of South Australia). These districts have seen drastic anthropogenic change (agriculture, road), as such it now grows in areas more utilised by farming and roadsides. Distribution in relation to the project: The northern half of the alignment is within the mapped distribution where the species or species habitat may occur. Species records: The species has 321 individual records within the 40km buffer of the alignment, two records are located within the locality (3 km north west and 2.3 km south of alignment), they were recorded in 1957 and 1959. Both records are located within close proximity to Pittsworth (5 km west of Pittsworth and 20 km west of Pittsworth). Both records are situated on cleared agriculture land (ALA, 2024). Records in the Project footprint: No Records in the locality: Yes, two records within the 10km buffer, however records are from 1957 and 1959.	WildNet ALA Species profile Publications	Potential	No	Preferred habitat was detected within the Project footprint during field surveys. Flora and habitat assessments illustrated that sections of the Projects footprint contain habitat and soil characteristics which the species requires, which are rich, heavy clay soils, in grassland and open eucalypt woodland. Also note that majority of the Project alignment contains cleared vegetation (pasture land) which has the potential to harbor species. It can be deemed that preferred habitat exists for the species within the Project footprint, however minimal records exist within proximity of the Project footprint, as majority of records are 20-40 km away from the Project footprint. With two located within the locality (3km north west & 2.3 km South of alignment), which were recorded in 1957 and 1959.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Solanum stenopterum</i>	-	V	-	<i>Solanum stenopterum</i> is patchily distributed across the Darling Downs in Queensland, from Gayndah south to Goondiwindi, west to Jackson and east to Oakey (Bean, 2004). <i>Solanum stenopterum</i> grows on black, brown, or red clay loam soils and inhabits grassland or woodlands of belah (<i>Casuarina cristata</i>) and poplar box (<i>Eucalyptus populnea</i>), brigalow (<i>Acacia harpophylla</i>), as well as SEVT. The species also grows on loamy ridges within more disturbed areas including along roadsides and in paddocks (Bean, 2004). Distribution in relation to the Project: There is no official distribution for this species, however there is a population at Oakey, near the northern extent of the Project. This is at the species' eastern limit. Species records: The closest record is within 2.3 km east of the Project footprint at Canning Creek, recorded in 2022 (ALA, 2023; DES, 2023). Other records are approximately 11 km north-west of the footprint near Oakey from 2006. Records in the Project footprint: No Records in the locality: Yes	WildNet ALA Publications	Potential	No	Habitat for the species, as described in the literature, was found within the Project footprint, however, no individuals were detected during targeted surveys in potential habitat. Associate floristic species described in the literature and detected in the Project footprint include <i>Acacia harpophylla</i>, <i>Casuarina cristata</i> and <i>Eucalyptus populnea</i>. Suitable vegetation communities with clay soils described in the literature occurring in the Project footprint included woodlands (RE 11.3.1, 11.3.2, 11.3.17, 11.3.18, 11.4.3, 11.4.10), grasslands (11.3.21) and non-remnant areas. The species has serval records within the locality, 3 km east of the Project footprint at Canning Creek, recorded in 2022 and approximately 11 km north-west of the footprint near Oakey from 2006. Field surveys within the Project footprint identified general habitat for the species, however no specimens were observed during surveys. Therefore, with general habitat present and records of the species within the locality, the species is assessed as being potential to occur within the Project footprint.	Potential
<i>Sophora fraseri</i>	Brush sophora	V	V	<i>Sophora fraseri</i> occurs across south-eastern Queensland and north-eastern NSW, as well as along the Great Dividing Range to Toowoomba (DES, 2022b). The species is widespread but not common. The species general habitat consists of moist habitats, often in hilly terrain at altitudes from 60–660 m on shallow soils along rainforest margins in eucalypt forests or in large canopy gaps in closed forest communities (DEWHA, 2008e). It has been recorded growing mostly shallow stony to shaly soils, of loam to clay texture derived from sandstone or basalt rocks (DES, 2022b). Associated species include: <i>Corymbia citriodora</i>, <i>Eucalyptus carnea</i>, <i>E. microcorys</i>, <i>E. acmenoides</i>, <i>E. propinqua</i>, and <i>Lophostemon confertus</i>. (Barker and Borsboom, 1997b; DES, 2022b). SPRAT profile distribution in relation to the Project: A very small area of the Project footprint at Gowrie is within the mapped distribution where the species or species habitat is likely to or may occur. Species records: The nearest records of the species are from 1997 to 2023 at Mount Kingsthorpe Reserve, approximately 1.3 km north of the eastern extent Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet DES Species Profile	Potential	No	General habitat, landform and vegetation types for the species, as described in the literature, do not occur within the Project footprint. The associate species listed in the literature do not occur in the Project footprint. Flora surveys along the alignment did not result in detection of the species.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Styphelia</i> spp. <i>Coolmunda</i> (D.Halford Q1635)	-	E	E	<i>Styphelia</i> spp. Coolmunda (previously <i>Leucopogon</i> spp. Coolmunda) is known from a small area south-east of Inglewood. It is also known to occur in Yelarbon State Forest (Queensland Herbarium, 2007). Within this restricted area of occurrence, the species occurs in undulating terrain between 300 and 340 m above sea level (Halford, 1993). The soil is typically shallow (1 m), light coloured sandy-loam with mottled orange clayey subsoils, and the vegetation is predominantly open forest to woodland with a dense lower stratum of heath up to 1.5 m high (Halford, 1993). The species general habitat is associated with the following species: <i>Eucalyptus terrica</i>, <i>Corymbia trachyphloia</i>, <i>E. virens</i> and <i>Callitris endlicheri</i>. The lower stratum is very diverse with a range of different species, including: <i>Calytrix tetragona</i>, <i>Triodia</i> sp., <i>Grevillea floribunda</i>, <i>Boronia glabra</i>, <i>Xanthorrhoea johnsonii</i>, <i>Brachyloma daphnoides</i>, <i>Ricinocarpos linearifolius</i> and <i>Melichrus urceolatus</i> (Halford, 1993). SPRAT profile distribution in relation to the Project: An area approximately 10 km south-east of Inglewood is within the mapped distribution where the species or species habitat may occur, however, none of this mapping overlaps with the Project Footprint. Species records: Several records are located around Coolmunda Dam and in Coolmunda Conservation Park (between approximately 10.5 km and 16 km from the Project footprint), the most recent of which is from 2013 (ALA, 2023; DES, 2023). The closest records in this area are from the 1970s. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet	Potential	No	General habitat for the species, as described in the literature, was observed at only a few locations within the Project footprint and the species was not observed during surveys and the Project footprint is outside the species mapped distribution. Suitable landforms described as undulating terrain is common throughout the potential habitat areas identified. Suitable soil substrate described as sandy loam was found to occur in the Project footprint. Suitable vegetation communities described in the literature as open forest to woodland with a dense lower stratum of heath up to 1.5 m high, were detected within the Project footprint but were rare and restricted to the stretch between Yelarbon and Millmerran. Associate floristic species described in the literature, detected in the Project footprint: <i>Triodia</i> sp., <i>Corymbia trachyphloia</i>, <i>Callitris endlicheri</i>, <i>Calytrix tetragona</i>, <i>Triodia</i> spp. and <i>Melichrus urceolatus</i>.	Unlikely
<i>Swainsona murrayana</i>	Slender Darling-pea, Murray Swainson-pea, and Slender Swainson	V	V	<i>Swainsona murrayana</i> occurs from South Australia through south-west Victoria and central NSW to south-east Queensland. In Queensland the species has been recorded in Surat and Eromanga. Majority of the sub-populations have less then 50 individuals, however, the largest known population has approximately 42,000 individuals. The common names for the <i>Swainsona murrayana</i> are Slender Darling-pea, Murray Swainson-pea and Slender Swainson. The general habitat for <i>Swainsona murrayana</i> is primarily found within grasslands, herbland, and open black-box woodland, commonly in depressions. The species grows in heavy grey or brown clay, loam, or red cracking clays. The <i>Swainsona murrayana</i> is commonly associated with low chenopod shrubs, wallaby-grass, and spear grass. Most areas that the species is found has had some form of disturbance, commonly occurring in paddocks that have been grazed or used for cultivation activities. The distribution and the preferred habitat of this species overlaps with the following EPBC Act-listed threatened ecological communities: - The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin, - Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant), - White box-yellow box-Blakely's red gum grassy woodland and derived native grassland, and - Buloke woodlands of the Riverina and Murray-Darling Depression Bioregions. SPRAT profile distribution in relation to the Project: The middle and northern sections of the alignment are outside of the mapped distribution where the species or species' habitat is likely to and may occur, however section of the southern section of the alignment are within the	SPRAT WildNet DES Species Profile Publications	Potential	No	The Project alignment has small areas of general habitat, in the form of disturbed pasturelands and grasslands. However, no specimens were found within the Project alignment, and the closet record exist approximately 30 km south of the Project alignment. Sections of the B2G Project alignment has natural grassland communities consisted of 11.3.21, 11.8.11 and 11.5.14. RE 11.3.21 was also observed which consisted of grassland dominated by <i>Dichanthium sericeum</i>, and <i>Aristida leptopoda</i>, scattered mixed native forbs with cracking clay soils on alluvial plains. No particular associate floristic assemblage were identified in the literature to define habitat suitable for the species; as it occurs generally amongst native and introduced grasses, forbs and sedges and disturbed pasture lands. The species is associated with the following TECs that are found within the Project footprint: • Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant), and • White box-yellow box-Blakely's red gum grassy woodland and derive native grassland. Parts of the Project footprint are within totally cultivated areas. The majority of the Project footprint that the species distribution range overlaps is contained within an already existing railway line, and within a non-remnant patch of poplar box and brigalow regrowth adjacent to Rainbow Reserve extending into the Macintyre River. Rainbow Reserve does not contain any vegetation community associated with the presence of the species.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				mapped distribution where the species or species' habitat is likely to and may occur. Species records: The nearest record of the species is located approximately over 30 km south of the Project alignment; however, this record has a very high spatial uncertainty/inaccuracy of 75 km and the specimen was collected in 2004 (ALA, 2024). Records in the Project footprint: No Records in the locality: No				A total of five quaternary assessments were conducted within Rainbow Reserve (two by Ausecology, three by Cardno). and an additional 12 south to the Macintyre River (nine by Ausecology, three by Cardno). The species was not recorded during any of these assessments, and as such is considered unlikely to occur.	
<i>Thesium australe</i>	Austral toadflax	V	V	The distribution of <i>Thesium australe</i> in SEQ is sporadic but widespread, going as far inland as the Toowoomba region (DoE, 2013). <i>Thesium australe</i> is semi-parasitic on roots of a range of grass species, notably on <i>Themeda triandra</i> (Kangaroo Grass) (DoE, 2013). It occurs in subtropical, temperate, and subalpine climates over a wide range of altitudes. It typically occurs on soils derived from sedimentary, igneous and metamorphic geology on a range of soils, including black clay loams to yellow podzolics and peaty loams (Leigh et al. 1984; Hunter et al. 1999; Cohn 2004). The species general habitat is considered to be shrubland, grassland, or woodland often noted on damp sites (George 1984; Harden 1992). Preferred habitat features the following vegetation types: open grassy heath, kangaroo grass (<i>Themeda triandra</i>) grassland surrounded by <i>Eucalyptus</i> woodland, and grassland dominated by barbed-wire Grass (<i>Cymbopogon refractus</i>) (Leigh et al. 1984; Hunter et al. 1999). SPRAT profile distribution in relation to the Project: The central and northeast sections of the alignment between Gowrie and Yelarbon are within the mapped distribution where the species or species habitat is likely to or may occur. Two sections of the alignment (from Gowrie to Pittsworth and Pampas to Bringlily) are within the mapped distribution where the species or species habitat is likely to occur. Species records: The closest record is from Highfields from 2022 (~10 km away), with some other records south of Toowoomba within 15 km of the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	Preferred and general habitat for the species occurs within the Project footprint. Multiple individuals have been recorded during field surveys within the Project footprint, approximately 2 km north-east of Pittsworth. Habitat for the species is patchily located from Canning Creek to Gowrie (approximately 111 km of the alignment). Potential vegetation communities detected include Dry sclerophyll (Eucalypt) woodlands, <i>Eucalyptus</i> and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest and Natural grasslands. Non-remnant and disturbed habitats, including grasslands, may also offer some marginal habitat to the species. Suitable soil substrates described in the literature are also distributed throughout the alignment particularly east from Inglewood and Millmerran.	Known
<i>Vincetoxicum forsteri</i>	-	E	E	<i>Vincetoxicum forsteri</i> (formerly known as <i>Tylophora linearis</i>) has rarely been collected and is known from eight localities in NSW, and one locality near Glenmorgan in Queensland. Besides these locations, it has a potential distribution from inland southern Queensland to central NSW. The species general habitat is considered to be areas of dry scrub, open forest and woodlands associated with <i>Melaleuca uncinata</i> , <i>Eucalyptus fibrosa</i> , <i>E. sideroxylon</i> , <i>E. albens</i> , <i>Callitris endlicheri</i> , <i>C. glaucophylla</i> , <i>Allocasuarina luehmannii</i> , <i>Acacia hakeoides</i> , <i>A. lineata</i> , <i>Myoporum spp.</i> , and <i>Casuarina spp.</i> (Forster et al., 2004). It has also been noted to grow in dry scrubland that may have a eucalypt, <i>Callitris glaucophylla</i> and/or <i>Allocasuarina luehmannii</i> overtopping the scrub (DEH, 2021). It has been recorded from low-altitude sedimentary flats in dry woodlands, and it is also noted to generally grow in the range of 300-- 400 m elevation (DEH, 2021). SPRAT profile distribution in relation to the Project: The area from Bringalily to Yelarbon is within the mapped distribution where the species or species habitat may occur. Species records:	SPRAT WildNet Publications	Potential	No	Limited general habitat for the species occurs within the Project footprint. Although dry scrubland was not noted during surveys, vegetation communities detected include dry sclerophyll (Eucalypt) woodlands or <i>Eucalyptus</i> and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest. Suitable soil substrates and landforms described in the literature and the conservation advice (DEWHA, 2008) may occur in the Project footprint but these do not seem to be a defining characteristic of the species given the low number of records. Majority of the associate floristic species described in the literature, were not common along the alignment, and vegetation communities that may suit the species include approximately 20 ha of <i>Eucalyptus fibrosa</i> dominated woodland and 2 ha of <i>Eucalyptus albens</i> dominated woodland. Flora surveys along the alignment did not result in detection of the species. It has been considered that the Project footprint contains limited habitat for the species. The closest records are additionally Forest 30-50 km east of the Project footprint, in which in addition to the limited suitable habitat lead to it being classed as unlikely to occur within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Multiple recent records exist west of Durikai State Forest 30-50 km east of the Project footprint (2018-2023) (ALA, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Westringia parvifolia</i>	Small-flowered westringia	V	V	<i>Westringia parvifolia</i> is known from four collections near Yelarbon, Inglewood and Goondiwindi in SEQ (DEWHA, 2008f). The species is known from a small area near Yelarbon and Inglewood, its distribution range is approximately 80 km and there is no available information on population size (DEWHA, 2008f). The preferred habitat of <i>Westringia parvifolia</i> contains Baker's mallee (<i>Eucalyptus bakeri</i>) and green mallee (<i>E. viridis</i>) and between clumps of spinifex (<i>Triodia</i> sp.) on sandy and stony soils (White & Francis 1921, DEWHA, 2008f). SPRAT profile distribution in relation to the Project: The area around Inglewood and Yelarbon is within or borders the mapped distribution where the species or species habitat is likely to occur. Species records: Past records of the species are in close proximity to the alignment near Inglewood, Yelarbon and Goondiwindi. Only one record, near Yelarbon, is recent (from 2020) and borders the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	Preferred and general habitat for the species, as described in the literature, is present within the Project footprint. Multiple individuals were detected within the alignment north-east of Yelarbon. Habitat for the species is located along approximately 8 km of the alignment around Yelarbon. Suitable vegetation communities described in the literature and detected within the Project footprint, include: dry sclerophyll (Eucalypt) woodlands, disturbed areas of Eucalypt woodlands and open hummock grasslands. Suitable soil substrates described in the literature occur across the Project footprint.	Known
<i>Xerothamnella herbacea</i>	-	E	E	<i>Xerothamnella herbacea</i> is known from 12 sites, including sites near Yelarbon and Goondiwindi, Queensland (Shapcott, 2016). This species preferred habitat occurs in brigalow (<i>Acacia harpophylla</i>) dominated communities in shaded situations (i.e., underneath trees/shrubs), often in leaf litter (DEWHA, 2008g). The species are associated with heavy, grey to dark brown clays and gilgais (shallow ground depressions). Typically recorded on soils noted as heavy, grey to dark brown clays (DEWHA, 2008g). A recent study by Shapcott et al. (2016) found that the species has a tendency to die back in response to dry conditions and thus is effectively ephemeral within the landscape. SPRAT profile distribution in relation to the Project: The area around Yelarbon is within the mapped distribution where the species or species habitat is likely to or may occur. Species records: One record from 2020 appears on the alignment and another record from 2006 is approximately 4 km north of the alignment at Yelarbon (ALA, 2023). Records in the Project footprint: Yes Records in the locality: Yes	SPRAT WildNet DES Species Profile	Known	Yes	Preferred and general habitat for the species, as described in the literature, includes Eucalyptus and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest within the Project footprint. Multiple individuals were detected within the alignment south-west of Yelarbon. Habitat for the species is located along approximately 44 km of the alignment from the border to the edge of Whetstone State Forest. Suitable soil substrates described in the literature occur across the Project footprint. <i>Xerothamnella herbacea</i> was found in brigalow/belah communities particularly in areas dominated by shade lines in remnant and non-remnant areas and surrounded by mainly cropping and grazing areas. Microhabitat present where <i>X. herbacea</i> was identified consisted of leaf litter, shaded areas and fallen logs. Identified threats include historical clearing, grazing pressure (sheep and cattle), and competition from other plant species, both native and exotic.	Known
Threatened Fauna									
Birds									
<i>Anthochaera phrygia</i>	Regent honeyeater	CE	CE	The regent honeyeater has a patchy distribution which extends from SEQ, through NSW and the Australian Capital Territory, to central Victoria. Records are widely distributed across its range, but it is only found regularly at a few localities in NSW and Victoria, where most of the sightings have been recorded. There are four known key breeding areas: three in NSW and one in Victoria (DoE, 2015a). It is highly mobile, occurring only irregularly in most sites, and in variable numbers, often with long periods with few observations anywhere (DoE, 2016).	SPRAT WildNet Publications	Potential	No	Preferred foraging habitat for the species, as described in the literature which occurs in the Project footprint includes, remnant dry sclerophyll (Eucalypt) woodlands, especially box-ironbark communities, disturbed areas of Eucalypt woodlands and <i>Eucalyptus</i> and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest. The Project falls outside of the breeding range of the species as the four known locations are in NSW and Victoria.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				The species is nomadic and partly migratory, with some predictable seasonal movements observed. Breeding varies between regions and corresponds with flowering of key eucalypt and mistletoe species (DoE, 2015a). The species mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation (DoE, 2015a). Principally a canopy bird, it is reliant on select species of eucalypt and mistletoe which provide rich nectar flows (DoE, 2015). The species prefers dry sclerophyll, box ironbark, <i>Eucalyptus</i> woodlands and forests on inland slopes, especially in moister sites along creeks, river valleys and lower slopes of foothills, and typically dominated by reliable nectar-producing trees including (specific to Project footprint): <i>Eucalyptus melliodora</i> and <i>Eucalyptus albens</i>. Regent honeyeater also occurs commonly in more open savanna-type woodland of such eucalypt species, or in remnants of such associations in cleared or partly cleared agricultural land (DoE, 2016). Of 168 observations of habitat across their range, 80% were eucalypt woodland or dry sclerophyll forest. Less often in riparian <i>Casuarina</i> forests dominated by river sheoak (<i>Casuarina30unninghamiana</i>), usually with heavy load of the mistletoe <i>Amyema cambagei</i> (and sometimes mixed with eucalypts) (Higgins et al., 2020, DoE, 2015a). Preferred habitat can be considered any breeding or foraging areas of habitat. However, the Project falls outside of the breeding range of this species. Habitat critical to the survival of the regent honeyeater includes: Any breeding or foraging areas where the species is likely to occur. Any newly discovered breeding or foraging locations. SPRAT profile distribution in relation to the Project: The majority of the alignment (from Gowrie to just east of Yelarbon) is within the mapped distribution where the species or species habitat is likely to or may occur. Only a small portion of the alignment south of Millmerran is within the mapped distribution where the species or species habitat is likely to occur. Species records: Records of regent honeyeater have been generalised (within 2 km) to protect the species. However, one record from 2020 is located in Wondul Range National Park (~9 km west of the alignment) and there are a number of records from the Durikai area (which is considered critical habitat for the species), located approximately 35 km southeast of the Project footprint (ALA, 2023). Two undated records are located approximately 25 km north-west of the Project footprint, north of Toowoomba. The lack of records for the regent honeyeater in the region makes it difficult to predict the likelihood of its occurrence in the Project footprint. As suitable foraging habitat, some landscape connectivity, and some scattered regional records from 2000 to 2020 are present, there is some potential for the species to occur. However, there is not enough evidence to increase the species to a likely likelihood of occurrence, nor to discount it. Records in the Project footprint: No Records in the locality: Yes				As this species is highly mobile and nomadic, scattered records were found within the locality, and foraging habitat as described in the literature was located, the species has potential to occur within the Project footprint.	
<i>Aphelocephala leucopsis</i>	Southern whiteface	V	V (listed 31 March 2023, after controlled action date)	Southern whiteface occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range (SPRAT 2023).	SPRAT ALA OCG	Known	No	Habitat for the species, as described in the literature, was located within the Project footprint. Suitable microhabitat features recorded within the Project footprint included herbaceous leaf litter and course woody debris.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Southern whiteface live in a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains. They forage almost exclusively on the ground, favouring habitat with low tree densities and an herbaceous understorey litter cover (DCCEEW 2023). Breeding takes place from July to October throughout most of the species' range, however, the timing of breeding can be affected by rainfall in arid regions. Birds may breed outside of their usual season following sufficient rainfall or may not breed at all during drought. Birds build large bulky domed nest of grass, bark, and roots, usually in a hollow or crevice, although sometimes in low bushes. Distribution in relation to the Project: The entire alignment is inside of the mapped distribution where the species or species habitat is likely to or may occur. The alignment intersects with the species or species' habitat likely to occur distribution between Goondiwindi and Glenarbon (18 km south-west of Inglewood), 14 km north-east of Inglewood to Millmerran, and the area surrounding Pittsworth. Species records: There are numerous records (> 80 records) (ALA, 2023; DES, 2023) of the species within 10 km of the Project footprint, with two records in Yelarbon from 2007 and 2018 appearing within the Project footprint. Records in the Project footprint: Yes Records in the locality: Yes	WildNet			Suitable RE's include: 11.3.2, 11.3.3, 11.3.10, 11.3.12, 11.3.16, 11.3.20, 11.3.23, 11.3.28, 11.4.5, 11.5.14, 11.10.9, 11.11.6, 11.11.8, 11.11.9, 11.11.11, 11.11.12, and 11.11.15. No individuals were detected during surveys in potential habitat.	
<i>Botaurus poiciloptilus</i>	Australasian bittern	E	E	The Australasian Bittern occurs across south-east Australia, southern Australia, and Tasmania. In Queensland, the species occurs as far north as Yeppoon and west to Wyandra (TSSC, 2019). The Australasian bittern inhabits a range of wetland habitats, mainly in freshwater wetlands with tall dense vegetation (TSSC, 2019). The species prefers still, shallow waters with little fluctuation in water level, such as swamps or lagoons. It favours freshwater habitats dominated by sedges, rushes and reeds (e.g. <i>Phragmites</i>, <i>Cyperus</i>, <i>Eleocharis</i>, <i>Juncus</i>, <i>Typha</i>, <i>Baumea</i>, <i>Bolboschoenus</i>) or cutting grass (<i>Gahnia</i>) growing over a muddy or peaty substrate (Marchant & Higgins 1990). The species can also be found in paddocks with sitting water and long grass during and after periods of heavy rainfall (Martínez-Vilalta et al., 2020). The species nests adjacent to relatively deep, densely vegetated freshwater swamps and pools, building its nests under dense cover (prefers vegetation up to 2.5 m) over shallow water (Marchant & Higgins 1990). All natural habitat (including constructed wetlands with preferred habitat) in which the Australasian bittern is known or is likely to occur should be considered critical to the survival of the species (TSSC, 2019). Additionally, any breeding/roosting habitat is classified as preferred habitat, with any foraging habitat classed as general habitat. SPRAT profile distribution in relation to the Project: One area the border and Yelarbon is within the mapped distribution where the species or species habitat may occur. The northern most end of that alignment at Gowrie is just outside the distribution. Species records: The nearest recent record to the alignment (2009) is from Lake Clarendon (near Gatton), approximately 48 km east of the Project footprint (ALA, 2023). There are undated	SPRAT WildNet	Likely	No	Preferred habitat for the species, as described in the literature, is present within the Project footprint, approximately 1 km of the alignment where it runs through Bringalily State Forest. The species was not detected despite targeted surveys in potential habitat. Wetland habitat within the Project footprint includes dams and reservoirs (lacustrine), wetlands associated with the floodplains of watercourses (riverine) and vegetated swamps (palustrine). In total, 8 ha of potential wetland habitat was found in remnant vegetation including Eucalypt woodland fringing drainage lines and freshwater wetlands (RE 11.3.25, 11.3.27b and 11.3.27i) in the alignment. Of the wetlands observed during surveys, vegetation cover and species richness was variable depending on drainage and water inundation at the time of survey. Throughout all of these areas, hydrophytic sedge and herb species dominated including <i>Eleocharis plana</i>, <i>Marsilea mutica</i>, mixed <i>Cyperus</i> and <i>Juncus</i> species. Emergent aquatic vegetation was generally present, with a height of 0.2 to 5 m.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				and older records (1980's or before) from 24 km from the Project footprint. Records in the Project footprint: No Records in the locality: No					
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	CE; Ma; Mi (Bonn, CAMBA, JAMBA, ROKAMBA)	The curlew sandpiper is a non-breeding migrant to Australia; in Queensland, the species has widespread records along the coast with records sparsely scattered inland (DoE 2015b). The species is a summer migrant found in both fresh and brackish waters, mainly occurring on intertidal mudflats in sheltered coastal areas. They have also been recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. (Van Gils et. al., 2020). Occasionally they have been recorded around floodwaters (Higgins & Davies, 1996). Preferred habitat can be classified as breeding habitat, whilst general habitat is considered any roosting or foraging habitat. SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat may occur. Species records: The nearest recent record of the species (2018) is located 14 km north of the Project footprint at Cooby Creek Reservoir (ALA, 2023). An older, closer record (from 1972) is located at Lake Coolmunda, 12 km east of the Project footprint. Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Potential	No	The Project footprint contains general habitat for the curlew sandpiper during times of flooding only. These habitat areas are generally dry and would not provide suitable habitat, unless inundated with water (which is only likely to occur during times of heavy rainfall leading to flooding). Whilst wetland habitats occur throughout the Project footprint, these are generally densely vegetated and small, indicating they may only present general (marginal) habitat for the species. Potential wetland habitat was found in remnant vegetation including Eucalypt woodland along drainage lines and freshwater wetlands (RE 11.3.2, 11.3.25, 11.4.10,11.3.27 and 11.3.27i) in the alignment.	Potential
<i>Calyptorhynchus lathami lathami</i>	Glossy black-cockatoo (south-eastern)	V	V (listed 10 August 2022, after controlled action date)	The glossy black-cockatoo (south-eastern) are distributed from Mitchell in Queensland, south to East Gippsland in Victoria. Within this range, the species distribution is considered continuous throughout the forested regions of the Great Dividing Range, becoming scattered in inland regions towards Riverina in New South Wales. The glossy black-cockatoo (south-eastern) prefers woodland areas dominated by she-oak <i>Allocasuarina</i>, or open sclerophyll forests and woodlands with a stratum of <i>Allocasuarina</i> spp. beneath <i>Eucalyptus</i> spp., <i>Corymbia</i> spp. or <i>Angophora</i> spp. (Glossy Black Conservancy, 2010). Glossy black-cockatoos have also been observed in mixed <i>Allocasuarina</i>, <i>Casuarina</i>, cypress, <i>Callitris</i> and brigalow (<i>Acacia harpophylla</i>) woodland assemblages (Glossy Black Conservancy, 2010). In SEQ west of the Great Dividing Range, they have been observed feeding in remnant belah (<i>Casuarina cristata</i>), bulloak (<i>Allocasuarina luehmannii</i>) and <i>Allocasuarina torulosa</i> forests. This species is also known to utilise appropriate remnant woodlands, and individual or small pockets of <i>Allocasuarina</i> and <i>Casuarina</i> feed trees (Glossy Black Conservancy, 2010; North et al., 2020). An obligate hollow nester, glossy black-cockatoos require large old trees (living or dead), usually eucalypts, for breeding (Garnett et al., 1999; Cameron, 2006). As such, nesting sites are mainly in areas containing large old trees. There are areas of high-quality habitat (e.g., with abundant <i>Casuarina</i> spp./<i>Allocasuarina</i> spp., hollow-bearing trees, and high connectivity), particularly within Bringalily State Forest. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution of species or species habitat likely to occur and	SPRAT WildNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the project footprint. Suitable vegetation structural types, including open forest with a stratum of <i>Allocasuarina</i> ssp. beneath <i>Eucalyptus</i> spp., <i>Corymbia</i> spp. or <i>Angophora</i> spp. and mixed <i>Allocasuarina</i>, <i>Casuarina</i>, <i>Callitris</i> and <i>Acacia harpophylla</i> woodland, occurs frequently within the Project footprint. Suitable REs, include RE 11.3.1, 11.3.14, 11.3.17, 11.4.3, 11.4.10, 11.5.1, 11.5.20, 11.5.4, 11.7.7 and 11.9.5. Suitable feed trees, including <i>Allocasuarina luehmannii</i> and <i>Casuarina cristata</i> were commonly recorded within the Project footprint. Suitable REs with large trees (a surrogate for hollow-bearing trees) were recorded within the Project footprint, particularly within RE 11.3.17, 11.4.3, 11.4.10, 11.5.1, 11.5.20, and 11.7.7. In total, seven individual <i>Calyptorhynchus lathami lathami</i> were directly recorded and an additional five areas with indirect signs of occupation (oorts) were identified within the Project footprint.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				may occur. A very small section the alignment intersects with the species' distribution mapping of species or species habitat may occur north-east of Millmerran, and west of Yelarbon to Goondiwindi. Species records: There is 1 record of the species located within the footprint, recorded in 2005 in Eucalypt woodland with a tussock grass understorey (ALA, 2023; DES, 2023). There are 5 additional records located within 10 km of the Project footprint (ALA, 2023). The most recent record within 10 km of the footprint was recorded in 2014, in Bringalily State Forest, approximately 6 km west of the footprint. Records in the Project footprint: Yes, however it is a historic record. Records in the locality: Yes					
<i>Climacteris picumnus victoriae</i>	Brown treecreeper (south-eastern)	V	V (listed 31 March 2023, after controlled action date)	Brown treecreeper (south-eastern) is endemic to south-eastern Australia from the Grampians in western Victoria, through central New South Wales to the Bunya Mountains in Queensland, and from the coast to the inland slopes of Great Dividing Range (SPRAT 2023). Brown treecreeper (south-eastern) occupy dry open eucalypt forests and woodlands. The subspecies mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. They also occur in mallee, forests, and woodlands subject to periodic inundation, e.g., river red gum (<i>Eucalyptus camaldulensis</i>) woodlands with an open understorey of acacias, saltbush, lignum, cumbungi, and grasses in the upper Murray River. The subspecies is not usually found in woodlands with a dense shrub layer, and it is absent from heavily degraded woodlands and steep rocky hills. Optimal habitat for brown treecreeper (south-eastern) must experience some kind of ongoing disturbance regime (historically Indigenous burning practices) to keep the ground layer from becoming too dense and uniform. The subspecies forages both on the ground and in mature live and dead trees, feeding on a variety of invertebrate prey. Nectar from mugga ironbark (<i>Eucalyptus sideroxylon</i>) and paperbarks, and sap from unidentified eucalypt species are also eaten, along with lizards and food scraps (DCCEEW 2023b). Brown treecreeper (south-eastern) nest and roost in naturally occurring tree cavities in a variety of eucalypt species. Hollows in standing dead or live trees and tree stumps are essential for nesting (DCCEEW 2023b). Breeding takes place from July to February across its range. Females typically lay 2–3 eggs. Pairs often have two broods during each breeding season. Immature females disperse but are reluctant to cross large tracts of open land (DCCEEW 2023b). Brown treecreeper (south-eastern) have higher breeding success in territories with lower densities of shrubs, moderate levels of ground cover, greater amounts of foraging substrate and greater invertebrate biomass and substantial volumes of fallen timber (DCCEEW 2023b).	SPRAT ALA OCG Wildnet	Known	Yes – an observation of an adult and juvenile brown treecreepers was made in October 2023, approximately 300 m from the Project footprint on Glenlovely offset property, however, the subspecies was not noted.	Habitat for the species, as described in the literature, was detected within the project footprint. Suitable vegetation structural types, including dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, occurs frequently within the Project footprint. Suitable RE's include: 11.3.1, 11.3.4, 11.3.12, 11.3.14, 11.3.25, 11.3.38, 11.4.8, 11.7.7, 11.10.1, and 11.11.7. No individuals of the south-eastern subspecies were detected during targeted surveys in potential habitat, however the northern subspecies was recorded in the Project footprint during targeted surveys. There is one record of the species located within the Project footprint, recorded in 2021 in Yelarbon (DES, 2023).	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Distribution in relation to the Project: The entirety of the Project footprint is located within the modelled distribution of species or species habitat that may occur. Species records: There is one record of the species located within the Project footprint, recorded in 2021 in Yelarbon (DES, 2023). Additionally, there are 2 records of the species within 10 km of the Project footprint, recorded in 1985 in Eucalypt open woodlands with shrubby understorey, approximately 3.5 km west of the southern-most portion of the alignment and in 2021, approximately 5.6 km east of the footprint, along Dumaresq River in NSW (DES, 2023). Records in the Project footprint: Yes Records in the locality: Yes					
<i>Erythrotriorchis radiatus</i>	Red goshawk	E	V (at the time of the referral) (uplisted to E effective 31 March 2023, after controlled action date)	The Red Goshawk is very sparsely dispersed across coastal and sub-coastal Australia, from the western Kimberley to south-east Qld (TSSC, 2015). The species gradually became extinct in NSW during the 1980s and 1990s with populations in southeast Qld also suggested to have largely disappeared (Garnett and Baker, 2021). The species is currently known to breed in coastal and sub-coastal areas of wooded and forests regions from the Kimberley east to Cape York Peninsula and north to the Tiwi Islands. It is possible they may breed in low densities in the Wet Tropics and Einasleigh Uploads, although a paucity of data (TSSC, 2015 and Garnett, 2021). This species general habitat is located in forests and woodlands with a mosaic of vegetation types, large prey populations (birds), and permanent water. Nesting habitat consists of tall stands of trees. All identified nest trees have been within 1 km of permanent water, often adjacent to rivers or clearings, and usually the tallest (mean height = 31 m) and most massive trees (Aumann and Baker-Gabb, 1991; Czechura, 2001). There has been a substantial northwards contraction of the range in parts of eastern Australia and the area of occupancy has declined since European settlement. Further, it is suggested that development and habitat alteration have rendered about 20% of the predicted Red Goshawk's range unsuitable for breeding, especially in coastal Queensland (TSSC, 2015). A more recent paper suggests that the red goshawk has an extirpation area of 27% and its average habitat area size has decreased by 46% (Ward et al. 2022). Further to this, MacColl et al. (2023) clearly present the northward range contraction of the red goshawk, with only one record in NSW and one in southern Queensland (south of 23°S) since 2010. A further check of these records reveals three in NSW (2011, 2018 and 2022) and two in southern Queensland (2012 and 2016) (ALA, 2023). Consistently recorded pairs were associated with permanently watered, rather remote areas of rugged terrain supporting mosaics of tall vegetation, primarily forest (TSSC, 2015). In south-east Queensland, Araucaria vine forests and open forests are a significant component of the vegetation mosaics frequented by red goshawks. Habitat for red goshawk survival needs to contain all known sites for nesting, food resources, water, shelter, essential travel routes, dispersal, buffer areas, and sites needed for the future recovery as defined by the EPBC Act (Department of Environment and Resource Management, 2012). SPRAT profile distribution in relation to the Project:	SPRAT WildNet Publications	Unlikely	No	There is potential for the species to occur within the Project footprint seldomly when dispersing, particularly within proximity to the Toowoomba region, albeit this would likely be considered an extremely rare and sporadic occurrence. Although the Project footprint contains potentially suitable stands of large trees for breeding, there are not large enough bodies of permanent water to support the species. The severe paucity of recent records for the red goshawk in the region, combined with recorded substantial extirpation and contractions of habitat for the population, indicates it is unlikely to occur in the Project footprint. As some general foraging habitat, some landscape connectivity, and some scattered regional records are present, there is a very small potential for the species to pass through. There has been a substantial northwards contraction of distribution range for the red goshawk species in eastern parts of Australia. Literature has estimated that average habitat for the red goshawk species has decreased by 46%. Due to this, it can be considered that while the Project footprint contains some general habitat, due to the species northward movement it is unlikely that the species occurs within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Almost the entire alignment is mapped within the mapped distribution where the species or species habitat is likely to or may occur. Species records: Records of red goshawk have been generalised to protect the species. However, there are a number of records in the region, the nearest database record (2012) is located east of Toowoomba, approximately 15 km east of the Project footprint. Additional older records (1990s or older) occur to the north and east of Toowoomba (ALA, 2023). Notwithstanding, the 10 to 30 pairs in the South Eastern Queensland bioregion have reportedly disappeared (Seaton, 2014 as cited in Garnett and Baker, 2021). Records in the Project footprint: No Records in the locality: No					
<i>Falco hypoleucos</i>	Grey falcon	V	V (effective 9 July 2020, after controlled action date)	The grey falcon generally occurs in arid and semi-arid Australia where annual rainfall is less than 500 mm, except when wet years are followed by drought, when the species might become marginally more widespread, although it is essentially confined to the arid and semi-arid zones at all times (Marchant and Higgins 1993). The species occurs at low densities across a wide range of habitats, from dunes, savanna, and woodlands, in a range of altitudes from 0 to 1000 m above sea level (TSSC, 2020). The species prefers timbered lowland plains, particularly acacia shrublands crossed by tree-lined watercourses; though is also found in other grassland and woodland habitats. The grey falcon nests in the old nests of other birds, in riparian woodland of the arid zone, and nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (<i>Eucalyptus camaldulensis</i>) and Coolibah (<i>E. coolabah</i>) (TSSC, 2020). SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat is likely to or may occur. Species records: Database records are generalised to 2 km and those that are in the region are undated. There are four records within a 50 km radius of the Project footprint, all within the Toowoomba region (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet Publications	Unlikely	No	The species is unlikely to occur within the Project footprint due to the preference of the species to occur in arid and semi-arid areas of Australia, although extremely rare and sporadic occurrence fly over cannot be ruled out. The lack of recent records for the species in the region, combined with known low population density indicates it is unlikely to occur in the Project footprint.	Unlikely
<i>Geophaps scripta scripta</i>	Squatter pigeon (southern)	V	V	The squatter pigeon (southern subspecies) occurs on the inland slopes of the Great Dividing Range where it inhabits open-forests to sparse, open-woodland and scrub often found near permanent water such as rivers, creeks and waterholes, with open and short grass cover (TSSC, 2015b). Typically, it prefers sandy areas that are dissected by gravel ridges, allowing easier movement. The species is less commonly found on heavy soils with dense grass. It also occurs in burnt areas and sometimes on tracks and roadsides (Higgins & Davies, 1996; Garnett & Crowley, 2000). Preferred habitat is considered any present foraging and breeding habitat, whilst any dispersal habitat is classed as general habitat. Foraging habitat includes open forest to sparse, open-woodland or scrub dominated by <i>Eucalyptus</i>, <i>Corymbia</i>, <i>Callitris</i> or <i>Acacia</i> species, on gravelly or sandy soils, within 3 km of an appropriate ephemeral or permanent waterbody (Squatter Pigeon Workshop 2011). Suitable breeding habitat occurs on stony rises occurring on sandy or gravelly soils, within 1 km proximity to a permanent waterbody (Squatter Pigeon Workshop, 2011). The subspecies nests on the ground, usually laying two eggs among or under vegetation. It forages for seeds	SPRAT WildNet Publications	Likely	Yes – two observations of this species were made in November 2023 on the Canning Creek offset property, directly adjacent to the Project footprint. Additionally, a potential observation of this species was made along a roadside during the Cardno spring ecological	Preferred habitat for foraging and breeding of the species, as described in the literature occurs in the Project footprint including woodlands, open forest and grasslands with denser grass near water sources particularly Landzones 3, 5, and 7. Both foraging and breeding habitat occurs on well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills across the Project footprint. Habitat for the species is located along approximately 67 km of the alignment from Yelarbon to Canning Creek.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				among sparse and low grass, in improved pastures, and beside railway lines (DAWE: DoE, 2015). The southern boundary of the known distribution of the Squatter Pigeon (southern ssp.) is contracting northwards. Therefore, all the relatively small, isolated and sparsely distributed sub-populations occurring south of the Carnarvon Ranges in Central Queensland are considered to be important sub-populations of the subspecies (Squatter pigeon workshop, 2011). This includes populations occurring in the Condamine River catchment and Darling Downs of southern Queensland. SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat is likely to or may occur. Only the far southern section of the alignment (south-west of Yelarbon) is within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species is from Bringalily State Forest, directly adjacent to the Project footprint in 2021 (ALA, 2023). There are numerous database records of the species surrounding the Project footprint in the Inglewood area and Durikai State Forest. Records in the Project footprint: No Records in the locality: Yes			assessments near Inglewood.		
<i>Grantiella picta</i>	Painted honeyeater	V	V	<i>Grantiella picta</i> is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation and can be found in a range of other habitats including remnant trees in farmland, roadside reserves and travelling stock routes. Principally a canopy bird, it is reliant on select species of eucalypt and mistletoe (National Recovery Plan, 2016). The species preferred habitat is found in woodlands which contain a higher number of mature trees (Conservation Advice, 2015), as these host more mistletoes. However, the species can be seen in areas of scattered eucalypts or patches of forest in farmland and in narrow roadside strips if ample flowering and fruiting mistletoe and flowering eucalypts is available which is considered general habitat. They are less often found in patches of <i>Acacia</i> with mistletoes, in woodlands dominated by cypress-pine (<i>Callitris</i>), woodlands of <i>Eucalyptus camaldulensis</i> and in paperbark (<i>Melaleuca</i>) association (Higgins et al. 2020). The greatest concentrations and almost all records of breeding come from south of 26°S, on inland slopes of the Great Dividing Range between the Grampians, Victoria and Roma, Queensland (Higgins et al., 2001). SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat is likely to occur. Species records: The nearest record of the species is from Bringalily State Forest, directly adjacent to the Project footprint in 2017 (ALA, 2023). There are numerous database records both historic and recent of the species surrounding the Project footprint, with a concentration of records near Yelarbon and adjacent to Bringalily State Forest. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	The species was recorded across the Project footprint at multiple locations, with a concentration of records near Yelarbon and adjacent to Bringalily State Forest. Habitat for the species is located along the entire alignment, with more significant and continuous areas in the southern portion of the alignment. Suitable preferred habitat for foraging and breeding of the species, as described in the literature, was also confirmed within the Project footprint. REs with suitable microhabitat features (i.e., a good availability of flowering and fruiting mistletoe and flowering eucalypts) were recorded within the Project footprint, including RE 11.3.2, 11.4.3, 11.5.1, 11.5.4, 11.5.14, 11.5.20, 11.8.4, 11.7.7 and 11.9.5. Numerous painted honeyeater individuals were recorded within many of these RE's within the Project footprint.	Known
<i>Hirundapus caudacutus</i>	White-throated needletail	V	V (listed 4 July 2019, after controlled action date)	The white-throated needletail is widespread in eastern Australia and in Queensland, extends inland to the western slopes of the Great Dividing Range and occasionally onto the adjacent inland plains. The white-throated needletail is a summer migratory bird to Australia and is widespread throughout east and south-east Australia. They enter	SPRAT WildNet Publications	Likely	Yes	The species was recorded in the Project footprint at Bringalily State Forest and Millmerran, where the species was observed flying over woodland. Habitat for the species, as described in the literature, was also observed within the Project footprint including aerial space above forests, woodlands,	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
			Ma; Mi (CAMBA, JAMBA, ROKAMBA)	Australia from the Torres Strait, between September and October (Draffan et al., 1983). They leave between March and April (Higgins, 1999). The species is recorded extending inland to the Western slopes of the Great Dividing Range (Barrett et al., 2003; Higgins, 1999). In Australia, the species is almost exclusively aerial, living most of its life between 1 m and 1000 m above the ground (Coventry, 1989; Tarburton, 1993; Watson, 1955). They occur over most types of habitats but have been recorded most often above wooded areas, including open forest, rainforest and, less commonly, above woodland. They are also known to occur over heathland, grassland, swamps, and farmland, particularly above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks (Higgins, 1999; Cooper, 1971; Gosper, 1981; Learmonth, 1951; McFarland, 1988 The species has been recorded roosting among dense foliage and in hollows within forests and woodlands. However, the species is not known to breed in Australia (Chantler and Kirwan, 2020). SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat is likely to or may occur. Only the far southern section of the alignment (south-west of Yelarbon) and a small section between Pittsworth and Millmerran are within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species is from Bringalily State Forest, directly adjacent to the Project footprint in 2021 (ALA, 2023). There are numerous database records both historic and recent of the species surrounding the Project footprint, with a concentration of records near Pittsworth, Millmerran and the region surrounding the Bringalily State Forest. Records in the Project footprint: No Records in the locality: Yes				grasslands and farmland and non-remnant vegetation along approximately 67 km of the alignment from Yelarbon to Canning Creek.	
<i>Lathamus discolor</i>	Swift parrot	E	CE; Ma	The swift parrot is a migratory species, breeding in Tasmania and moving to mainland Australia for the non-breeding season (usually arriving between February and March). Most of the population winters in Victoria and NSW, with smaller numbers reaching south-east Queensland, Australian Capital Territory and south-east South Australia. The species returns to Tasmania during spring (September to October) (Higgins 1999). Movements on the mainland are poorly understood but the species is considered to be nomadic and irruptive, moving in response to food supply—especially areas of heavily flowering eucalypts (Higgins 1999). Vegetation communities and key tree species that provide important foraging habitat for Swift Parrots, include <i>Eucalyptus leucoxylon</i>, <i>Eucalyptus tricarpa</i>, <i>Eucalyptus sideroxylon</i>, <i>Eucalyptus microcarpa</i>, <i>Eucalyptus albens</i>, <i>Eucalyptus melliodora</i>, <i>Eucalyptus robusta</i>, <i>Eucalyptus tereticornis</i>, <i>Eucalyptus pilularis</i>, and <i>Corymbia maculata</i>. The use of these habitats is dependent on prevailing climatic conditions and corresponding food availability (Saunders 2008) with a preference across inland slopes of the Great Dividing Range for box-ironbark and grassy woodlands (Garnett and Baker 2021). Due to the variable production of nectar and lerps across this species' range, it is considered important to protect and manage a broad range of habitats to provide a range of foraging resources	SPRAT WildNet Publications	Potential	No	General habitat for the species, as described in the literature, was recorded within the Project footprint. Suitable vegetation structural types, including dry sclerophyll eucalypt woodland, eucalypt open forest and brigalow open forest commonly occur within the Project footprint. Associate floristic species described in the literature, and detected in the Project footprint, include: <i>Eucalyptus albens</i> and <i>Eucalyptus tereticornis</i>. There is potential for the species to occur within the Project footprint, albeit this would likely be considered a rare and sporadic occurrence. As suitable foraging habitat and some scattered regional records are present, there is a small potential for the species to disperse into areas of the Project footprint however this is likely to be strongly dependent on long-term habitat resource availability cycles.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				(Saunder and Tzatos, 2011). General habitat for the species is considered any foraging habitat. Habitat critical to the survival of the Swift Parrot includes those areas of priority habitat for which the Swift Parrot has a level of site fidelity or possess phenological characteristics likely to be of importance to the Swift Parrot, or are otherwise identified by the recovery team (Saunders and Tzatos, 2011). Site fidelity is highly important for the long-term survival of the species at both breeding and non-breeding sites. Over 100 sites have been identified on mainland locations as being used repeatedly by the species over ≥2 years. Notwithstanding, areas where site fidelity has not yet been established may be attributable to long-term resource availability cycles and observational limitations and are still considered important habitat for the species (Saunders, 2008). SPRAT profile distribution in relation to the Project: The entire alignment is mapped within the mapped distribution where the species or species habitat is likely to or may occur. Only a very small section at Gowrie is within the mapped distribution where the species or species habitat is likely to occur. Species records: The nearest records of the species are from the Toowoomba area, the closest of which is 4.5 km east of the Project footprint and undated. However, the exact locations of the records have been generalised to protect the species, and so they are not highly accurate. There are also multiple records of the species within Durikai State Forest, ~40 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo	V	E (listed 31 March 2023, after controlled action date)	Major Mitchell's Cockatoo (<i>Lophochroa leadbeateri</i>) occur From Isisford and Roma (Queensland) south through western New South Wales and to north-western Victoria and eastern South Australia. Within this distribution, the species occurs in the Murray-Darling, Eyre, and Bulloo River Basins. Uncommon and patchily distributed across much of inland Australia, the Major Mitchell's cockatoo is mainly found in areas that receive 250 to 400 mm of rain per annum (Rowley and Kirwan, 2020). The species usually inhabits dry woodlands in arid and semi-arid areas where Mulga (<i>Acacia aneura</i>), mallee and box eucalypts, Slender Cypress Pine (<i>Callitris gracilis</i>) or Belah (<i>Casuarina cristata</i>) are dominant. The species requires fresh surface water and trees with suitable nesting hollows within these habitats (DCCEEW 2023c). Additionally, the species can occur in treed and treeless inland areas that are within easy access to water. The species feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines (OEH, 2017). Major Mitchell's cockatoo nests in hollows in large, old trees, typically located along tree-lined watercourses or woodland, including cypress (Callitris), Acacia and Casuarina (Rowley and Kirwan, 2020). Suitable nesting hollows are found in large, tall trees relative to the typical structure of arid and semi-arid woodlands, with the species preferring to nest in hollows in Cypress pines that preferably 130 – 140 years old (Gibson & Florentine 2008).	WildNet ALA OEH SPRAT Publications	Potential	No	Limited habitat for the species, as described in the literature, was detected within the Project footprint. Major Mitchell's cockatoo is mainly found in areas that receive 250 to 400 mm of rain per annum. The northern section of the Project footprint near Toowoomba receives on average 709.0 mm per annum, Pittsworth receives 694.9 mm per annum, Millmerran receives 663.2 mm per annum and Inglewood receives 643.8 mm per annum. Therefore, areas within the Project footprint likely provide only marginal habitat for the species. Suitable vegetation structural types, including dry sclerophyll woodland dominated by <i>Eucalyptus</i> spp. and Eucalyptus and/or <i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest commonly occur within the Project footprint. Associated feed species, including Saltbushes, Acacias, Callitris, Eremophila, and Santalum occur within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Distribution in relation to the Project: The current distribution of where the species or species habitat is likely to or may occur is located outside of the Project footprint, to the west of the most western point of the alignment. Species records: Records are widely and patchily dispersed throughout southern inland Qld, with a strong preference for arid to semi-arid Mulga and Mallee regions of inland Australia. There is one record of the species within 10 km of the Project footprint, recorded in 1980, approximately 1.5 km from the footprint (ALA, 2023). Overall, a paucity of records exists, with most likely to be non-breeding individuals dispersing across the wider landscape. Records in the Project footprint: No Records in the locality: Yes, however it is a historic record.					
<i>Melanodryas cucullata cucullata</i>	Hooded robin (south-eastern)	E	E (listed 31 March 2023, after controlled action date)	Hooded robin (south-eastern) occurs in south-eastern Australia from far south-east Queensland to Yorke Peninsula, South Australia, intergrading with <i>M. c. picta</i> in the southern Murray Basin. The population is not severely fragmented, and the number of locations is greater than 10. However, fragmented populations do occur in some areas, and these are assumed to be genetically isolated (SPRAT 2023). Hooded robin (south-eastern) is described as shy and largely sedentary and are mostly seen in pairs or small groups. They prefer dry eucalypt and acacia woodlands and shrublands with an open understorey, some grassy areas and a complex ground layer. They avoid woodlands with tall trees or dense tree cover but sometimes occur in tall, dense heaths with scattered open areas. While they can occur in patches as small as 2.9 h, in agricultural landscapes they prefer larger patches greater than 10 ha with moderately deep to deep soils. Birds usually return to the same breeding site where they typically rear several broods each season. Nests comprise small, neat cups of bark and grasses bound with webs, and are situated in a tree fork or crevice, from less than 1 m to 5 m above the ground. Distribution in relation to the Project: Majority of the Project footprint is located outside of the species modelled distribution; however, the southern-most portion of the footprint (Goondiwindi to Yelarbon) is located within the species modelled distribution of species or species habitat may occur. Species records: There is one record of the species located within 10 km of the footprint, recorded in 2018 in New South Wales, approximately 9 km south of the footprint (ALA, 2023). This record was recorded in cleared, non-native vegetation. Records in the Project footprint: No Records in the locality: Yes	SPRAT ALA OCG	Potential	No	Habitat for the species, as described in the literature, was detected within the Project footprint. Cardno identified <i>Melanodryas cucullata</i> within the Project footprint, however the subspecies was not identified.	Potential
<i>Neophema chrysostoma</i>	Blue-winged parrot	V	V (listed 31 March 2023, after controlled action date)	Blue-winged parrots breed on mainland Australia south of the Great Dividing Range in southern Victoria from Port Albert in Gippsland west to Nelson, and sometimes in the far south-east of South Australia, and the north-western, central, and eastern parts of Tasmania (SPRAT 2023). Blue-winged parrots inhabit a range of habitats from	SPRAT ALA OCG	Unlikely	No	Habitat for the species, as described in the literature, was detected within the Project footprint. Suitable vegetation structural types, including grasslands and grassy woodlands, including some areas near wetlands. However, with only one record of	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones. The species can also be seen in altered environments such as airfields, golf-courses, and paddocks. Pairs or small parties of blue-winged parrots forage mainly near or on the ground for seeds of a wide range of native and introduced grasses, herbs, and shrubs. Blue-winged parrots breed in Tasmania, coastal south-eastern South Australia, and southern Victoria. During the breeding season (spring and summer), birds occupy eucalypt forests and woodlands. Distribution in relation to the Project: Majority of the Project footprint is located within the species modelled distribution of species or species habitat may occur. There are sections near and to the north of Inglewood and northeast Millmerran that are not included in the distribution mapping. The closest area of likely to occur distribution is a very small patch west of Moree in NSW (>120 km from the southern extent of the Project footprint). Species records: There are no records of the species located within the Project footprint, or within 10 km of the Project. The closest publicly available record was recorded in 2022 within cleared non-native vegetation, approximately 21 km north-west of the footprint (ALA, 2023). The bird was a single individual feeding with red-rumped parrots and appears to be outside of its natural range. All other records in Queensland are west of St George, although there are historic and undated easterly records in NSW. Records in the Project footprint: No Records in the locality: No				the species within 50 km of the alignment, the Project footprint is likely to be outside of the species' natural range. No individuals were detected during surveys in potential habitat.	
<i>Ninox strenua</i>	Powerful owl	V	-	Powerful owl inhabits eastern and south-eastern Australia, from north of Eungella National Park in Queensland to Victoria, mostly east of the Great Dividing Range (BirdLife Australia, 2023; Pizzey and Knight, 2014-2021). The powerful owl is found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses. They often roost and nest in dense gully eucalypt forest. Common roost sites are sheltered groves of mid-storey trees, e.g. sheoaks, turpentine, acacias, paperbarks, and rainforest trees (NSWSC, 2008). They will sometimes be found in open areas near forests such as farmland, parks, and suburban areas, as well as in remnant bushland patches. The species nests in large old trees, usually in vertical tree hollows and many of its prey species are also hollow-dependent (BirdLife Australia, 2023; NSWSC, 2008). Powerful owls feed on mostly medium to large arboreal mammals. They will occasionally prey upon roosting birds and sometimes small ground-dwelling mammals. Powerful owl mates for life and jointly defend their territory year-round, breeding between June and September. Distribution in relation to the Project: The alignment is near the western limit of the species' distribution in southern Queensland, with the species mainly occurring east of the Great Dividing Range.	WildNet ALA BirdLife Australia Publications	Potential	Unconfirmed sighting	A possible sighting of a powerful owl was recorded in Bringalily State Forest, approximately 3.6 km west of the alignment, during microbat surveys in March 2023 (Williams, 2023). Limited habitat for the species, as described in the literature, was detected within the Project footprint. Powerful owls predominately inhabit areas east of the Great Dividing Range. Suitable vegetation structural types, including open forests and woodlands along watercourses are present within the Project footprint. Microhabitat requirements such as tree hollows were also detected within the Project footprint. Potential prey species, such as common brushtail possums (<i>Trichosurus vulpecula</i>), were common in some areas. Areas in the Project footprint are likely to represent marginal habitat for the powerful owl, however, given the presence of recent records and a potential sighting in Bringalily SF, their presence cannot be ruled out.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Species records: There are no records of the species located within the Project footprint, however multiple exist within 10 km of the Project around Gowrie, Kingsthorpe, Highfields, and Toowoomba (ALA, 2023). It should be noted, however, that these records have been generalised to 29727 m to protect the species (ALA, 2023), meaning that some of these records could be further than 10 km from the alignment. Despite this, multiple records in Highfields (~9-10 km away) between 2010 and 2021 have accurate coordinates (DES, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Poephila cincta cincta</i>	Southern black-throated finch	E	E	The southern black-throated finch currently is confined to north Queensland with subpopulations in the central and northern Desert Uplands, southern Einasleigh Uplands, southern Wet Tropics and northern Brigalow Belt bioregions (Garnett and Baker, 2021). However, historically the subspecies had a wider distribution, occurring further south in north-eastern NSW and southeast Queensland (Black-throated finch Recovery Team, 2007). The subspecies occurs mainly in grassy, open woodlands and forests, generally dominated by <i>Eucalyptus</i>, <i>Corymbia</i> and <i>Melaleuca</i> and occasionally in tussock grasslands or freshwater wetlands, often along or near watercourses or in the vicinity of water. Some more commonly associated eucalypts that occur in woodlands and forests in the preferred foraging habitat of the subspecies, include: <i>Eucalyptus crebra</i>, <i>E. camaldulensis</i>, <i>E. melanophloia</i>, <i>E. brownii</i>, <i>E. similis</i>, and <i>E. tereticornis</i>. In south-eastern Queensland, it was formerly recorded in open forest on ridges, on grassy hillsides, and on ‘mountain flats’ (Lord 1956). However, virtually all recent records of the black-throated finch southern subspecies south of the tropics are from riverine habitat. It has been absent from Brisbane and its surrounds since the 1930s (Lord 1956; Woodall 1987) or 1940s (BTF Recovery Team 2004) and appears to have become extinct around most of Rockhampton during the early to mid-1970s, despite having been numerous there during the 1950s (Blakers et al. 1984; BTF Recovery Team 2004; Longmore 1978). It was last recorded in the Rockhampton region during 1988–89 (BTF Recovery Team 2004). There have been very few records of the subspecies south of 23° S since the late 1970s, and there have been almost no records from this region since 1995 (Barrett et al. 2003; Blakers et al. 1984; BTF Recovery Team 2004). Black-throated Finches (southern) were recorded from the Severn River, near Ballandean in southern Queensland, in the early 1980s and mid 1990s (BTF Recovery Team 2004) and there is a single record from Stanthorpe in 2002 (BTF recovery Team 2008, pers. comm.) (as cited on SPRAT). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside of the mapped distribution where the species or species habitat is likely to or may occur (>400 km north of the Project footprint). Species records: The nearest database records are located near Toowoomba approximately 4 km from the alignment. However, the	SPRAT WildNet	Unlikely	No	Preferred habitat for the species, as described in the literature, was detected within the Project footprint, including grassy open woodlands, woodlands and open forests dominated by <i>Eucalyptus</i>, especially areas where there is access to seeding grasses and water. Associated floristic species described in the literature, and detected in the Project footprint, include: <i>Eucalyptus crebra</i>, <i>E. camaldulensis</i>, <i>E. melanophloia</i>, and <i>E. tereticornis</i>. Notwithstanding, recent research on the current range of the species and the complete absence of contemporary records in the entire southern Brigalow Belt and SEQ bioregions, strongly indicates that the species is unlikely to disperse into areas of the Project footprint. The National recovery plan for the southern black-throated finch states that in the last 20 years it is estimated that the species extent of occurrence has decreased by approximately 80% if the species former extent. The population of the species has also been estimated to decrease by 50%. This dramatic decrease in occurrence extent and decrease in estimated population indicates that the species is unlikely to occur within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				location has been generalised to 2 km and the date of the record has not been provided (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Rostratula australis</i>	Australian painted snipe	E	E; Ma	The Australian painted snipe inhabits shallow freshwater (occasionally brackish) ephemeral and permanent wetlands or flooded brackish wetlands, especially where inundation is temporary but also permanent wetlands with shallow zones (Conservation Advice, 2013; Draft National Recovery Plan, 2019). Preferred habitat for this species is located in wetlands with complex shorelines and a matrix of shallow water, small islands, exposed wet mulch, and low, dense cover of emergent grass, sedges, rushes or reeds, often scattered with Muehlenbeckia, canegrass or <i>Melaleuca</i> spp. (~ <1 m) (del Hoyo et al. 2020 and Garnett and Baker, 2021) (~1m). During non-breeding periods, the species is known to utilise wetlands where trees shrubs or samphire is present, as well as sewage farms, dams, bores and irrigation schemes, rice fields, swamps and waterlogged grassland where they feed on invertebrates and seeds from the water's edge (Garnett and Baker, 2021, and Marchant and Higgins, 1993), this is considered general habitat. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat is likely to occur. Species records: There are numerous records of the species distributed throughout coastal sub-coastal and inland areas of southern Qld and across the Australian continent. The nearest record is along Mosquito Creek Road south of Devine State Forest, >7 km from Project footprint. There are also numerous records throughout the Toowoomba region (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Potential	Yes – the Australian Painted Snipe was recorded on the Glenlovely offset site near Yelarbon in October 2023, approximately 300 m from the Project footprint	The species may occur within the Project footprint when suitable breeding and foraging conditions exist, albeit this may be considered a relatively uncommon and/or sporadic occurrence. General habitat for the species occurs within the Project footprint, along the majority of the alignment. The most substantial areas of habitat are between the border and Whetstone State Forest (~42 km), with the remainder of the alignment containing only very small patches of habitat. Preferred habitat was found in ephemeral RE 11.3.27i and 11.3.27 shallow, freshwater wetland areas that contained a mosaic of ground cover including areas of bare ground, mud and tufted hydrophytic wetland species. Many of the associate floristic assemblage species occur in the Project footprint. Vegetation communities detected, included dominant hydrophytic sedge and emergent aquatic vegetation in RE 11.3.27, 11.3.27b, and 11.3.27i.	Likely
<i>Stagonopleura guttata</i>	Diamond firetail	V	V (listed 31 March 2023, after controlled action date)	Diamond firetail occurs on the south-east mainland of Australia from south-east Queensland to Eyre Peninsula, South Australia, and about 300 km inland from the sea (SPRAT 2023). Diamond firetails occurs in eucalypt, acacia or casuarina woodlands, open forests, and other lightly timbered habitats, including farmland and grassland with scattered trees. They prefer areas with relatively low tree density, few large logs, and little litter cover but high grass cover. Diamond firetails usually occur in flocks of between 5 to 40, and occasionally more (DCCEEW 2023d). Diamond firetail feeds predominantly at ground level, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. Between August and January, groups separate into small colonies to breed. Nests are bottle shaped and are made of green grass blades and stems lined with fine grasses and feathers. (DCCEEW 2023d). Distribution in relation to the Project: The Project footprint is located entirely within the species modelled distribution of species or species habitat likely to occur.	SPRAT ALA OCG	Likely	No	Habitat for the species, as described in the literature, was detected within the Project footprint. Microhabitat requirements such as tree hollows were also detected within the Project footprint. Suitable vegetation structural types, including eucalypt, acacia and casuarina woodlands and open forests, grassy woodlands and grasslands with scattered trees are present within the Project footprint. No individuals were detected during ecological surveys in potential habitat.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Species records: There are two undated records of the species located within the Project footprint, however records have been generalised to within 2 km to protect the species, so the exact location of the records cannot be confirmed. There are an additional 59 records of the species recorded within 10 km of the footprint (ALA, 2023), the most recent record was recorded in 2021, approximately 3 km east of the Project. Records in the Project footprint: Yes, however, record locations have been generalised and therefore it cannot be confirmed whether the records were inside or outside the Project footprint. Records in the locality: Yes					
<i>Turnix melanogaster</i>	Black-breasted button-quail	V	V	Black-breasted button-quail occurs in vine thickets, softwood scrubs in the Brigalow belt, mature hoop pine (<i>Araucaria cunninghamii</i>) plantations, especially where there is lantana (<i>Lantana camara</i>); dry sclerophyll forest adjacent to rainforest; and <i>Acacia</i> and <i>Austromyrtus</i> scrubs on sandy coastal soils (Marchant & Higgins, 1993 and Garnett and Baker, 2021). Preferred habitat for this species is located in dry forest described as bottle tree scrub, comprising brigalow (<i>Acacia harpophylla</i>), belah (<i>Casuarina cristata</i>) and bottle tree (<i>Brachychiton rupestris</i>), with a shrub understorey and thick litter layer. In some coastal areas, particularly north of Brisbane, associated with vegetation behind dunes, including dry vine thickets, <i>Acacia</i> thickets and areas densely covered in shrubs, particularly midgen berry (<i>Austromyrtus dulcis</i>) (Mathieson and Smith, 2009). Habitat considered critical to the survival of the black-breasted button-quail includes: Vine thickets and rainforest vegetation types that are periodically water-stressed. These include: semi-evergreen vine thicket, and <i>Brachychiton</i> scrubs that may incorporate bottle trees (<i>Brachychiton</i> sp.), brigalow (<i>Acacia harpophylla</i>) and belah (<i>Casuarina cristata</i>).Low thickets or woodlands with a dense understorey but little ground cover, typically dominated by <i>Acacia</i> spp.In littoral situations, dry vine scrubs, acacia thickets and areas densely covered in shrubs, particularly midgen berry <i>Austromyrtus dulcis</i>. SPRAT profile distribution in relation to the Project: Approximately a third of the alignment, between Gowrie and the Condamine River, is within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species is from 1999, located 1.5 km north of the Project footprint in Kingsthorpe. Closest records are isolated by clearing for urban development and agriculture (ALA, 2023). Other records are undated and generalised to within 10 km. The species is now considered to be confined to south-eastern Qld from near Byfield in the north to the Border Ranges in the south and as far west as Palmgrove NP and Barakula State Forest (Garnett and Baker, 2021). Records in the Project footprint: No Records in the locality: Yes, however they are older than 20 years or generalised within 10 km.	SPRAT	Potential	No	Very limited preferred habitat for the species occurs within the Project footprint. Associate floristic assemblage species: <i>Acacia harpophylla</i>, <i>Casuarina cristata</i> were found throughout the Project footprint. Areas close to the nearest historical record have been subject to significant habitat loss due to land clearing, agricultural impacts, residential and road development. For these reasons, if an extant population remains near Kingsthorpe, the ability of the species to disperse into nearby areas of the Project footprint appear to be unlikely.	Unlikely
Mammals									
<i>Chalinolobus dwyeri</i>	Large-eared pied bat	E	V (at time of the referral)	There are scattered records of the large-eared pied bat in Queensland within the sandstone escarpments of the Carnarvon, Expedition Ranges and Blackdown Tablelands. Additional records also exist in the Scenic Rim near the NSW/Queensland border.	SPRAT	Potential	No	Limited suitable foraging habitat for the species occurs within the Project footprint. No preferred habitat of caves, overhangs in sandstone cliff breeding/roosting habitat were recorded within the Project footprint. Although some potential foraging	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
			(uplisted to E effective 15 Nov 2023, after controlled action date)	The large-eared pied bat is known to roost predominantly in western facing caves and overhangs in sandstone cliffs and forage within 700 m of the day roost in nearby high-fertility forest or woodland near watercourses (DERM, 2011; Williams and Thompson, 2018). Surveys in the Brigalow Belt Bioregion of NSW and species habitat modelling by Pennay and Gosper (2002) largely supports this hypothesis. The species has also been recorded roosting in culverts and/or fairy martin nests in Queensland (Schulz, 1998). All reported communal roosts are from the northwestern slopes of NSW, the Pilliga Sandstone region and one from a mine at Woods Reef (now collapsed). No reports of maternity roosts are found in Queensland (Pennay, 2008). Additional records exist in the Scenic Rim near the NSW/Queensland border. The populations in this area appear to be reliant on the presence of roosts in volcanic rock types (Hoye 2005). Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously understood (NSW DECC 2007d). Critical habitat to the survival of the large-eared pied bat are areas with the presence of diurnal roosts for shelter and breeding, including caves and overhangs (sandstone cliffs) but also disused mine shafts and abandoned fairy martin nests (DERM, 2011). The species preferred habitat is regarded as all roosting and breeding habitat, whilst general habitat is considered any foraging habitat. SPRAT profile distribution in relation to the Project: The majority of the alignment is within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species is from 1997, approximately 40 km west of the Project footprint. All other records are >50 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No				habitat occurs within forest or woodland near watercourses within the Project footprint, no <i>C. dwyeri</i> were detected in initial targeted surveys or surveys of Wondul National Park, Bringally Sate Forest and the Canning Creek offset property in March/April 2023 (Williams, 2023). Additionally, sandstone areas investigated in Wondul NP are considered only marginal roosting habitat and it is not known whether this species would forage as far as those potential habitat areas within the Project footprint (9.9 km away). A key requirement for foraging habitat for this species is proximity to roosting habitat, which is absent from the Project study area.	
<i>Dasyurus hallucatus</i>	Northern quoll	-	E	The northern quoll was historically common across the northern third of Australia, occurring near-continuously from the Pilbara to Brisbane (Braithwaite & Griffiths, 1994). However, the current distribution in Qld is discontinuous, with the species occurring in rocky and/or high rainfall areas including: Cape Cleveland/Mt Elliott, Mareeba, Crediton, Eungella, Clarke Range, Cleveland, Cape Upstart, Cape Gloucester and Condor Range (Hill and Ward, 2010). The Northern Quoll is known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton, as far north as Weipa in Queensland and extends as far west into central Queensland to the vicinity of Carnarvon Range NP (McGoldrick 2013; Woinarski et al. 2008). There are occasionally records as far south in Queensland as Maleny on the sunshine coast hinterland (DERM 2009a). The species is highly fragmented in the state and surveys Woinarski and colleagues (2008) indicated severe reductions from the species' former distribution. Northern quolls do not have highly specific habitat requirements. They occur in a variety of habitats, including open dry sclerophyll forest and woodland, riparian woodland, low dry vine thicket, the margins of notophyll vineforest, mangroves, sugarcane farms and in urban areas. However, they are most abundant in hilly or rocky areas close to permanent water. Shelter sites are also non-specific and include rocky outcrops, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings (Oakwood, 2002). The species preferred habitat	SPRAT	Unlikely	No	General habitat as described in the literature for the species occurs within the Project footprint however the footprint is located outside of the historic range for the species. Suitable vegetation structural types, including open dry sclerophyll forest and woodland, and riparian woodland, occur within the Project footprint. Suitable microhabitat features, such as tree hollows, hollow logs and termite mounds were recorded within the Project footprint at a range of REs. Habitat critical to the survival of the species, specifically rocky outcrops, were limited to small areas of RE 11.7.7. Notwithstanding, as the present distribution of the northern quoll has contracted throughout its former range and in Queensland it is now fragmented into a number of populations largely in central to far northern Queensland, it is unlikely the species would occur within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				is considered as high quality denning/breeding and foraging habitat, whilst general habitat is regarded as low quality denning and foraging habitat and dispersal habitat. SPRAT profile distribution in relation to the Project: A portion of the alignment, between Gowrie and Millmerran, is within the mapped distribution where the species or species habitat is likely to or may occur. Only the Project footprint around Gowrie is within the likely to occur distribution. Species records: There are a number of old historical records in close proximity to the Alignment. The nearest records are: one between Goombungee and Highfields (<16 km from Alignment, 1965), one west of Ravensbourne NP (<34 km from Alignment, 1966), one in Crows Nest NP (<35 km from Alignment, 1960) and one in Clifton (<38 km from Alignment, 1985). However, the most recent records within 100 km of the Project footprint are along North MacLagan Road north-east of Quinalow (1990) and in Bunya Mountains NP (1990) (ALA, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed quoll (southeastern mainland population)	E	E	The spotted-tailed quoll occurs in five broad geographic regions, including the eastern Darling Downs-Inglewood Sandstone provinces of the Brigalow Belt South Bioregion (S. Burnett n.d., pers. comm. cited in Long & Nelson, 2004). As per the National Recovery Plan for the species (DELWP, 2016), the spotted-tailed quoll occurs in a wide range of habitat types, primarily depending on forests, which all appear to be in relatively high (>600 mm/year) and predictable seasonal rainfall areas. The southern species, <i>D. m. maculatus</i>, has been found to inhabit a wide range of habitats, from coastal heathland, scrub and dunes, to dry sclerophyll forests, rainforest and heathy woodland. It has also been recorded (less frequently) in grassland or pastoral areas adjacent to forested areas. Their home range is generally large (from several hundred to several thousand hectares in size). Day time dens include hollow logs, tree hollows, clumps of vegetation, caves and hollow boulder tumbles, rock crevices, windrows, under buildings and underground burrows. Multiple dens are used, usually relocating every 1 to 4 days. The species preferred habitat is considered as high quality denning/breeding and foraging habitat, whilst general habitat is regarded as low quality denning and foraging habitat and dispersal habitat. Additionally, habitat critical to the survival of the spotted-tailed quoll includes large patches of forest with adequate denning sites and relatively high densities of medium-sized mammalian prey (DELWP, 2016). SPRAT profile distribution in relation to the Project: The majority of the alignment is within the mapped distribution where the species or species habitat may occur. Species records: Five records occur in close proximity to the Project footprint: one in Pittsworth (<2 km, 1980), one in Inglewood (<3 km, 2019), one west of Toowoomba Wellcamp Airport (<6 km, 1991), one south of Hodgson Vale (<18 km, 1979) and the other in Yelarbon State Forest (20 km) (ALA, 2023). These records may no longer be representative of this current species distribution, given the scale of anthropogenic development and disturbance around the Toowoomba region over the past 30 - 40 years. Given this species occurs throughout other areas of similar habitat within the Inglewood Sandstones biogeographic	SPRAT WildNet Publications	Likely	Yes – a spotted-tailed quoll was recorded in Bringalily State Forest, approximately 4.5 km from the Project footprint	General and preferred habitat for the species occurs within the Project footprint. Suitable vegetation structural types, including dry sclerophyll forest, grassland and pastoral areas adjacent to forested areas, occur within the Project footprint. Potential habitat was surveyed in REs 11.3.14, 11.3.17, 11.3.2, 11.3.25, 11.3.27i, 11.3.4, 11.4.10, 11.4.3, 11.5.1, 11.5.14, 11.5.20, 11.5.4, 11.7.7, 11.8.4, 11.8.5, 11.9.5 and 11.9.9a. Suitable microhabitat features, such as tree hollows and hollow logs were recorded within the Project footprint, particularly within RE 11.3.25 fringing creeks and drainage lines. As suitable foraging habitat and a paucity of scattered regional records are present, there is potential for the species to disperse into areas of the Project footprint such as Bringalily State Forest which shares habitat similar to those found in the Inglewood Sandstones biogeographic subregion; representing an under-surveyed and data deficient area. Areas of the Project footprint within proximity to Toowoomba historical records may be considered unviable due to the widespread landscape fragmentation and agricultural practices over the past 40 years or more. However, their presence is likely to be strongly dependent on long-term habitat resource availability and may be considered an uncommon and/or sporadic occurrence.	Likely

