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Broad-scale Ecological Assessment Report

Parts of Lots 6TR11, 7TR39, 8TR15, 9TR17, 7TR22, 8TR23 and 807PH1979, within tenements PL 234, PL420, PL421 and PL 440

Compiled by BOOBOOK for Santos

Revision	Date	Description	Author	Verifier	Approved
A	07/12/2017	Draft issued to client for review	R. Johnson, L. Hardwick, R. Aisthorpe	C. Eddie	C. Eddie
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DEHP	Department of Environment and Heritage Protection (State)
DNRM	Department of Natural Resources and Mines (State)
DoEE	Department of the Environment and Energy (Commonwealth)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
DSITI	Department of Science, Information Technology and Innovation (State)
E	Endangered
EH	Essential Habitat
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERE	Endangered Regional Ecosystems
GPS	Global Positioning System
ha	hectare (s)
km	Kilometre (s)
LC	Least Concern
m	metre (s)
NC Act	*Nature Conservation Act 1992*
NCAP	No Concern At Present
OC	Of Concern
PMST	Protected Matters Search Tool
RE	Regional Ecosystem (s)
REDD	Regional Ecosystem Description Database
SEVT	Semi-evergreen vine thicket
TEC	Threatened Ecological Community (ies)
TSSC	Threatened Species Scientific Committee

1. Introduction

1.1. Purpose and Scope

Santos (the Client) required the following services in relation to identifying ecological values of vegetation in parts of several properties in the Arcadia Valley, located north-east of Injune in south central Queensland:

- Regional ecosystem (RE) mapping using the functional RE condition thresholds;
- Quantification of Threatened Ecological Communities (TEC);
- Fauna general habitat mapping and assessment for nominated *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened species;
- Flora general habitat mapping and assessment for nominated EPBC Act listed threatened species;
- Searches for the presence of EPBC Act and/or *Nature Conservation Act 1992* (NC Act) listed threatened flora; and
- Incidental observations of EPBC Act and/or NC Act listed threatened fauna.

Specifically, the area to be assessed was defined by a Google Earth kml file supplied by the Client and consists of parts of Lot/Plans 6TR11, 7TR39, 8TR15, 9TR17, 7TR22, 8TR23 and 807PH1979, within tenements PL234, PL420, PL421 and PL440. They are hereafter collectively referred to as 'the Site' (Appendix A).

Note that for RE (and thus habitat) mapping purposes within this report, the boundaries of the Client-identified survey area (i.e. Site) were modified as follows:

- Where the Site extended beyond the cadastral boundary of an identified Lot/Plan, the Site was adjusted to the cadastral boundary. This was most significant when mapping the slopes of the eastern boundaries of several Lot/Plans which adjoined the Expedition Range (Limited Depth) National Park.
- In the event of an identifiable Endangered RE polygon extending beyond the Site it was mapped where practicable to its full extent.
- Where the Client identified areas of interest which extended beyond the boundary of the Site, mapping of vegetation was extended as far as practicable to the extent of RE polygons. This circumstance mainly arose in mapping of valley floors and slopes on the eastern side of Lot/Plan 8TR23.

1.2. Survey Team

A field survey of the Site was conducted by Craig Eddie (Principal Ecologist), Richard Johnson (Senior Ecologist) and Scott Akins-Sellar (Intermediate Ecologist / Senior Fauna Spotter) in the periods 23rd – 24th October and 26th October – 3rd November 2017.

The project supervisor (Craig Eddie) was approved by the Department of the Environment and Energy (DoEE), formerly the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), in writing on the 28th of January 2011 for the purpose of undertaking ecological assessment works for the Gladstone Liquefied Natural Gas (GLNG) project. All aspects of the project including field survey and reporting were conducted under the supervision of Craig Eddie.