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				subregion, it is possible that the Whetstone, Western Creek and Kumbarilla State Forests represent under-surveyed/data-deficient areas of potential habitat within the spotted-tailed quoll's Queensland distribution. Records in the Project footprint: No Records in the locality: Yes					
<i>Nyctophilus corbeni</i>	South-eastern long-eared bat	V	V	The south-eastern long-eared bat is mainly found inland of the Great Dividing Range, with most records in Queensland from within the Brigalow Belt South bioregion. It is found in a wide range of mainly woodland vegetation types including: brigalow woodland, belah woodland, black box woodland, smooth-barked apple woodland, river red gum forest, buloke woodlands and box, ironbark and cypress pine woodlands (Schulz and Lumsden, 2010). However, box, ironbark and cypress pine woodlands seem to be the preferred habitat in Queensland. It has been suggested that the home range of the south-eastern long-eared bat is probably large, since it is more abundant in extensive stands of vegetation than in smaller patches of woodland. Abundance of the species is higher in habitats that have a distinct tree canopy and a dense, cluttered understorey layer (Threatened Species Scientific Committee, 2015c). Southern Brigalow Belt habitat is poorly understood. However, studies in NSW in comparable habitat have found the following (Law et al. 2016; Law et al. 2018): • Areas of high stem density, particularly those containing dead trees, provide significant roosting habitat for <i>N. corbeni</i> and this is likely to be a key factor explaining the species rarity. • Dense stands with many hollows provide shelter and options for roost switching on a regular basis. • Small maternity colonies (<10 bats) have been recorded in hollows and fissures often in exposed locations of trees with a small diameter at breast height (typically 23 to 39 cm) that were usually dead (82.5% of roosts). • <i>Allocasuarina luehmannii</i> is most commonly used for roosting (~50%). • The species avoids roosting in commercially thinned stands and selected old regrowth. The species preferred habitat is regarded as any combined foraging, roosting and breeding habitat. General habitat for the species is regarded as any foraging and roosting habitat combined and foraging habitat only. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species is from 2006, in the Bringalily State Forest <3 km from the Project footprint. Yelarbon State Forest also has recorded several sightings, <15 km from the rail alignment, although they were in 1999. All other records are either recorded earlier than 2006 or are >50 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	General and preferred habitat for the species occurs within the Project footprint. The species was captured within the Project footprint along an access track located within eucalypt woodland with a very dense secondary tree layer of <i>Allocasuarina luehmannii</i> in Bringalily State Forest during spring surveys. During subsequent microbat surveys in March/April 2023, ten <i>N. corbeni</i> were captured in harp traps (three within the Canning Creek offset site and seven within Bringalily SF immediately adjacent to the offset site) (Williams, 2023). GPS and radio-tracking revealed the species to use the following tree species for roosting in the area (although none were within the Project footprint): <i>Acacia harpophylla</i>, <i>Acacia</i> spp. (likely <i>Acacia burrowii</i>), <i>Angophora leiocarpa</i>, <i>Eucalyptus chloroclada</i>, and <i>Alphitonia excelsa</i>. Roosts were typically under bark in dead trees, or live trees with dead stems/large branches. Two roosts were in hollows, however all tracking was conducted during the non-breeding season. Habitat for the species occurs along the alignment between Bringalily and east of Yelarbon (~70 km). Suitable vegetation structural types, including brigalow woodland to open forest, box, ironbark and cypress pine woodlands are common within the Project footprint. Suitable REs were detected within the project footprint, including RE 11.3.1, 11.3.14, 11.3.17, 11.3.2, 11.3.25, 11.4.10, 11.5.1, 11.5.4, 11.5.20, 11.7.7, 11.8.4 and 11.9.5. <i>Allocasuarina luehmannii</i>, a species commonly used by the south-eastern long-eared bat for roosting was commonly recorded within the Project footprint, particularly between Whetstone and Bringalily State Forests. Suitable REs with suitable microhabitat features, including a dense subcanopy and canopy stratum, hollow-bearing trees and exfoliating bark were recorded within the Project footprint, particularly in large areas of connected woodland between Whetstone and Bringalily State Forest.	Known
<i>Petauroides volans</i>	Greater glider (southern and central)	E	V (at time of the referral) (uplisted to E effective 5 July 2022, after controlled	Recently, McGregor et al. (2020) genetically confirmed <i>Petauroides volans</i> as comprising three distinct species, geographically delineated across the range of <i>Petauroides</i>. <i>P. volans</i> has been retained as the most southerly distributed species, occurring from Bundaberg south to Victoria. In general, the habitat of <i>Petauroides</i> spp. is restricted to tall, expansive <i>Eucalyptus</i> forests (Grzimek, 1990). Possingham et al. (1994) found there must be a patch of	SPRAT WildNet Publications	Likely	No	General and preferred habitat for the species, as described in the literature, was detected within the project footprint. Suitable remnant eucalypt woodland to open forest occurs within the Project footprint. Areas of eucalypt woodland/open forest to the west of the Project footprint (between Canning Creek and the Qld/NSW border) are dominated by largely intact mature box, ironbark and red gum communities, including areas	Potential

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			action date)	old growth forest at least 20 ha in size to sustain a population. However, simulations suggest small habitat patches (≥3 ha) can contribute to the persistence of greater gliders, depending on the surrounding landscape context. Eyre et al. (2022) therefore suggests that ‘any RE that has been identified as greater glider habitat, no matter how fragmented, will have value for greater gliders either now (if hollow-bearing trees present), or in the future with restoration’. Breeding and denning habitat for <i>Petauroides</i> spp. must also include large, old living trees with hollows, which the species uses to create den sites (Lindenmayer et al. 1993; Smith et al. 2007). A study located in the southern section of the Brigalow Belt Bioregion found the species only foraged and created den sites within myrtaceous trees, and that <i>E. fibrosa</i> and <i>E. tereticornis</i> were preferred significantly more than expected by their availability in the forest (Smith et al., 2007). Foraging habitat must be within close proximity to breeding and denning habitat, connected by tall trees within gliding distance of each other. The species preferred habitat is considered any breeding/denning and foraging habitat, whilst general habitat is considered foraging habitat only and dispersal habitat. In general, the species requires at least 2 to 4 live den trees for every 2 ha of habitat (TSSC, 2016). However, within the Brigalow Belt Bioregion, Smith et al (2007) determined 4 to 20 den trees were required per glider. The species has a relatively small home range (1 to 4 ha) and has a low dispersal ability (TSSC, 2016). Therefore, the species is heavily reliant on locally dominant available hollow-bearing trees. Overall, the greater glider is vulnerable to habitat loss and disturbance due to their specialised diet of eucalypt leaves and strict dependence on mature trees with large shelter/den hollows (McGregor et al., 2020). SPRAT profile distribution in relation to the Project: Almost the entire alignment is within the mapped distribution where the species or species habitat is likely to or may occur. Patches of the alignment that are just outside of the species distribution are between Pittsworth and Bringalily. Species records: The nearest record of the species is from the Highfields area, approximately 10 km north-east of the Project footprint in 2010 and 2016. There are also records of the species from Yelarbon State Forest in 1999, approximately 17 km from the Project footprint and multiple other records within 50 km (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes				within highly connected State Forests. Areas of eucalypt woodland/remnant forest to the east of the Project footprint were generally more fragmented. Preferred feed trees, <i>Eucalyptus crebra</i>, <i>E. fibrosa</i> and <i>E. tereticornis</i> were recorded within the Project footprint, particularly within RE 11.7.7, 11.3.25, 11.5.1, and 11.5.20. Suitable remnant eucalypt woodland /forest communities with large eucalypt trees (a surrogate for hollow-bearing trees) were recorded within the Project footprint, particularly within RE 11.3.17, 11.3.25, 11.3.27i, 11.4.10, 11.5.1, 11.5.20, 11.7.7, 11.8.4 and 11.9.9a. However, during surveys conducted in December 2023 (ERM, 2024) only three isolated patches of suitable remnant eucalypt woodland/forest communities with large eucalypt trees were recorded within the Project footprint, in RE 11.3.25. These patches were small and had poor connectivity between each of them and the state forests. The trees observed in these patches featured <i>E. tereticornis</i> and/or <i>E. camaldulensis</i> and were comparatively short, averaging approximately 15 m, with a maximum height of 20 m. No individuals, signs or scats were observed during these surveys.	
<i>Petaurus australis australis</i>	Yellow-bellied glider (south-eastern)	V	V (listed 2 March 2023, after controlled action date)	Yellow-bellied gliders (south-eastern) occur in altitudes ranging from sea level to 1,400 m above sea level, with a widespread, yet patchy distribution occurring from south-eastern Queensland to south-eastern Australia, near the South Australia – Victoria border (SPRAT 2022). Yellow-bellied gliders (south-eastern) occur in both wet and dry Eucalypt dominated forests in south-east Australia. This species prefers mature forest in large and connected patches that provide habitat for foraging and denning. They also show a clear preference for winter flowering and smooth barked Eucalypts, however, they require a floristic diversity for food resources year-round (SPRAT 2022).	Wildnet SPRAT ALA	Potential	No	Potential habitat for the species, as described in the literature, was detected within the Project footprint. Microhabitat requirements such as tree hollows were also detected within the Project footprint. A potential yellow-bellied glider scat was observed in one location within the Project footprint adjacent to Whetstone State Forest, however, was unable to be confirmed as yellow-bellied glider (south-eastern). Potential scat and feed-marks were also identified on Lindenmayer Road east of Millmerran approximately 2 km west of the Project footprint.	Potential

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				Species abundance is typically dependent on habitat suitability which is determined by forest age and floristics (DCCEEW 2023). Smooth-barked eucalypts are considered important resources for the yellow-bellied glider (south-eastern) as they provide shelter for insect prey. Yellow-bellied glider (south-eastern) shelter in hollows in large, old trees with a diameter of one meter or more. Hollow-bearing trees are considered a critical habitat feature for the yellow-bellied glider (south-eastern) as these are used for denning, and are typically living, smooth-barked eucalypts of multiple species. Sap trees (i.e., <i>Acacia</i> spp., <i>Corymbia</i> spp., <i>Eucalyptus</i> spp., brush box (<i>Lophostemon confertus</i>) and turpentine (<i>Syncarpia glomulifera</i>)) are also considered a critical habitat feature for the Yellow-bellied glider (south-eastern). Distribution in relation to the Project: The northern portion of the Project footprint is located within the species modelled distribution of species or species habitat may occur. However, the southern portion of the footprint, Goondiwindi to Pittsworth is located outside the species modelled distribution, with the exception of a small area around Millmerran. Species records: There are no records of the species located within the Project footprint, or within 10 km of the footprint. The closest publicly available record was recorded in 1993 within Lockyer National Park, approximately 30 km north-east of the footprint (ALA, 2023). The nearest, most recent (within 20 years) record was recorded in 2013 in Main Range National Park, approximately 73 km south-east of the footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Petrogale penicillata</i>	Brush-tailed rock-wallaby	V	V	In Queensland, populations of the brush-tailed rock-wallaby occur, or did occur, throughout the Great Dividing Range from the border with NSW to Nanango, 100 km northwest of Brisbane. Brush-tailed rock-wallaby preferred habitat includes refuge habitat, foraging habitat, with each habitat element considered critical to the survival of the species (Menkhorst and Hynes, 2010). Refuge habitat includes rock faces or outcrops with large tumbled boulders, ledges and caves (often with vegetation cover) that provide shelter and some protection from predators. According to Short (1982), preferred rocky habitat includes loose piles of large boulders containing a maze of subterranean holes and passageways, cliffs with many mid-level ledges (with some caves and/or ledges covered by overhangs) and isolated rock stacks. General habitat is considered as the routes the species takes in between each habitat type. Foraging habitat includes forest and woodland with a grassy understorey. The national recovery plan (Menkhorst and Hynes, 2010) states that 'precise vegetation community type may not be critical in habitat selection as brush-tailed rock-wallabies eat a wide variety of plant material (although mainly grasses) and animals will forage in artificial clearings and pastures'. SPRAT profile distribution in relation to the Project: Two very small portions of the alignment are within the mapped distribution where the species or species habitat	SPRAT WildNet Publications	Potential	No	Limited preferred and general habitat for the species, as described in the literature, was detected within the Project footprint. The Project footprint is also located west of the Great Dividing Range. Refuge habitat – rocky outcrops and large rocks were recorded within a small area of RE 11.7.7. However, no ledges, caves, cliffs, rock stacks or large boulders containing subterranean holes and passages were present. Feeding habitat – woodland with a grassy understorey occurs within the Project footprint. However, the areas between potential refuge habitat e.g., at Gowrie Mountain, and feeding habitat within the Project footprint has been heavily fragmented and developed for residential dwellings, roads, cropping and agriculture providing area of habitat highly exposed to threats from predators in these areas. As per the conservation advice, one of the species largest threats is habitat loss, in which fragmented habitats would significantly decrease the amount of connected general habitat for the species. Due to heavily fragmented habitat within the Project footprint, only incurring small areas of general habitat, and no suitable refuge habitat present, it is considered that the species is unlikely to occur.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				may occur. This is a small area around Gowrie and another south of Millmerran. Species records: The nearest record of the species is 1.2 km from the Project footprint on Gowrie Mountain in 2018 (ALA, 2022). There is also a record from 1992 ~12 km from the Project footprint east of Bulli State Forest. Records in the Project footprint: No Records in the locality: Yes					
<i>Phascolarctos cinereus</i>	Koala	E	V (at the time of the referral) (uplisted to E effective 12 Feb 2022, after controlled action date)	In Queensland, the koala's distribution extends inland from the east coast: from the Wet Tropics interim biogeographic regionalisation of Australia bioregion, into the Einasleigh Uplands bioregion in the north of the state; from the Central Mackay Coast bioregion, through the Brigalow Belt North bioregion to the Desert Uplands and Mitchell Grass Downs bioregions, and from the Southeast Queensland bioregion, through the Brigalow Belt to the Mulga Lands and Channel Country bioregions in the southwest of the state (TSSC, 2012). Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by <i>Eucalyptus</i> species. Although koalas are generally found in higher densities where food trees are growing on more fertile soils and along watercourses, they are also known to occur in modified or regenerating native vegetation communities, as well as urban and rural landscapes where food trees or shelter trees may be highly scattered (DAWE, 2021). For instance, in agricultural and fragmented landscapes of south-east Queensland, scattered paddock trees have been found, along with roadside vegetation, to be disproportionately important to local koala populations (Barth et al. 2019). Locally important koala trees within the Brigalow Belt bioregion, include: <i>Eucalyptus brownii</i>, <i>E. camaldulensis</i>, <i>E. chloroclada</i>, <i>E. conica</i>, <i>E. coolabah</i>, <i>E. crebra</i>, <i>E. drepanophylla</i>, <i>E. dura</i>, <i>E. exserta</i>, <i>E. fibrosa</i>, <i>E. laevopinea</i>, <i>E. largiflorens</i>, <i>E. longirostrata</i>, <i>E. major</i>, <i>E. melanophloia</i>, <i>E. microcarpa</i>, <i>E. moluccana</i>, <i>E. ochrophloia</i>, <i>E. orgadophila</i>, <i>E. populnea</i>, <i>E. punctata</i>, <i>E. saligna</i>, <i>E. sideroxylon</i> and <i>E. tereticornis</i> (Youngentob et al. 2021). According to the draft recovery plan for the koala (DAWE, 2021b), koala habitat includes forests or woodlands; roadside and railway vegetation and paddock trees; safe intervening ground matrix for travelling between trees and patches to forage and shelter and reproduce; and access to vegetated corridors or paddock trees to facilitate movement between patches. Preferred habitat for the species is considered as both foraging and breeding habitat, whilst general habitat is regarded as any present dispersal habitat. The draft recovery plan for the koala (DAWE, 2021b) does not define habitat critical to the survival of the Koala. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat is likely to occur. Species records: The nearest and most recent records of the species are from the area west of Pittsworth, directly adjacent to the Project footprint in 2023 (ALA, 2023). There are numerous database records both historic and recent of the species surrounding the Project footprint, with a concentration of records near Pittsworth, Millmerran and the region surrounding Toowoomba. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet Publications	Likely	Yes	Both preferred and general habitat for the species, as described in the literature, was detected within the project footprint albeit very patchily in some areas. Twenty-six (26) koalas were directly recorded and 62 koalas indirectly recorded (via scat and tracks) within the Project footprint. Koalas were detected east of Yelarbon, in the northern section of Bringalily State Forest, near Millmerran, and between Brookstead and Gowrie. Suitable eucalypt woodland to open forest is widespread within the Project footprint. Areas of eucalypt woodland/open forest to the west of the Project footprint (between Canning Creek and the Qld/NSW border) are dominated by largely intact mature box, ironbark and red gum communities, including areas within highly connected state forests. Areas of eucalypt woodland/forest to the east of the Project footprint were generally more fragmented. However, habitat occurred within roadside vegetation and scattered paddock trees within agricultural landscapes, particularly around the Pittsworth area. Habitat within the Project footprint includes remnant and regrowth eucalypt or mixed eucalypt woodland/open forest and non-remnant communities with scattered eucalypt paddock trees. Remnant and non-remnant grassland and pasture is also considered koala habitat where these areas are used for travelling between trees and woodland/forest patches across the landscape. Therefore, only areas that had intensive cropping regimes and other treeless areas, including roads, were removed as potential habitat during the assessment. Locally important koala trees recorded within the Project footprint, include: <i>Eucalyptus camaldulensis</i> , <i>E. chloroclada</i> , <i>E. crebra</i> , <i>E. fibrosa</i> , <i>E. melanophloia</i> , <i>E. orgadophila</i> , <i>E. populnea</i> and <i>E. tereticornis</i> . Ancillary habitat trees, including <i>Acacia harpophylla</i> , <i>A. salacina</i> , <i>Corymbia erythrophloia</i> and <i>C. tessellaris</i> were also recorded within the Project footprint.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Potorous tridactylus tridactylus</i>	Long-nosed potoroo (northern)	V	V	The long-nosed potoroo (northern) is sparsely distributed along the coast and Great Dividing Range of SEQ (Van Dyck and Strahan, 2008). There is no consistent pattern to the habitat of the species, which can be found in wet eucalypt forests, rainforest, wet and dry woodland to coastal heaths and scrubs (Seebeck, 1995; Mason 1997). The main habitat features appear to be access to some form of dense vegetation for shelter (Bennett 1987) and the presence of an abundant supply of fungi for food (Claridge et al. 1992). Due to the limited knowledge regarding the species preferred habitat any vegetation delineated as some form of dense vegetation for shelter (Bennett 1987) and the presence of an abundant supply of fungi for food (Claridge et al. 1992) is regarded as preferred habitat. The species has also often been recorded in gullies and near creeks, which provide refuge during fire and drought. SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside the mapped distribution where the species or species habitat is likely to or may occur. The mapped distribution is however very close to the alignment at its northern extent at Gowrie. Species records: Nearest record is from 2015 and is south of Toowoomba, approximately 25 km from Project footprint. All other records restricted to the east of Toowoomba and Warwick (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT	Unlikely	No	Preferred habitat for the species, as described in the literature, was not detected within the Project footprint. Vegetation communities at the northern extent of the Project footprint are predominantly non-remnant cropping and agricultural land with sections of remnant grassland (11.3.21 and 11.8.11) and small patches of 11.8.5 regrowth that are not considered habitat for the species.	Unlikely
<i>Pseudomys novaehollandiae</i>	New Holland mouse	V	V	The New Holland mouse has a fragmented distribution across Queensland. The species is typically found from coastal areas, up to 100 km inland on sandstone country (Menkhorst et al., 2008; Wilson & Laidlaw, 2003). Across its range, the preferred habitat for this species is open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes (TSSC, 2010). Soil type is believed to be an important indicator of habitat suitability for the New Holland mouse, with deeper top soils and softer substrates preferable for digging burrows. In Victoria, this species has been recorded on deep siliceous podsols, sandy clay, loamy sands, sand dunes and coastal dunes (Wilson & Laidlaw, 2003). Other factors including slope, geology and an area's sun exposure may also influence site selection (Wilson & Laidlaw, 2003). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside the mapped distribution where the species or species habitat is likely to or may occur. The mapped distribution where the species or species habitat may occur is however very close to the alignment at its northern extent at Gowrie. Species records: The nearest records of the species are recorded within the Toowoomba Range, approximately 30 to 40 km from the Project footprint. No other records are located within 50 km (ALA, 2023). Records in the Project footprint: No Records in the locality: No	WildNet SPRAT	Unlikely	No	Preferred habitat for the species, as described in the literature, was not detected within the project footprint. Suitable sandy soil substrates are common throughout the project footprint from Goondiwindi to Millmerran, particularly on Landzone 5 and 3 (REs 11.5.1, 11.5.4, 11.3.18, 11.3.7). However, suitable vegetation structural types including heathland, open woodlands with a heathland understorey and vegetated sand dunes were not recorded within the project footprint. Fauna surveys along the alignment did not result in detection of the species	Unlikely
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	-	V	The grey-headed flying-fox occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria (Tidemann 1998). However, only a small proportion of this range is used at any one time, as the species selectively forages where food is available. The species preferred habitat contains areas suitable for both foraging and roosting. Foraging habitat includes a range of vegetation communities such as rainforests, open forests, closed and open woodlands, <i>Melaleuca</i> swamps, <i>Banksia</i> woodlands, commercial fruit crops and introduced	SPRAT	Likely	Yes	Preferred habitat for the species, as described in the literature, was detected within the project footprint. The most substantial areas of habitat are in the southern half of the alignment, between from Bringalily State Forest to west of Yelarbon. Another substantial area of habitat is mapped between Brookstead and Pittsworth. A single individual was recorded foraging within the Project footprint. Additionally, despite the nearest regularly used grey-headed flying-fox camp being located in Toowoomba, a	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Acanthophis antarcticus</i>	Common death adder	V	-	The Common death adder is found in a wide range of well-drained habitats, from woodlands, shrublands to grasslands and wet sclerophyll forests. Microhabitat consists of deep fixed leaf litter where it hides to ambush prey. In Queensland it occurs from Central Queensland to South-east Queensland and the southwestern part of Queensland (Cogger 2014; DES 2019). Distribution in relation to the Project: There is no official distribution for this species, however it has been recorded throughout Central and South-east Queensland which would make it likely that it would intersect with the Project alignment. Species records: There are ten recent records of the species within 10 km of the Project footprint (ALA 2023, DES, 2023). The nearest records are along Millmerran-Inglewood Road, directly adjacent to the Project footprint in 2011 and 2022. Records in the Project footprint: No Records in the locality: Yes	WildNet ALA DES Species Profile Publications	Likely	Yes - along Millmerran-Inglewood Road, Inglewood-Texas Road, and Grays Road, in or near Bringalily State Forest. Mostly records are outside of the Project footprint, however two records in late February 2024 were recorded within the Project footprint.	Habitat for the species, as described in the literature, was located within the Project footprint. Suitable microhabitat features recorded within the Project footprint included leaf litter and coarse woody debris. Habitat was identified within the following REs: 11.3.1, 11.3.14, 11.3.17, 11.3.2, 11.3.21, 11.3.25, 11.3.27i, 11.3.4, 11.4.10, 11.4.3, 11.5.1, 11.5.14, 11.5.20, 11.5.4, 11.7.7, 11.8.11, 11.8.4, 11.8.5, 11.9.5 and 11.9.9a. Areas of the Project footprint that fall within modelled or known distribution of the species are focused around Bringalily State Forest and Whetstone State Forest. No individuals were detected during targeted surveys in the Project footprint, however recent supplementary surveys by UniSQ have recorded six specimens, including two within the Project footprint.	Known
<i>Anomalopus mackayi</i>	Five-clawed worm-skink	E	V	The five-clawed worm-skink is known from the upper Condamine River Floodplain from Warwick in the south to Jimbour in the north with species recorded in Allora, Bongeen, Cecil Plains and Oakey. In general, the species is known to occur in both remnant and non-remnant woodlands and grasslands (not subject to cropping or heavy grazing) on alluvial, cracking clay soils or self-mulching, friable basalt soils (DSEWPAC, 2011). The species shelters under coarse woody debris, decaying leaf litter or artificial debris where there is enough soil moisture retention. Where these habitat features are present, it is regarded as preferred habitat. It often lives in permanent deep tunnel-like burrows and deep soil cracks. The species has also been found sheltering under artificial materials such as discarded railway sleepers, sheet metal and hay bales in areas modified by agriculture and other human activities (DEWHA, 2008h; DoE, 2021). In Queensland, suitable REs include: 11.3.21, 11.3.25, 11.8.5, 11.8.15, 13.3.3 and 13.3.4. Known important habitat, includes: - All habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands, and - Habitat within the known/likely-to occur distribution of the species. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat is likely to or may occur. The only portion of the alignment within the species' may occur distribution is at Whetstone State Forest, with the remainder within the species' likely to occur distribution. Species records: The nearest records of the species are from just outside the Project footprint (200 m) east of Pittsworth from 2002 and 2009 (ALA, 2023). It is likely that this species has been poorly surveyed across much of its southern Queensland distribution and therefore it may occur in areas along the Project footprint where no records exist. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet DES Species Profile Publications	Likely	No	Preferred habitat for the species, as described in the literature, was detected within the project footprint and has been mapped in sections along the entire alignment. Suitable alluvial and cracking clay soils are common throughout the project footprint, particularly on Landzone 3 and 4. Suitable REs were detected within the project footprint, including 11.3.17, 11.3.2, 11.3.21, 11.3.25, 11.3.4, 11.4.10, 11.8.11, 11.8.4, 11.8.5 and 11.9.9a Suitable microhabitat features, including coarse woody debris, leaf litter and artificial materials (e.g., railway sleepers) were recorded within the project footprint. Known important habitat, as described in the literature, was recorded within the project footprint, including floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves and travelling stock routes.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Delma torquata</i>	Collared delma	V	V	The collared delma is endemic to Queensland, where it has been recorded at the Bunya Mountains, Blackdown Tablelands NP, Expedition NP, Western Creek (near Millmerran), Toowoomba Range and the western suburbs of Brisbane (Davidson 1993; Peck and Hobson 2007). The collared delma has been recorded from a number of different soil types throughout south-east Queensland, including sandy loams, grey and black cracking clays, stony lithosols and basalt derived Podzolics). Land zones (LZs) mentioned are LZ 3, LZ 9 and LZ 10 (Brigalow Belt Reptiles Workshop, 2010), but species have also recently been recorded in LZ12 (AusEcology, 2015 & 2018 observations). In the eastern parts of the species' range (i.e., the Toowoomba Range), general habitat is commonly associated with exposed rocky outcrops on ridges or slopes in vegetation communities dominated by narrow-leaved ironbark (<i>Eucalyptus crebra</i>) (Brigalow Belt Reptiles Workshop 2010). The most westerly records were made in popular box (<i>Eucalyptus populnea</i>) open woodland on alluvial plains (Brigalow Belt Reptiles Workshop 2010; Venz 2010 pers. comm.) which is also considered general habitat for the species. Associated REs include: 11.3.2, 11.9.10, 11.10.1 and 11.10.4. The presence of logs, bark, rocks, and other coarse woody debris, in conjunction with a present leaf litter layer of 30 to 100 mm thick appear to be an essential characteristic of the microhabitat for the species (DoE, 2021). Collared delma have mostly been detected under rocks or coarse woody debris. They have also been found in termite holes and have been observed moving through low grass (DSEWPAC, 2011). Given the difficulty in detecting this species, the Commonwealth environment department considers that an occurrence of important habitat for the collared delma is a surrogate for an 'important population' of the species" (DoE, 2021). Known important habitat, includes: • Habitat within the Known/Likely-to occur distribution of the species and the Toowoomba Range, • Habitat between grazed or cropped areas, along road reserves, and travelling stock routes, especially the Donnybrook Stock Route region. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat may occur. Species records: The nearest records of the species are within the Toowoomba Range, approximately 12 km and 13 km east of the Project footprint in 2003 and 2021, respectively. There is also an older record from 1998 at the boundary of Western Creek State Forest, approximately 29 km west of the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet DES Species Profile	Potential	Yes - ~13 km from the Project footprint	Marginal general habitat for the species, as described in the literature, was detected within the project footprint. Collared delma were not detected during ecological surveys within the Project footprint, however, were recorded during additional surveys at two sites in eucalypt forest in Ballard, approximately 14 km from the northern-most end of the alignment, in 2023 (Allen et al., 2023). The area between Bringalily State Forest and Millmerran contain only small and isolated areas that may be marginal habitat. Suitable sandy loams and grey and black cracking clay soil occurs within the project footprint. Suitable poplar box open woodland on alluvial plains occurs along the project footprint within the western section of the species range. Suitable REs were detected within the project footprint, including 11.3.2 and 11.9.10. Suitable microhabitat features, including dense leaf litter, logs, bark, rocks and other coarse woody debris were recorded in some sections of the Project footprint (including within RE 11.3.2) but are generally absent.	Potential
<i>Egernia rugosa</i>	Yakka skink	V	V	The yakka skink is endemic to Queensland and has a patchy known distribution extending from the coast to the hinterland of sub-humid to semi-arid eastern Australia. The species is known to occur in open dry sclerophyll forest, woodland and scrub (Brigalow Belt Reptiles Workshop 2010), with the core habitat of this species present within the Mulga Lands and Brigalow Belt South (TSN, 2008). Land zones (LZ) mentioned are LZ 3, LZ 4, LZ5, LZ7, LZ9, LZ 10 and LZ12 (DoE, 2021). The species might also use LZ8 (not core habitat) and LZ12 (in Wet Tropics Bioregion only) (DoE, 2021). Preferred habitat for the yakka skink occurs in a wide variety of vegetation types, including: brigalow (A.	SPRAT WildNet DES Species Profile	Potential	No	Preferred habitat for the species, as described in the literature, was detected within the project footprint and generally occurs between Yelarbon and Gowrie. Suitable Landzones occur within the project footprint, including Landzones 3, 4, 5, 7 and 9. Multiple suitable REs occur within the project footprint, including (but not limited to) 11.3.2, 11.4.3, 11.4.10 and 11.9.5. Suitable microhabitat features (within suitable REs) occur within the project footprint, including areas with hollow logs, rocks and burrows in some restricted areas. Although preferred habitat for the species occurs within the Project footprint, the species has not been	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				<i>harpophylla</i>), mulga (<i>A. aneura</i>), bendee (<i>A. catenulata</i>), poplar box (<i>Eucalyptus populnea</i>), belah (<i>Casuarina cristata</i>), ironbark (<i>Eucalyptus</i> spp), cypress pine (<i>Callitris glaucophylla</i>) and lancewood (<i>A. shirleyi</i>) woodlands and open forests (DSEWPAC, 2011). Chapple (2003) also observed the species in ecotonal forest in rainforest and wet/dry sclerophyll forest. Microhabitat for the yakka skink consists of cavities under and between logs or tree stumps, root cavities, abandoned burrows (e.g., rabbit warrens) and under rocks. The species is known to take refuge in large hollow logs. They will also excavate deep burrow systems, sometimes under dense vegetation (DoE, 2021). In cleared habitat, this species can persist where there are shelter sites such as raked log piles, deep gullies, tunnel erosion/sinkholes and rabbit warrens. Known important habitat, includes: - Any contiguous patch of habitat, particularly remnant vegetation, where a colony is known or identified, and - Any microhabitat where colonies are likely to be found. SPRAT profile distribution in relation to the Project: The majority of the alignment (between Gowrie and Whetstone State Forest) is within the mapped distribution where the species or species habitat may occur. Species records: The closest record is from 1994 at Bunya Mountains NP, approximately 70 km north of the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No				detected within over 50 km of the Project. This species can also be difficult to detect and, as such, it is considered to only have the potential to occur.	
<i>Eseya albagula</i>	Southern snapping turtle	CE	CE	The southern snapping turtle is a habitat specialist (TSSC 2014). Within the river system, preferred habitat is considered to feature clear, flowing, well-oxygenated waters. Water quality is an important aspect of the species ability to utilise habitat as due to its physiological adaptation to extract oxygen from water via cloacal respiration (DoEE 2017; TSSC 2014). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside the mapped distribution where the species or species habitat is likely to or may occur. The southern edge of the distribution is approximately 60 km to the north of the alignment. Species records: Although the mapping does not predict that the species will be within the Project footprint, an individual was found in a creek in Toowoomba <16 km the footprint in 2014. It is likely that this individual did not naturally disperse and was released. Other than the record in Toowoomba, the next nearest record was found in Fernvale in 2021, >80 km from the railway alignment (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNET DES Species Profile	Unlikely	No	Preferred habitat as described in the literature, and species records are absent from the Study area and surrounding region (ALA 2023). As such, the species is unlikely to occur in the impact assessment area.	Unlikely
<i>Furina dunmalli</i>	Dunmall's snake	V	V	The distribution of Dunmall's snake extends from the Central Queensland region (Clermont and Carnarvon areas) to the Queensland border and northern NSW, with the species mainly occurring in the Brigalow Belt Bioregion in Queensland. The species is rarely seen, but most records indicate sites at elevations between 200 to 500 m above sea level (DoE, 2021). Preferred habitat for the species has been found in a wide range of habitats such as forests and woodlands on black alluvial cracking clay and clay loams. Characteristic flora species associations on these soils include brigalow (<i>A. harpophylla</i>) and other <i>Acacia</i> spp., bulloak (<i>Allocasuarina leuhmannii</i>) or cypress pine (<i>Callitris</i> spp) forests. It has also been recorded on sandstone derived soils with open woodland and forests growing on it, consisting of lemon-	SPRAT WildNet DES Species Profile	Likely	Yes – incidentally recorded in Bringalily State Forest	Preferred habitat for the species, as described in the literature, was detected within the project footprint and has been mapped along almost the entire alignment. The species was recently incidentally recorded in Bringalily State Forest beside a drainage line in bulloak forest in November 2023. Suitable REs containing adequate microhabitat features in the form of leaf litter and coarse woody debris, include: 11.5.1, 11.3.2, 11.3.14,11.5.20, 11.5.4, 11.7.7, 11.9.5.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				scented gum (<i>Corymbia citriodora</i>), ironbarks (<i>E. crebra</i> and <i>E. melanophloia</i>), bulloak (<i>Casuarina leuhmannii</i>) and white cypress pine (<i>Callitris glaucophylla</i>). (DoE, 2021). The species is thought to seek shelter under fallen timber and in ground litter, and potentially may use cracks in alluvial clay soils. The species is nocturnal, cryptic, secretive species that is very rarely encountered. (DSEWPAC, 2011). Known important habitat, includes: Habitat within the Known/Likely to occur distribution of the species and any habitat corridors in between. SPRAT profile distribution in relation to the Project: The entire alignment is within the mapped distribution where the species or species habitat may occur. Species records: The nearest record of the species was recorded in 2011 ~50 m from the Project footprint along Millmerran - Inglewood Road in Bringalily State Forest (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Hemiaspis damelii</i>	Grey snake	E	E (listed 5 October 2022, after controlled action date)	Grey snake (<i>Hemiaspis damelii</i>) are broadly distributed in Queensland, with most records occurring along the Macintyre and Condamine Rivers and associated floodplains of the southern Brigalow Belt region. The species is commonly detected in areas 70 m above sea level to 540 m above sea level (SPRAT 2023). Grey snake is closely associated with floodplain habitats. In Queensland, the grey snake occurs in brigalow/belah (<i>Acacia harpophylla</i>/ <i>Casuarina cristata</i>) woodlands, usually associated with heavier, cracking clay soils. It is particularly associated with water bodies, gilgais and small gullies (DCCEEW 2021 and DES, 2012). The species is a crepuscular to nocturnal frog specialist (Wilson, 2013) known to shelter under rocks, logs and flood debris, as well as in soil cracks or abandoned burrows within these moist/seasonally inundated habitats (DCCEEW, 2021). Habitat critical to the survival of the species has been described as: “<i>Seasonally inundated floodplains and associated wetlands, swamps or lake systems with cracking clay soils and frog diversity within the species known and likely distribution. Where any of the above habitats are discovered within the distribution of the species, these should be surveyed for the grey snake and where any new populations of the species are discovered, the habitat should also be considered critical to its survival</i>” (DCCEEW, 2021). Distribution in relation to the Project: The entirety of the footprint is located within the species modelled distribution of species or species habitat likely to occur or may occur. The portion of the alignment between Pittsworth and Toowoomba is for the most part mapped as species or species habitat may occur, while a small section of this region around Wellcamp is mapped as species or species habitat is likely to occur. Species records: There are no publicly available records of the species within the Project footprint, however there are two records recorded within 10 km of the footprint. One record was recorded in 2005, in Brigalow (<i>Acacia harpophylla</i>) forests and woodlands, and is located 7.7 km north of the southern-most point of the footprint (ALA and WildNet). Whilst the other was recorded in cleared, non-native	DCCEEW SPRAT ALA WildNet DES Species Profile Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the project footprint. Suitable floodplain habitat occurs within the Project footprint, specifically the Condamine River floodplain. Suitable soil i.e., heavy, cracking clay soils, occurs within the Project footprint. Suitable brigalow/belah (<i>Acacia harpophylla</i>/ <i>Casuarina cristata</i>) woodlands occur within the Project footprint. REs include: 11.3.1, 11.4.3, 11.4.10, 11.9.5 and 11.9.10. Suitable microhabitat features within suitable REs, included: cracking clay soil, gilgais/waterbodies, leaf litter and coarse woody debris. Suitable floodplain habitat with suitable soil and microhabitat features were also recorded within RE 11.3.14 along a watercourse, RE 11.5.14 in close proximity to a dam, RE 11.3.1, 11.3.17, 11.3.2, 11.3.21, 11.3.25, 11.3.27i and 11.3.4. The species was recorded at two locations within the Project footprint one near Yelarbon and the other near Inglewood. One individual was recorded in <i>Melaleuca densispicata</i> wetland that was recently inundated by heavy rain and the other at the edge of a riparian woodland with a predominantly ephemeral creek that had retained moderate pools of water.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				vegetation and is located 10 km east of the footprint, nearing Westbrook (no date). Records in the Project footprint: No Records in the locality: Yes, although they are historic records.					
<i>Myuchelys (Wollumbinia) bellii</i>	Bell's turtle	E	V (at the time of the referral) (uplisted to E effective 15 March 2023, after controlled action date)	The species is restricted to upland streams (between 600 and 1100 m altitude) that contain permanent pools deeper than about 2 m, granite boulders and bedrock. The general habitat for this species is often complex, with underwater caverns formed by boulders, logs and overhanging banks. In areas of lower velocity, the typical substratum is coarse granitic sand overlain by fine silt, algal growth, and dense beds of macrophytes (DoEE 2019b). It is absent from areas away from flowing streams, such as farm ponds and natural wetlands (DoEE 2019b). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside the mapped distribution where the species or species habitat is likely to or may occur. The mapped distribution is ~60 km south-east of the alignment at Inglewood. Species records: No species records occur within 10 km of the impact assessment area, with the closest records being around Girraween National Park >90 km away (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT	Unlikely	No	General habitat as described in the literature, and species records are absent from the Study area and surrounding region (ALA 2023). As such, the species is unlikely to occur in the impact assessment area.	Unlikely
<i>Tympanocryptis condaminensis</i>	Condamine earless dragon	E	E	At the time when the grassland earless dragon (<i>T. pinguicolla</i>) was included in the EPBC Act list of threatened species, on 16 July 2000, the species was believed to occur in the Darling Downs in Queensland. This part of the species range is now described as a new species, the Condamine earless dragon (<i>T. condaminensis</i>). As provided by section 184(d) of the EPBC Act, the Delegate of the Minister of the Environment amended the EPBC Act list of threatened species by updating the name of <i>T. pinguicolla</i> to <i>T. pinguicolla</i> and <i>T. condaminensis</i> , effective from 5 May 2016." (DoE, 2021; Melville, 2014). The Condamine earless dragon currently occurs in the eastern Darling Downs region of south-east Queensland, where it occurs on the Condamine floodplain, with records at Oakey, Mt Tyson, Brookstead, Bongeen and Bowenville. The population extent of occurrence is estimated to be less than 2,000 km, with the area of actual anticipated occupancy around 76 km² (TSSC, 2016). The species is active during the day and will seek shelter in preferred habitat of soil cracks (cracking clay) and under/within ground cover, such as surface rocks, rocky outcrops, tussocks, root masses of thistles and coarse surface debris (Melville, 2018). The pre-European habitat for the Condamine earless dragon was natural grassland (RE 11.3.21). However, this has been extensively cleared, and currently the species is found on black cracking clay soils that in general are intensively cropped, this has also been considered as preferred habitat. The species can occur in general habitat featuring mixed cropping farmland, headlands (thin, less than 10-m-wide strips of grassland on paddock verges), small fragmentary remnant or 'regrowth' grassland and stubble fields (Melville, 2018). However, a recent study by Starr and Leung (2006), found Condamine earless dragon numbers were more abundant and had a better body-condition in sorghum stubble than grasslands and grass verges. SPRAT profile distribution in relation to the Project:	SPRAT WildNet Publications	Likely	Yes	Preferred habitat for the species, as described in the literature, was detected within the project footprint approximately 13 km north-east of Millmerran. Habitat is restricted to the northern portion of the alignment between Millmerran and Gowrie (~80 km) and mostly patchily distributed. Condamine earless dragon was detected in an existing rail reserve located between Millmerran and Brookstead during preliminary field surveys. During more recent surveys between September 2023 and mid-February 2024, 76 dragons were captured to the north of the Project footprint in the Condamine River floodplain (Allen et al., 2023; JP Emery pers. comm., 2024). Genetic samples were taken from 32 individuals. General habitat was found in remnant grassland including RE 11.3.21 and 11.8.11, as well as non-remnant areas (e.g., crop fields and grass verges) with cracking clay soil and/or sorghum stubble. All habitat in non-remnant grasslands (within the species known range) were found to provide habitat for the species.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Patches of the alignment between Millmerran and Gowrie are within the mapped distribution where the species or species habitat is likely to or may occur. Species records: Numerous records of this species are located within 10 km of the alignment, the most recent of which is from 2015 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					
<i>Uvidicolus sphyrurus</i>	Border thick-tailed gecko	-	V	The border thick-tailed gecko occurs in the New England Tableland, Nandewar and Brigalow Belt South Bioregions of northern NSW and SEQ in an area bounded by Durikai State Forest (Queensland) to the north, the Great Dividing Range (NSW) to the east, the Liverpool Range (NSW) to the south and Moree/Mt Kaputar NP (NSW) to the west (NSW OEH, 2013p; Spark pers. comm., 2001b). The nocturnal border thick-tailed gecko shelters by day and is most commonly found in undisturbed remnant habitat on rocky outcrops and stony hills within eucalypt and cypress-pine open forest or woodland between 500 to 1100m above sea level (NSW OEH 2013p; NSW SC 2010b). The species is found in preferred habitat featuring granitic substrates, as well as regenerating habitat on basalt and metasediment lower slopes and flats (i.e. more fertile and less rugged sites) (Spark pers. comm. 2008 cited in NSW SC 2010b). It most often occurs on steep rocky or scree slopes, especially on granite and it may prefer sites with easterly aspects and the base of rocky escarpments (NSW OEH, 2013p). Sheltering occurs in well-shaded microhabitats amongst boulders, rock slabs, fallen timber and debris, bark on tree trunks and deep leaf litter (NSW OEH 2013p; Spark unpub. data cited in NSW SC 2010b). Rough-barked Apple (<i>Angophora floribunda</i>) logs may be moist drought refuge (NSW SC 2010b). Habitat often has dense canopy cover that creates a sparse grass/herb ground cover and abundant litter (Spark unpub. data cited in NSW SC 2010b). Studies have found the majority of sites occupied by <i>Uvidicolus sphyrurus</i> had undergone mild fires 20 to 30 years ago (Spark pers. comm. 2001b). SPRAT profile distribution in relation to the Project: The entirety of the alignment is outside the mapped distribution where the species or species habitat is likely to or may occur. The mapped distribution is ~10 km east of the alignment at Inglewood, near Lake Coolmunda. Species records: The nearest records of the species are >50 km to the east of the alignment in Durikai State Forest (2007) and Arcot State Forest (2011) (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet	Unlikely	No	Preferred habitat as described in the literature, and species records are absent from the Study area and surrounding region (ALA 2023). As such, the species is unlikely to occur in the impact assessment area.	Unlikely
Fish									
<i>Bidyanus bidyanus</i>	Silver perch	-	CE	Silver perch are a highly migratory freshwater fish and are endemic to the Murray-Darling system (including all states and sub-basins) (Allen <i>et al.</i> 2002). Silver Perch are consistently reported by anglers and researchers to show a general preference for faster-flowing water, including rapids and races, and more open sections of river and preference for submergent macrophytes, which may be important nursery areas for juveniles (DoEE 2018). Adult Silver Perch are omnivorous, taking a variety of small prey including zooplankton, aquatic insects, molluscs, small crustaceans and worms as well as algae (NSW DPI, 2006). SPRAT profile distribution in relation to the Project: The Macintyre River is within the mapped distribution where the species or species habitat is likely to occur. The	SPRAT	Unlikely	No	Despite an historical record in proximity to the Project footprint, the species is unlikely to occur in the impact assessment area due to the absence of fast-flowing water systems in the impact assessment area. eDNA surveys at ten sites throughout the Project footprint also failed to detect the species (Hydrobiology 2023).	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Condamine River is within the mapped distribution where the species or species habitat may occur. Oakey Creek near Gowrie is within the mapped distribution where the species or species habitat is likely to or may occur, however this is ~12 km from the Project footprint. Species records: An historical species record occurs in Back Creek, near Millmerran (within 10 km of the impact assessment area; ALA 2023). Additionally there are two records in Toowoomba from 2014, approximately 15 km from the alignment. Records in the Project footprint: No Records in the locality: Yes					
<i>Maccullochella peelii</i>	Murray cod	-	V	Murray cod are main-channel specialists and are frequently found in the main channels of rivers and larger tributaries (DoEE 2018). Preferred habitat and microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water. They also serve as predatory ambush points for foraging, particularly during the day (DoEE 2019a). SPRAT profile distribution in relation to the Project: The Condamine River is within the mapped distribution where the species or species habitat is likely to occur. Parts of the alignment that intersect with rivers and creeks from Bringalily to Yelarbon are within the mapped distribution where the species or species habitat may occur. Species records: The closest known records (within 10 km of the impact assessment area) occur in Dumaresq River and the southern reach of Boonal Anabranh from 2005 to 2011 (ALA, 2023). Another recent record occurs on Lake Coolmunda (2019) (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT	Likely	Yes	Preferred habitat for the species occurs where areas of deep stream occur throughout the southern portion of the impact assessment area, such as in some reaches of Bringalily Creek. Habitat is restricted to three sections of the alignment: small sections at the southern extent of the alignment, between Bringlily and Brookstead, and a very small section of Gowrie Creek. Most areas in the impact assessment area are unsuitable due to the ephemeral nature of the systems. The Murray Cod was confirmed to be present during eDNA surveys, at the Macintyre River (south of the B2G Project footprint) and Canning Creek (Hydrobiology 2023).	Known
Invertebrates									
<i>Adclarkia cameroni</i>	Brigalow woodland snail	V	E	The Brigalow woodland snail is endemic to south-east Queensland, where it occurs on the Condamine River floodplain, especially in the area around Dalby and Chinchilla (Stanisic, 2011). The species inhabits a small number of remnant and scattered <i>Acacia harpophylla</i> (brigalow) and eucalypt woodland patches (such as road verges and riparian corridors) on alluvial black soils. The species general habitat occurs under logs and leaf litter and requires both canopy and on-ground timber cover for survival and egg-laying (Stanisic, 2011). Desiccation is the greatest threat to land snail eggs and hence ground debris, as well as an over-storey of trees and shrubs is required in order to maintain high levels of relative humidity at the substrate level. SPRAT profile distribution in relation to the Project: The section of the alignment between Pittsworth and Millmerran is within the mapped distribution where the species or species habitat is likely to or may occur. A very small section along the south arm of the Condamine River is within the species' likely to occur distribution. Species records: The nearest record to the project footprint is approximately 40 km to the north-west near Bowenville, Qld (ALA, 2023). Records in the Project footprint: No	SPRAT WildNet Publications	Potential	Yes	General habitat for the species, as described in the literature, was detected within the Project footprint. Snail surveys conducted by Boobook recorded Brigalow Woodland Snails at 11 survey sites between Brookstead and Canning Creek. Habitat is restricted to approximately 80 km of the alignment from the northern edge of Bringalily State Forest to Pittsworth. Suitable brigalow and eucalypt woodland communities on alluvial grey-black soils occur within the Condamine River floodplain (within the project footprint). REs include: 11.3.4, 11.3.25, 11.4.3 and 11.4.10 however these were often fragmented patches with limited course woody debris and leaf litter. The areas were found to be impacted from agricultural practices often resulting in poorly developed or no good shrub layer present.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				Records in the locality: No					
<i>Adclarkia dulacca</i>	Dulacca woodland snail	E	E	The Dulacca woodland snail is endemic to south-east Queensland, where it occurs in a small number of isolated, fragmented populations in the area between Miles and Dulacca, south to Meandarra (Stanisic, 2011). The species general habitat can be located in various remnant and scattered habitats, including vine thicket and <i>Acacia harpophylla</i> (brigalow) woodland patches on rocky outcrops with clay to loam soils, <i>Eucalyptus</i> (ironbark) communities and <i>Acacia shirleyi</i> woodlands on ridges (with and without rock), and <i>Eucalyptus woollsiana</i> woodland (Eddie, 2016; Stanisic, 2011). These habitat locations are separated by areas of unsuitable habitat, affecting both dispersal and colonisation, and restricting genetic exchange within the species. The Dulacca woodland snail is also able to persist in areas of brigalow regrowth and even cleared paddocks, however, only where logs, woody debris or other suitable microhabitat sites/features remain (Eddie, 2016). This species will also shelter under loose bark at tree bases. The Dulacca woodland snail inhabits microhabitats under rocks and timber and requires both canopy and ground-layer timber cover for survival and egg-laying (Stanisic et al., 2010). Desiccation is the largest threat facing land snail eggs, thus the necessity for extensive ground debris and a tree and shrub overstorey, in order to maintain high levels of relative substrate humidity. SPRAT profile distribution in relation to the Project: The section of the alignment between Pittsworth and Millmerran is within the mapped distribution where the species or species habitat may occur. Species records: All known records are restricted to a small area of southern central Queensland, 44 km from the Project footprint between Barakula and Yuleba State Forests (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet	Potential	No	Limited general habitat for the species, as described in the literature, was detected within the project footprint. <i>Acacia harpophylla</i> (brigalow) woodland patches were commonly recorded across the project footprint; however, none of these patches contained rocky outcrops.	Unlikely
<i>Hypochrysops piceatus</i>	Bulloak jewel butterfly	CR	CE (listed 7 September 2023, after controlled action date)	The bulloak jewel butterfly has a very limited distribution, being limited to small area in southeast Queensland from Goondiwindi south to Smithfield, then north to Dalby and in areas south of Pittsworth. The bulloak jewel butterfly is only known to exist in the one area and is regarded as being an extremely rare butterfly species. The butterfly species commonly occurs in bulloak woodlands. The flora species that are associated with the butterfly species are <i>Allocasuarina luehmannii</i>, <i>A. leiocarpa</i>, <i>Eucalyptus tetricornis</i> and <i>Acacia neriifolia</i>, with understorey <i>Jacksonia scoparia</i>, <i>Cassinia laevis</i>, <i>Acacia</i> sp. and <i>Callitris columellaris var campestris</i> (Dunn and Kitching, 1994). There is a ground cover of various small herbs, grasses, mat rushes and leaf litter. Several species of mistletoes are found on the <i>Allocasuarina</i>, <i>Eucalyptus</i>, <i>Angophora</i> and <i>Acacia</i> trees. The habitat requirements of the bulloak jewel butterfly are complicated, in that the species requires the flora species (in particular <i>Allocasuarina</i> spp.) above and an undescribed ant species (<i>Anonychomyrma</i>) that occupies trees that permit female butterflies to dwell. SPRAT profile distribution in relation to the Project: Majority of the alignment is within the mapped distribution where the species or species' habitat may occur or is likely to. Species records: The species has 4 known records within its distribution, all the records are in excess of 20 km from the Project	SPRAT WildNet DES Species Profile Publications	Potential	No	Preferred habitat was detected within the Project footprint during field surveys. Flora and habitat assessments illustrated that sections of the Project footprint contains species associated with the species habitat requirements, those being <i>Allocasuarina luehmannii</i>, <i>A. leiocarpa</i>, and <i>Eucalyptus tetricornis</i>. However, minimal mistletoe species were observed during field survey efforts. It can be deemed that preferred habitat exists for the species within the Project footprint, however minimal records exist within proximity of the Project footprint, as all records are 20-40 km away from the Project footprint. However, as the species was not targeted during field surveys, and very few records of the species, its presence within the Project footprint cannot be discounted.	Potential