2. Methodology

2.1. Desktop Assessment

A desktop assessment was conducted to inform the field survey. Sources of information utilised during the desktop assessment included the following:

- Remnant RE (DSITI 2017a) and mature regrowth (DEHP 2012) mapping – biodiversity status;
- Essential Habitat (EH) (DNRM 2017) mapping;
- EPBC Act Protected Matters Search Tool (PMST) (DoEE 2017a);
- Wildlife Online fauna and flora records (DSITI 2017b);
- Protected Plants Flora Survey Trigger Map (DEHP 2017a); and

- Vegetation and habitat assessment and mapping reported in previous surveys of properties or infrastructure disturbance footprints within the Site, including results of quaternary assessments and incidental observations. Sources included reports on:
    - a series of assessments on infrastructure disturbance zones within Lot/Plans 9TR17 and 7TR22 (BOOBOOK (2014 a-i);
    - a survey on biodiversity offset values of the property "Bottle Tree' , 7TR39 (BOOBOOK 2015);
    - a survey of vegetation in adjacent parts of the Arcadia Valley (BOOBOOK 2016); and
    - an ecological survey for the GLNG gas pipeline route with relevance to 807PH1979 (Ecologica Consulting 2012).

2.2. Field Survey

In-field verification of desktop findings and additional findings of significance were undertaken in general accordance with the following:

- *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al*. 2017);
- *Methodology for Conducting Ecological Assessments* – GLNG Areas Rev 4.1 (Santos 2014); and
- *Functional Thresholds for Assessing Regional Ecosystem Functionality* (Santos 2015).

Methodologies that were employed for each element of the field survey are further described in the following sections.

The seven properties were visited to examine areas of remnant and regrowth vegetation. For some vegetation only assessable from a distance, visual inspection was conducted using binoculars. Representative photographs of these areas were used as a guide in post-field delineation of mapping polygon boundaries.

2.2.1. RE and TEC Assessment

RE and TEC assessment was informed by both desktop review of earlier assessments where relevant (see Section 2.1) and by ground-truthing during field assessment. Where required in the light of new field-based information, assessment included revision of previously reported mapping. Typically this occurred when vegetation previously assessed remotely due to land access constraints was inspected on the ground during this survey. Another potential revision was required when differentiating Brigalow and semi-evergreen vine thicket (SEVT) communities. This is discussed in more detail at Section 3.1.

Ground-truthing (and confidence level scoring) of the DSITI regional ecosystem (RE) designation was undertaken using the quaternary level of data collection as described by Neldner *et al*. (2017).

Assessments were undertaken within 50 m x 10 m plots for the purpose of typifying the vegetation community under assessment. The number of vegetation community assessments undertaken at each property depended on the diversity of vegetation communities present at each. Plots were chosen within representative areas of each vegetation type encountered. Locations of quaternary assessment sites are mapped in Appendix A.

Vegetation community polygons were verified in accordance with Queensland RE description and biodiversity status as per the Regional Ecosystem Description Database (REDD) (DSITI 2017) and classified as remnant RE, vegetation consistent with RE (advanced regrowth) or non-remnant vegetation (Santos 2014a). For each area of potential TEC an assessment of vegetation survey data was made against TEC threshold criteria (e.g. TSSC 2013).

Vegetation community data was captured in the field and entered into Santos-specific data fields within spatial databases via Motion tablet devices. Representative photographs were taken via a Canon digital camera at each vegetation survey site and at vegetation patches as supporting evidence of the identity of the subject vegetation community where full documentation was not required. Capture and delineation of RE and TEC boundaries was undertaken using a combination of mobile GIS devices, GPS and/or delineation from imagery. A minimum mappable width of 30 m for linear vegetation corridors (e.g. road corridors and shade lines) was applied. Patches were mapped to their full extent within the Site within practical limits (including land access constraints).

For identified advanced regrowth (i.e. vegetation floristically equivalent to an RE but not meeting structural thresholds of remnant RE) an ecosystem functionality assessment was conducted. This assessed selected vegetation characteristics against the parameters described in Santos (2015).

Plant names used within this document conform to those given in Bostock and Holland (2017).