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				footprint. One of the records exist in the Brendidee National Park and State Forest, over 40 km from the Project footprint (ALA, 2024). The next nearest records are within and adjacent to Leyburn State Forest, approximately 20 km from the Project footprint. The last record is approximately 25 km south of the township of Warrick and approximately 30 km form the Project footprint (ALA, 2024). Records in the Project footprint: No Records in the locality: No, all records exceed the 10 km buffer (all records are in excess of 20 km from the Project footprint)					
<i>Jalmenus eubulus</i>	Pale imperial hairstreak	V	-	Pale imperial hairstreak (<i>Jalmenus eubulus</i>) occur in Queensland and New South Wales. In Queensland, the species is restricted to the seasonally sub-humid central and southern areas of the state within the Brigalow Belt bioregion. Pale imperial hairstreak has been recognised as a separate species from the closely related imperial hairstreak, <i>J. evagoras</i> (Donovan), being distinct in morphology, ecology and genetics (Eastwood et al. 2008). The species breeds only in old-growth forest and does not colonise regrowth habitats following clearing or areas that have been disturbed (Eastwood et al. 2008). Preferred habitat is dominated by <i>Acacia harpophylla</i> and <i>Casuarina cristata</i> on clay soils comprising Quaternary alluvial systems or Tertiary clay deposits, on flat to gently undulating plains with poorly developed drainage systems, usually with scattered emergent eucalypts such as <i>Eucalyptus populnea</i> and low trees of <i>Geijera parviflora</i> in the understorey (Young et al. 1999). Larvae of <i>Jalmenus eubulus</i> are monophagous, specialising on small understorey plants of <i>Acacia harpophylla</i>. Only found in areas where Brigalow (<i>Acacia harpophylla</i>) is a highly dominant canopy species. This species is not known to occur in areas where Belah (<i>Casuarina cristata</i>) or Poplar Box (<i>Eucalyptus populnea</i>) is the dominant species and Brigalow is sub-dominant. The species is also not known to occur in areas where patches of Brigalow are amongst a grassland mosaic. The species occurs in old growth Brigalow to dense saplings (0.1 to 3m). The understorey can range from bare ground to grassy to shrubby. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution. Species records: There are over 80 records located approximately 2 km west of the footprint in the Millmerran township, the majority of which are undated but are likely to be historic. The dated records in Millmerran were recorded between 1928 and 1950 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes, however they are undated and historic records.	WildNet ALA Publications	Potential	No	Limited habitat for the species, as described in the literature, was detected within the Project footprint. It is noted, however, that 26.59 ha of essential habitat (EH) is mapped within the Project footprint and an additional 0.19 ha of MSES wildlife habitat (where EH does not occur). According to State mapping, the areas mapped as EH for this species are REs 11.5.20/11.9.5, 11.5.4/11.3.18, 11.3.4/11.5.1/11.3.25 and 11.5.4/11.5.20/11.5.1; and the area of MSES wildlife habitat are 11.9.5/11.5.20 and a small area of 11.3.2/11.3.4/11.3.25. Whereas ground-truthed mapping identified these EH and MSES wildlife habitat areas as 11.5.4, 11.5.20, 11.9.5 and 11.3.25. Of these ground-truthed REs, only 11.9.5 would comprise habitat for the pale imperial hairstreak, however, this patch of 11.9.5 is regrowth, which the butterfly is known to not recolonise. Therefore, the mapped EH and MSES wildlife habitat within the Project footprint for this species does not actually constitute habitat for the species. Suitable soil i.e., clay soils comprising Quaternary alluvial systems or Tertiary clay deposits, occur widely within the Project footprint. There are patches of remnant <i>Acacia harpophylla</i> open forest (where <i>Acacia harpophylla</i> is the dominant species) occurs within the Project footprint. REs include: 11.3.1, 11.4.3, 11.4.10, 11.9.5 and 11.9.10 however these are often associated with roadside verges and wind breaks or impacted by agricultural practices.	Unlikely
Special Least Concern Flora									
<i>Caladenia carnea</i>	Pink fingers	SLC	-	<i>Caladenia carnea</i> grows in a wide variety of habitats from coastal heath and shrubland to sclerophyll forest and woodland, often surviving and/or recolonizing cleared	Wildnet PlantNet	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				areas (PlantNet, 2021). Generally occurs amongst grass on gravelly soils (Lester, 2008). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species within the Project footprint, however there is one record located 7 km east of the footprint, recorded in 1912 (ALA, 2023). Several recent and historic records exist in the Toowoomba and Lockyer Valley areas, >13 km from the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes, however, it is a historic record.	ALA Publications			Recorded within the Project footprint.	
<i>Crinum arenarium</i>	-	SLC	-	As per other members of the genus, <i>Crinum arenarium</i> grows in seasonally flooded areas and flowers following inundation (Lester, 2008). Distribution in relation to the Project: There is no official distribution for this species. Species records: There is one record of the species recorded 0.34 km from the footprint along the Cunningham Highway in Yelarbon, recorded in 2018 (ALA, 2023). There are no additional records within 10 km of the footprint (ALA, 2023; DES, 2023). Records in the Project footprint: No Records in the locality: Yes	Wildnet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. Recorded within the Project footprint.	Known
<i>Cymbidium canaliculatum</i>	Black orchid	SLC	-	<i>Cymbidium canaliculatum</i> is a widespread species that grows in the hollows of trees in dry sclerophyll forest or woodland (Lester, 2008; PlantNet, 2021). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species located within the footprint (ALA, 2023; DES, 2023), however there are 7 records located within 10 km of the footprint, recorded between 1992 and 2021 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	Wildnet PlantNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. Recorded within the Project footprint.	Known
<i>Wahlenbergia capillaris</i> (formerly <i>Wahlenbergia communis</i>)	Tufted bluebell	SLC	-	<i>Wahlenbergia capillaris</i> is widespread, occurring on a range of soil types (Lester, 2008). The species is frequently recorded in open disturbed sites, particularly along roadsides (PlantNet, 2021). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species located within the footprint (ALA, 2023; DES, 2023), however there are several records located within 10 km of the footprint, recorded between 2003 and 2020 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	Wildnet PlantNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. Recorded within the Project footprint (as <i>Wahlenbergia communis</i>) at one location in <i>Eucalyptus fibrosa</i> and <i>Corymbia trachyphloia</i> open forest (RE 11.7.7) near Inglewood during spring surveys.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Wahlenbergia gracilis</i>	Sprawling bluebell	SLC	-	As per other members of the genus, <i>Wahlenbergia gracilis</i> occurs on a range of soil types and is frequently recorded in open disturbed sites, particularly along roadsides (Lester 2008). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species located within the footprint (ALA, 2023; DES, 2023), however there are 15 records located within 10 km of the footprint, recorded between 1974 and 2023 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	Wildnet PlantNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. Recorded within the Project footprint.	Known
<i>Wahlenbergia stricta</i>	Tall bluebell	SLC	-	<i>Wahlenbergia stricta</i> is widespread throughout the southern Queensland Brigalow Belt and occurs on sandy soils (Lester, 2008). Distribution in relation to the Project: There is no official distribution for this species. Species records: There are no records of the species located within the footprint (ALA, 2023; DES, 2023), however there are 3 records located within 10 km of the footprint, recorded between 1986 and 2006 (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	Wildnet PlantNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. Recorded within the Project footprint.	Known
Special Least Concern Fauna									
<i>Ornithorhynchus anatinus</i>	Platypus	SLC	-	Preferred habitat for the species includes a river or a stream with earth banks and native vegetation that provides shading of the stream and cover near the bank. The presence of logs, twigs, and roots, as well as cobbled or gravel water substrate result in increased macroinvertebrate fauna (a main food source), and the Platypus also tends to be more abundant in areas with pool-riffle sequences (Australia Museum 2018). Platypus can also be found in freshwater creeks, slow-moving rivers, lakes joined by rivers, and within built water storages such as farm dams (DES 2021). Distribution in relation to the Project: Platypus (<i>Ornithorhynchus anatinus</i>) occur throughout eastern Australia, from Far North Queensland to Victoria and Tasmania. In Queensland, Platypus primarily inhabit the rivers along the eastern side of the Great Dividing Range, however, may occasionally be found in western-flowing streams. The Project footprint is located within the species modelled distribution habitat. Species records: There are no records of the species within the Project footprint, however there are 4 records of the species recorded within 10 km of the footprint (ALA, 2023; DES, 2023), The nearest record was recorded in 2002, approximately 3 km east of the footprint, in Inglewood. Whilst the most recent record within 10 km of the Project footprint was recorded in 2023, approximately 8 km east of the Project, near Westbrook. Records in the Project footprint: No Records in the locality: Yes	WildNet ALA Publications	Likely	Yes	Platypus was observed in the Macintyre Brook outside of the current Project Footprint, near Inglewood during the dry season aquatic survey in 2018. The species is also known to inhabit the Macintyre River (ALA 2018). Platypus were also detected in five eDNA survey locations. These were on the southern branch of the Condamine River near Yandilla, Bringalily Creek, and at three survey sites along Back Creek near Millmerran (Hydrobiology 2023).	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	SLC	-	The short-beaked echidna is found throughout open woodlands, shrublands, rocky outcrops, forests, savanna regions, semi-arid to arid regions. They are more prevalent in areas where there are termite mounds, logs and tree stumps (Smith, Wellham & Green, 1989). Short-beaked echidna generally have no fixed shelter sites, taking refuge in hollow logs, under piles of rubble and brush and under thick clumps of vegetation (Hyett and Shaw, 1980). However, sometimes they dig shallow burrows as long as 4 feet, which may be reused (Aplin et al. 2008). Distribution in relation to the Project: Short-beaked Echidna occur throughout Australia and are considered Australia's most widespread native animal. The footprint is located within the species modelled distribution habitat. Species records: There are 2 records of the species within the footprint (recorded in 2003 in Pampas, and in 2019 along the border) (ALA, 2023; DES, 2023). There are an additional 16 records of the species recorded within 10 km of the Project (ALA, 2023; DES, 2023), the most recent record within 10 km of the footprint was recorded in 2022, approximately 2 km off the northern-most point of the footprint, near Charlton. Records in the Project footprint: Yes Records in the locality: Yes	WildNet ALA Publications	Known	Yes	Four individuals were recorded during surveys, three of which were within the Project footprint. These were in Whetstone State Forest, just north of Inglewood, near the northern end of Bringalily State Forest (outside footprint), and near Millmerran. Habitat for the species occurs throughout the entire the Project footprint. There are no particular landforms, soil substrates, or associate floristic assemblage species of particular importance to echidnas. Vegetation communities detected in the Project footprint include open woodlands, shrublands, rocky outcrops, forests. The following microhabitat features used for sheltering were common throughout the Project footprint: hollow logs, piles of rubble and brush, and thick clumps of vegetation.	Known
<i>Actitis hypoleucos</i>	Common sandpiper	SLC	Mi (Bonn, CAMBA, JAMBA, ROKAMBA)	The common sandpiper uses a wide range of coastal wetlands and some inland wetlands, with varying salinity levels, and is mostly found around muddy margins or rocky shores and occasionally on mudflats. Actitis hypoleucos has been observed in estuaries and stream deltas, as well as on banks farther upstream; lakes, pools, billabongs, reservoirs, dams, claypans, and occasionally piers and jetties. The muddy margins around the water's edge utilised by the common sandpiper are often narrow, and sometimes steep. This species is often associated with mangroves, and occasionally found in muddy areas littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996). Common sandpiper generally forages in shallow water and on soft mud at the edges of wetlands; often where obstacles protrude from substrate, e.g., rocks or mangrove roots. Individuals sometimes venture into grassy areas adjoining these wetlands (Higgins & Davies 1996). This species typically roosts on rocks or amongst roots or branches of vegetation (esp. mangroves). It is also known to perch on posts, jetties, moored boats, and other artificial structures, and occasionally rests on mud or 'loaf' (i.e., low crouched position) on rocks (Higgins & Davies 1996). Common sandpiper does not breed in Australia, and as such, breeding habitat is not applicable. Distribution in relation to the Project: Common Sandpiper occur along all coastlines of Australia during the non-breeding season (August – May). Along the Australian coastlines, the species is widespread in small numbers, and generally concentrated in northern and western Australia (SPRAT 2023). The Project footprint is	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the project footprint. Freshwater wetlands with fringing sedgeland or woodland (i.e., RE 11.3.27, 11.3.27b and 11.3.27i) was recorded within the project footprint however did not contain the required suitable microhabitat features, such as mangroves and muddy areas littered with rocks or snags. Fauna surveys did not detect the species within the Project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				located within the species modelled habitat distribution of species or species habitat may occur (SPRAT 2023). Species records: There are no records of the species within the Project footprint, or within 10 km of the footprint (ALA, 2023; DES, 2023). The nearest record is located 18 km east of the northern-most point of the footprint, recorded in 1992. The most recent record within 50 km of the footprint was recorded in 2016. Records in the Project footprint: No Records in the locality: No					
<i>Apus pacificus</i>	Fork-tailed swift	SLC	Mi (CAMBA, JAMBA, ROKAMBA)	The fork-tailed swift is a non-breeding visitor to all states and territories of Australia (Higgins 1999). The fork-tailed swift is an almost exclusively aerial species, flying from less than 1 m to >300 m above ground. They are more inclined to hunt at lower altitudes above open areas or over water. They forage along the edges of low-pressure systems and thus, are considered a precursor to unsettled weather. Within Australia, the species mainly occur over inland plains, occasionally above foothills or in coastal areas. They often occur above cliffs, beaches, islands and sometimes far out to sea. They are also known to occur over settled areas, including towns, urban areas and cities. They mostly occur above dry or open habitats, such as riparian woodland, tea-tree swamps, low scrub, heathland or saltmarsh, as well as treeless grassland and spinifex-covered sandplains, open farmland and inland and coastal sand-dunes. Fork-tailed swift sometimes occur above rainforests, wet sclerophyll forest or open forest or pine plantations (Higgins 1999). These birds probably also 'roost' aerially but are occasionally observed to land (Higgins 1999; Newell 1930). Fork-tailed swift does not breed in Australia, and as such, breeding habitat is not applicable. Distribution in relation to the Project: In Queensland, the species is widespread along the western regions of the Great Dividing Range from Chinchilla to Hughenden. East of the Great Dividing Range the species is widespread yet scattered. The footprint is located within the species modelled habitat distribution of species or species habitat likely to occur (SPRAT 2023). Species records: There is one record of the species within the Project footprint (recorded in 2018 in Yelarbon) (ALA, 2023). There are an additional 16 records of the species recorded within 10 km of the footprint (ALA, 2023; DES, 2023), the most recent record within 10 km of the footprint was recorded in 2021, approximately 9 km east of the footprint, near Lake Coolmunda. Records in the Project footprint: Yes Records in the locality: Yes	SPRAT WildNet ALA Publications	Known	No	Habitat for the species, as described in the literature, was detected within the project footprint, however the species was not detected during targeted surveys. The species is almost exclusively aerial and forages over a wide range of remnant and non-remnant habitats. Therefore, habitat was recorded across the entire Project footprint.	Known
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	SLC	Mi (Bonn, CAMBA, JAMBA, ROKAMBA) at time of the referral	Sharp-tailed sandpiper migrates to Australia for the non-breeding season, mostly to the mainland's south-east and are widespread in both inland and coastal locations, as well as both freshwater and saline habitats (Higgins and Davies 1996).	SPRAT WildNet ALA Publications	Likely	No	Habitat for the species, as described in the literature, was detected within the project footprint. Habitat was found in RE 11.3.25, 11.3.27, 11.3.27b and 11.3.27i, which contained riverine/wetland habitat and microhabitat features including emergent aquatic vegetation.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
			V (listed 5 January 2024, after controlled action date)	Within Australasia, the sharp-tailed sandpiper's preferred habitats are muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low semi-aquatic vegetation, including lagoons, swamps, lakes and even pools near the coast. Throughout inland regions, preferred sites include dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes. Sharp-tailed sandpiper also occurs in saltworks and sewage farms, and utilises flooded paddocks, sedgeland and other ephemeral wetlands, but leave when these dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. The sharp-tailed sandpiper tends to occupy coastal mudflats after ephemeral terrestrial wetlands have dried out, before moving back during the wet season. They may be attracted to algae and water weed mats floating or washed up around terrestrial wetlands, and coastal areas with abundant beach cast seaweed. Sometimes they occur on rocky shores and very occasionally on exposed reefs (Higgins & Davies 1996). Sharp-tailed sandpiper does not breed in Australia, and as such, breeding habitat is not applicable. The species migrates to Australia during the non-breeding season, generally arriving in mid-August, with the species departure in April. Roosting occurs at wetland edges, on wet open mud or sand, in shallow water or in short sparse vegetation, such as grass or saltmarsh. Occasionally, these sandpipers roost in mangroves, on sandy beaches, stony shores or on rocks surrounded by water (Higgins & Davies 1996; Minton & Whitelaw 2000). Distribution in relation to the Project: In Queensland, the species occurs in most regions, and are widespread along the coastline, with scattered records occurring inland. The Project footprint is located within the species modelled distribution habitat of species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There are no records of the species within the Project footprint, however there are 7 records of the species recorded within 10 km of the footprint (ALA 2023, DES, 2023), the most recent record within 10 km of the footprint was recorded in 2022, approximately 50 m east of the footprint, near Yelarbon. The species has also been recorded at Lake Coolmunda, approximately 12 km from the Project footprint and other locations (generally associated with waterbodies) within 50 km. Records in the Project footprint: No Records in the locality: Yes				Farm dams and flooded paddocks were also recorded within the project footprint and may also provide occasional habitat for the species.	
<i>Calidris melanotos</i>	Pectoral sandpiper	SLC	Mi (Bonn, JAMBA, ROKAMBA)	In Queensland, most records of the pectoral sandpiper occur around Cairns. However, there are scattered records elsewhere, mainly east of the Great Dividing Range between Townsville and Yeppoon. Records also exist in SEQ, as well as occasional inland records at Mount Isa, Longreach and Oakey. Within Australasia, pectoral sandpiper prefers shallow fresh to saline wetlands, being found at various waterbodies, such as coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Higgins & Davies 1996).	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the project footprint. Freshwater wetlands with fringing sedgeland or woodland (i.e., RE 11.3.27, 11.3.27b and 11.3.27i) were recorded within the project footprint. The project footprint also crosses creeks, floodplains, and grasslands (with potential to be inundated). Suitable microhabitat features, specifically open fringing mudflats do not occur within the project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				The species is usually found in coastal or near coastal habitat but is occasionally found further inland. The pectoral sandpiper shows preference for wetlands with open fringing mudflats and low, emergent or fringing vegetation (e.g., grass or samphire) as well as in swamps overgrown with lignum. They forage at the edge of wetlands in shallow water or soft mud (Higgins & Davies 1996). Pectoral sandpiper do not breed in Australia, and as such, breeding habitat is not applicable. The species migrates to Australia during the non-breeding season, generally arriving in September, with the species departure in June. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution habitat of species or species may occur (SPRAT 2023). Species records: There are no records of the species within the Project footprint, however there is one undated record of the species within 10 km of the footprint near Pittsworth (~3.5 km distant) (ALA, 2023). The supplied date for this record is "1979-12-11980-2-29", suggesting that the record is from either 1979 or 1980. Additionally, the location uncertainty of this record is 9 km, and so the actual distance from the Project footprint is not known. The species has also been recorded twice near Oakey, approximately 12 km from the Project footprint, in 1979 (DES, 2023). Records in the Project footprint: No Records in the locality: Yes, however the record is undated and likely to be historic.				No individuals were detected during targeted fauna surveys in potential habitat.	
<i>Calidris ruficollis</i>	Red-necked stint	SLC	Mi (Bonn, CAMBA, JAMBA, ROKAMBA)	The red-necked stint is distributed along the majority of the Australian coastline, having been recorded in all coastal regions, and found inland in all states where suitable conditions exist. In Australasia, the species is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally, they are recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They are also known to occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in salt flats. They sometimes utilise flooded paddocks or damp grasslands. They have also occasionally been recorded on dry gibber plains, with little or no perennial vegetation (Higgins & Davies 1996). The Red-necked Stint mostly forages in bare wet mud on intertidal mudflats or sandflats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. During high tides they sometimes forage in non-tidal wetlands. Red-necked Stint may also forage in samphire, generally avoiding seagrass beds, but may feed along edges. They have been recorded foraging in flooded paddocks and in a freshly cropped lucerne paddock near lagoons (Higgins & Davies 1996). The red-necked stint does not breed in Australia, and as such, breeding habitat is not applicable. The species migrates to Australia during the non-breeding season,	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the project footprint. The project footprint does not occur in coastal areas or contain sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, sandy or coralline shores, exposed or ocean beaches, stony or rocky shores, reefs or shoals. Freshwater wetlands with fringing sedgeland or woodland (i.e., RE 11.3.27, 11.3.27b and 11.3.27i) were recorded within the project footprint. The project footprint also crosses creeks, floodplains and grasslands (with potential to be inundated). Specific habitat features, such as bare wet mud and very shallow water were not recorded within the project footprint. No individuals were detected during targeted fauna surveys in potential habitat.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				generally arriving in August, with the species departure between February and April. Distribution in relation to the Project: The Project footprint is not located within the species modelled distribution (SPRAT 2023). Species records: Inland records for this species are scattered. There are no records of the species within the Project footprint or 10 km of the footprint (ALA, 2023; DES, 2023). The nearest records are within 12 km of the footprint, with 9 individuals recorded at Lake Coolmunda in 2019 (ALA, 2023). The species has also been recorded on 10 occasions near Oakey (approximately 12 km north-west), in 1797, 1980 and 2020 (ALA, 2023). Records in the Project footprint: No Records in the locality: No					
<i>Cuculus optatus</i>	Oriental cuckoo	SLC	Mi (CAMBA, JAMBA, ROKAMBA)	Oriental cuckoo is a regular migrant to Australia, usually spending the non-breeding season (September-May) within 100 km of the north and east coasts. Oriental Cuckoo occurs widely on the tablelands and eastern slopes of the Great Dividing Range but has a more scattered distribution to the west. In Australia, important habitat for the Oriental Cuckoo consists of monsoon rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands (SPRAT 2015), and more occasionally, swamps, mangroves and plantations (Payne and Kirwan, 2020). The species frequently occurs at the edges or ecotones between habitats (SPRAT 2015). Distribution in relation to the Project: The northern portion of the Project footprint is located within the species modelled distribution habitat of species or species habitat may occur, whilst the southern portion is located outside of the modelled distribution (SPRAT 2023). Species records: There are no records of the species within the footprint, however there are some records of the species recorded within 10 km of the footprint (ALA 2023, DES, 2023), the nearest recorded 500 m from the footprint, in Pittsworth (undated). All other records around Pittsworth are from the 1970s. Another record in Toowoomba (~9 km from the Project footprint) is from 1982. The most recent record of the species was recorded in 2021, near Kearneys Spring, approximately 15 km east of the footprint. Records in the Project footprint: No Records in the locality: Yes, however, they are historic or undated records.	SPRAT WildNet ALA Publications	Potential	No	Habitat for the species, as described in the literature, was detected within the project footprint. Suitable vegetation includes Eucalyptus, Casuarina, and Acacia woodlands and a very small area of vine forest. Rainforests and wet sclerophyll forests are not present within the Project footprint.	Potential
<i>Gallinago hardwickii</i>	Latham's snipe	SLC	V (listed 5 January 2024, after controlled action date); Mi (Bonn, JAMBA, ROKAMBA) at the time of the referral	Latham's snipe is a passage migrate through northern Australia, with the species recorded to occur from Cape York Peninsula to south-eastern South Australia. The species occurs inland over the eastern tablelands and west of the Great Dividing Range. Within Australia, Latham's snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). The species usually inhabits open, freshwater wetlands with low, dense vegetation (e.g., swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977). However, they can also occur in habitats with saline or brackish water, in or around modified/artificial	SPRAT WildNet ALA Publications	Known	No	Habitat for the species, as described in the literature, was detected within the Project footprint. Freshwater wetlands with fringing sedgeland or woodland (i.e., RE 11.3.27, 11.3.27b and 11.3.27i) were recorded within the Project footprint. Many of these freshwater wetlands contained low (0.2 to 5 m), dense, emergent vegetation. The Project footprint also includes potentially suitable artificial features such as irrigation channels and pasture/ploughed paddocks (with potential to be inundated).	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches, rice fields, orchards, saltworks, and sewage and dairy farms (Fielding 1979; Frith et al. 1977; Lane & Jessop 1985). They may also occur in various sites close to humans or human activity, including near roads, railways, airfields, commercial or industrial complexes) (Frith et al. 1977). Latham's snipe does not breed in Australia, and as such, breeding habitat is not applicable. The species migrates to Australia during the non-breeding season, generally arriving in between July to November, with the species departure between February and early March. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution habitat of species or species habitat likely to occur or may occur (SPRAT 2023). Species records: There are 4 records of the species within the Project footprint (recorded in Yelarbon in 2018 – 2023) (ALA, 2023). There are an additional 94 records of the species recorded within 10 km of the footprint recorded (ALA, 2023). Records in the Project footprint: Yes Records in the locality: Yes					
<i>Monarcha melanopsis</i>	Black-faced monarch	SLC	Mi (Bonn)	The black-faced monarch is widespread in eastern Australia, occurring along the coasts and the eastern slopes of the Great Dividing Range. The black-faced monarch mainly occurs in coastal scrub and damp gullies, and in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest (Blakers et al. 1984; Laurance et al. 1996). The species also occurs in selectively logged and 20 to 30 years old regrowth rainforest (Laurance et al. 1996) and is sometimes found in nearby open eucalypt forests (mainly wet sclerophyll forests), especially in gullies with a dense, shrubby understorey as well as in dry sclerophyll forests and woodlands, often with a patchy understorey. The species can be found in open woodland when migrating to breed to coastal south-eastern Australia from September, until returning northward in March (Simpson & Day, 1999). The black-faced monarch, forages among foliage of rainforest and open eucalypt forests, and nests in the fork of a tree approximately 3 to 6 m above ground. Distribution in relation to the Project: Majority of the Project footprint is located outside of the species modelled distribution; however, the northern portion (Pittsworth to Gowrie) is located within species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There are no records of the species within the Project footprint, however there are numerous records within 10 km of the Project footprint (ALA, 2023). The most recent from around Pittsworth are from 2018 and 2021 and are approximately 6-7 km away. Numerous records around Gowrie, Kingsthorpe and Highfields are dated between	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the Project footprint. The vegetation structural types usually utilised by the species, i.e., rainforest ecosystems were not recorded within the project footprint. 'Marginal' habitats sometimes utilised by species, such as open eucalypt forests with gullies and a dense, shrubby understorey, were also not recorded within the project footprint.	Unlikely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				1999 and 2023 (with some undated) and between 500 m and 10 km from the Project footprint. Records in the Project footprint: No Records in the locality: Yes					
<i>Motacilla flava</i>	Yellow wagtail	SLC	Mi (CAMBA, JAMBA, ROKAMBA)	Yellow wagtail (<i>Motacilla flava</i>) is an uncommon migrant to Australia during non-breeding season. Habitat for yellow wagtail is highly variable but is typically characterised by open areas with low vegetation near water. Therefore, the species has been known to inhabit a wide range of natural and modified environments including, open grasslands, airstrips, pasture, sports fields, wetlands, rivers, irrigated farmland, dams, waterholes, sewerage farms and sometimes tidal mudflats and the edges of mangroves (Department of the Environment, 2015; Tyler and Christie, 2020). The species roosts in mangroves and other dense vegetation. According to the referral guideline for 14 birds listed as migratory species under the EPBC Act (SPRAT 2015), the numbers of individuals at any one site are so small relative to their global populations that no small group of individuals is likely to be significant for either the species in Australia or the ecological attributes of a site. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution of species or species habitat may occur (SPRAT 2023). Species records: There are no records of the species within the footprint or within 10 km of the footprint (ALA, 2023; DES, 2023). Additionally, there are no records of the species within 50 km of the footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: No	SPRAT WildNet ALA Publications	Unlikely	No	Habitat for the species, as described in the literature, was detected within the project footprint. Freshwater wetlands with fringing sedgeland were recorded within the project footprint. The project footprint also crosses creeks, floodplains, grasslands (with potential to be inundated), as well as irrigated farmland and dams.	Unlikely
<i>Myiagra cyanoleuca</i>	Satin flycatcher	SLC	Mi (Bonn)	The satin flycatcher has a widespread distribution throughout south-east QLD, from Fraser Island, west to Goombi and south to the NSW border. Satin flycatcher mainly inhabits eucalypt forests, often near wetlands or watercourses and generally prefer heavily forested gullies (Simpson & Day, 1999). During migration the species occurs in coastal forests, woodlands, mangroves and drier woodlands and open forests. The species migrates northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in the spring. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution of species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There is one record of the species just outside the Project footprint, recorded in 2019 at the southern-most portion of the footprint, but in New South Wales (ALA, 2023). There are an additional 15 records of the species within 10 km of the Project footprint (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the Project footprint. The species was observed in woodland habitat within RE 11.5.4 and 11.5.20. Suitable vegetation structural types including woodlands, drier woodlands and open forests occur and are common throughout the Project footprint. The species main habitat, being Eucalypt-dominated forests near wetlands or watercourses also occur within the Project footprint.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Pandion haliaetus cristatus</i>	Eastern osprey	SLC	Mi (Bonn)	In Australia, eastern osprey (<i>Pandion haliaetus cristatus</i>) occurs in the northern coast of Australia (including many offshore islands) from Albany in Western Australia, through the Northern Territory and Queensland, to Lake Macquarie in NSW. The species are mostly found in coastal areas but occasionally travel inland along major rivers (Johnstone and Storr, 1998; Marchant and Higgins, 1993; Olsen, 1995). In Australia, eastern osprey mainly feeds on fish and require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes (Czechura, 1985; Domm, 1977; Fleming, 1987; Gosper, 1983; Gosper and Holmes, 2002; Johnstone and Storr, 1998; Olsen, 1995; Roberts and Ingram, 1976). They exhibit a preference for coastal cliffs and elevated islands in some parts of their range (Boekel, 1976; Domm, 1977), but may also occur on low sandy, muddy, or rocky shores and over coral cays (Marchant and Higgins, 1993). They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites (Czechura, 1985; Hembrow, 1988; Pruett-Jones and O'Donnell, 2004; Roberts and Ingram, 1976). The eastern osprey breeds between July and September in northern NSW and southern QLD. Their nests are made high up in stags, usually within one kilometre of the sea. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution of species or species habitat may occur (SPRAT 2023). Species records: The nearest record was recorded in 2010 in Inglewood, approximately 2.5 km from the Project footprint. There are also three recent records (2005, 2006 and 2023) at Lake Coolmunda, approximately 10 km, 11 km and 16 km from the Project footprint respectively (ALA, 2023; DES, 2023). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the project footprint. The species preferred habitat of coastal cliffs, elevated islands, low sandy, muddy, or rocky shores and coral cays are not present within the project footprint. Freshwater wetlands with fringing sedgeland and/or woodland were recorded within the Project footprint and the Project footprint crosses multiple creeks. However, extensive areas of open water for foraging are not present. The Project footprint may provide 'atypical' habitat in the form of woodland and forest when the species is travelling to and from foraging sites.	Unlikely
<i>Plegadis falcinellus</i>	Glossy ibis	SLC	Mi (Bonn)	The glossy ibis is considered migratory and nomadic, undergoing post-breeding dispersal and, within Australia, moving in response to good rainfalls. The species preferred habitat for foraging and breeding are freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is also occasionally found in coastal locations such as estuaries, deltas, saltmarshes, and coastal lagoons (del Hoyo et al. 1992; Hancock et al. 1992; Marchant & Higgins 1990). The species may retreat to permanent wetlands or coastal areas during drought periods (Marchant & Higgins, 1990). Distribution in relation to the Project: There is no official distribution for this species, however in Australia the species is generally located east of the Kimberley in Western Australia and Eyre Peninsula in South Australia, which would overlap with the Project alignment (SPRAT 2023). Species records:	SPRAT ALA Publications	Known	Yes	Habitat for the species, as described in the literature, was detected within the project footprint. This species was observed near Yelarbon in non-remnant habitat. Freshwater wetlands with fringing sedgeland and/or woodland were recorded within the project footprint and the project footprint crosses creeks, floodplains, grasslands (with potential to be inundated), as well as irrigated farmland and dams.	Known

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				There are 8 records of the species within the footprint, recorded between 2017 and 2022 in Yelarbon (ALA, 2023). There are an additional 65 records of the species recorded within 10 km of the footprint. The species has also been recorded at Lake Coolmunda, approximately 12 km from the Project footprint and other locations. Records in the Project footprint: Yes Records in the locality: Yes					
<i>Rhipidura rufifrons</i>	Rufous fantail	SLC	Mi (Bonn)	The rufous fantail has a widespread distribution in northern and eastern coastal Australia. The species mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts, with a dense shrubby understorey often including ferns. They also occur in subtropical and temperate rainforests and secondary regrowth forests and/or rainforests. When on passage, they are sometimes recorded in drier sclerophyll forests and woodlands, including Spotted Gum (<i>Eucalyptus maculata</i>), Yellow Box (<i>E. melliodora</i>), ironbarks or stringybarks, often with a shrubby or heath understorey, as well as from parks and gardens (Higgins et al. 2006). The species migrates northwards in the winter months, and during this time can be found in more open habitats or urban areas (Simpson & Day, 1999). It feeds in the lower and middle levels of the tree canopy, and nests in tree branches approximately 5 m above ground. Distribution in relation to the Project: The Project footprint is located within the species modelled distribution of species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There are no records of the species within the footprint, however, there are numerous records of the species within 10 km of the footprint (ALA, 2023; DES, 2023), with the nearest records within 2.5 km of the northern-most portion of the footprint (1999-2020). Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet ALA Publications	Likely	Yes	Habitat for the species, as described in the literature, was detected within the project footprint. Suitable vegetation structural types including dry sclerophyll forests and woodlands occur and are common throughout the project footprint. These dry sclerophyll forests and woodlands likely provide habitat for the species when on passage. Associate floristic assemblage species, such as ironbarks (e.g., <i>Eucalyptus melanophloia</i>, <i>E. crebra</i> and <i>E. fibrosa</i>) occur within the project footprint. A rufous fantail was observed during targeted surveys by Cardno. It was detected outside of the Project footprint (~ 600 m away) at the northern end of Bringalily State Forest.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
<i>Symposiachrus trivirgatus</i>	Spectacled monarch	SLC	Mi (Bonn)	The spectacled monarch has a widespread distribution along the east coast, including the eastern slopes of the Great Dividing Range, with more scattered records to the west of the Great Dividing Range. The species forages by gleaning in foliage including vines, creepers and behind loose bark. The species inhabits densely vegetated areas, mainly in rainforest but also in moist or wet sclerophyll forest and occasionally in other densely vegetated habitats such as tropical or subtropical mangroves, drier forest, woodlands, parks, and gardens (Department of the Environment, 2015; Clement, 2020). Distribution in relation to the Project: The majority of the Project footprint is located outside of the species modelled distribution, however a small portion of the Project centered in Toowoomba is located within the species modelled distribution of species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There are no records of the species within the Project footprint, however there are 56 records of the species recorded within 10 km of the Project footprint, all within Highfields Falls Bushland Reserve (~10 km distant, the most recent being in 2023). Other records of the species are located approximately 12 km east of the Project footprint within the Toowoomba Range. Records in the Project footprint: No Records in the locality: Yes	SPRAT WildNet ALA Publications	Unlikely	No	Limited habitat for the species, as described in the literature, was detected within the Project footprint. No individuals were observed during targeted surveys. The species' main habitat of rainforest and moist or wet sclerophyll forest is not present within the Project footprint. However, the Project footprint contains occasional habitat, such as drier forest and woodland. Modelled 'may occur' habitat occurs at the very northern extent of the project footprint closest to Toowoomba.	Unlikely
<i>Tringa nebularia</i>	Common greenshank	SLC	E (listed 5 January 2024, after controlled action date) Mi (Bonn, CAMBA, JAMBA, ROKAMBA) at the time of the referral	The common greenshank has the widest distribution of any shorebird in Australia. In Queensland the species predominantly occurs along the east coast, with scattered records inland of the Great Dividing Range, especially near the larger watercourses like the Lachlan and Murray Rivers in NSW (Higgins and Davies, 1996). The species inhabits natural and artificial wetlands and sheltered coastal habitats including, embayment's, harbours, river estuaries, deltas, lagoons, tidal pools, rock fats/platforms, swamps, lakes, dams, rivers, billabongs, waterholes, inundated floodplains, claypans, salt flats, sewage farms, inundated rice crops and bores (Higgins and Davies, 1996). The species is known to forage at the edges of the wetlands, which are generally of mud or clay, and occasionally of sand. They may be bare or with fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. The Common Greenshank was once recorded in pasture but are generally not found in dry grassland (Higgins and Davies, 1996). The species does not breed in Australia and as such, breeding habitat is not applicable. Distribution in relation to the Project: The Project footprint is located outside of the species modelled distribution of species or species habitat likely to occur and may occur (SPRAT 2023). Species records: There are no records of the species within the footprint (ALA, 2023; DES, 2023), however there are 2 records of the species recorded within 10 km of the footprint. The	SPRAT WildNet ALA Publications	Likely	No	Habitat for the species, as described in the literature, was detected within the project footprint. Freshwater wetlands with fringing sedgeland and/or woodland were recorded within the project footprint. Suitable terrestrial wetlands, including creeks and inundated floodplains, as well as artificial wetlands, such as irrigated farmland and dams were also recorded.	Likely

Scientific name	Common name	NC Act	EPBC Act	Desktop assessment – known distribution / specific habitat requirements	Source	Likelihood of occurrence* (desktop)	Detected in surveys	Habitat assessment data – ground-truthed survey data	Likelihood of occurrence (final)
				most recent record within 10 km of the footprint was recorded in 2016 in Lake Coolmunda, whereas the other record in from 1998 near the edge of Whetstone State Forest, approximately 2.5km distant to the footprint (ALA, 2023). There are additional records of the species at Lake Coolmunda, approximately 12 km from the Project footprint and other locations (generally associated with waterbodies) within 50 km (ALA, 2023). Records in the Project footprint: No Records in the locality: Yes					

Table notes:

CE – Critically Endangered, E – Endangered, V – Vulnerable, NT – Near Threatened, SLC – Special Least Concern, Mi – Migratory, Ma – Marine

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ⁱ Listed as *Leuzea australis*

APPENDIX

L

Terrestrial and Aquatic Ecology Technical Report

Appendix C Herbarium verification

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Queensland Herbarium

Brisbane Botanic Gardens Mt Coot-tha • Toowong 4066 Queensland • Australia
Telephone +61 7 3896 9326 • Facsimile +61 7 3896 9624
e-mail Queensland.Herbarium@qld.gov.au
<http://www.qld.gov.au/herbarium>

Enquiries	Tony Bean
Telephone	07 3896 9318
Your reference	
Our reference	ARB:mh 340/18

1 May 2018

Chris Schell
Aurecon Australia
Locked Bag 331
BRISBANE Qld 4001

Dear Chris

The botanical specimens received by the Queensland Herbarium on 24 April 2018 have been identified as:

#Picris barbarorum. This species is listed as Vulnerable under Queensland's *Nature Conservation Act 1992*.

Acacia polybotrya

Dodonaea sp., fertile material needed for identification.

#Digitaria porrecta, confirmed. This species is listed as Near Threatened under Queensland's *Nature Conservation Act 1992*.

#Homopholis belsonii, confirmed. This species is listed as Endangered under Queensland's *Nature Conservation Act 1992*.

Bothriochloa erianthoides

These specimens have been kept for incorporation into the Herbarium collection, with thanks.

There is a charge of \$110.55 (minimum charge 1hr) for these identifications. A tax invoice and receipt are enclosed.

Yours sincerely

G.P. Guymer
Director

APPENDIX

L

Terrestrial and Aquatic Ecology Technical Report

Appendix D Completed vegetation assessment proformas

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Vegetation Proforma

Date: 16/4/2018 C82L		 Future Freight Integrating Community, Environment and Engineering
Observers: CS + OR	Site Name: Site 1.	

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N

End point Zone 5 E 0 N

Photo points (number): North: East: South: West:

28-60824
150-62366

GPS 057

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Cases of Cervical Intraepithelial Neoplasia (CIN) and Cervical Cancer in the United States, 1990-2000

Canopy/ Emergent		Shrub*		Ground	
Height Range (m): 12-14	Height Range: 6-8	Height Range: 2-5m	Height Range: 0.1-0.3m		
Av. Height (m): 12	Av. Height: 7	Av. Height: 3m	Av. Height: 0.1		
Cover (%): 0 - 65	Cover: 20%	Cover: 30	Cover: 10%		
Balak. Sungai	Sekok	mitja Semb. kanoreli	Engel baka Cakka anak Cyan baka Ala gajon Cyan baka Dawa Chon jaba Hany Nanda Black Path		

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. ^a Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Table 2	
Mapped Regional Ecosystem: 11.4-3	Confirmed Regional Ecosystem: 11.4-3.
Landform: Claypan	
Soils: Fine silty clays	
Structural formation (eg woodland, open-forest etc.):	Open Bracken
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Road	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	

Veg

Date _____

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GPS

Phot

Tab

Heig

Av.

Cov

Vegetation Proforma

Date: 16/4/2018

Observers: CS/OR

Site Name: North Site 2



Future Freight
Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length: _____

Start point Zone 5 E 0 0 0 0 0 0 N 0 0 0 0 0 0

End point Zone 5 E 0 0 0 0 0 0 N 0 0 0 0 0 0

Photo points (numbers): North: _____ East: _____ South: _____ West: _____

S 28.59330
E 150.67551
GPS-038

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (all sites)

Canopy/ Emergent	Shrub	Ground
Height Range (m): 10-12	Height Range: 6-8	Height Range: 0.1-0.2
Av. Height (m): 11m	Av. Height: 7m	Av. Height: 0.1
Cover (%): 10%	Cover: 3%	Cover: 10%
E. woody tree Buloh H. p. p.	Acan. aurea Grevillea striata Sagittaria	Kerangah m. l. l. Ginger p. m.
Point down of canopy, Red to can and		Shake of m. l. w. l. l. p. m. Coastal p. m. p. m. m. l. g. m. m. l. p. m. Sagittaria m.

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non rem Confirmed Regional Ecosystem: Non rem

Landform: clay pan

Soils: fine silts

Structural formation (eg woodland, open-forest etc.): (closed)

Field Observations/ Notes (eg. Level of disturbance connectivity): highly disturbed (least)

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):
i. ge. m. l. - m. l. l. p. m. m. l. l. p. m.

Vegetation Proforma

Date:

16/4/16

Observers:

CS OR

Site Name:

Site 3.



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:

Datum:

Transect length:

Start point

Zone

5

E

0

End point

Zone

5

E

0

Photo points (numbers):

North:

East:

South:

West:

S 28.57300.

E 150.74577

APS-039

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated". Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Shrub*	Ground
Height Range (m): 10-12m	Height Range:	Height Range:
Av. Height (m): 1.2	Av. Height:	Av. Height:
Cover (%): 10%	Cover:	Cover:
Bullock	about	Acacia capillaris Cyperus sp. etc.
Melaleuca densispecta		

Table notes: * use following terms; D = dominant; C = co-dominant; A = associated; S = suppressed; * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: 11.5.14.	Confirmed Regional Ecosystem: 11.5.12.
Landform: Dune	
Soils: Fine silt.	
Structural formation (eg woodland, open-forest etc.):	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Heavy grazed	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	

Veg

Date: _____

Observations

Transe

GPS coord

Photo p

Table 1

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Height

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Cover (%)	
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pw: drUG epu Q7Zu!

Vegetation Proforma

Date: 12/4/2018

Observers: CS / OR

Site Name: New site 4



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:

Datum: 5

Transect length:

Start point

Zone

5 6

E

0 2 7 8 7 3 9

N

6 4 3 4 7 7 5

GPS 040

End point

Zone

5

E

0

N

Photo points (numbers):

North:

East:

South:

West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover

Canopy/ Emergent	Shrub*	Ground
Height Range (m):	Height Range: 1-2m	Height Range:
Av. Height (m):	Av. Height: 1m	Av. Height:
Cover (%):	Cover: 5%	Cover:
Absent	E. mitchellii	ash at mth Opuntia hirta Lomax slash mth Eucalyptus globulus clover Run

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed, * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non River	Confirmed Regional Ecosystem:
Landform: Clay pan	
Soils: Fine silty-clay	
Structural formation (eg woodland, open-forest etc.):	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
largely cleared & vegetated - heavily grazed by sheep	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
velvet tree par Hakea - old mth Hakea - old mth 30%	

Vegeta

Date:

Observers:

Transect De

GPS coordinate

Start

End p

Photo points (r

Table 1: Est

Canopy.

Height Range

Av. Height (m)

Cover (%):

Table notes: * stems within

Table 2

Mapped F

Landform

Soils:

Structure

Structural	
Field Ob	

Field Ob:

Weed sp

Note: on malle is
several occur of "Bekuni Poni" were found

1 - canopy
tive


Future Freight
 Innovation, Community, Environment and Engineering

GPS coordinates: Datum: 1 Transect length:

Start point Zone 5 6 E 0 2 8 4 0 3 5 N 6 8 3 9 0 6 7

End point Zone 5 E 0 N

Photo points (numbers): North: East: South: West:

GPS 41

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Canopy/ Er		Shrub [#]		Ground	
Height Range (m): 19-22	Height Range: 2-6m	Height Range: 1-3	Height Range: 0-10.2'		
Av. Height (m): 20	Av. Height: 5m	Av. Height: 2m	Av. Height: 0.1		
Cover (%): 0%	Cover: 10%	Cover: 10%	Cover: 30%		
E. western	Bugabo	l. ligan	Bugabo grass		
Bugabo		Bugabo	grout brush		
		Rela southern	thorn		
		Opuntia	lignum		
			schm nake		
			Eryngium sp		

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Mapped Regional Ecosystem:	Non term.	Confirmed Regional Ecosystem:
Landform:	Plain	
Soils:	fine silty sands	
Structural formation (eg woodland, open-forest etc.):	open mallee	
Field Observations/ Notes (eg. Level of disturbance connectivity):	highly disturbed	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	Henslow's sheath Opuntia basilaris	

Vegetation Proforma

Date: 17/4/18

Observers: CS/OR

Site Name: Site 9.



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Integrating Community, Environment and Engineering

Transect Details (required for all sites)

Open forest

GPS coordinates:		Datum: T	Transect length:	
Start point	Zone 56	E 0247110	N 6839904	GPS 42
End point	Zone 5	E 0	N	
Photo points (numbers): North: East: South: West:				

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent		Shrub ^a		Ground	
Height Range (m): 10-18	Height Range:	Height Range:		Height Range:	
Av. Height (m): 13	Av. Height:	Av. Height:		Av. Height:	
Cover (%): 60%	Cover: 60%	Cover: 60%		Cover: 70	
E. g. ...	C	Calcha grass	C	Calcha grass	d
Alto ...	C	Alto ...	C	Alto ...	a
E. ...	a	E. ...	a	E. ...	d
E. ...	a	E. ...	a	E. ...	
Calch	C				
E. ...	C				

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. ^a Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: 11.5.10/11.5.14	Confirmed Regional Ecosystem: 11.5.10
Landform:	
Soils:	
Structural formation (eg woodland, open-forest etc.): Open forest 60%	
Field Observations/ Notes (eg. Level of disturbance connectivity): Relative ...	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): open forest risk of ...] - 2%	

Vegetation Proforma

Date:

17/4/18

Observers:

CS / OR.

Site Name:

Site 14



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 56 E 0296570 N 6845503 GPS 043

End point Zone 5 E 0 N

Photo points (numbers): North: East: South: West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy	Tree 2	Shrub*	Ground
Height Range (m):	Height Range: 4-7	Height Range: 2-5m	Height Range:
Av. Height (m):	Av. Height: 6m	Av. Height: 3m	Av. Height:
Cover (%): 5%	Cover: 10%	Cover: 20%	Cover:
E.pip d	Catkin glau d	gnrk hark d	E.pip a
		E.pip	gnrk weed
			Soft hcr
			She hcr
			Nahr ghes

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non Perm. Confirmed Regional Ecosystem:

Landform: Plains

Soils: Spurn d. 1

Structural formation (eg woodland, open-forest etc.): Chen

Field Observations/ Notes (eg. Level of disturbance connectivity):

Chenod - gnark

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):

gnrk 30%

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible][illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]

Vegetation Proforma

Date: 18/4/18

Observers: CS / AR

Site Name: Site 18



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 56	E 0300838	N 6853007	CS 44	
End point	Zone 5	E 0	N		
Photo points (numbers): North: _____ East: _____ South: _____ West: _____					
Non res					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimating Canopy Cover (mandatory for all sites)

Canopy		Tree 1		Tree 2		Shrub*		Ground	
Height Range (m):		Height Range:		Height Range:		Height Range:		Height Range:	
Av. Height (m):		Av. Height:		Av. Height:		Av. Height:		Av. Height:	
Cover (%):		Cover:		Cover:		Cover:		Cover:	
Fe-bushy (mallee) d	*	Robusta frb	c	Opuntia basilaris	c	Acacia sp	c		
E-mallee	a	Callitriche glauca	c	Scaevola taccada	c	Conocarpus sp.	c		
E. ? - sic	a	Robusta	a			Phytolacca sp.	c		
						Ulex			
Arg. leucophylla	a					Eragrost sp.	0		

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. # Shrub is a woody plant <8m tall with multiple stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non res	Confirmed Regional Ecosystem:
Landform: Plains	
Soils: Sandy loam / Shale	
Structural formation (eg woodland, open-forest etc.): open forest regrowth	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Highly disturbed ground to cattle	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
Opuntia basilaris 2%	
Scaevola taccada	

Vege

Date:

Observations

Transect

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Cover (%)

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Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

<i>E. leh</i> <i>K. ludman</i> <i>P. parkman</i> <i>Conoclinium</i> with <i>white spurs</i> grass. <i>Alouatta colera</i> <i>Alouatta</i> sp. <i>Phytolacca</i> <i>viridis</i> <i>Cathartes aura</i> <i>Myiarchus cinerascens</i> <i>Parula</i> <i>del.</i> <i>Parula</i> <i>pulchra</i> <i>Alouatta</i> <i>glauca</i> sp. <i>E. carolinensis</i> <i>Alouatta</i> <i>leucorhina</i> <i>Spizella</i> <i>pass.</i> <i>Sturnella</i> <i>coaxans</i> <i>Chalcophaps indica</i> (not <i>indica</i>) <i>Zenaidura macroura</i>	<i>Parula</i> <i>del.</i> <i>Alouatta</i> <i>glauca</i> <i>Alouatta</i> <i>glauca</i> <i>Alouatta</i>
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Vegetation Proforma

Date: 18/9/18

Observers: CS OR.

Site Name: new sites 15



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 56 E 0297206 N 6847771 GPS

End point Zone 5 E 0 N 045

Photo points (numbers): North: East: South: West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Data (mandatory for all sites)

Canopy/ Emergent	Shrub*	Ground
Height Range (m): 10-12	Height Range: 1-3m	Height Range: 0.1-0.3
Av. Height (m): 10m	Av. Height: 2m	Av. Height: 0.3
Cover (%): 10%	Cover: 15%	Cover: 30%
Cor. munda C Eucalypt sp (s.c. C. eryth.) C (A. shuldyi) C B. lanka (s.) C C. munda	A. lanka C A. caribaea C A. munda C	C. munda C N. munda C B. lanka

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Hg, HSL Confirmed Regional Ecosystem: L7 (7)

Landform: small rise

Soils: Sandy

Structural formation (eg woodland, open-forest etc.):

Field Observations/ Notes (eg. Level of disturbance connectivity): on edge of L27. Lowland dune area - edge

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): grass pasture

Vegetation Proforma

Date: 16/4/18.

Observers: CS / OR

Site Name: New site 16



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5	E 0 2 9 7 8 5 5	N 6 8 4 8 2 3 5		
End point	Zone 5	E 0	N		
Photo points (numbers): North: _____ East: _____ South: _____ West: _____					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

GPS
046

Table 1: Estimated Canopy/ Emergent, Shrub* and Ground (All sites)

Canopy/ Emergent		Shrub*		Ground	
Height Range (m):	6-12m	Height Range:	1-2m	Height Range:	0.1-0.2
Av. Height (m):	10m	Av. Height:	2m	Av. Height:	0.1
Cover (%):	40	Cover:	00	Cover:	30
E. laevis	C	mulge (Acacia)	A	Nahm grass	
E. mucronata	C	Codden gum	D	+ Ash	30
A. stricta	A	Alba myrtus	A		
Corymbia (ie. She gum)	A				
C. gilliesii	C				

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem: 11.3.2 / 11.3.28	Confirmed Regional Ecosystem:
Landform: Gentle slope	
Soils: sand / underlying sandstone (C29)	
Structural formation (eg woodland, open-forest etc.):	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
fences, some clearing, relatively good	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
A. laevis (1%)	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Alla ka e raplan. wadga col. ka B. ka Ash caput ash D. cantha Laxman G. ka Kabir sapta Concha L. ka Embryo sketch Chandra ka Erona ka Appara ka Ash ka Ash ka D. ka Ash ka		
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Vegetation Proforma

Date: 18/4/18.

Observers: CS/OR.

Site Name: New site 17.



Future Freight
Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: T Transect length:

Start point Zone 5 6 E 0 2 9 7 6 4 7 N 6 8 4 8 2 6 1 GPS

End point Zone 5 E 0 Oxy

Photo points (numbers): North: East: South: West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (m) for all sites

Canopy/ Emergent	Shrub*	Ground
Height Range (m): 10 - 13	Height Range:	Height Range:
Av. Height (m): 12	Av. Height:	Av. Height:
Cover (%): 30	Cover:	Cover:
C. glaucophylla	A. caribaea lepto per sp. Dacrydium	Angora grass Proserpinaca Mint cladonia sp. Xanthorrhoea

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem: 11/5.1/11.7.7/11.7.8 Confirmed Regional Ecosystem:

Landform: sand slope

Soils: sandy

Structural formation (eg woodland, open-forest etc.): open eucalypt forest

Field Observations/ Notes (eg. Level of disturbance connectivity): relatively undisturbed, some selective clearing

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):
Opuntia stricta 1%
Piper peruvianum 1%

Vegetation Proforma

Date:

19/01/18

Observers:

CS OR

Site Name:

Site 27



Future Freight

Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:

Datum:

J

Transect length:

Start point

Zone

56

E

0320576

N

6880871

GPS

End point

Zone

5

E

0

N

AG

Photo points (numbers):

North:

East:

South:

West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree	Shrub*	Ground
Height Range (m): 17-18	Height Range: 4-8m	Height Range: 1-2m	Height Range: 0.1-0.2
Av. Height (m): 14	Av. Height: 5m	Av. Height: 1.5m	Av. Height: 0.1
Cover (%): 70% - 80%	Cover: 10%	Cover: 10%	Cover: 20%
Canopy outside E. mangrove A. Lycopodium	milga d.	Bellot milga E. pyramidalis	Native grasses F. ps.

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem: 11.5.20 / 11.9.5	Confirmed Regional Ecosystem: 11.9.5
Landform:	
Soils: Linc & sandr. → mdky L2 9.	
Structural formation (eg woodland, open-forest etc.):	Closed forest / woodland
Field Observations/ Notes (eg. Level of disturbance connectivity):	evident at chng. stands at Bellot and vst Bogalow
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	HA African boxthorn 2% gymn. shala

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

Interval (metres)	Intercept	Str./height
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	
-	m	

Summary:

Minimum height of plants included in the transect table:	m
Intercept of EDL 0 - 50m:	m
Intercept of EDL 50 - 100m:	m
Measured crown cover % of EDL 0 - 100m:	%
Structural formation	

Conclusions/notes:

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]

Vegetation Proforma

Date: 19/03/18

Observers: CS / OR

Site Name: New site 21



Future Freight
Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 56 E 0319408 N 6867999 CPS

End point Zone 5 E 0 N 050

Photo points (numbers): North: East: South: West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree	Shrub*	Ground
Height Range (m): 10-12	Height Range: 4-6	Height Range: 1-2m	Height Range: 0.2-0.5
Av. Height (m): 12m	Av. Height: 6m	Av. Height: 1m	Av. Height: 0.2
Cover (%): 30%	Cover: 20%	Cover: 20%	Cover: 20% 60%
<i>E. chloroloba</i> ? (grey bark, with crack bark from top) C	<i>Acacia</i> sp. <i>Callitris</i> glauca	<i>Agave</i> sp. (Ric) collected) giant bamboo <i>A. conchata</i>	<i>Leop. curvata</i> <i>Arctostaphylos</i> sp. <i>Eugenia</i> sp. rock grass Riparian
<i>A. leucophaea</i>			
<i>E. microlopha</i> C			
<i>Callitris</i>			
<i>Banksia</i>			

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non rem Confirmed Regional Ecosystem: Non rem

Landform: Plain

Soils: Sandy

Structural formation (eg woodland, open-forest etc.): Acacia woodland

Field Observations/ Notes (eg. Level of disturbance connectivity): Adjacent to road / higher site

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):
giant bamboo - 10%
open shrub

Vegetation Proforma

Date:

17/3/18

Observers:

CS / OR

Site Name:

Site 20



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:

Datum:

Transect length:

Start point

Zone

5 E 0319217

N 6863319

GPS

End point

Zone

5 E 0

N

OSL

Photo points (numbers): North: East: South: West:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 6-10m	Height Range: 4-5m	Height Range: 1-2m	Height Range: 0.1-0.5m
Av. Height (m): 8m	Av. Height: 3-5m	Av. Height: 1.5m	Av. Height: 0.2
Cover (%): 20%	Cover: 10%	Cover: 15%	Cover: 15%
E. microcarpa d	Callitris glauca d E. mus s Sukooke s	Brachylaena ovata d melga a Acacia opacifolia c	Nahia gorae + Becks

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem:

Mon Rem

Confirmed Regional Ecosystem:

Mon Rem

Landform:

low rise

Soils:

Shaly L2 II / L2 91

Structural formation (eg woodland, open-forest etc.):

woodland

Field Observations/ Notes (eg. Level of disturbance connectivity):

Highly disturbed / near road / adjacent with trees

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):

Opuntia basilaris - 1%

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]

Vegetation Proforma

Date: 19/4/18

Observers: CS / OR

Site Name: Site 19.



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:	Transect length:	
Start point	Zone	56	E 0316009	N 6859266
End point	Zone	5	E 0	N
Photo points (numbers):		North:	East:	South:

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 16-20	Height Range: 8-12	Height Range: 2-5	Height Range: 0.1-0.5
Av. Height (m): 18m	Av. Height: 10m	Av. Height: 3m	Av. Height: 0.2
Cover (%): 15%	Cover: 60%	Cover: 60%	Cover: 30%
E. pop R. Canad.	C. glaucophylla	Willow C. lutea	natural grasses

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: 11.3.2	Confirmed Regional Ecosystem: 11.3.2
Landform: dune	
Soils: dune	
Structural formation (eg woodland, open-forest etc.): woodland	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
gully area	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
severe cover	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible][illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]**Veget:**

Date:

Observer:

Transect D

GPS coordin

Sta

E

Photo point

Table 1: E

Cano

Height Ra

Av. Heigh

Cover (%)	Number of plants	Number of seeds	Number of fruits	Number of seeds per fruit	Number of seeds per plant
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9
10	10	10	10	10	10
11	11	11	11	11	11
12	12	12	12	12	12
13	13	13	13	13	13
14	14	14	14	14	14
15	15	15	15	15	15
16	16	16	16	16	16
17	17	17	17	17	17
18	18	18	18	18	18
19	19	19	19	19	19
20	20	20	20	20	20
21	21	21	21	21	21
22	22	22	22	22	22
23	23	23	23	23	23
24	24	24	24	24	24
25	25	25	25	25	25
26	26	26	26	26	26
27	27	27	27	27	27
28	28	28	28	28	28
29	29	29	29	29	29
30	30	30	30	30	30
31	31	31	31	31	31
32	32	32	32	32	32
33	33	33	33	33	33
34	34	34	34	34	34
35	35	35	35	35	35
36	36	36	36	36	36
37	37	37	37	37	37
38	38	38	38	38	38
39	39	39	39	39	39
40	40	40	40	40	40
41	41	41	41	41	41
42	42	42	42	42	42
43	43	43	43	43	43
44	44	44	44	44	44
45	45	45	45	45	45
46	46	46	46	46	46
47	47	47	47	47	47
48	48	48	48	48	48
49	49	49	49	49	49
50	50	50	50	50	50
51	51	51	51	51	51
52	52	52	52	52	52
53	53	53	53	53	53
54	54	54	54	54	54
55	55	55	55	55	55
56	56	56	56	56	56
57	57	57	57	57	57
58	58	58	58	58	58
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62	62	62	62	62	62
63	63	63	63	63	63
64	64	64	64	64	64
65	65	65	65	65	65
66	66	66	66	66	66
67	67	67	67	67	67
68	68	68	68	68	68
69	69	69	69	69	69
70	70	70	70	70	70
71	71	71	71	71	71
72	72	72	72	72	72
73	73	73	73	73	73
7					

Vegetation Proforma

Date: 19/4/18

Observers: CS / OR.

Site Name: New site 29.



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone: 5 E 0 N

End point Zone: 5 E 0 N

Photo points (numbers): North: East: South: West:

S 26.13984
E 151.18794

GPS
059

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 5m	Height Range:	Height Range: 1-3m	Height Range: 80m
Av. Height (m): 7-9m	Av. Height:	Av. Height: 2m	Av. Height: 0.3
Cover (%): 70%	Cover:	Cover: 30%	Cover: 0.1-0.5
Ab. hoop d E. pop (C) a in strip	—	wilgum Braydon	Cack bank Coar pan eye dark Dg dark

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem: Non Rain Confirmed Regional Ecosystem: Non Rain

Landform: plain

Soils: E2 2.

Structural formation (eg woodland, open-forest etc.): Closed forest

Field Observations/ Notes (eg. Level of disturbance connectivity):

Braydon shrub on road side

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

A. Salom	colom pink	
Buglar	digress	
Wigam		
Aluplos unia		
Chas arstata	(X) Digibon project	
Lipk bar		
Gosman growth		
Por Lohin		
Chin gipin		
Mohash asan		
Jacke		
Kish. plae.		
Mojima growth		
Si Ro' g 12		
Arayshon bread		
Paniam eba		
Sekah mika		
Bingala g 11		
Sida hoch bar		

we

Vegetation Proforma

Date:

20/4/18

Observers:

CS / OR

Site Name:

56 30.



Future Freight

Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5	E 0		N	
End point	Zone 5	E 0		N	
Photo points (numbers): North: _____ East: _____ South: _____ West: _____					
S: -28.12.114					
E: 151.18953.					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range:
Av. Height (m):	Av. Height:	Av. Height:	Av. Height:
Cover (%):	Cover:	Cover:	Cover:
Appt	Wood	B Aluka	Shrub 4m progn night Huhh. nuphoush Nahr + exoh gooses

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem:	Non rem	Confirmed Regional Ecosystem:	Non rem
Landform:	undulating - historic drainage line (creek)		Non wetland
Soils:			
Structural formation (eg woodland, open-forest etc.):			
Field Observations/ Notes (eg. Level of disturbance connectivity):	to Eucalyptus munda (also native) No other muffs		
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	Spina strata U.		

Vegetation Proforma

Date: 20/4/18

Observers: CS / OR

Site Name: Site 31.



Future Freight
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	GPS
End point	Zone 5 E 0			N	056
Photo points (numbers):		North:	East:	South:	West:
		S: 24.10756 E: 151.19574.			

Note: if canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent:	Trees	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range: 0.1-0.5m
Av. Height (m):	Av. Height:	Av. Height:	Av. Height: 0.2m
Cover (%):	Cover:	Cover:	Cover: 100%
Apart	Apart	Apart	[Mature (90%) New Mt (10%) Gross.

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: No. 100	Confirmed Regional Ecosystem: No. 100
Landform: Bang Loke soils (L29) - Bangalow district.	
Soils:	
Structural formation (eg woodland, open-forest etc.):	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Road Reserve - Nelsons Point (collected).	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
Opuntia tomentosa 1%.	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect is used to measure canopy cover). A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]

Vegetation Proforma

Date:

20/4/18

Observers:

CS / OR

Site Name:

Site 32



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:

Datum:

Transect length:

Start point

Zone

5

E

0

N

End point

Zone

5

E

0

N

Photo points (numbers):

North:

East:

South:

West:

5 25-07461

6 151-19788

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 15-18	Height Range: 8-10	Height Range: 1-3	Height Range: 0.1-0.5
Av. Height (m): 15	Av. Height: 9m	Av. Height: 2m	Av. Height: 0.2
Cover (%): 20%	Cover: 40%	Cover: 40%	Cover: 10%
Bungalow c	Brigade d	Wulgar c	Chenged bark c
Belah c	Belah a	Amchi Amchi a	Rock bark c
		Cassia acuta a	Quat shrub c
		Alacrya Linn a	Bigod grass c
		Coppin Loranth a	Bulbous lily a
		Coppin mitchell a	

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: ?	Confirmed Regional Ecosystem: 1159?
Landform: 629	
Soils: Heavy brown soils with surface stones	
Structural formation (eg woodland, open-forest etc.): Open woodland	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Bungalow pole, few large trees lots of regrowth	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
orange box tree	
Quat shrub	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy “measured”, not “estimated”) A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Bugbane	Pine cedar
Belted	Pig toad
Cyanic porcupine	Magnolia grandifolia
Cypress natch	Eucalyptus debilis
Indigo	Green heron
Atchafalaya	Belted garter
Chesapeake	
Angela grass	
Opuntia coccinea	
Florida leather	
Large fish	
Canal & San gray	
Arundinaria, dogwood	
Portulaca	
Schima bark	
Pigeon wood original	
Lawsonia	
Salicaria (tall, narrow)	

Weed

Vegetation Proforma

Date:

21/4/18

Observers:

CS / OR

Site Name:

Site 39



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N

End point Zone 5 E 0 N

Photo points (numbers): North: East: South: West:

27.89956
151.29138

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 8-15m	Height Range:	Height Range:	Height Range:
Av. Height (m): 12m	Av. Height:	Av. Height:	Av. Height:
Cover (%): 70%	Cover:	Cover:	Cover:
Banksia	Almond	Shrub Opuntia	Banksia Banksia Scaevola Eucalyptus Opuntia Hibiscus Eucalyptus

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem:

Confirmed Regional Ecosystem:

Landform:

Plain

Soils:

Dark brown fine sand/clay

Structural formation (eg woodland, open-forest etc.):

open/closed forest

Field Observations/ Notes (eg. Level of disturbance connectivity):

Banksia panic scrub → highly stable

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):

Hibiscus
Opuntia
Banksia → 10%

Table 3: Canopy cover using Canopy Intercept method (use only if a minimum of 1 measured canopy survey is required per representative Regional Ecosystem). A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

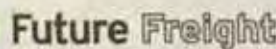
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12. 97		
12. 98		
12. 99		
12. 100		

анорху

21/4/18

CS / or

Side x (new)



Integrating Community, Environment and Engineering

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. † Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Table 2	
Mapped Regional Ecosystem:	Confirmed Regional Ecosystem:
Landform: <i>Plains</i>	
Soils: <i>Dark Brown Sandy loam</i>	
Structural formation (eg woodland, open-forest etc.): <i>Woodland</i>	
Field Observations/ Notes (eg. Level of disturbance connectivity): <i>in Belbin's Park - Johnson</i>	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): <i>grass shrub</i>	

[3608
Oman Samba
Rd.]

* Barry Lindermeier
↳ Rank on both room
search.