2.2.2. Threatened Species Habitat Assessment and Mapping

Microhabitat assessments were undertaken in conjunction with vegetation community surveys at each survey plot, or as required where significant variation in the type and abundance of habitat features occurred. The results of these assessments, combined with ecologist knowledge, were used to predict habitat suitability for the following species, as nominated by the Client:

- *Chalinolobus dwyeri* (Large-eared Pied Bat, Large Pied Bat);
- *Dasyurus hallucatus* (Northern Quoll);
- *Nyctophilus corbeni* (South-eastern Long-eared Bat, Corben's Long-eared Bat);
- *Petrogale penicillata* (Brush-tailed Rock-wallaby);
- *Phascolarctos cinereus* (Koala);
- *Tachyglossus aculeatus* (Short-beaked Echidna);
- *Botaurus poiciloptilus* (Australasian Bittern);
- *Turnix melanogaster* (Black-breasted Button-quail);
- *Erythrotriorchis radiatus* (Red Goshawk);
- *Geophaps scripta scripta* (Squatter Pigeon (Southern));
- *Poephila cincta cincta* (Black-throated Finch);
- *Rostratula australis* (Australian Painted Snipe);
- *Neochmia ruficauda ruficauda* (Star Finch);
- *Polytelis swainsonii* (Superb Parrot);
- *Lathamus discolor* (Swift Parrot);
- *Ardea ibis* (Cattle Egret);
- *Ardea modesta* (Great Egret);
- *Plegadis falcinellus* (Glossy Ibis);
- *Pandion haliaetus* (Osprey);
- *Merops ornatus* (Rainbow Bee-eater);
- *Pedionomus torquatus* (Plains-wanderer);
- *Anomalopus mackayi* (Five-clawed Worm-skink);
- *Delma torquata* (Collared Delma);
- *Denisonia maculata* (Ornamental Snake);
- *Egernia rugosa* (Yakka Skink);
- *Furina dunmalli* (Dunmall's Snake);
- *Rheodytes leukops* (Fitzroy River Turtle);
- *Maccullochella peelii* (Murray Cod);
- *Cadellia pentastylis* (Ooline);
- *Dichanthium setosum* (A bluegrass);
- *Swainsona murrayana* (Slender Darling-pea);
- *Tylophora linearis* (Slender Tylophora);
- *Xerothamnella herbacea* (Xerothamnella);
- *Eriocaulon carsonii* (Salt Pipewort);
- *Bertya opponens*
- *Daviesia discolor;*
- *Westringia parvifolia;*
- *Acacia curranii* (Curly-bark Wattle);
- *Acacia grandifolia;*
- *Calytrix gurulmundensis*;
- *Eucalyptus beaniana* (Bean's Ironbark);
- *Homoranthus decumbens;*
- *Phaius australis* (Swamp Orchid);
- *Aristida annua;*
- *Arthraxon hispidus* (Hairy-joint Grass);
- *Dichanthium queenslandicum* (King Bluegrass);
- *Homopholis belsonii* (Belson's Panic);
- *Thesium australe* (Austral Toadflax); and
- *Macrozamia platyrhachis* (a Cycad).

These results were used to develop GIS-based mapping of potential habitat for the identified species within the Site.

2.2.3. Threatened Flora Survey

Targeted surveys for threat-listed flora were informed by the desktop search results and local experience. Searches for threat-listed flora under the EPBC and/or NC Act were carried out at vegetation assessment sites and in random meanders in targeted habitat types, including remnant and non-remnant vegetation.

If detected, counts and extent of each population of threat-listed flora were made as well as structural characteristics and representative photographs taken. Data was recorded using the Santos-specific Notable Species - Flora Point or Region data capture layer.

2.2.4. Incidental Threatened Fauna Records

Any incidental records of threatened fauna obtained during vegetation assessments and general property traverses to and between sites (on foot and driving) were fully documented including species name, location (with site co-ordinates or area of extent), habitat and number detected.

2.2.5. Survey Limitations

Vegetation mapping accuracy was dependent on the ability to examine areas in the field, reliability of imagery interpretation and the degree of heterogeneity within given vegetation polygons (i.e. diversity of RE present) (Neldner *et al*. 2017). Individual mapped vegetation polygons have been assigned a confidence level (high, moderate, low) for both boundary accuracy and vegetation attributes within the polygon. Within the spatial database confidence ratings are designated as 'A' for high, 'B' for moderate and 'C' for low. The following schema was applied to vegetation polygons:

Table 1: Boundary accuracy confidence ratings applied to mapped polygons.