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Poplar Bea Salween par Near Salween Bristled grass Salween Cyrtus red Cyrtus canth Dact. viscosus Alpin terrestris Cat. and. Tarsus and. Chlam. and. Chlam. grass Regular Grass Lodge and. Aphid. very Chlam. grass Salween sp. and bulge. Abundant in	Urtica Alas. sp. asparagus par Alas. par	
---	---	--

Sphacelota.

Vegetation Proforma

Date:

21/4/18

Observers:

CS / OR

Site Name:

Site 36



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	GPS
End point	Zone 5 E 0			N	190
Photo points (numbers): North: East: South: West:					
S 27 97502					
E 151 21924					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m): 12-18	Height Range: 7-8	Height Range: 2-3	Height Range: 0.1-1
Av. Height (m): 18m	Av. Height: 7	Av. Height: 3m	Av. Height: 0.5m
Cover (%): 60%	Cover: 30%	Cover: 50%	Cover: 60%
Sagahon Sabal	d a Bogah Baldh	d a wilga Giant Gumbo Coppah oak	d a a chm desert Bogah ycs cop loc chm dmi chm post Spunk wia Opuntia
			Belson Pore

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem:	Confirmed Regional Ecosystem:
Landform: Low hills	
Soils: heavy soils / weathered	
Structural formation (eg woodland, open-forest etc.):	
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Sagahon ph / ground	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
Opuntia Opuntia thick Sorghum	3-5%

Vegetation Proforma

** wetland area
Dead water
Acacia &
Lantana*

Date:

21/4/18

Observers:

CS / OR

Site Name:

Site 40



Future Freight

Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0 0 0 0 0	N	0 0 0 0 0 0	GPS	
End point	Zone 5 E 0 0 0 0 0	N	0 0 0 0 0 0	191	
Photo points (numbers): North: _____ East: _____ South: _____ West: _____					
S 27.57240					
E 151.31532					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/Emergent	Tree 2	Shrub*	Ground
Height Range (m): 17-20	Height Range: 8-10	Height Range:	Height Range:
Av. Height (m): 18	Av. Height: 7m	Av. Height:	Av. Height:
Cover (%): 60% (canopy)	Cover: 15%	Cover:	Cover:
Piper Bay d E. canth.	Belt Piper d	Shrub	Gulgi Grass Open park Pos. Soil Both designs Chlor. gay Open shrub

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed <2m tall.

Table 2

Mapped Regional Ecosystem:	Non rain	Confirmed Regional Ecosystem:	Non Rain
Landform:	Shrub / 629		
Soils:	Dark brown silty sand-loam		
Structural formation (eg woodland, open-forest etc.):	Open hilly		
Field Observations/ Notes (eg. Level of disturbance connectivity):	Road cut		
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):			
Open hilly			

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established and measured). A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Pepin box	Soda chalk
Bat glass	Cyan rotundif.
Balab.	Glycine abartha
Gilgig st.	Magnus pest.
Pos dish	Rosmar. sanct.
Guaa post	Turans vort.
Spoken bark	
Smart Grogut	
Yang weed (collet)	
Medon - bang	
Koching reef.	
Vochl mound.	
Pos dish	
Olou pest.	
Gromph weed	
Cotton lather tree	
Bear house	
Panen Lascap	
Mohroshu mureu	

Vegetation Proforma

Date: 21/4/18

Observers: CS / OR

Site Name: Site 41



Future Freight
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Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	
End point	Zone 5 E 0			N	
Photo points (numbers): North: East: South: West:					
S 27.53856					
E 151.36815					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range:
Av. Height (m):	Av. Height:	Av. Height:	Av. Height:
Cover (%):	Cover:	Cover:	Cover:
Aln	Aln	Aln	Natun + No-nach gosses

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non rem	Confirmed Regional Ecosystem: Non rem
Landform: Plot	
Soils: Black soil	
Structural formation (eg woodland, open-forest etc.):	crossed grass
Field Observations/ Notes (eg. Level of disturbance connectivity):	
High disturbance Red rem	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
N/A	

Vegetation Proforma

Date: 22/4/18.
 Observers: CS OR. Site Name: site 42



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Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N APS
 End point Zone 5 E 0 N 193.

Photo points (numbers): North: East: South: West: S - 27.71060 E 151.41299.

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub ^a	Ground
Height Range (m):	Height Range:	Height Range:	Height Range:
Av. Height (m): 13m	Av. Height:	Av. Height:	Av. Height:
Cover (%): 10%	Cover:	Cover:	Cover:
At least 1 tree	At least	At least	Phyla sand Maiden (Long) Retic goss Noddy oak gosses

Table notes: ^a use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. ^a Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non-acc Confirmed Regional Ecosystem: Non-acc

Landform: Plain

Soils: Bloccle soils / crocking soils

Structural formation (eg woodland, open-forest etc.): Road across Grass/Forest land

Field Observations/ Notes (eg. Level of disturbance connectivity): Highly disturbed - central wetland in back plants & landform.

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): 90% - no listed weeds

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Chely. gary ptych. dent. Mery. nelsoni Heterodon Pseudot. Parke's lane Lat P. n. a. i. a. Elipse inden Tor. ure. Rhinoceros m. m. d. Convolv. Chama. pedunc. Hairy. lycop. Lich. compe. Olym. elyden P. n. s. d. a. D. n. s. m. Elong. t. humilis Anom. p. f. s.	low. chole G. n. m. m. m. ap. d. d. t. S. n. l. y. m. Anom. p. m. P. n. a. P. n. a. o. l. i. n.
---	---

Wee

Vegetation Proforma

Date: 22/4/18

Observers: CS OR

Site Name: Ste 44



Future Freight

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Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	
End point	Zone 5 E 0			N	
Photo points (numbers): North: East: South: West:					
S - 27.78063					
E - 151.42378					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy Element	Tree 1	Tree 2	Shrub*	Ground
Height Range (m): 3-15	Height Range: 4-8	Height Range: 1-24	Height Range:	Height Range:
Av. Height (m): 12m	Av. Height: 6m	Av. Height: 2m	Av. Height:	Av. Height:
Cover (%): 60% (along line)	Cover: 70% (along line)	Cover: 10% (along line)	Cover:	Cover:
Eucalypt	A. steno	A. steno		Native to earth garden + paper

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: <i>Plan River</i>	Confirmed Regional Ecosystem: <i>Plan River</i>
Landform: <i>Adjacent to drainage</i>	
Soils: <i>alluvium / Black soil</i>	
Structural formation (eg woodland, open-forest etc.): <i>Crossland / Redden / open forest</i>	
Field Observations/ Notes (eg. Level of disturbance connectivity): <i>adjacent to drainage to</i>	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
60% - No weeds	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible][illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

[illegible]

Vegetation Proforma

Date: 22/4/18.

Observers: CS / OR.

Site Name: Site 45.



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Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N CPS

End point Zone 5 E 0 N 195

Photo points (numbers): North: East: South: West:

S: 27.75623
E: 151.4566

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/Tree 1	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range:
Av. Height (m): 12m	Av. Height:	Av. Height:	Av. Height:
Cover (%): 5%	Cover:	Cover:	Cover:
Platan trees adjacent to site	N/A	N/A	Wahia + exorb grasses/bush

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. # Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non rem Confirmed Regional Ecosystem: Non rem

Landform: Plain

Soils: Black soil

Structural formation (eg woodland, open-forest etc.):

Field Observations/ Notes (eg. Level of disturbance connectivity): Mown Road/Rail corridor

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): 30% none listed.

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

	Refer to BH034 sp list!	X <i>D. parvata</i> known
	Create new	
	Area subject to mining	

Vegetation Proforma

Date: 22/4/18

Observers: CS / OR

Site Name: Site 43



Future Freight

Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	GPS
End point	Zone 5 E 0			N	196
Photo points (numbers): North: East: South: West:					
S 22-78631					
E 151-41858					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range: 1-3m	Height Range:
Av. Height (m):	Av. Height:	Av. Height: 2m	Av. Height:
Cover (%):	Cover:	Cover: 90%	Cover:
Aspen	Shrub	legume - adjacent to road line ↓ only in road corridor	Nahua + non-nahua grass + Forbs

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: NA	Confirmed Regional Ecosystem: NA
Landform: Plain	
Soils: Blocky soils	
Structural formation (eg woodland, open-forest etc.):	Closed grassland / Forbs
Field Observations/ Notes (eg. Level of disturbance connectivity):	wetlands, water point
Highway ditch along road/road.	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
60% non native	

Table 3: Canopy cover using Canopy Intercept method. A minimum of 1 measured canopy survey is required per representative "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible][illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Hyphae		
Poa		
Albida gra		
Cyperus		
Acacia		
Por dol		
Cory canch		
Hordeum		
Stele right		
Scabrum		
Myrica ped		
Eragrost		
Collyria		
Tridax		
Hyphae		
Hordeum		
Scabrum		
Bothriochloa		
Cratichneumon		

Vegetation Proforma

Date: 23/4/18

Observers: CS/OR Site Name: Site 54.

 **Future Freight**
Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N

End point Zone 5 E 0 N

Photo points (numbers): North: East: South: West:

S - 27.50509
E - 151.81789.

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated". Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range: 0.1 - 1m
Av. Height (m):	Av. Height:	Av. Height:	Av. Height: 1m
Cover (%):	Cover:	Cover:	Cover: 90%
Absent	Absent	Absent	Non / Non-Rock grasses

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non Rain Confirmed Regional Ecosystem: Non Rain

Landform: Plain

Soils: Black soils

Structural formation (eg woodland, open-forest etc.): clumped grasses

Field Observations/ Notes (eg. Level of disturbance connectivity): Road reserve, Rock grasses

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): 90% non herb

Vegetation Proforma

Date: 23/4/18

Observers: CS / OR.

Site Name: Site 53



Future Freight
Integrating Economics Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N 206

End point Zone 5 E 0 N 206

Photo points (numbers): North: East: South: West:

S - 27.94117
E 151.84323

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy	Tree 2	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range: 0.1 - 1m
Av. Height (m):	Av. Height:	Av. Height:	Av. Height: 0.5m
Cover (%):	Cover:	Cover:	Cover: 95%
NA	NA	NA	Herb + grass grass + Ruffin
			* D. purpurea

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: NA Confirmed Regional Ecosystem: NA

Landform: Telling

Soils: Black soil

Structural formation (eg woodland, open-forest etc.): closed grassland

Field Observations/ Notes (eg. Level of disturbance connectivity): Road near heron drag/creek.

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): 70% non native

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

<i>Spiraea cuneata</i> <i>S. alba</i> <i>Rosa</i> <i>Rosa rugosa</i> <i>Rosa villosa</i> <i>Brachyotum</i> <i>Rosa</i> <i>Rosa</i> <i>Quercus</i>	<i>Alnus</i> <i>Alnus</i> <i>Cyanus</i> <i>Quercus</i> <i>Quercus</i> <i>Alnus</i> <i>Cyanus</i> <i>Alnus</i>
<i>R. parviflora</i> 30 plants <i>Viburnum</i> <i>Conium</i>	
<i>Diracanthus</i> - collected.	
<i>Sorghum</i>	

Vegetation Proforma

Date: 23/4/16

Observers: CS / OR.

Site Name: Site 52



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Integrating Community, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates:		Datum:		Transect length:	
Start point	Zone 5 E 0			N	
End point	Zone 5 E 0			N	
Photo points (numbers): North: East: South: West:					
S 27.49315					
E 151.84506					

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Tree 2	Shrub [#]	Ground
Height Range (m):	Height Range:	Height Range:	Height Range:
Av. Height (m):	Av. Height:	Av. Height:	Av. Height:
Cover (%):	Cover:	Cover:	Cover:
NA	NA	NA	Non-native grasses

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. [#] Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: Non-rem	Confirmed Regional Ecosystem: Non-rem
Landform: Peneplain	
Soils: Black soil	
Structural formation (eg woodland, open-forest etc.):	closed grassland
Field Observations/ Notes (eg. Level of disturbance connectivity):	
Road reserve / rock gorges	
Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016):	
80% non native	

Table 3: Canopy cover using Canopy Intercept method (use only if a transect has been established – canopy "measured", not "estimated") A minimum of 1 measured canopy survey is required per representative Regional Ecosystem.

[illegible]

Table 4: Flora species Present (15-20 minute random meander) (required for all sites):

Eight types Khassam with one North to light Dams seen near main Place goes strike hill some green Swamp lake Kanga cur. Daa Open vegeta Dagit drink		
--	--	--

26. 11

Vegetation Proforma

Date: 23/4/18

Observers: CS / OR

Site Name: Site 55



Future Freight
Integrating Communities, Environment and Engineering

Transect Details (required for all sites)

GPS coordinates: Datum: Transect length:

Start point Zone 5 E 0 N

End point Zone 5 E 0 N

Photo points (numbers): North: East: South: West:

S - 27.53602
E 151.74825

Site 55

Note: If canopy is estimated (eg. No transect), provide only a single GPS point with a transect length of "0" and state "estimated" Complete Tables 1, 2 and 4 only.

Table 1: Estimated Canopy Cover (mandatory for all sites)

Canopy/ Emergent	Trees	Shrub*	Ground
Height Range (m):	Height Range:	Height Range:	Height Range: 0.1-0.3
Av. Height (m):	Av. Height:	Av. Height:	Av. Height: 0.2
Cover (%):	Cover:	Cover:	Cover: 90%
Abn	N/A	N/A	Closed grass Note + exch sp.

Table notes: * use following terms: D = dominant; C = co-dominant; A = associated; S = suppressed. * Shrub is a woody plant <8m tall with multi-stems within 20cm from base or if single stemmed < 2m tall.

Table 2

Mapped Regional Ecosystem: N/A Confirmed Regional Ecosystem: N/A

Landform: mid-slope

Soils: Dark brown loam

Structural formation (eg woodland, open-forest etc.): Closed grass

Field Observations/ Notes (eg. Level of disturbance connectivity): Road reserve

Weed species and approx. cover (%) (including restricted matters under the Qld Biosecurity Act 2016): 80% non-rob

APPENDIX

L

Terrestrial and Aquatic Ecology Technical Report

Appendix E Completed fauna assessment proformas

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Fauna Proforma



Future Freight
Integrating Community, Environment and Engineering

Site Information

Site Name: 1

Date: 16/4/18

Observers: CR + CS

Refer to flora proforma

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: _____

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Regent HE
curlew SP
black-throated F
border thick-tailed gecko
spotted pigeon
painted HE
keoola
southern greyta
glider
eastern long-eared bat
dunnals snake
ballale Jewell
grey snake
woma
white-throated noddie
white-winged black tern
caper tern
sharp-tailed sunbitter
glossy ibis
short-billed echin
glossy black-caterpillar
Midge Mitchell's cecropia
powerful owl
common death adder

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Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	1
Fallen logs (>10cm diam.)		4
Coarse woody debris (<10cm diam.)		3
Decorticating bark		1
Leaf litter (%)		5%
Bare ground (%)		70%
Grass (%)		10%
Soil cracks		1
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		NO
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		0.5 mostly
Fruit Abundance (%)		0
Water present (Y/N)		Y road side ditch

Note: 0 = absent: 1 = Rare: 2 = Rare

[illegible]

Variegated fly ✓
 WW chough ✓
 bar-shouldered dove ✓
 stoped HE ✓
 large macropod - (tracks + scats) ✓
 Rufous whistler ✓
 Willie wagtail ✓
 T'crow ✓
 Crows ✓

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 2 (mored)

Date: 16/4/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: *Refer to veg proforma.*

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics



Habitat Features – Abundance:

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	3
Clearing	3
Erosion	2

Habitat suitability for target fauna

[illegible]

Incidental fauna

observations/scats/traces:

crested pyg
hairy miner ✓

acbbles ✓

mistake

~~rice~~ ~~Wang~~ ~~Indang~~
guru bahasa su

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		7
Coarse woody debris (<10cm diam.)		6
Decorticating bark		0
Leaf litter (%)		20
Bare ground (%)		40
Grass (%)		20 30
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		10
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		Y shallow

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Y shallow gully
occasional; 3 =

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 3

Date: 16/4/18

Observers: OE + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: refer to veg proforma

Plot Centre: Zone: Easting: Northing: Accuracy m

Altitude: m Altitude accuracy: +/- m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree Canopy present Y / N average height m cover %

Dominant species:

Sub canopy present Y / N average height m cover %

Dominant species:

Shrub layer present Y / N average height m cover %

Dominant species:

Ground layer: cover % weeds % Dominant species

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	3
Clearing	1
Erosion	2

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
Aus' bittern	✓	
Painted snipe	✓	

Incidental fauna

observations/scats/traces:

mistletoe bird
 sheep
 w's swallow
 w. magpie

T. crow

C. parus

dusky toadlet
 eastern grey

Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant



Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	>30cm diameter: 0 >15cm, <30cm diameter: 0 >10cm, <15cm diameter: 0 >5cm, <10cm diameter: 0 < 5cm diameter: 0
Fallen logs (>10cm diam.)	3
Coarse woody debris (<10cm diam.)	4
Decorticating bark	2
Leaf litter (%)	5
Bare ground (%)	85
Grass (%)	5
Soil cracks	2
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	Y
Weeds and non-native species (%)	5
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	Wetland

Gymnodynastes tasmanian
 red-capped robin

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 4 new

Date: 11/11/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s	Photo No/s	Other photo numbers and notes:
North:	South:	
East:	West:	

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	3
Clearing	3
Erosion	1

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) – from database searches	Yes	No

Incidental fauna

observations/scats/traces:

Brown TB ✓
 willow ✓
 red-cap R ✓
 white-plummed HE
 ww chough



Future Freight
 Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter 0
	>15cm, <30cm diameter 0
	>10cm, <15cm diameter 0
	>5cm, <10cm diameter 1
	< 5cm diameter 2
Fallen logs (>10cm diam.)	0
Coarse woody debris (<10cm diam.)	0
Decorticating bark	0
Leaf litter (%)	0
Bare ground (%)	70
Grass (%)	20
Soil cracks	0
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	10
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	Y small depression

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: new site 6

Date: 17.4.18

Observers: ER, CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: all veg proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	3
Clearing	3
Erosion	1

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
	Yes	No
What EVNT species are known from region (complete in rows below) – from database searches		

Incidental fauna

observations/scats/traces:

2 min ✓
 n.g. neck ✓
 avian nest in tree on roadside ✓
 eastern grey tracks ✓
 noisy miner ✓

gc babs ✓

41

skunk (crypto)

patches patches ✓
 Plagiocentrus



Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter
	>15cm, <30cm diameter
	>10cm, <15cm diameter
	>5cm, <10cm diameter
	< 5cm diameter
Fallen logs (>10cm diam.)	
Coarse woody debris (<10cm diam.)	
Decorticating bark	
Leaf litter (%)	
Bare ground (%)	
Grass (%)	
Soil cracks	
Soil banks (eg. River banks/road cuttings, etc.)	
Surface Rocks and/or Boulders	
Wetlands (Y/N). If yes complete wetland Proforma	
Weeds and non-native species (%)	
Rock Crevices	
Flower Abundance (%)	
Fruit Abundance (%)	
Water present (Y/N)	

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 9

Date: 17/4/18

Observers: CR + CS

refer to veg proforma

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s		Photo No/s	Other photo numbers and notes:	
North:		South:		
East:		West:		

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) – from database searches	Yes	No
Imperial hairstreak	Acacia irrigata	

Incidental fauna

observations/scats/traces:

Acacia irrigata has signs of herbivory (ie imperial hairstreak)
 weebill.
 weebill sp rednecked.

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter 2
	>15cm, <30cm diameter 4
	>10cm, <15cm diameter 2
	>5cm, <10cm diameter 2
	< 5cm diameter 1
Fallen logs (>10cm diam.)	6
Coarse woody debris (<10cm diam.)	7
Decorticating bark	4
Leaf litter (%)	55
Bare ground (%)	30
Grass (%)	10
Soil cracks	0
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	5
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

eulampius tenuis

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 14

Date: 17/4/18

Observers: GR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	2
Clearing	3
Erosion	1

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

pied bb
norm miner
pale head not
a possible

Terror ✓
c' pyrene ✓
wobly ✓
emu (track) ✓

Bees (Honeybees)
Leightonham hives
under bridge $\Rightarrow$ fairy mounds

Future Freight
Innovative Community Development and Education

Habitat Features – Abundance:

Characteristics	Abundance (# of % within landscape)
Hollows in trees and stags. (May include hollows in termite mounds)	
>20cm diameter	0
>15cm, <20cm diameter	0
>10cm, <15cm diameter	0
>5cm, <10cm diameter	0
<5cm diameter	0
Fallen logs (>10cm diam.)	1
Coarse woody debris (<10cm diam.)	2
Decorticating bark	0
Leaf litter (%)	1%
Bare ground (%)	30
Grass (%)	50
Soil cracks	0
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	29%
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	g

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 18 GPS# 14

Date: ... / ... / ...

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

refer to veg proforma

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	3
Clearing	2
Erosion	2

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

T crow ^{Aug} Raven.

~~what a beautiful day~~

yellow-faced HE feeding in green and (mostly) (metallic).

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	≥30cm diameter	0
	≥15cm, <30cm diameter	0
	≥10cm, <15cm diameter	0
	≥5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		5
Coarse woody debris (<10cm diam.)		6
Decortivating bark		5
Leaf litter (%)		20
Bare ground (%)		60 55
Grass (%)		20
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		2
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		≤ 5
Rock Crevices		0
Flower Abundance (%)		5
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = Bare; 2 = ...

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma



Future Freight
Infrastructure, Environment, Community and Engineering

Site Information

Site Name: New Site 15

Date: 10/10/10

Observers: CL & CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: refer to map

Plot Centre: Zone: Easting: Northing: Accuracy m

Altitude: m Altitude accuracy: $\pm$ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: if a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height m cover %

Dominant species:

Sub canopy present Y / N average height m cover %

Dominant species:

Shrub layer present Y / N average height m cover %

Dominant species:

Ground layer: cover % weeds % Dominant species

Site Photos

Photo No/s		Photo No/s	
North:		South:	
East:		West:	

Other photo numbers and notes:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

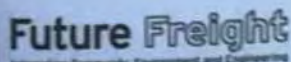
Habitat suitability for target fauna

[illegible]

yellow TB ✓
Incidental fauna
observations/scats/traces? ^{grey fantail} ✓
sitellus ✓ brown TB ✓

use 6, 11 ✓ yellow for HEX

Alloesuarina ^{g.s.t.} in ~~sp~~ phloem. potential
glochid food
wallaby sp (scat) ✓



Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in <i>termentartia</i>)	>30cm diameter	0
	>15cm, <30cm diameter	1
	>10cm, <15cm diameter	1
	>5cm, <10cm diameter	1
	<5cm diameter	2
Fallen logs (>10cm diam.)		7
Coarse woody debris (<10cm diam.)		7
Decorticating bark		3
Leaf litter (%)		40
Bare ground (%)		40
Grass (%)		20
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		5 (musk to)
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

common to abundant; 7 = abundant

2mm (scat) ✓
rabbit + warren ✓
confirmed yellow-bellied glider ✓
scat see photo (red/brown) / Glider
in colour
↳ coarse brown material

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: New site 16

Date: 18/2/18

GPS 046

Observers: CS-1 OR

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA84 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

pelicans above ✓
emu (track) ✓
e' gony k' (track) ✓
a postle bir ✓



Future Freight
Interactive Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	1
	>10cm, <15cm diameter	1
	>5cm, <10cm diameter	2
	< 5cm diameter	3
Fallen logs (>10cm diam.)		7
Coarse woody debris (<10cm diam.)		7
Decorticating bark		3
Leaf litter (%)		60
Bare ground (%)		20
Grass (%)		20
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		dry gully
Surface Rocks and/or Boulders		3
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		5 (mistake)
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = Rare; 2 = Common; 3 = Abundant; 4 = Very Abundant; 5 = Dominant; 6 = Exclusive; 7 = Monoculture

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

yellow spotted monitor ✓
see photo

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: New site 19.

Date: 18/4/18

Observers: OR + CR

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

Habitat suitability for target fauna

[illegible]

Incidental fauna

observations/scats/traces:

e' yellow robin ✓
bearded dragon ✓
luma scnt f
eas' gray k' scnt/f



Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	1
	< 5cm diameter	2.
Fallen logs (>10cm diam.)		5
Coarse woody debris (<10cm diam.)		6
Decorticating bark		2
Leaf litter (%)		50
Bare ground (%)		40
Grass (%)		10
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		0
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		5 (mistlebe)
Fruit Abundance (%)		0
Water present (Y/N)		0

* Note: 0 = absent; 1 = Rare; 2 = Common; 3 = Abundant; 4 = Very Abundant; 5 = Dominant; 6 = Very Dominant; 7 = Exclusive

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

scat w seeds see photo

↳ confronted ~~yellow bellied~~
fox scat. gopher (scat.)

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 27.

Date: 19/4/18

Observers: CR + CS.

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

Refer to veg proforma

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	1
Clearing	0
Erosion	0

belah woodland. on sandy clay
Habitat suitability for target fauna ^{no mistletoe}

Habitat suitability for target fauna

[illegible]

Incidental fauna

observations/scats/traces:

grey kangaroo scat / tracks ✓
variegated fw ✓
grey FT ✓
wee bill. ✓
refers with
noisy miners



Future Freight

Interactive Community Engagement and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	4
	>15cm, <30cm diameter	4
	>10cm, <15cm diameter	4 4
	>5cm, <10cm diameter	5
	< 5cm diameter	5
Fallen logs (>10cm diam.)		6
Coarse woody debris (<10cm diam.)		7
Decorticating bark		2
Leaf litter (%)		80
Bare ground (%)		10
Grass (%)		10
Soil cracks		1
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		1
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		15% wilga
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

silver eye ✓
yellow TB ✓

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: new site 21

Date: 19/4/18

Observers: DD & CS

LOCATION (GPS reference)

Datum: ☐ AGD84

☐ GDA94 (WGS84)

OTHER: refer to veg proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

21

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0 3
Clearing	2
Erosion	1

callis - 60x-6cm on sand

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
S'pigeon	✓	
Painted he	✓	
zosterobit	✓	
death accler	✓	

Incidental fauna

observations/scats/traces:

weebill ✓
yellow TB ✓
e'grey'k' fender ✓
gc tabs.

carlia pectoralis ✓



Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	1
	>15cm, <30cm diameter	2
	>10cm, <15cm diameter	2
	>5cm, <10cm diameter	2
	< 5cm diameter	2
Fallen logs (>10cm diam.)		5
Coarse woody debris (<10cm diam.)		5
Decorticating bark		3
Leaf litter (%)		10
Bare ground (%)		30/40
Grass (%)		50
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		2
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		N
Rock Crevices		N
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma



Future Freight
Integrating Community, Environment and Engineering

Site Information

Site Name: 20

Date: 19, 4, 18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: refer to veg proforma

Plot Centre: Zone: Easting: Northing: Accuracy m

Altitude: m Altitude accuracy: +/- m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height m cover %

Dominant species:

Sub canopy present Y / N average height m cover %

Dominant species:

Shrub layer present Y / N average height m cover %

Dominant species:

Ground layer: cover % weeds % Dominant species

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

20

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	1
Erosion	2

box-callers on sandy ground (LZ 5)

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
acacia irritator		
blue hardshoe	✓	

Incidental fauna

observations/scats/traces:

camera trap ~500m north
fox confirmed
red-necked wallaby
weebill
stoer-see

yellow-faced HE
yellow TB
white-eared HE



Habitat Features - Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter: 0 >15cm, <30cm diameter: 1 >10cm, <15cm diameter: 2 >5cm, <10cm diameter: 3 < 5cm diameter: 4
Fallen logs (>10cm diam.)	3
Coarse woody debris (<10cm diam.)	5
Decorticating bark	2
Leaf litter (%)	20
Bare ground (%)	50-70
Grass (%)	10
Soil cracks	0
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	7
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	0
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
warrior butt	10
Water present (Y/N)	dam

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

nearby dam w water
ab fine h

Fauna Proforma



Future Freight
Integrating Community, Environment and Engineering

Site Information

Site Name: 19

Date: 19/11/18

Observers: OR-CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: refer to veg proforma

Plot Centre: Zone: Easting: Northing: Accuracy m

Altitude: m Altitude accuracy: +/- m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height m cover %

Dominant species:

Sub canopy present Y / N average height m cover %

Dominant species:

Shrub layer present Y / N average height m cover %

Dominant species:

Ground layer: cover % weeds % Dominant species

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

alluvium.

Fauna Proforma

Habitat characteristics

Habitat Disturbance $\rightarrow$ box/gum.
+ ferekanis

Disturbance type	Severity (0-3) (0=nil, 3=severe)
Fire	0
Grazing	1
Clearing	0
Erosion	0

Common
note

alluvial in - fine sand, clay,

Habitat suitability for target fauna

Species (EANT) known from Region	Suitable habitat present	
	Yes	No
What EANT species are known from region (complete in rows below) – from database searches		

Incidental fauna

observations/scats/traces:

Impress ✓

average line
(deep cut)

وعداها

white-throated
sparrow.

heads to creek
yellow TB.
grey FT.



Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in <i>Lamentaria</i>)	>30cm diameter	2
	>15cm, <30cm diameter	2
	>10cm, <15cm diameter	3
	>5cm, <10cm diameter	4
	<5cm diameter	3
Fallen logs (>10cm diam.)		5
Coarse woody debris (<10cm diam.)		6
Decorticating bark		3
Leaf litter (%)		75
Bare ground (%)		10
Grass (%)		15
Soil cracks		0
Soil banks (eg. river banks/road cuttings, etc.)		✓
Surface Rocks and/or Boulders		0
Wetlands (V/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%) L5/p		very low 0/1
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		5 w/lyg
Water present (V/N) NO WATER		N - creek

Note: 1 = abundant; 1 = rare, 2 = rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant.

? little stroke / dull light
red covering - robin -
golden w

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 29

Date: 19/4/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0 1
Erosion	0

Habitat suitability for target fauna

Habitat suitability for target fauna

[illegible]

Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		1
Coarse woody debris (<10cm diam.)		3
Decorticating bark		0
Leaf litter (%)		50 75
Bare ground (%)		0
Grass (%)		50
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		2
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		N
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		LS
Water present (Y/N)		N

*Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Incidental fauna

observations/scats/traces:

Incidental fauna observations/scats/traces: eastern grey roo scat/scat track Water present (Y/N) N

note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

insects with ✓
db finch. → nests in adjacent paddock → in native lime ✓
cockatiel. ✓
dark shouldered kite ✓
she FW ✓
T or GW ✓
black-faced CS ✓
bushes
BOPAS

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 30

Date: 20/4/18 GPS# 55.

Observers: GR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

30

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	2
Clearing	3
Erosion	1

grassy paddock

half native
half exotice
grasses

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
major mitchell	✓	
scatter pigeon	✓	

small cracks
not big enough
for pythons.



Habitat Features - Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter —
	>15cm, <30cm diameter —
	>10cm, <15cm diameter —
	>5cm, <10cm diameter —
	< 5cm diameter —
Fallen logs (>10cm diam.)	—
Coarse woody debris (<10cm diam.)	2
Decorticating bark	0
Leaf litter (%)	0
Bare ground (%)	40
Grass (%)	30
Soil cracks	2
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N damaged lake
Weeds and non-native species (%)	30
Rock Crevices	—
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Incidental fauna

observations/scats/traces:

W'kestrel ✓

coonella ✓

strated

gularh

players ✓

ab Finch ✓

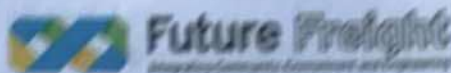
active nest in cappa bush

land zone 9

five sandy n 17

Fauna Proforma

Site Information



Site Name: 31

Date: 20/4/18

Observer: CA - CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy: _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

31

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

two deposits
bright low habitat

L2 9

native grassland on dark heavy
cracking clay
derived from sandstone

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
Major mitchell	✓	
earlier dragon	✓	
chameleons		

Incidental fauna

golden-headed
observations/scats/traces: cisticola ✓

cockatiel ✓
grey kangaroo (scat)
T. crow
magpie

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	
>20cm diameter	0
>15cm, <20cm diameter	6
>10cm, <15cm diameter	0
>5cm, <10cm diameter	0
< 5cm diameter	0
Fallen logs (>10cm diam.)	0
Coarse woody debris (<10cm diam.)	0
Decorticating bark	0
Leaf litter (%)	0
Bare ground (%)	0
Grass (%)	100
Soil cracks	6
but small.	
Soil banks (eg. River banks/road cuttings, etc.)	
Surface Rocks and/or Boulders	
Wetlands (Y/N). If yes complete wetland Proforma	
Weeds and non-native species (%)	
Rock Crevices	
Flower Abundance (%)	
Fruit Abundance (%)	
Water present (Y/N)	

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

kestrel
db Finch.
blue FW

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 32

Date: 20/4/18

Observers: CR + ZS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

(32)

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	1 1
Clearing	0
Erosion	1

with mistletoe
w/ gumfruits

orig - below on heavy dark clay

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
Painted HE	✓	

Incidental fauna

observations/scats/traces:

gc bats / spiny-cheeked HE
brown HE
grey roo (scat)

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	>30cm diameter
	>15cm, <30cm diameter
	>10cm, <15cm diameter
	>5cm, <10cm diameter
	< 5cm diameter
Fallen logs (>10cm diam.)	4
Coarse woody debris (<10cm diam.)	5
Decorticating bark	1
Leaf litter (%)	70
Bare ground (%)	20
Grass (%)	10
Soil cracks	20
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	7
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma	N
Weeds and non-native species (%)	< 1
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	10 (widge)
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

cherry-pals in grand layer
cupans - paired thorn.

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 39

Date: 21.1.18

Observers: DR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

thick below under
paper box
no gross for squatters

L29 - dark grey soil

no wish to

Habitat suitability for target fauna

[illegible]

Incidental fauna

observations/scats/traces:

Plow / magpie.
+ crow / crested jay
sassy miner /
streaked pardalote /
fox den. active (scats + tracks).



Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in tarmentaria)	>30cm diameter	2
	>15cm, <30cm diameter	2
	>10cm, <15cm diameter	3
	>5cm, <10cm diameter	3
	< 5cm diameter	4
Fallen logs (>10cm diam.)		4
Coarse woody debris (<10cm diam.)		5
Decorticating bark		1
Leaf litter (%)		80
Bare ground (%)		10
Grass (%)		10
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		1
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		0
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		0

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

eastern gray (scat)
+ trouble.

Fauna Proforma



Future Freight

Integrating Community, Environment and Engineering

Site Information

S -27.90022 / 151.29285

Site Name:

Site X gps #

Date:

21/4/18

Observers:

CR + CS

LOCATION (GPS reference)

Datum:

☐

AGD84

☐

GDA94 (WGS84)

OTHER:

refer to prev
proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	0
Erosion	0

grass open forest? woodland. poplars.

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
not suitable for squatter.		
powerful owl	✓	

Incidental fauna observations/scats/traces:

T. crow ✓
c. pigeon ✓
noisy miner ✓
ringnecked plover ✓
grey bird ✓

willaby (scat) ✓

skunk - refer to incidentals in notes book

Habitat Features - Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	>30cm diameter: 7
	>15cm, <30cm diameter: 7
	>10cm, <15cm diameter: 7
	>5cm, <10cm diameter: 7
	< 5cm diameter: 7
Fallen logs (>10cm diam.)	3
Coarse woody debris (<10cm diam.)	4
Decorticating bark	0
Leaf litter (%)	25
Bare ground (%)	5
Grass (%)	70
Soil cracks	0
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	0
Rock Crevices	0
Flower Abundance (%)	Acacia 10
Fruit Abundance (%)	5
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 36

Date: 21/11/18

Observers: Q + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA84 (WGS84) OTHER: refer to veg proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	1
Clearing	6
Erosion	1

gray - chenopod.
grand (a/p).

Brige belch open first to mistlebe.

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
	Yes	No
What EVNT species are known from region (complete in rows below) – from database searches		

high density of inhibitor.

Incidental fauna
observations/scats/traces:

observations/scats/traces:

T'crow / grey '66' ✓
Aus Raven ✓
not 17 in the ✓
nightclub ✓

shg

striped he.
spiny-checked he



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Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	0
>30cm diameter	0
>15cm, <30cm diameter	0
>10cm, <15cm diameter	0
>5cm, <10cm diameter	1
< 5cm diameter	1
Fallen logs (>10cm diam.)	5
Coarse woody debris (<10cm diam.)	6
Decorticating bark	0
Leaf litter (%)	30
Bare ground (%)	20
Grass (%)	50
Soil cracks <i>but too small</i>	3
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma	N
Weeds and non-native species (%)	<1
Rock Crevices	0
Flower Abundance (%)	10 mostly
Fruit Abundance (%)	5 only
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Far Site

Site Name

Date: 4

LOC

Datur

Plot C

Altitude

Locali

VEG

sectio

Gener

Region

Remn

STRU

Free

Domini

Sub o

Domini

Shrub

Dom

1

100

Site

North

East:

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 40

Date: 21/4/17

Observers: CR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84

☐ GDA84 (WGS84)

OTHER: refer to reg proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

M
N
1

small down hearing

Ex. ~~game of dots~~'s.
tetracants.

small down hearing

on black cracking clays

on black cracking clays

hoary-headed grebe
s/traces: in dam

Sulphur crested cockatoo ✓



Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	3
	>10cm, <15cm diameter	3
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		1
Coarse woody debris (<10cm diam.)		2
Decorticating bark		0
Leaf litter (%)		10
Bare ground (%)		0
Grass (%)		90
Soil cracks		5
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		1
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		80% of grasses 30% 80%
Rock Crevices		N
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		Y dam

Note: 0 = absent; 1 = Rare; 2 = Rare to occasional

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 4

Date: 21/4/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER: refer to veg proforma

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): _____ Regional Ecosystem Observed: _____

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

grassland on heavy black cracking clay

Habitat suitability for target fauna

[illegible]

**Incidental fauna
observations/scats/traces:**

very deep large cracks
in soil.

T crow
nestrel.



Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	>30cm diameter	—
	>15cm, <30cm diameter	—
	>10cm, <15cm diameter	—
	>5cm, <10cm diameter	—
	< 5cm diameter	—
Fallen logs (>10cm diam.)		—
Coarse woody debris (<10cm diam.)		—
Decorticating bark		—
Leaf litter (%)		—
Bare ground (%)		—
Grass (%)		100
Soil cracks		5
Soil banks (eg. River banks/road cuttings, etc.)		—
Surface Rocks and/or Boulders		—
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		✓
Weeds and non-native species (%)		90%
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent: 1 = Rare: 2 = Common: 3 = Abundant: 4 = Very Abundant: 5 = Dominant: 6 = Very Dominant: 7 = Exclusive

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 42

Date: 22/9/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

dominated by lipid.

weedy, open roadside

Habitat suitability for target fauna

[illegible]

Incidental fauna

observations/scats/traces:

rock dove ✓
indian myna ✓

maybe.

n'keone



Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		0
Coarse woody debris (<10cm diam.)		2
Decorticating bark		0
Leaf litter (%)		0
Bare ground (%)		20
Grass (%)		10
Soil cracks		7
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		
Weeds and non-native species (%)		70
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = 100%

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 44

Date: 22/4/18

Observers: ON Les

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s		Photo No/s	Other photo numbers and notes:
North:		South:	
East:		West:	

44

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

Slashed grass roadside

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
carless drgh	✓	

Incidental fauna observations/scats/traces:

emu (track)



sp list for nearby creek (offsite)
- SC cockatoo
- grey FI
- willie wagtail
- T'crow



Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter —
	>15cm, <30cm diameter —
	>10cm, <15cm diameter —
	>5cm, <10cm diameter —
	< 5cm diameter —
Fallen logs (>10cm diam.)	—
Coarse woody debris (<10cm diam.)	—
Decorticating bark	—
Leaf litter (%)	—
Bare ground (%)	10
Grass (%)	90
Soil cracks	7
Soil banks (eg. River banks/road cuttings, etc.)	drainage line
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	60%
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

older scars?
see photo

Fauna Proforma



Future Freight
Integrating Community, Environment and Engineering

Site Information

Site Name:

45 (mud) gps# 195

Date:

21/5/18

Observers:

OR + CS

LOCATION (GPS reference)

Datum:

☐

AGD84

☐

GDA94 (WGS84)

OTHER:

Plot Centre:

Zone:

Easting:

Northing:

Accuracy ____ m

Altitude:

____ m

Altitude accuracy: +/-

____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

refer to veg proforma

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped):

Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height ____ m cover ____ %

Dominant species:

Sub canopy present Y / N average height ____ m cover ____ %

Dominant species:

Shrub layer present Y / N average height ____ m cover ____ %

Dominant species:

Ground layer: cover ____ % weeds ____ % Dominant species

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

45

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	0

GPS # 0915 195

planted trees adjacent to site
E. albens
E. tereticaus

slashed roadside grassland on black cracking clay

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
What EVNT species are known from region (complete in rows below) - from database searches	Yes	No
condemned e' d'ogn ✓		

Incidental fauna observations/scats/traces:

grey miter ✓
pied bb
mudmark!
stratified road.
magpie.

in elva myna.