Boundary Accuracy			
Confidence	**Range of Accuracy**	**Homogenous Patches**	**Heterogeneous Patches**
High (A)	<1 - <10 m	Ground-truthed on site, or viewed at a distance	Ground-truthed on site
Moderate (B)	>10 - <50 m	Not ground-truthed (image interpretation only)	Portion ground-truthed on site
Low (C)	>50 - >200 m	nil	No ground truthing: vegetation viewed at a distance or image interpretation only

Table 2: Vegetation attribute confidence ratings applied to mapped polygons.

Vegetation Attributes		
Confidence	Homogenous Patches	Heterogeneous Patches
High (A)	Ground-truthed on site	Ground-truthed on site
Moderate (B)	No ground truthing: vegetation viewed at a distance	Portion ground-truthed on site
Low (C)	Image interpretation only	Viewed at a distance or image interpretation only

In some instances vegetation communities could not be readily assigned to an RE, even when ground-truthed, as their floristics and structure reflected historical disturbance patterns such as clearing, thinning and fire history. In these cases RE have been allocated on the basis of 'best fit' with current RE descriptions.

Microhabitat assessments were conducted at several representative sites within each ground-truthed RE present at the Site. Some assessment data was also available from earlier work within the Site e.g. BOOBOOK (2015). Though the presence and abundance of microhabitat features e.g. hollow logs likely varies within and between patches (mapping polygons) of a given RE for the purposes of predictive fauna habitat mapping it is assumed that the results of microhabitat assessment for an RE are applicable throughout the Site. That is to say, a conservative approach has been taken with regard to mapping of species habitat where no ground-truthing has been undertaken. Where patches have not been ground-truthed, relevant fauna microhabitat features were assumed to be present and patches have been mapped as habitat until further assessments can be undertaken. Similarly, where predictive mapping of flora habitat is based on known associations with RE it is assumed that suitable habitat exists in all patches of the RE at the Site.

Threatened fauna searches were confined to incidental observations only (i.e. no trapping or targeted search techniques were employed). Additional survey effort would be required to provide a more comprehensive inventory of threatened fauna species present at the Site.

The timing (season) and duration of the survey period during early spring and following some rainfall was generally favourable for identification of woody plants (trees and shrubs), grasses and forbs. Some rain fell within the Site during the survey period.

3. Results & Discussion

3.1. Vegetation Mapping

3.1.1. Desktop RE Mapping

Mapped remnant RE (DSITI 2017a) and mature regrowth (DEHP 2012) is shown in Appendix B.

3.1.2. Revised RE Mapping

Ground-truthing, inspection at a distance and examination of aerial imagery identified thirteen remnant and eight advanced regrowth RE types within the Site. Mapping of remnant and regrowth RE based on desktop interpretation and field analysis is presented in Appendix C.

Difficulty arose in reliably differentiating two RE (11.9.4 and 11.9.5a) occurring on the lower to upper slopes of hillsides, including the Expedition Range which formed the eastern boundary of much of the Site. Extensive areas of vegetation presented as woodland of Brigalow (*Acacia harpophylla*) and other trees, typically Narrow-leaved and/or Broad-leaved Bottle Tree (*Brachychiton rupestris*, *B. australis*) overtopping a more or less dense lower tree layer of numerous SEVT species. Areas comprising SEVT species only and thus attributable to RE 11.9.4 were typically very small and adjacent to vegetation with a Brigalow overstorey. Differentiation was further hindered by the impacts of a complex disturbance history on these slopes. Evidence was present of periodic incursion by fire. There was also abundant evidence of major disturbance by landslides. This included both recent and historical events featuring a range of states from little re-vegetation to advanced recovery of vegetation communities. Hence vegetation structure was variable and formed a complex mosaic of structure and floristics. A conservative approach to RE attribution was to assume that all remnant and advanced regrowth of the community represented RE 11.9.5a. It is acknowledged that some areas of SEVT (RE 11.9.4) were present but due to their small size, scattered occurrence and the uncertainty of their relationship to surrounding 11.9.5a these have been included in the latter RE.