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	-
	>15cm, <30cm diameter	-
	>10cm, <15cm diameter	-
	>5cm, <10cm diameter	-
	< 5cm diameter	-
Fallen logs (>10cm diam.)		-
Coarse woody debris (<10cm diam.)		-
Decorticating bark		-
Leaf litter (%)		0
Bare ground (%)		10
Grass (%)		90
Soil cracks		3
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		0
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		60 30
Rock Crevices		0
Flower Abundance (%)		0
Fruit Abundance (%)		0
Water present (Y/N)		0 N

* Note: 0 = absent; 1 = Rare; 2 = Common; 3 = Abundant; 4 = Very Abundant; 5 = Dominant; 6 = Very Dominant; 7 = Exclusive

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 43

Date: 21/4/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

43

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	
Grazing	
Clearing	
Erosion	

or black cracking clay -
lighter across tracks.

Roadside grassland (disturbed).
Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
	Yes	No
What EVNT species are known from region (complete in rows below) - from database searches		
earless dragon	✓	

Incidental fauna observations/scats/traces:

T'crow



Habitat Features - Abundance:

Characteristics	Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentaria)	>30cm diameter
	>15cm, <30cm diameter
	>10cm, <15cm diameter
	>5cm, <10cm diameter
	< 5cm diameter
Fallen logs (>10cm diam.)	
Coarse woody debris (<10cm diam.)	
Decorticating bark	
Leaf litter (%)	
Bare ground (%)	10
Grass (%)	90
Soil cracks	5
Soil banks (eg. River banks/road cuttings, etc.)	0
Surface Rocks and/or Boulders	0
Wetlands (Y/N). If yes complete wetland Proforma	N
Weeds and non-native species (%)	70
Rock Crevices	0
Flower Abundance (%)	0
Fruit Abundance (%)	0
Water present (Y/N)	N

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 54

Date: 23/4/18

Observers: CR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	2

road side grassland

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

Indian myna
golden headed cisticola.
white wagtail.



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Innovating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape	
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)	0	
Coarse woody debris (<10cm diam.)	0	
Decorticating bark	0	
Leaf litter (%)	0	
Bare ground (%)	10	
Grass (%)	80	
Soil cracks	0	
Soil banks (eg. River banks/road cuttings, etc.)	0	
Surface Rocks and/or Boulders	0	
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma	N	
Weeds and non-native species (%)	90	
Rock Crevices	0	
Flower Abundance (%)	41 (herbs)	
Fruit Abundance (%)	0	
Water present (Y/N)	N	

Note: 0 = absent; 1 = 100%

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fault Site

Site Name

Date: 23/

LOCA

Datum:

Plot Cc

Altitude

Locality

VEGET

section)

General

Regiona

Remnant

STRUCT

Tree can

Dominant

Sub cand

Dominant

Shrub la

Dominant

Ground 1

Site Ph

PH

North:

East:

Fauna Proforma



Future Freight
Integrating Community, Environment and Engineering

Site Information

Site Name: 53 ^{moved} gps # 267

Date: 23/4/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

grassy river terrace

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

Superb fairy wren.
with ~~white~~ tail.
black kite.



Future Freight

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	0
	>15cm, <30cm diameter	0
	>10cm, <15cm diameter	0
	>5cm, <10cm diameter	0
	< 5cm diameter	0
Fallen logs (>10cm diam.)		0
Coarse woody debris (<10cm diam.)		0
Decorticating bark		0
Leaf litter (%)		0
Bare ground (%)		5
Grass (%)		70
Soil cracks		7
Soil banks (eg. River banks/road cuttings, etc.)		creek bank
Surface Rocks and/or Boulders		21
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		20
Rock Crevices		0
Flower Abundance (%)		20 herbs.
Fruit Abundance (%)		0
Water present (Y/N)		Y creek

* Note: 0 = absent; 1 = Rare; 2 = Common

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

dog (scat.)

Faur Site In

Site Name:

Date: 23/1/20

LOCATIO

Datum:

Plot Centre

Altitude:

Locality De

VEGETA
section)

General De

Regional E

Remnant /

STRUCTURE

Free canopy

Dominant

Sub canopy

Dominant

Shrub layer

Dominant

Ground la

Site Photo

North:

East:

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 52

Date: 3/4/18

Observers: OR & CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA84 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s	Photo No/s
North:	South:
East:	West:

Other photo numbers and notes:

52

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	0.

Habitat suitability for target fauna

Species (EVNT) known from Region	Suitable habitat present	
	Yes	No
What EVNT species are known from region (complete in rows below) - from database searches		
car-leers dgn	✓	

Incidental fauna

observations/scats/traces:

black faced c s

kestrel

yellow-rumped TIB

sparrow.

c/ pigeon.

willy wagtail.



Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics	Abundance (0-7)* or % within landscape	
Hollows in trees and stags. (May include hollows in termentartia)	>30cm diameter	—
	>15cm, <30cm diameter	—
	>10cm, <15cm diameter	—
	>5cm, <10cm diameter	—
	< 5cm diameter	—
Fallen logs (>10cm diam.)	—	
Coarse woody debris (<10cm diam.)	—	
Decorticating bark	—	
Leaf litter (%)	—	
Bare ground (%)	—	
Grass (%)	100	
Soil cracks	7	
Soil banks (eg. River banks/road cuttings, etc.)	0	
Surface Rocks and/or Boulders	0	
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma	N	
Weeds and non-native species (%)	80	
Rock Crevices	0	
Flower Abundance (%)	0	
Fruit Abundance (%)	0	
Water present (Y/N)	0	
creek nearby	✓	

* Note: 0 = absent; 1 = Rare

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

eastern roseola
pink-headed

Fauna Site

Site Name

Date: 23

LOCALITY

Datum:

Plot Cent

Altitude

Locality

VEGETATION

General

Regional

Remnant

STRUCTURE

Tree can

Dominant

Sub can

Dominant

Shrub la

Dominant

Ground

Site Plan

North:

East:

Fauna Proforma

Site Information



Future Freight
Integrating Community, Environment and Engineering

Site Name: 55

Date: 23/9/18

Observers: OR + CS

LOCATION (GPS reference)

Datum: ☐ AGD84 ☐ GDA94 (WGS84) OTHER:

Plot Centre: Zone: _____ Easting: _____ Northing: _____ Accuracy _____ m

Altitude: _____ m Altitude accuracy: +/- _____ m

Locality Description (e.g. proximity to roads, towns, creeks etc.):
.....

VEGETATION (Note: If a site specific vegetation assessment proforma has been completed, ignore this section)

General Description (e.g. Open woodland on alluvium):
.....

Regional Ecosystem (mapped): Regional Ecosystem Observed:

Remnant / Non-remnant (circle)

STRUCTURE

Tree canopy present Y / N average height _____ m cover _____ %

Dominant species:

Sub canopy present Y / N average height _____ m cover _____ %

Dominant species:

Shrub layer present Y / N average height _____ m cover _____ %

Dominant species:

Ground layer: cover _____ % weeds _____ % Dominant species _____

Site Photos

Photo No/s

Photo No/s

Other photo numbers and notes:

North:

South:

East:

West:

Fauna Proforma

Habitat characteristics

Habitat Disturbance

Disturbance type	Severity 0-3 (0=nil, 3=severe)
Fire	0
Grazing	0
Clearing	3
Erosion	1

slashed roadside grassland.	5
Erosion	1

on dark brown loam

Habitat suitability for target fauna

[illegible]

Incidental fauna
observations/scats/traces:

willie wagtail.
meat ants.
leestrel.



Future Freight
Integrating Community, Environment and Engineering

Habitat Features – Abundance:

Characteristics		Abundance (0-7)* or % within landscape
Hollows in trees and stags. (May include hollows in <i>termentartia</i>)	>30cm diameter	—
	>15cm, <30cm diameter	—
	>10cm, <15cm diameter	—
	>5cm, <10cm diameter	—
	< 5cm diameter	✓
Fallen logs (>10cm diam.)		—
Coarse woody debris (<10cm diam.)		—
Decorticating bark		—
Leaf litter (%)		—
Bare ground (%)		5
Grass (%)		95
Soil cracks		0
Soil banks (eg. River banks/road cuttings, etc.)		0
Surface Rocks and/or Boulders		4
Wetlands (Y/N). If <u>yes</u> complete wetland Proforma		N
Weeds and non-native species (%)		80
Rock Crevices		0
Flower Abundance (%)		herbs < 1
Fruit Abundance (%)		0
Water present (Y/N)		N

* Note: 0 = absent; 1 = ...

* Note: 0 = absent; 1 = Rare; 2 = Rare to occasional; 3 = occasional; 4 = occasional to common; 5 = common; 6 = common to abundant; 7 = abundant

Fau Site I

Site Name

Date: ... / ... / ...

LOCAT

Datum:

Plot Cent

Altitude:

Locality 1

VEGETA

section)

General D

Regional

Remnant

STRUCTURE

Dominant

Sub cano

Dominant

Shrub layer

Dominan

Ground I

Site Ph

PH

North:

East:

APPENDIX

L

Terrestrial and Aquatic Ecology Technical Report

Appendix F Survey adequacy

BORDER TO GOWRIE REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
MNES and MSES Listed Birds						
Australasian bittern <i>(Botaurus poiciloptilus)</i>	EN	EN	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017). <			

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
Australian painted snipe <i>(Rostratula australis)</i>	EN	EN	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	Area searches and transect should be conducted throughout suitable wetlands, with detection either by sighting or flushing. Targeted stationary observations should be conducted at dawn and dusk in suitable foraging habitat. Additionally, a brief spotlight survey may be beneficial after dusk. Land-based area searches / line transects for sites less than 50 ha when the wetland holds water should be conducted for 10 hours over 3 days. Targeted stationary observations should be conducted for 10 hours over 5 days.	Camera trap – 51 traps for 4 nights across 6 sites (surveyed twice). <i>Total hours: 2,448 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	The survey effort included area searches, habitat assessments and diurnal searches in suitable wetlands. Area searches did not exceed the 10 hours over 3 days requirement. The dawn and dusk survey effort do not meet the targeted stationary observations of 10 hours over 5 days. Spotlighting surveys were undertaken during the survey effort however these did not target bird species and are therefore not considered in the Australian painted snipe survey effort. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is partially adequate for detecting Australian painted snipe due to survey hours almost meeting the required effort in suitable habitat.</i>
					Area searches – 8 hours for 5 days at 6 sites (surveyed twice). <i>Total: 96 hours</i>	
					Diurnal searches – 4 hours for 5 days at 6 sites (surveyed twice). Total: 48 hours	
					Habitat assessments – 4 hours at 6 sites (surveyed twice). <i>Total: 48 hours</i>	
					Dawn survey – 4 hours for 2 days at 6 sites (surveyed twice). <i>Total: 48 hours</i>	
					Dusk survey – 4 hours for 2 days at 6 sites (surveyed twice). <i>Total: 48 hours</i>	
Black-breasted button-quail <i>(Turnix melanogaster)</i>	VU	VU	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	Species is typically detected by observation of birds flushed out from an area after disturbance such as walking through long grass. Area searches of suitable habitat with detection of flushed birds. Land-based area searches in areas of less than 50 ha should be conducted for 15 hours over 3 days. Species may be indirectly detected by distinctive foraging platelets identified in leaf litter.	Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	Area searches did not exceed the 15 hours over 3 days requirement. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is not adequate for detecting black-breasted button-quail due to area searches not meeting the required survey effort. Additional area searches will be required to meet survey adequacy.</i>
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i>	
					UniSQ baited camera traps – 100 traps spaced 2 km apart along	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Curlew sandpiper <i>(Calidris ferruginea)</i>	CE	CE, Mi, Ma	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017). Industry guidelines for avoiding, assessing, and mitigating impacts on EPBC Act listed migratory shorebird species (DoE 2017)	There are no species-specific survey guidelines for the curlew sandpiper, however recommended general techniques include: - Observations from vantage points over suitable foraging or roosting habitat, using binoculars or telescopes conducted at appropriate periods of the tidal cycle; - Transect surveys by boat around offshore islands, lakes, coastlines and rivers; - Aerial surveys over large foraging habitat at appropriate periods of the tidal cycle; - Diurnal surveys in appropriate habitat, including flushing surveys; and - Count surveys during the non-breeding season (September to March). Survey coverage in tidal areas should include the entire area of contiguous habitat where the shorebirds may occur, as well as all of the habitat used by the same population of shorebirds. Surveys for migratory shorebirds should be conducted during the months when majority of shorebirds are in the area (typically September to March), as well as during the northern hemisphere breeding season (mid-April to mid-August) for non-breeding population extents. Survey timing and effort for roosting shorebirds: - Timing – as close to time of high tide as possible, and at a maximum of no more than 2 hours either side of high tide. - Surveys must be undertaken during dry periods and low winds. - Surveys must only be undertaken during times of no disturbance (i.e., development activities).	Camera traps – 51 traps for 4 nights across 6 sites (surveyed twice). <i>Total hours: 2,448 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Area searches – 8 hours over 5 days at 6 sites (surveyed twice). <i>Total: 96 hours</i> Diurnal searches – 4 hours over 5 days at 6 sites (surveyed twice). Total: 48 hours Habitat assessments – 4 hours at 6 sites (surveyed twice). <i>Total: 48 hours</i>	As there are no species-specific guidelines for curlew sandpiper, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting Curlew Sandpiper.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				- Survey effort – four surveys during the period when most shorebirds are in the area (September to March), with replicate surveys required. Generally, one survey in December, two surveys in January, and one survey in February will be adequate to fulfil this requirement. Survey timing and effort for foraging shorebirds: - Timing – as close to time of low tide as possible, and at a maximum of no more than 2 hours either side of low tide. - Survey effort – four surveys including two surveys at spring low tide and two surveys at neap low tide. As well as one survey during the northern hemisphere breeding season (mid-April to mid-August).	Bird surveys – total of 14.6 hours over 44 sites Dawn survey – 4 hours over 2 days at 6 sites (surveyed twice). <i>Total: 48 hours</i> Dusk survey – 4 hours over 2 days at 6 sites (surveyed twice). <i>Total: 48 hours</i>	
Painted honeyeater <i>(Grantiella picta)</i>	VU	VU	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no national species-specific survey guidelines for the painted honeyeater, however recommended general techniques for most honeyeaters include: - Diurnal area searches or transect-point surveys in favoured habitat; and - Diurnal transect surveys along watercourses or roads.	Call playback – 5 hours over 5 days at 8 sites (surveyed twice). <i>Total: 80 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 8 sites (surveyed twice). <i>Total: 1,280 minutes</i>	As there are no species-specific guidelines for painted honeyeater, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys.

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
			Targeted Species Survey Guidelines - Painted honeyeater, (<i>Grantiella picta</i>) (DES, n.d (a))	Diurnal bird surveys involve 100 x 100 m survey plots, by one observer for 5 minutes, with at least 6 replicates during the survey period. Typically, diurnal bird surveys are spread out over different days, and should be conducted twice 2 hours after sunrise, twice in mid-morning (2-4 hours after sunrise) and twice during periods 4 hours after sunrise and 2 hours before sunset. Queensland guidelines for the species include on-foot area searches during the breeding season, specifically targeting foraging and breeding habitat (woodlands with abundant mistletoe). Area searches should be undertaken for a minimum of 4 hours over 4 days, per 50 ha of suitable habitat areas.	Dawn survey – 4 hours over 2 days at 8 sites (surveyed twice). <i>Total: 64 hours</i> Dusk survey – 4 hours over 2 days at 8 sites (surveyed twice). <i>Total: 64 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 8 sites (surveyed twice). <i>Total: 128 hours</i> Diurnal searches – 4 hours over 5 days at 8 sites (surveyed twice). <i>Total: 96 hours</i> Habitat assessments – 4 hours at 8 sites (surveyed twice). <i>Total: 64 hours</i> Camera traps – 225 traps for 4 nights at 8 sites (surveyed twice). <i>Total: 14,400 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, being within the species breeding season. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting painted honeyeater.</i>
Red goshawk <i>(Erythrotriorchis radiatus)</i>	EN	VU	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as	Area searches in sub-coastal woodland, ground searches along riverbanks for nests within the tallest trees. Area searches should be undertaken for 80	Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 160 hours</i>	Area searches were undertaken in all survey sites across the Project footprint. The survey effort did not focus on detecting nests, and therefore the area

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
			threatened under the EPBC Act (DEWHA 2017).	hours over 10 days (for one nest). In areas of 50 ha, survey effort is reduced to 50 hours over 8 days. Vehicle transects can be conducted by driving slowly through tropical woodland tracks and scanning tall trees for nests. Soaring birds can be detected from high vantage points.	Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	search effort does not meet the required effort to find one nest (50 hours over 8 days). Additional surveys were undertaken including dawn and dusk surveys, bird surveys, diurnal surveys, camera traps and call playback. Quantifiable vehicle transects were not conducted; however, nests and individuals were searched for while driving at and between sites and near significant watercourses. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is partially adequate for detecting red goshawk due to the extent of general bird surveys completed during the two survey periods. The primary recommended survey method of searching for nests cannot be confidently deemed as adequate due to the lack of quantification of driving while observing for nests and soaring birds. This likely would have met the survey requirements had it been quantified as contributing towards survey efforts conducted by Cardno.</i>
Regent honeyeater <i>(Anthochaera phrygia)</i>	CE	CE	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	Area searches in suitable habitat during the morning, detection is generally by sighting. The survey effort guide for area searches in areas of less than 50 ha is 20 hours over 10 days. Targeted searches of woodland patches where heavily flowering trees are present. These searches should	Dawn survey – 4 hours for 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice).	Area searches were undertaken in all survey sites across the Project footprint; however, do not meet the requirement for 20 hours over 5 days. The species was not targeted during the survey period, however general bird

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				be conducted nearby waterbodies (i.e., dams and creek lines) with a survey effort of 20 hours over 5 days). Detection may be possible by call during the non-breeding season.	<i>Total: 96 hours</i>	surveys including dawn and dusk surveys were undertaken. These surveys, however, do not meet the required survey effort. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is not adequate for detecting regent honeyeater due to area searches, and dawn and dusk surveys not meeting the required survey effort.</i>
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i>	
					UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
Squatter pigeon (southern) <i>(Geophaps scripta scripta)</i>	VU	VU	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	Area searches or transect surveys in suitable habitat for 15 hours over 3 days in areas less than 50 ha. Flushing surveys in suitable habitat for 10 hours over 3 days in areas less than 50 ha.	Dawn survey – 4 hours over 2 days at 9 sites (surveyed twice). <i>Total: 72 hours</i>	Area searches were undertaken for 8 hours over 5 days, not meeting the requirement for 15 hours over 3 days. However, active diurnal searches bring this closer to the requirement for areas less than 50 ha, totaling 12 hours over 5 (or more) days at 9 sites. Additional surveys were undertaken including dawn and dusk surveys targeting birds, and bird surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021.
					Dusk survey – 4 hours over 2 days at 9 sites (surveyed twice). <i>Total: 72 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 9 sites (surveyed twice).	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					<i>Total: 144 hours</i>	<i>Survey effort is considered adequate for detecting squatter pigeon (southern) as additional bird surveys were undertaken in suitable habitat for the species.</i>
					Diurnal searches – 4 hours over 5 days at 9 sites (surveyed twice). <i>Total: 72 hours</i>	
					Habitat assessments – 4 hours at 9 sites (surveyed twice). <i>Total: 72 hours</i>	
					Camera traps – 148 traps for 4 nights at 9 sites across the two survey periods. <i>Total:10,656 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Swift parrot <i>(Lathamus discolor)</i>	EN	CE, Ma	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	Area searches or transect surveys within the species' suitable habitat. Surveys should be undertaken during the early morning and afternoon when the species is most active / vocal. Area or transect surveys in areas less than 50 ha should be undertaken for 20 hours over 8 days. Additionally, vehicle transects may be beneficial in detecting the species call, particularly in large, expansive areas. Targeted surveys should be undertaken in patches of heavily flowering eucalypts, surveying for 20 hours over 8 days. All surveys on the Australian mainland should be conducted between March and July.	Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	Area searches were undertaken in all survey sites across the Project footprint; however, do not meet the requirement for 20 hours over 5 days. The species was not targeted during the survey period, however general bird surveys including dawn and dusk surveys were undertaken. These surveys, however, do not meet the required survey effort. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, bordering the optimal time for species detection. <i>Survey effort is not adequate for detecting swift parrot due to area searches and dawn and dusk surveys</i>
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	<i>not meeting the survey effort requirement.</i>
MNES and MSES Listed Bats						
Large-eared pied bat <i>(Chalinolobus dwyeri)</i>	EN	VU	Survey Guidelines for Australia's Threatened Bats (DEWHA 2010)	Prior to undertaking surveys, rocky outcrops, caves and mines within the area should be identified through a desktop assessment. Field surveys should include: - Passive acoustic detection – recorders to be placed near mines, rocky outcrops, caves and foraging habitat. Unattended detectors should be left overnight at multiple locations, with a total 16 detector nights over a minimum of 4 nights in areas less than 50 ha. - Active acoustic detection – walking or driving transects using hand-held detectors. Transects should begin at dusk and be carried out for 6 detector hours over a minimum of 3 nights in areas less than 50 ha. - Roost searches – ground-based surveys for caves, mines, rock overhangs and crevices should be undertaken over several days. - Harp trapping and mist-net trapping – set overnight in forest flyways and riparian zones, near scarps and cliffs. Traps should be set for 16 trap or net nights over a minimum of 4 nights in areas less than 50 ha.	Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	Field surveys included acoustic surveys by two consultancies, for a combined total of 1,170 detector nights, exceeding the 16 detector nights over 4 nights requirement for areas of habitat <50 ha. Attended bat detector surveys were conducted for 4 hours over 4 nights, totaling 96 hours and exceeding the requirement. Harp-trapping was undertaken by two consultancies, for a combined total of 1,209 nights, exceeding the 16 trap nights over 4 nights requirement for areas of habitat <50 ha. Additional surveys were conducted, including habitat assessments, camera trapping, diurnal searches, spotlighting and area searches to detect the species. Surveys were undertaken between 19 October and 11 November 2020, 8 – 27 March 2021, and 17 March to 3 April 2023, being the optimal time to detect the species.
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Camera traps – 149 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 11,920 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Harp traps – 15 harp traps for 4 nights at 12 sites (surveyed twice). <i>Total: 1,200 nights</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				A combination of the above survey methods is optimal for detecting the species. Surveys are best conducted from October to March.	Harp traps (BAAM) – a total of 95 harp traps over 25 locations, for 5 nights on the offset property and 9 nights in Bringalily State Forest. Undertaken from 17 March to 3 April 2023.	Survey effort is considered adequate for detecting large-eared pied bat.
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Spotlighting – 2 x 200 m transects at 10 sites (surveyed twice). <i>Total: 40 x 200 m transects</i>	
					Unattended bat detectors – 14 for 4 nights at 10 sites (surveyed twice). <i>Total: 1,120 detector nights</i>	
					Unattended bat detectors (BAAM) – a total of 13 acoustic recorders for 2-6 nights were located across the offset property, B2G study area and Bringalily State Forest. <i>Total: 50 bat detector nights.</i>	
					Attended bat detectors – 4 hours over 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	
South-eastern long-eared bat <i>(Nyctophilus corbeni)</i>	VU	VU	Survey Guidelines for Australia's Threatened Bats (DEWHA 2010)	Prior to undertaking surveys, a desktop assessment should determine the trapping effort through researching digital aerial photography of the Project Area for vegetation remnants. Field surveys should include:	Area searches – 8 hours over 5 days at 10 sites (surveyed twice). <i>Total: 160 hours</i>	The survey effort included attended and unattended bat detectors and harp trapping by two consultancies. Despite being included in the survey guidelines; the relevance of attended and unattended acoustic bat detectors is limited due to calls of <i>Nyctophilus</i>
					Diurnal searches – 4 hours over 5 days at 10 sites (surveyed twice). <i>Total: 80 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Additional habitat assessments and opportunistic observations at 10 sites.	
MNES and MSES Listed Mammals						
Brush-tailed rock-wallaby <i>(Petrogale penicillata)</i>	VU	VU	Survey Guidelines for Australia's Threatened Mammals (DSEWPC 2011a) Species Profile and Threats Database: <i>Petrogale penicillata</i> — Brush-tailed Rock-wallaby (DoE 2023).	In areas up to 5 ha in size, the following techniques are recommended: - Baited camera trapping – cameras should be located at a water source, near refuge exists and known shelter sites. Camera traps should be baited with lucerne. - Daytime searches for shelter sites, escarpment and cliff-line habitats, activity (i.e., tracks, scats and rock shelters worn smooth from resting) and basking/active wallabies, conducted on ground beneath suitable habitat using binoculars and are best undertaken at down or dusk. Daytime observations should not be undertaken during summer or in hot weather. - Detection of predator scats, owl casts or remains, with specific focus on predatory bird/mammal nests/dens. Surveys should be undertaken by a minimum of 2 experienced investigators.	Diurnal searches – 2 x 100 m transects for 5 days at 12 sites (surveyed twice). <i>Total: 48 x 100 m transects.</i>	The survey effort consisted of camera trapping in all survey sites across the Project footprint, for a total of 960 trap nights. Area searches were undertaken for a total of 960 hours by two suitably qualified personnel. Additionally, habitat assessments were conducted in all survey sites across the Project footprint to determine suitable habitat for the species. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting brush-tailed rock-wallaby.</i>
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Greater glider (southern and central) <i>(Petauroides volans)</i>	EN	VU	Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022) Guide to greater glider habitat in Queensland (Eyre et al., 2022) Survey Guidelines for Australia's Threatened	Requires two 30-person minute spotlight searches of 100 x 100 m survey site across multiple nights. This can include spotlighting up one side of the 100 x 100 m area and then spotlighting back the other side of the 100 x 100m area. Scat and sign search can coincide with the systematic diurnal active searches, within 50 x 50 m quadrates of the survey site. It is recommended that counting of hollow bearing trees is replaced with counting large trees due to	Spotlighting – 2 x 200 m transects at 4 sites (surveyed twice). <i>Total: 16 x 200 m transects</i>	Cardno spotlighting efforts were undertaken in suitable habitat, consisting of 2 x 200 m transects, with a total of 16 transects conducted throughout the two survey periods. Additionally, habitat assessments, area searches, stag watching, diurnal searches were conducted to detect the species or species habitat.
					Stag watching – 40 minutes before dusk and 40 minutes after dusk for 2 nights at 4 sites (surveyed twice). <i>Total: 1,280 minutes</i>	
					Habitat assessment – 4 hours at 4 sites (surveyed twice).	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
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			Mammals (DSEWPC, 2011a)	large observer bias in estimating hollow-bearing trees.	<i>Total: 32 hours</i>	Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Further targeted greater glider habitat assessment and spotlighting surveys were conducted from 18 – 22 December 2023. These habitat assessment surveys collected specific data to assess habitat according to the Guide to greater glider habitat in Queensland (Eyre et al., 2022). <i>Survey effort is considered adequate for detecting greater glider (southern and central).</i>
			Regional habitat selection of large gliding possums at forest stand and landscape scales in southern Queensland, Australia I. Greater glider (<i>Petauroides volans</i>) (Eyre, 2006) T. Eyre pers. comm. (2024)	Bright nightlight lowers the detectability of greater gliders (Eyre, 2006). Spotlighting should include (at a minimum) two 200 m transects per 5 ha sites, with 100 m spacing between survey transects.	Area searches – 8 hours over 5 days at 4 sites (surveyed twice). <i>Total: 64 hours</i>	
				Guidelines in Queensland are currently being reviewed and longer transects are now recommended (e.g., 300 m x 30 m).	Diurnal searches – 2 x 100 m transects over up to 5 days at 4 sites (surveyed twice). <i>Total: 16 x 100 m transects.</i>	
					Camera traps – 46 traps for 4 nights at 4 sites across the two survey periods. <i>Total: 1,472 trap nights</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	
					Targeted habitat assessments – 2 x 13 sites + 4 additional using updated habitat assessment methodology as per Eyre et al. (2022). <i>Total: 30 habitat assessments</i>	
					Targeted spotlighting – 1 x 200 m transect at 13 sites. <i>Total: 13 x 200 m transects</i>	
				Koala (<i>Phascolarctos cinereus</i>)	EN	
Genetic analysis – 1 sample per site for 36 sites. <i>Total: 36 samples</i>						
Koala Rapid Assessment Method – 35 sites.						

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				- Remote sensor activated cameras in areas where fresh scats and/or scratchings have been detected; - Mark-resight or mark-recapture; - Detection dogs; and - Radio or satellite collars. Indirect observations: - Scratchings; - Spot Assessment Technique (SAT); - Scats – Regularised grid based SAT; - Scats – Koala optimised Rapid assessment methodology; and - Faecal standing crop assessment.	Spotlighting – 2 x 200 m transects at 12 sites (surveyed twice). <i>Total: 48 x 200 m transects.</i> Habitat assessment – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Diurnal searches – 2 x 100 m transects for 5 days at 12 sites (surveyed twice). <i>Total: 48 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). UniSQ Koala capture and tagging – 34 Koalas captured and tagged UniSQ Scat collection and SNA metabarcoding – 30 scat samples collected Additional habitat assessments and opportunistic observations at 10 sites.	Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Species was recorded during the field surveys. <i>Survey effort is considered adequate for detecting Koala.</i>
Spotted-tailed quoll (SE mainland population) <i>(Dasyurus maculatus maculatus)</i>	EN	EN	Survey Guidelines for Australia's Threatened Mammals (DSEWPC 2011a)	Sampling units of 100 ha are most appropriate due to the species large home ranges. Spotted-tailed quoll (SE mainland population) surveys should be	Spotlighting – 2 x 200 m transects at 12 sites (surveyed twice). <i>Total: 48 x 200 m transects</i>	The surveys consisted of hair tube trapping; however, these were not deployed for the recommended 14 consecutive days.

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				conducted during the species breeding season, being April to August. The following survey techniques are recommended for the spotted-tailed quoll (SE mainland population): - Daytime searches in areas of suitable habitat for den sites, activity, scats and latrines. - Hair sampling devices (hair funnel) surveys – placed 100 m apart and using a mixture of sardines, tuna oil and flour for bait. Hair funnels are to be set for a minimum of 14 consecutive nights. - Remote camera trapping – two cameras should be placed per 100 ha (i.e., 500 m apart, S. Burnett pers. comm., 2024) and left for a minimum of three weeks.	Habitat assessment – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Diurnal searches – 2 x 100 m transects for 5 days at 12 sites (surveyed twice). <i>Total: 48 hours</i> Hair tube traps – 20 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 1,920 hair tube nights.</i> Elliot (b) / cage traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 trap nights.</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	Camera trapping was undertaken during the two survey periods; with additional UniSQ baited camera trapping deployed for consecutive months since mid-2023. Additionally, the surveys consisted of spotlighting, habitat assessments, Elliot / cage trapping, area and diurnal searches, although it is noted that these are poor at detecting spotted-tailed quolls. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, being outside the recommended survey timeframe. However, it is noted that detections of males during the breeding season may occur in areas that are not considered habitat due to their very wide-ranging behaviour during this time. <i>Survey effort is not adequate for detecting spotted-tailed quoll due to hair-tube trapping and camera trapping not meeting the survey effort requirement.</i>
MNES and MSES Listed Reptiles						
Collared delma <i>(Delma torquata)</i>	VU	VU	Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011b)	Effective survey methods include: - Active searches – during warm conditions. Optimal survey times include early morning	Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	The field surveys consisted of diurnal searches for 3 hours over 5 days at

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
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			Species profile and threats database – Delma torquata (Collared delma) (DoE 2023) Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c)	(within 4 hours of dawn) and during the evening on warm nights; - One-off hand searches (including raking through leaf litter) in appropriate habitats; and - Turning rocks and logs / timber. Surveys for Collared Delma should be conducted for a minimum over three days, with at least one replicate survey employing <u>all</u> of the recommended techniques if the species has not yet been detected. Effective survey methods include: - One-off diurnal searches – searching microhabitats, turning woody debris, rocks, raking the surface soil or leaf litter beneath trees, etc. Surveys should be conducted during the coolest part of the day, for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Tile grids – grids of 50 tiles placed at 5 m intervals in suitable habitats. A minimum of 2 grids should be used for sites less than 2 ha in size; 1 grid per 2 ha for sites up to 40 ha and 20 grids for sites greater than 40 ha. Tile grids should be trialled as a supplementary method, as species may take up to 6 months to move in.	Pitfall trapping – 4 pitfall traps 4 nights at 3 sites (surveyed twice). <i>Total: 96 pitfall trap nights.</i> Funnel traps – 16 funnel traps for 4 nights at 4 sites (surveyed twice). <i>Total: 512 funnel trap nights.</i> Reptile monitoring trap grids – 1 grid of traps per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i> Diurnal searches – 3 hours over 5 days at 4 sites (surveyed twice). <i>Total: 24 hours</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	numerous sites, exceeding the required 1.5 hours over 4 days. The surveys further consisted of pitfall trapping, funnel trapping and habitat assessments. Artificial habitat trap grids have been deployed at 20 sites since mid-2023, with four collared delma recorded at 2 sites, under timber carpet and tin, approximately 14 km from the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is adequate for detecting collared delma based on hours searched.</i>
Condamine (Darling Downs) earless dragon <i>(Tymanocryptis condaminensis)</i>	EN	EN	Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC, 2011c) J.P. Emery pers. comm. (2024)	There are no species-specific survey guidelines for Condamine earless dragon, however, effective surveys include: - One-off diurnal searches – searching microhabitats, turning woody debris, rocks, raking the surface soil or leaf litter beneath trees, etc. Surveys should be conducted	Artificial burrows – 58 traps across 2 target sites, 6 trap nights per site. <i>Total: 969 trap nights</i> Pitfall traps – 6 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 576 trap nights</i>	Survey effort is adequate for the Condamine earless dragon as diurnal searches were undertaken in accordance with the Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c), as well as additional surveys conducted.

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
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				during mid-morning (8:30 am – 12:30 pm), however this is temperature dependent, for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Driving / walking transects – driving roads at a slow pace (e.g., 5 km/hr driving speed) whilst looking for basking / foraging individuals. Driving and walking transects should be undertaken during mid-morning (8:30 am – 12:30 pm), however this is temperature dependent. Whilst an effective method, this is not an officially established survey method.	Funnel traps – 2 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 192 trap nights</i> Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i> Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 960 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 192 hours</i> Diurnal searches – 3 hours over 5 days at 12 sites (surveyed twice). <i>Total: 72 hours</i> Spotlighting – 6 hours over 4 nights at 12 sites (surveyed twice). <i>Total: 144 hours</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. The species has been recorded on numerous occasions (58 records) since the September 2023 survey. <i>Survey effort is considered adequate for detecting Condamine earless dragon.</i>
Dunmall's snake <i>(Furina dunmalli)</i>	VU	VU	Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011b)	There are no survey methods known to reliably detect the species, however the recommended survey techniques include:	Pitfall traps – 10 traps for 4 nights at 7 sites (surveyed twice). <i>Total: 560 trap nights</i>	The survey effort consisted of diurnal searches for 3 hours over 5 days, totaling 42 hours across the two survey

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
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			Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c)	- One-off diurnal searches – searching microhabitats, turning woody debris, rocks, raking the surface soil or leaf litter beneath trees, etc. Surveys should be conducted during the coolest part of the day, for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Spotlighting – targeting water-inundated gilgais, wetlands, riparian habitats and roads between dusk and early morning hours. These surveys are most effective on warm, humid evenings and should be conducted for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Transect surveys – transects strategically designed and positioned in large habitat patches of more than 10 ha. - Opportunistic road surveys – actively searching for reptiles whilst driving along roads, particularly following heavy rain events and during warm evenings. - Pitfall and funnel trapping – six 20 L (500 mm deep) buckets evenly distributed under a 30 m drift fence in optimal microhabitats. At least 2 replicates should be conducted per habitat type, checking the traps every morning and evening over four days.	Funnel traps – 20 traps for 4 nights at 7 sites (surveyed twice). <i>Total: 1,120 trap nights</i> Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i> Area searches – 8 hours over 5 days at 7 sites (surveyed twice). <i>Total: 112 hours</i> Habitat assessments – 4 hours at 7 sites (surveyed twice). <i>Total: 56 hours</i> Diurnal searches – 3 hours over 5 days at 7 sites (surveyed twice). <i>Total: 42 hours</i> Spotlighting – 6 hours over 4 nights at 7 sites (surveyed twice). <i>Total: 84 hours</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	periods, and therefore, exceeding the 1.5 hours over 3 days requirement. Spotlighting was undertaken for 6 hours over 4 nights, totaling 84 hours across the two survey periods, and therefore, exceeding the 1.5 hours over 3 days requirement. Pitfall trapping and funnel trapping was conducted, with 10 pitfall traps and 20 funnel traps for 4 nights, totaling 560 pitfall trap nights and 1,120 funnel trap nights. The pitfall traps and funnel traps were placed in suitable habitat, with 6 pitfalls placed along a 30 m drift fence. Grid traps have been deployed at 20 sites since mid-2023. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting Dunmall's snake.</i>
Five-clawed worm-skink (<i>Anomalopus mackayi</i>)	EN	VU	Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011)	Effective surveys include:	Pitfall traps – 8 traps for 4 nights at 6 sites (surveyed twice).	The survey effort consisted of diurnal searches for 3 hours over 5 days,

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			Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c)	- One-off diurnal searches – searching microhabitats, turning woody debris, rocks, raking the surface soil or leaf litter beneath trees, etc. Surveys should be conducted during the coolest part of the day, for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Hay bale plots – hay bales deployed in suitable habitat, in 4 m x 4x fenced plots over a long period (6 months), periodically checking underneath.	<i>Total: 284 trap nights</i> Funnel traps – 16 traps for 4 nights at 6 sites (surveyed twice). <i>Total: 768 trap nights</i> Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i> Area searches – 8 hours over 5 days at 8 sites (surveyed twice). <i>Total: 640 hours</i> Habitat assessments – 4 hours at 8 sites (surveyed twice). <i>Total: 128 hours</i> Diurnal searches – 3 hours over 5 days at 8 sites (surveyed twice). <i>Total: 48 hours</i> Spotlighting – 6 hours over 4 nights at 8 sites (surveyed twice). <i>Total: 96 hours</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	totaling 48 hours across the two survey periods, and therefore, exceeding the 1.5 hours over 3 days requirement. Additional surveys including spotlighting, pitfall and funnel trapping, area searches and habitat assessments were undertaken to detect the species. Hay bale plots were not deployed; however, 20 reptile monitoring grids were placed across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting five-clawed worm-skink.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
Yakka skink (<i>Egernia rugosa</i>)	VU	VU	Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011) Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPC 2011c) Targeted Species Survey Guidelines – Yakka Skink (<i>Egernia rugosa</i>) (DES, n.d (b)).	Effective surveys include: - One-off diurnal searches – searching microhabitats, turning woody debris, rocks, raking the surface soil or leaf litter beneath trees, etc. Surveys should be conducted during the coolest part of the day, for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Spotlighting – targeting water-inundated gilgais, wetlands, riparian habitats and roads between dusk and early morning hours. These surveys are most effective on warm, humid evenings and should be conducted for a minimum of 1.5 person hours per hectare, over a minimum of 3 days. - Transect surveys – transects strategically designed and positioned in large habitat patches of more than 10 ha. - Elliot and cage trapping – Colony sites through diurnal surveys in suitable habitat should be targeted. One large Elliot-style trap (15.5 cm x 15 cm x 46 cm) and one cage trap places as close as possible to burrow entrances. At least 2 replicates should be conducted per habitat type, checking the traps every morning and evening over four days.	Pitfall traps – 5 traps for 4 nights at 3 sites (surveyed twice). <i>Total: 120 trap nights</i>	The survey effort consisted of diurnal searches for 3 hours over 5 days, totaling 24 hours across the two survey periods, and therefore, exceeding the 1.5 hours over 3 days requirement. Spotlighting was undertaken for 6 hours over 4 nights, totaling 48 hours across the two survey periods, and therefore, exceeding the 1.5 hours over 3 days requirement. Elliot / cage trapping was deployed where presence of yakka skink burrows within a survey site was known or suspected. 20 reptile monitoring grids were placed across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting yakka skink.</i>
					Funnel traps – 10 traps for 4 nights at 3 sites (surveyed twice). <i>Total: 240 trap nights</i>	
					Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i>	
					Area searches – 8 hours over 5 days at 4 sites (surveyed twice). <i>Total: 320 hours</i>	
					Habitat assessments – 4 hours at 4 sites (surveyed twice). <i>Total: 64 hours</i>	
					Elliot traps (a) – 20 traps for 4 nights at 4 sites (surveyed twice).	
					Diurnal searches – 3 hours over 5 days at 4 sites (surveyed twice). <i>Total: 24 hours</i>	
					Spotlighting – 6 hours over 4 nights at 4 sites (surveyed twice). <i>Total: 48 hours</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	
MNES and MSES Snails						
Brigalow woodland snail <i>(Adclarkia cameroni)</i>	VU	EN	Conservation Advice <i>Adclarkia cameroni</i> brigalow woodland snail (TSSC 2016a)	There are no formal survey guidelines for this species. The species conservation advice provides effective survey techniques include nocturnal spotlighting and turning logs and raking accumulated leaves. Surveys for live individuals should be conducted during October to March, particularly following storm and rain events. Shells of dead individuals can be detected at any time of the year (C. Eddie pers. comm., 2024). Adequate survey effort for the species is two person-hours targeting areas of favourable microhabitat.	Targeted searches (Boobook) – total of 5 days covering 20 sites. Each site searched for a minimum of 2 person hours or until all microhabitat areas had been searched (in <2 person hours).	The survey effort consisted of targeted species searches, area searches, habitat assessments and microhabitat assessments. Surveys were undertaken by Cardno between 19 October and 11 November 2020 and 8 – 27 March 2021 being within the optimal survey timeframe for the species. Targeted searches and microhabitat assessments by land snail specialists from Boobook were undertaken from 22 – 26 August 2022; and whilst not the optimal survey timeframe for detecting live individuals, survey conditions onsite were favourable for the species. Both live and dead individuals were detected during these surveys. Brigalow woodland snail was detected at 11 out of 20 sites during targeted searches conducted by Boobook. <i>Survey effort is considered adequate for detecting brigalow woodland snail.</i>
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Microhabitat assessments (Boobook) – total of 5 days covering 20 sites (50 x 100 plots).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Dulacca woodland snail <i>(Adclarkia dulacca)</i>	EN	EN	Conservation Advice <i>Adclarkia dulacca</i> , Dulacca woodland snail (TSSC 2016b)	There are no formal survey guidelines for this species. The species conservation advice provides effective survey techniques include nocturnal spotlighting and turning logs and raking accumulated leaves. Surveys for live individuals should be conducted during October to March, particularly following storm and rain events. Shells of dead individuals can be detected at any time of the year (C. Eddie pers. comm., 2024). Adequate survey effort	Targeted searches (Boobook) – total of 5 days covering 20 sites. Each site searched for a minimum of 2 person hours or until all microhabitat areas had been searched (in <2 person hours).	The survey effort consisted of targeted species searches, area searches, habitat assessments and microhabitat assessments. Surveys were undertaken by Cardno between 19 October and 11 November 2020 and 8 – 27 March 2021 being within the optimal survey timeframe for the species.
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				for the species is two person-hours targeting areas of favourable microhabitat.	Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Microhabitat assessments (Boobook) – total of 5 days covering 20 sites (50 x 100 plots). Additional habitat assessments and opportunistic observations at 10 sites.	Targeted searches and microhabitat assessments by land snail specialists from Boobook were undertaken from 22 – 26 August 2022; and whilst not the optimal survey timeframe for detecting live individuals, survey conditions onsite were favourable for the species. Survey methods employed were appropriate to detect the species if it was present, noting that the site is well beyond the currently known range of the species. <i>Survey effort is considered adequate for detecting Dulacca woodland snail.</i>
MNES Only Bats						
Grey-headed flying-fox <i>(Pteropus poliocephalus)</i>	-	VU	Survey Guidelines for Australia's Threatened Bats (DEWHA 2010)	Appropriate databases (i.e., held by the Department of Environment and Climate Change (NSW), Queensland Parks and Wildlife Service, the Victorian Department of Sustainability and Environment, the Australasian Bat Society) should be searched for the locations of camps prior to the field survey. Additionally, a search of the Eby and Law (2008) database will inform food plants occurring in each vegetation type, and therefore the vegetation within the Project Area. This data should be ground-truthed by a verified botanist to confirm vegetation communities and the presence of grey-headed flying-fox food plants. Grey-headed flying-foxes can be detected directly through sighting, or indirectly through calls, scats and distinctive odours. Daytime searches for camps can be conducted to detect day roosts. The ground and foliage should be examined for scats. Field surveys should include walking transects (100 m apart) at night-time for feeding and flying bats. The species distinct odour can provide signs of their presence. Additionally, audio recordings during night-time surveys may also record the presence of the species. The survey efforts have not been outlined, however the surveys must show that historic camps were	Desktop searches of the Queensland flying-fox camp locations were conducted in 2016, prior to ecological surveys. Vegetation communities and regional ecosystems were ground-truthed using quaternary surveys conducted by both Cardno and Ausecology along the alignment. Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Dusk surveys – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Spotlighting – 2 x 200 m transects at 12 sites (surveyed twice). <i>Total: 48 x 200 m transects</i>	Habitat assessments, area searches, dusk surveys and spotlighting were conducted at all survey sites across the Project footprint. Flying-fox camp locations were researched on the Queensland Government Flying Fox Locations maps prior to the field survey efforts in 2016. One camp in Pittsworth (<1 km from the Project footprint) was recorded to have 400 individuals during one monitoring event in 2012. The nearest mapped camp with grey-headed flying-foxes regularly recorded at the time was located in Highfields (~8 km from the Project footprint). Four other camps in Toowoomba and one camp in Oakey were also used by the species, all >10 km from the footprint. However, during ecological surveys for the Project, a camp with 500+ individuals was found in Inglewood (though as the permanency of the camp for grey-headed flying foxes has not been studied it cannot be recognised as an important camp for this species).

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				researched on the above databases, as well as a comprehensive vegetation survey undertaken.	Additional habitat assessments and opportunistic observations at 10 sites.	More recently, flying-fox camp locations were researched again on the Queensland Flying Fox Monitoring database. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting grey-headed flying-fox.</i>
MNES Only Fish						
Murray cod <i>(Maccullochella peelii)</i>	-	VU	Survey guidelines for Australia's threatened fish (DSEWPC 2011d)	Effective survey methods in detecting the Murray cod include: - Boat-based electrofishing, when in accordance with the Australian Code of Practice, and operated in a way to minimise damage to fish; - Daytime snorkelling, spotlighting at night and the use of underwater cameras should be conducted in clear waters throughout the species distribution, at any time of the year; - Lure fishing and angling using barbless hooks, in all habitat types, generally best conducted between March and May; - The use of doppler imaging equipment in turbid waters throughout the species distribution at any time of the year; - Fine mesh fyke nets in stream structures, billabongs, swamps, farm ponds, dams and irrigation channels from early September to early January; and - Larval drift nets downstream of breeding habitats from early September to early January. Surveys for detecting Murray cod are best conducted between March and May.	Aquatic surveys using AusRivAS physical habitat assessment protocol – 20 sites.	Surveys for detecting Murray cod included aquatic surveys, fish surveys and eDNA surveys, with a total 30 eDNA samples taken. Murray cod were trapped during the fish surveys and detected via eDNA.
					Fish surveys using a range of trapping methods across 6 sites, including backpack electrofishing, seine netting (2 – 5 mm mesh) and fyke nets. Where fyke nets were used, two nets were deployed overnight (one 3 mm stretched mesh and one 4 mm stretched mesh).	Site selection for eDNA sampling was based on the results of the aquatic habitat assessments and fish surveys. Collection methods for the eDNA samples used a Smith-Root eDNA sampler with 5 µm Smith-Root self-preserving filters following Smith-Root protocol (Hydrobiology, 2023). Filtration collection methods have been shown to have higher rates of species detectability compared to precipitation methods (Peioto et al., 2021). Although these methods are not included in the guidelines, eDNA sampling is considered a highly effective and less invasive modern technique for detecting aquatic fauna, particularly elusive or rare species (Rees et al., 2014).
					eDNA-Hydrobiology – 10 sites, a total of 30 eDNA samples (3 samples per site).	Sampling was undertaken in fish habitat during November 2022. <i>Survey effort is adequate for detecting Murray cod.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
MSES Only Mammals						
Platypus (<i>Ornithorhynchus anatinus</i>)	SLC	-	Platypus Survey & Monitoring (Australian Platypus Conservancy, n.d)	Effective survey methods to detect the platypus include: - Visual methods i.e., direct sightings from viewpoints; - Fyke nets – 2 fyke nets (per site) set at 4-8 sites in the afternoon and removed after dawn. Fyke nests must be placed 500 m – 1000 m apart; - Mesh/gill nets – nets scanned with a spotlight after dark at intervals of 10 minutes or less; - Environmental eDNA; - Camera trapping; and - Burrow counts. Surveys for detecting platypus are best conducted in August. The surveys document does not specify the survey effort required per survey method.	Aquatic surveys using AusRivAS physical habitat assessment protocol – 20 sites.	Surveys for detecting platypus included aquatic surveys and eDNA surveys, with a total 30 eDNA samples taken. Platypus were detected during aquatic surveys and via eDNA samples. Site selection for eDNA sampling was based on the results of the aquatic habitat assessments. Collection methods for the eDNA samples used a Smith-Root eDNA sampler with 5 µm Smith-Root self-preserving filters following Smith-Root protocol (Hydrobiology, 2023). Filtration collection methods have been shown to have higher rates of species detectability compared to precipitation methods (Peioto et al., 2021). Although these methods are not included in the guidelines, eDNA sampling is considered a highly effective and less invasive modern technique for detecting aquatic fauna, particularly elusive or rare species (Rees et al., 2014). Sampling was undertaken in fish habitat during November 2022, outside of the optimal survey timeframe, however timing is likely to be less important for eDNA sampling. <i>Survey effort is adequate for detecting platypus.</i>
					eDNA-Hydrobiology – 10 sites, a total of 30 eDNA samples (3 samples per site).	
Short-beaked echidna (<i>Tachyglossus aculeatus</i>)	SLC	-	N/A	There are no species-specific survey guidelines for the Short-beaked Echidna. Area searches should be conducted during habitat assessments and whilst traversing the landscape, searching for echidna diggings and scats. No timing can be provided for the survey techniques.	Camera traps – 10 trap nights for 4 nights at 12 sites (surveyed twice). <i>Total: 960 trap nights</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	As there are no species-specific guidelines for short-beaked echidna, general survey methods were applied, including, camera trapping, area searches, habitat assessments, diurnal searches, and spotlighting. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines or recommended survey timeframes, the survey effort is</i>
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice).	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Total: 192 hours Habitat assessments – 4 hours at 12 sites (surveyed twice). Total: 96 hours Diurnal searches – 2 x 100 m transects for 4 nights at 12 sites (surveyed twice). Total: 48 transects Spotlighting – 2 x 200 m transects at 12 sites (surveyed twice). Total: 48 transects Additional habitat assessments and opportunistic observations at 10 sites.	considered adequate for detecting short-beaked echidna.
Yellow-bellied glider (south-eastern) (<i>Petaurus australis australis</i>)	VU	-	Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022)	Effective survey methods include: - Call playback – conducted at the centre of the survey site, on two occasions on separate nights (i.e., one session within one hour of dusk and one session more than one hour after dusk). Followed by a 5-minute listening period and a five-minute spotlighting period. - Feeding marks on trees – inspecting tree species identified as sap trees (<i>Angophora leiocarpa</i>, <i>Corymbia citriodora</i>, <i>C. intermedia</i> and a variety of <i>Eucalyptus</i> spp.) for feeding marks left by yellow-bellied glider (south-eastern).	Spotlighting – 2 x 200 m transects at 3 sites (surveyed twice). Total: 12 x 200 m transects Stag watching – 40 minutes before dusk and 40 minutes after dusk for 2 nights at 3 sites (surveyed twice). Total: 960 minutes Habitat assessment – 4 hours at 3 sites (surveyed twice). Total: 24 hours Area searches – 8 hours over 5 days at 3 sites (surveyed twice). Total: 48 hours Diurnal searches – 2 x 100 m transects over up to 5 days at 3 sites (surveyed twice). Total: 12 x 100 m transects.	Spotlighting was undertaken in suitable habitat with 2 x 200 m transects conducted at three locations. Additionally, habitat assessments and active area searches were conducted to determine the presence of indirect signs of the species (i.e., scats, feeding marks) in suitable habitat. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Yellow-bellied glider scats were identified within the Project footprint adjacent to Whetstone State Forest and scats and feed marks were identified along Lindenmayer Road east of Millmerran, approximately 2 km west of the Project footprint. Survey effort is considered adequate for detecting yellow-bellied glider (south-eastern) due to the detection of scats within the footprint. However, if

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Camera traps – 47 traps for 4 nights at 3 sites across the two survey periods. <i>Total: 1,128 trap nights</i>	<i>evidence of this species had not been detected, the survey effort would only be partially adequate due to call playback surveys not targeting the species.</i>
					Additional habitat assessments and opportunistic observations at 10 sites.	
MSES Only Reptiles						
Common death adder <i>(Acanthophis antarcticus)</i>	VU	-	Targeted Species Survey Guidelines – Common death adder <i>(Acanthophis antarcticus)</i> (DES, n.d I)	Effective survey methods include the following: - Nocturnal vehicle transects – driving at a constant speed of 10 km/hr scanning the road for crossing/basking animals. Nocturnal vehicle transects should be conducted on roads and well-maintained tracks with limited vegetation on warm, humid nights in suitable habitat. Survey effort includes 500 km (or all suitable roads surveyed multiple times spread over a minimum of two nights and repeated for two surveys. - Pitfall and funnel trapping – in areas of tick leaf litter and/or low dense shrub cover within suitable habitat. Total effort includes more than 100 pitfall trap nights and 100 funnel trap nights per hectare.	Spotlighting – 6 hours over 4 nights at 12 sites (surveyed twice). <i>Total: 144 hours</i>	Spotlighting surveys were undertaken in all survey sites across the Project footprint; however, it was not specified if these were vehicle transects. Pitfall and funnel trapping was undertaken in all survey sites across the Project footprint; however, the survey effort does not meet the survey effort requirement. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Despite the species being detected in the Project footprint, the survey effort is not adequate due to pitfall and funnel trapping survey efforts not meeting the requirement.</i>
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i>	
					Diurnal searches – 3 hours over 5 days at 12 sites (surveyed twice). <i>Total: 72 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Pitfall traps – 6 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 576 trap nights</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Funnel traps – 2 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 192 trap nights</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	
Grey snake <i>(Hemiaspis damelii)</i>	EN	-	Conservation advice for <i>Hemiaspis damelii</i> (grey snake) (DCCEEW 2022) Targeted species survey guidelines Grey Snake (<i>Hemiaspis damelii</i>) (DES, n.d (d))	Nocturnal transect searches for grey snake should be conducted after dark and until midnight during warm nights. Recommended survey techniques include: - Passive nocturnal searches – searching around cracking clay and gilgai habitat during spotlights with a high focused beam. Surveys to be conducted on warm nights. Survey effort includes 60 minutes per plot, with 2 plots per 5 ha, or 3 plots if more than 5 ha. Survey effort per survey includes two 30-minute searches replicated for 2 survey events. - Nocturnal vehicle transects – driving at a constant speed of 10 km/hr scanning the road for crossing/basking animals. Nocturnal vehicle transects should be conducted on roads and well-maintained tracks with limited vegetation and debris on warm, humid nights in suitable habitat. Survey effort includes 250 km (or all suitable roads surveyed multiple times spread over a minimum of two nights and repeated for two surveys. - Active diurnal search – targeting sheltering sites and microhabitat features in or adjacent to suitable habitat. Active diurnal searches should be conducted between mid-morning and mid-afternoon. Survey effort includes 50	Spotlighting – 6 hours over 4 nights at 5 sites (surveyed twice). <i>Total: 60 hours</i> Area searches – 8 hours over 5 days at 5 sites (surveyed twice). <i>Total: 80 hours</i> Reptile monitoring grid traps – 1 trap per site for 20 sites. Traps are monitored monthly on 4-6 occasions so far. Each grid measures 40 x 40 m, containing 5 rows of 5 different artificial habitats (placed 10 m apart). <i>Total: 20 reptile monitoring grid traps</i> Diurnal searches – 3 hours over 5 days at 5 sites (surveyed twice). <i>Total: 30 hours</i> Habitat assessments – 4 hours at 5 sites (surveyed twice). <i>Total: 40 hours</i>	Active diurnal searches were undertaken within proximity to suitable grey snake habitat with a survey effort of 8 hours over 5 days, exceeding the required effort. Pitfall and funnel trapping was conducted during the two survey periods; however, the field survey effort does not meet the required 50 pitfall and funnel trap nights per hectare. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is not adequate for detecting grey snake due to pitfall and funnel trapping survey effort not meeting the survey requirements for each.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				m x 50 m plots; 60 minutes per plot, with 2 plots per 5 ha, or 3 plots if more than 5 ha. Survey effort per survey includes two 30-minute searches replicated for 2 survey events. - Pitfall and funnel trapping – should be conducted in addition to active searches and vehicle transects. A total of more than 50 pitfall and funnel trap nights per hectare is required.	Pitfall traps – 6 traps for 4 nights at 5 sites (surveyed twice). <i>Total: 240 trap nights</i> Funnel traps – 12 traps for 4 nights at 5 sites (surveyed twice). <i>Total: 480 trap nights</i> Additional habitat assessments and opportunistic observations at 10 sites. Active searches in suitable microhabitat for 20 minutes by two people at 44 sites. <i>Total: 29.3 person hours</i>	
MSES Only Butterflies						
Pale imperial hairstreak <i>(Jalmenus eubulus)</i>	VU	-	A survey of the pale imperial hairstreak butterfly <i>Jalmenus eubulus</i> in New South Wales (Taylor R., 2014).	There are no species-specific survey guidelines for pale imperial hairstreak, however it is recommended that searches are conducted during habitat assessments and whilst traversing the landscape. Surveys should be focused on Brigalow foliage from the ground level to 4 m in height. Optimal survey times are following heavy rains (typically during the late summer months).	Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	As there are no species-specific guidelines in detecting pale imperial hairstreak, general area searches and habitat methods were applied in all survey sites across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting pale imperial hairstreak.</i>
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Bulloak jewel butterfly <i>(Hypochrysops piceatus)</i>	CE	-	Conservation Advice <i>Hypochrysops piceatus</i> Bulloak jewel butterfly (TSSC, 2023)	There are no species-specific survey guidelines for bulloak jewel butterfly, however it is recommended that searches are conducted during habitat assessments and whilst traversing the landscape. Surveys should be focused on Bulloak trees more than 75 years old and with a DBH of 18 – 40 cm, containing dead limbs, hollow branches and twigs or fissures in the trunk.	Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	As there are no species-specific guidelines in detecting bulloak jewel butterfly, general area searches and habitat methods were applied in all survey sites across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Whilst surveys were conducted, bulloak jewel butterfly was listed following the
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Additional habitat assessments and opportunistic observations at 10 sites.	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
						survey dates, and as such, the species was not actively searched for. <i>Whilst there are no species-specific guidelines, the survey effort is considered inadequate as no targeted searches for the species were undertaken.</i>
MSES Only Woodland Birds						
Brown-throated treecreeper (south-eastern) <i>(Climacteris picumnus victoriae)</i>	VU	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no species-specific survey guidelines for brown-throated treecreeper (south-eastern), however general survey techniques include diurnal area searches and transect point searches in favourable habitat. Broadcast surveys should be conducted in the early morning, within favourable habitat. Broadcast surveys are most effective before and during the breeding season (July – February). Species can be detected by sighting or call. Mist-netting may be beneficial in dense habitats.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	As there are no species-specific guidelines in detecting brown-throated treecreeper (south-eastern), general bird surveys including call playback, dawn and dusk surveys, stag watching, diurnal searches, camera trapping, area searches and habitat methods were applied in all survey sites across the Project footprint. Mist-netting was not conducted during the two survey periods. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. The October to November surveys were conducted within the breeding season. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting brown-throated treecreeper (south-eastern).</i>
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 320 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Diamond firetail <i>(Stagonopleura guttata)</i>	VU	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no species-specific survey guidelines for diamond firetail, however recommended techniques and effort include active searches or transects whilst recording any sightings and calls within suitable habitat (i.e., grassy eucalypt, acacia, or casuarina woodlands, open forests, mallees or natural temperate grasslands) and suitable microhabitat (i.e., globular structured nests within the shrubby understorey of woodland areas).	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	As there are no species-specific guidelines in detecting diamond firetail, general bird surveys including call playback, dawn and dusk surveys, stag watching, diurnal searches, camera trapping, area searches and habitat methods were applied in suitable habitat in all survey sites across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting diamond firetail.</i>
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice).	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					<i>Total: 96 hours</i>	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Fork-tailed swift <i>(Apus pacificus)</i>	SLC	Mi, Ma	Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015).	There are no species-specific survey guidelines for the fork-tailed swift, however survey efforts are recommended from high vantage points over suitable habitat.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	As there are no species-specific guidelines in detecting fork-tailed swift, general bird surveys including call playback, dawn and dusk surveys, stag watching, diurnal searches, camera trapping, area searches and habitat methods were applied in all survey sites across the Project footprint. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting fork-tailed swift.</i>
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Glossy black cockatoo (south-eastern) <i>(Calyptorhynchus lathami lathami)</i>	VU	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017). Targeted Species Survey Guidelines – Glossy black-cockatoo, <i>(Calyptorhynchus lathami)</i> (DES, n.d(e))	There are no national species-specific survey guidelines for glossy black-cockatoo (south-eastern), however active searches or transects whilst recording any sightings and calls within suitable habitat is recommended. Suitable foraging habitat include eucalypt woodlands with <i>Allocasuarina</i> spp. or <i>Casuarina</i> spp. seeds. Active searches for microhabitat features include large hollows in both living and dead eucalypt trees. Most detectable during the first and last two hours of daylight. Diurnal bird surveys conducted on foot by walking transects within suitable habitat, particularly where <i>Allocasuarina</i> trees, waterbodies and large hollow-bearing eucalypts are present. Diurnal bird surveys are best conducted at dawn and dusk when the species is most active. Diurnal bird surveys must be conducted for a minimum of 5 hours over a minimum of 1 day/s (per 50 ha). Indirect surveys: Walking transects for foraging signs under <i>Allocasuarina</i> trees – presence of discarded, chewed she-oak seed cones ('orts') indicate species presence.	Call playback – 5 hours over 5 days at 8 sites (surveyed twice). <i>Total: 80 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 8 sites (surveyed twice). <i>Total: 1,280 minutes</i> Dawn survey – 4 hours over 2 days at 8 sites (surveyed twice). <i>Total: 64 hours</i> Dusk survey – 4 hours over 2 days at 8 sites (surveyed twice). <i>Total: 64 hours</i> Bird surveys – total of 14.6 hours over 44 sites Habitat assessments – 4 hours at 8 sites (surveyed twice). <i>Total: 64 hours</i> Area searches – 8 hours over 5 days at 8 sites (surveyed twice).	Active searches were undertaken in and surrounding suitable glossy black cockatoo (south-eastern) habitat. Dawn and dusk surveys were conducted for 4 hours over 2 days in suitable habitat. Additionally, diurnal searches were conducted for 4 hours over 5 days in suitable habitat, exceeding the requirement. Additionally, area searches and habitat assessments were undertaken in suitable habitat for indirect signs of the species (e.g., Presence of hollows and 'orts' searches conducted). Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Species was detected during the field survey effort. <i>Survey effort is considered adequate for detecting glossy black cockatoo (south-eastern).</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				Presence of suitable nests – hollows large enough for breeding birds. Nests may be located by listening to begging females and young. Indirect searches for foraging and nesting signs must be conducted for a minimum of 20 hours over a minimum of 4 days (per 50 ha).	<i>Total: 128 hours</i> Diurnal searches – 4 hours over 5 days at 8 sites (surveyed twice). <i>Total: 64 hours</i> Camera traps – 110 traps for 4 nights at 8 sites across the two survey periods. <i>Total: 7,040 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Grey falcon <i>(Falco hypoleucos)</i>	VU	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no species-specific survey guidelines for grey falcon, however general surveys for falcons include: - Observations from high vantage points over suitable habitat; - Area searches on foot in suitable habitat; - Transect surveys by vehicles in suitable habitat, looking for flying or perched birds and nests; - Aerial surveys over suitable habitat to detect birds and nests.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i> Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	As there are no species-specific guidelines for grey falcon, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting grey falcon.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Hooded robin (south-eastern) <i>(Melanodryas cucullata cucullata)</i>	EN	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no species-specific survey guidelines for hooded robin (south-eastern), however recommended techniques and effort include active searches or transects whilst recording any sightings and calls within suitable habitat (i.e., eucalypt and acacia woodlands and shrublands with an open understorey) and suitable microhabitat (i.e., standing dead and live trees and tree stumps, rocks and fallen timber on deep to moderately deep soils).	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i> Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 92 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 92 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice).	As there are no species-specific guidelines for hooded robin (south-eastern), general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. As there are no species-specific guidelines, the survey effort is considered adequate for detecting hooded robin (south-eastern).

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					<i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Major Mitchell's cockatoo <i>(Lophochroa leadbeateri leadbeateri)</i>	EN	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017). Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al., 2022)	There are no national species-specific survey guidelines for the species, however the recommended general techniques for most cockatoos include: - Area searches or transects in suitable habitat; - Vehicle transects in open and expansive habitat suitable to the species; - Targeted searches around waterbodies in arid areas; and - Aerial surveys in extensive and remote areas. Additionally, diurnal bird surveys may be beneficial, with 100 x 100 m survey plots, by one observer for 5 minutes, with at least 6 replicates during the survey period. Typically, diurnal bird surveys are spread out over different days, and should be conducted twice 2 hours after sunrise, twice in mid-morning (2-4 hours after sunrise) and twice during periods 4 hours after sunrise and 2 hours before sunset.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	As there are no species-specific guidelines for Major Mitchell's cockatoo, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Diurnal searches were undertaken for 4 hours over 5 days in all survey sites across the Project footprint, however these were not replicated 6 times per survey period. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered partially adequate for detecting Major Mitchell's cockatoo.</i>
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 960 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Oriental cuckoo <i>(Cuculus optatus)</i>	SLC	Mi	Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015).	Surveys during the migration seasons (austral autumn and austral spring) over standardised timed periods within suitable habitat types. Whereas surveys during the breeding season (late spring or summer) should include a two hectare survey in 20 minutes in breeding habitat.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	General bird survey techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, being within the breeding season. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting oriental cuckoo.</i>
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	
Powerful owl <i>(Ninox strenua)</i>	VU	-	Terrestrial vertebrate fauna survey guidelines (Eyre et al., 2022).	Recommended surveys for powerful owl include call playback within wet sclerophyll, dry sclerophyll and rainforest types adjacent to sclerophyll forest. Call playback should be conducted at the centre of the survey site, on two occasions on separate nights (i.e., one session within one hour of dusk and one session more than one hour after dusk). The first five minutes of the listening period should be done for un-elicited calls, followed by broadcasting. Each call should be played for 3 minutes, followed by a 2-minute listening period.	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i> Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice).	Broadcast/call playback surveys were undertaken for a total of 120 hours across the Project footprint. General bird survey techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>Survey effort is considered adequate for detecting powerful owl.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					<i>Total: 96 hours</i>	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i>	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
Rufous fantail <i>(Rhipidura rufifrons)</i>	SLC	Mi	Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015).	There are no species-specific survey guidelines for the rufous fantail, however surveys are recommended in breeding habitat including a two hectare survey in 20 minutes to provide an estimate density and population size across the Project Area. Surveys should be conducted in species habitat, including moist, dense habitats (i.e., mangroves, rainforest, riparian forests and thickets and wet eucalypt forests with a dense understorey).	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i>	As there are no species-specific guidelines for rufous fantail, general bird surveys were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken in all survey sites across the Project footprint, including in moist, dense habitats.
					Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i>	
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i>	

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. Survey effort is considered adequate for detecting rufous fantail.
Satin flycatcher <i>(Myiagra cyanoleuca)</i>	SLC	Mi	Draft referral guidelines for 14 birds listed as migratory species under the EPBC Act (DoE, 2015).	Surveys during the migration seasons (austral autumn and austral spring) over standardised timed periods within suitable habitat types (i.e., wooded habitats with the exception of rainforests). Whereas surveys during the breeding season (late spring or summer) should include a two hectare survey in 20 minutes in breeding habitat (i.e., eucalypt forests and woodlands, tall wet sclerophyll forest, in gullies and along watercourses).	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). <i>Total: 1,920 minutes</i> Habitat assessments – 4 hours at 12 sites (surveyed twice).	General bird survey techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, being within the migration and breeding seasons.

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Total: 96 hours Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). Total: 96 hours Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). Total: 96 hours Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). Total: 192 hours Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). Total: 96 hours Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). Total: 96 hours UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	Survey effort is considered adequate for detecting satin flycatcher.
Southern whiteface <i>(Aphelocephala leucopsis)</i>	VU	-	Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2017).	There are no species-specific survey guidelines for southern whiteface, however recommended techniques and effort include active searches or transects whilst recording any sightings and calls within suitable habitat (i.e., open woodlands and shrublands with a grassy or shrubby understorey, dominated by <i>Acacia</i> or <i>Eucalyptus</i> spp.) and suitable	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). Total: 120 hours Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice). Total: 1,920 minutes	As there are no species-specific guidelines for southern whiteface, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys.

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
				microhabitat (i.e., tree hollows in either living or dead eucalypt or acacia trees).	Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Bird surveys – total of 14.6 hours over 44 sites Area searches – 8 hours over 5 days at 12 sites (surveyed twice). <i>Total: 192 hours</i> Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i> Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). <i>Total: 96 hours</i> Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). <i>Total: 96 hours</i> UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing). Additional habitat assessments and opportunistic observations at 10 sites.	Surveys were conducted in all survey sites across the Project footprint, including within potential suitable habitat. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting southern whiteface.</i>
White-throated needletail <i>(Hirundapus caudacutus)</i>	VU	Mi, Ma	Referral Guideline for 14 birds listed as migratory under the EPBC Act. Species Profile and Threats Database: <i>Hirundapus caudacutus</i> –	There are no species-specific survey guidelines for white-throated needletail. However, survey efforts are advised by DCCEEW. Generalised bird surveys must be conducted as late as possible in the evening (as birds may fly down to roost in tall trees) between October and April in	Call playback – 5 hours over 5 days at 12 sites (surveyed twice). <i>Total: 120 hours</i> Stag watching – 40 minutes before and after dusk for 2 nights at 12 sites (surveyed twice).	As there are no species-specific guidelines for white-throated needletail, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
			White throated needletail (DOE 2023).	northern and eastern Australia, and between December and March in south-eastern Australia.	Total: 1,920 minutes	assessments and dawn and dusk surveys. Dusk surveys were conducted in all survey sites across the Project footprint to align with the recommended survey effort. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, being within the optimal survey timeframe for the species. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting white-throated needletail.</i>
					Dawn survey – 4 hours over 2 days at 12 sites (surveyed twice). Total: 96 hours	
					Dusk survey – 4 hours over 2 days at 12 sites (surveyed twice). Total: 96 hours	
					Bird surveys – total of 14.6 hours over 44 sites	
					Area searches – 8 hours over 5 days at 12 sites (surveyed twice). Total: 192 hours	
					Habitat assessments – 4 hours at 12 sites (surveyed twice). Total: 96 hours	
					Diurnal searches – 4 hours over 5 days at 12 sites (surveyed twice). Total: 96 hours	
					Camera traps – 10 traps for 4 nights at 12 sites (surveyed twice). Total: 960 hours UniSQ baited camera traps – 100 traps spaced 2 km apart along unconfirmed dirt roads in bushland areas in Bringalily SF since mid-2023 (continuing).	
					Additional habitat assessments and opportunistic observations at 10 sites.	
					MSES Only Wetland Birds and Shorebirds	
Common greenshank <i>(Tringa nebularia)</i>	SLC	Mi, Ma	Industry guidelines for avoiding, assessing, and mitigating impacts on	Count surveys during the non-breeding season (September to March).	Camera traps – 10 traps for 4 nights at 1 site (surveyed twice). Total: 80 trap nights	As there are no species-specific guidelines for common greenshank, general search techniques were

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
			EPBC Act listed migratory shorebird species (DoE 2017)	Survey coverage in tidal areas should include the entire area of contiguous habitat where the shorebirds may occur, as well as all of the habitat used by the same population of shorebirds. Surveys for migratory shorebirds should be conducted during the months when majority of shorebirds are in the area (typically September to March), as well as during the northern hemisphere breeding season (mid-April to mid-August) for non-breeding population extents. Survey timing and effort for roosting shorebirds: - Timing – as close to time of high tide as possible, and at a maximum of no more than 2 hours either side of high tide. - Surveys must be undertaken during dry periods and low winds. - Surveys must only be undertaken during times of no disturbance (i.e., development activities). - Survey effort – four surveys during the period when most shorebirds are in the area (September to March), with replicate surveys required. Generally, one survey in December, two surveys in January, and one survey in February will be adequate to fulfil this requirement. Survey timing and effort for foraging shorebirds: - Timing – as close to time of low tide as possible, and at a maximum of no more than 2 hours either side of low tide. - Survey effort – four surveys including two surveys at spring low tide and two surveys at neap low tide. As well as one survey during the northern hemisphere breeding season (mid-April to mid-August).	Area searches – 8 hours over 5 days at 1 site (surveyed twice). <i>Total: 16 hours</i> Habitat assessments – 4 hours at 1 site (surveyed twice). <i>Total: 8 hours</i> Diurnal searches – 4 hours over 5 days at 1 site (surveyed twice). Total: 8 hours Dawn survey – 4 hours over 2 days at 1 site (surveyed twice). <i>Total: 8 hours</i> Dusk survey – 4 hours over 2 days at 1 site (surveyed twice). <i>Total: 8 hours</i>	undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, within the species non-breeding season. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting common greenshank.</i>
Latham's snipe <i>(Gallinago hardwickii)</i>	SLC	Mi, Ma			Camera trap – 51 traps for 4 nights across 6 sites (surveyed twice). <i>Total hours: 2,448 trap nights</i> Area searches – 8 hours over 5 days at 6 sites (surveyed twice). <i>Total: 96 hours</i> Habitat assessments – 4 hours at 6 sites (surveyed twice). <i>Total: 48 hours</i> Diurnal searches – 4 hours over 5 days at 6 sites (surveyed twice). Total: 48 hours Dawn survey – 4 hours over 2 days at 6 sites (surveyed twice). <i>Total: 48 hours</i> Dusk survey – 4 hours over 2 days at 6 sites (surveyed twice).	As there are no species-specific guidelines for Latham's snipe, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, within the species non-breeding season. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting Latham's snipe.</i>

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					<i>Total: 48 hours</i>	As there are no species-specific guidelines for sharp-tailed sandpiper, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, within the species non-breeding season. *Camera traps were not directly located in sharp-tailed sandpiper habitat, some of which are located approximately 1-2 km outside of habitat boundary, however included due to species mobility. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting sharp-tailed sandpiper.</i>
Sharp-tailed sandpiper (<i>Calidris acuminata</i>)	SLC	Mi, Ma			Camera traps – 21 traps for 4 nights at 2 sites (surveyed twice). <i>Total: 336 trap nights*</i>	
					Area searches – 8 hours over 5 days at 2 sites (surveyed twice). <i>Total: 32 hours</i>	
					Habitat assessments – 4 hours at 2 sites (surveyed twice). <i>Total: 16 hours</i>	
					Diurnal searches – 4 hours over 5 days at 2 sites (surveyed twice). Total: 16 hours	
					Dawn survey – 4 hours over 2 days at 2 sites (surveyed twice). <i>Total: 16 hours</i>	
					Dusk survey – 4 hours over 2 days at 2 sites (surveyed twice). <i>Total: 16 hours</i>	
Glossy ibis (<i>Plegadis falcinellus</i>)	SLC	Mi, Ma	There are no species-specific survey guidelines for the glossy ibis, however generalised bird surveys can be applied.	Camera traps – 21 traps for 4 nights at 2 sites (surveyed twice). <i>Total: 336 trap nights</i>	As there are no species-specific guidelines for glossy ibis, general search techniques were undertaken throughout the survey period, including camera traps, area searches, diurnal searches, habitat assessments and dawn and dusk surveys. Surveys were undertaken between 19 October and 11 November 2020 and 8 – 27 March 2021, within the species non-breeding season. <i>As there are no species-specific guidelines, the survey effort is considered adequate for detecting glossy ibis.</i>	
				Area searches – 8 hours over 5 days at 2 sites (surveyed twice). <i>Total: 32 hours</i>		
				Diurnal searches – 4 hours over 5 days at 2 sites (surveyed twice). Total: 16 hours		
				Habitat assessments – 4 hours at 12 sites (surveyed twice). <i>Total: 96 hours</i>		

Species	Status		Species guideline source	Required effort as per species guidelines (including the area extent for which the methodology is applicable)	Survey effort conducted on the Project	Justification for survey adequacy for environmental approvals
	NC Act	EPBC Act				
					Dawn survey – 4 hours over 2 days at 2 sites (surveyed twice). <i>Total: 16 hours</i>	
					Dusk survey – 4 hours over 2 days at 2 sites (surveyed twice). <i>Total: 16 hours</i>	

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