The extent (total area) of each mapped remnant and advanced regrowth RE is summarised in Table 3. In total, approximately 2786.1 ha of vegetation (1711.0 ha of remnant and 1075.1 ha of advanced regrowth) was mapped within the Site. Note that this total does not include approximately 426.35 ha of young regrowth of Brigalow RE 11.9.5 within the Site and occurring on the property 'Bottle Tree' (7TR39). This vegetation was previously mapped for the purposes of biodiversity offsets (BOOBOOK 2015). It does not appear in Table 3 as it was not used in calculating potential habitat for fauna and flora of conservation concern (Section 3.2.2).

Table 3: Summary of extent of individual mapped REs from ground-truthing and imagery analysis within the Site.

RE Code	*VM Act* Class	Biodiversity Status	Short Description (DEHP 2015)	Extent – remnant (ha)	Extent – regrowth (ha)
11.3.2	OC	OC	*Eucalyptus populnea* woodland on alluvial plains	62.40	10.48
11.3.4	OC	OC	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	176.93	Not detected
11.3.17	OC	E	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	9.21	199.78
11.3.18	LC	NCAP	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium	4.97	Not detected
11.3.25	LC	OC	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	95.33	Not detected
11.3.39	LC	NCAP	*Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils	27.27	Not detected
11.9.5	E	E	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	21.74	562.92

RE Code	*VM Act* Class	Biodiversity Status	Short Description (DEHP 2015)	Extent – remnant (ha)	Extent – regrowth (ha)
11.9.5a	E	E	*Acacia harpophylla* predominates and forms a fairly continuous canopy (10-18m high). Other tree species such as *Eucalyptus populnea, Casuarina cristata, Cadellia pentastylis* and *Brachychiton* spp. may also be present in some areas and form part of the canopy or emerge above it. Scattered *Eucalyptus orgadophila* may occur, especially on upper slopes and crests. A dense tall shrub layer dominated by a range of species is usually present, while a more open low shrub layer often occurs.	511.19	273.53
11.9.7	OC	OC	*Eucalyptus populnea, Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	0.98	0.59
11.9.10	OC	E	*Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks	37.25	13.43
11.10.3	LC	NCAP	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps	2.18	0.84
11.10.4	LC	NCAP	*Eucalyptus decorticans, Lysicarpus angustifolius +/- Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks	756.22	13.56
11.10.7	LC	NCAP	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	5.33	Not detected

E = Endangered; OC = Of Concern; LC = Least Concern; NCAP = No Concern at Present

3.1.3. TEC Assessment

The field survey confirmed the presence of one TEC, this being Brigalow (Acacia harpophylla dominant and co-dominant). As described in Section 3.1.2 the RE 11.9.4 was not mapped. This RE is a component of the TEC "Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions", hence this TEC was not mapped within the Site.

For the purposes of this assessment all remnant and advanced regrowth RE 11.9.5 (a listed component of the Brigalow TEC) and 11.9.5a (a community within the definition of RE 11.9.5) were mapped as TEC (TSSC 2013) provided that *Acacia harpophylla* was dominant in the canopy and that the vegetation otherwise met condition criteria (TSSC 2013). The TEC was largely confined to the slopes and foothills of the Expedition Range.

The mapped extent of TEC at the Site is shown within Appendix D. Table 4 shows the extent (total area) of TEC mapped within the Site.

Table 4: Description and extent of TEC within the Site.

TEC Description	RE Code	Extent of TEC (ha)
Brigalow (*Acacia harpophylla* dominant and co-dominant)	11.9.5, 11.9.5a	553

3.2. Threatened and Migratory Species

3.2.1. Likelihood of Occurrence of Flora and Fauna of Conservation Concern at the Site

PMST search results predicted the potential occurrence of seven EPBC Act-listed threatened flora species within the Site, these being Ooline (*Cadellia pentastylis*), Slender Tylophora (*Tylophora linearis*), a bluegrass (*Dichanthium setosum*), Austral Toadflax (*Thesium australe*), two species of bush tomato (*Solanum dissectum* and *S. johnsoniana*) and a Bertya (*Bertya opponens*). The desktop assessment (ALA 2017, DSITI 2017b) indicated that three EPBC Act listed flora species have been historically recorded from, or within 10 km of, the Site, these being Ooline, the shrub *Bertya opponens* and the herb Xerothamnella *Xerothamnella herbacea*.

Both Ooline and Xerothamnella were detected within the Site during the present survey. The records for Xerothamnella include five new locations for the species, albeit in close proximity to existing records (ALA 2017) and confirm the importance of minor drainage lines in mature and regrowth Brigalow communities as habitat for the species within and proximate to the Site.

Wildlife Online searches (DSITI 2017b) did not produce records at or within 10 km of the Site for fauna species listed as threatened under the EPBC Act and/or NC Act. ALA (2017) shows historical records for Yakka Skink (*Egernia rugosa*) (records have been 'dithered' hence of very low precision) and two low-precision records for Squatter Pigeon (*Geophaps scripta scripta*) within or near the Site. A record for Dunmall's Snake within 1 km of the Site was obtained during previous ecological scouting (Ecologica Consulting 2012).

No threatened fauna species were detected during the assessment. Two EPBC Act listed migratory species were detected: the Glossy Ibis (*Plegadis falcinellus*) and the Rufous Fantail (*Rhipidura rufifrons*). Two Glossy Ibis were seen on the shore of a farm dam on "Kaimanna" (7TR22), while a single Rufous Fantail was seen in remnant Brigalow on "Hilltop" (6TR11). Note that the Rufous Fantail is not a Client-identified species as shown in Section 2.2.2.

The location of these records is given in Appendix D. Table 5 provides discussion of habitat requirements and likelihood of occurrence of the nominated (Section 2.2.2) threatened and/or migratory fauna and threatened flora at the Site.

Table 5: Assessment of likelihood of occurrence at the Site of nominated threatened/migratory flora and fauna.

[1] *CE = Critically Endangered; E = Endangered; V = Vulnerable; NT = Near Threatened; SLC = Special Least Concern; LC = Least Concern; M = Migratory; Ma = Marine*

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
Acanthaceae	*Xerothamnella herbacea* Xerothamnella	E	E	This species is a low, sprawling herbaceous species that occurs in Brigalow (*Acacia harpophylla*) dominated communities in shaded situations, often in leaf litter and is associated with gilgais (shallow ground depressions) and/or minor drainage lines (DEHP 2017i). *Xerothamnella herbacea* is known from a number of widely scattered sites ranging from near Yelarbon northward to Kokotungo, west of Gladstone (ALA 2017). It has been collected within the Santos gas field development area: there are six published records of the species in Brigalow open forest in the Arcadia Valley (ALA 2017; DSITI 2017d).	Confirmed present within the Site. Suitable habitat (Brigalow-dominated open forests and woodlands on minor drainage lines and gilgai) is present on Lonesome Holding (807PH1979) within the Site.	Confirmed present within the Site.
Apocynaceae	*Tylophora linearis* Slender Tylophora	E	E	Found in drier open forests and woodlands of *Eucalyptus, Callitris* and *Allocasuarina* species (DoEE 2017b). It has been collected at numerous localities in NSW, principally on the western slopes of the Great Dividing Range from Temora to the Linton - Yetman area (ALA 2017). It is only known in Queensland from one specimen collected near Glenmorgan in 1960 (ALA 2017).	Unlikely to be present. Although potentially suitable habitat is present the Site is outside the known range of this species (ALA 2017).	Not recorded within the Site.
Eriocaulaceae	*Eriocaulon carsonii* Salt Pipewort	E	E	This herbaceous species is endemic to flowing discharge springs of the Great Artesian Basin and has been recorded from spring complexes in Queensland, New South Wales and South Australia (DoEE 2017b). In south central Queensland this species is confined to artesian discharge springs in the Injune and Taroom areas (DSITI 2017d). There are six records within tenement PL99 (DSITI 2017d, ALA 2017).	Unlikely to be present. Suitable habitat (artesian discharge springs) is not present within the Site.	Not recorded within the Site.
Euphorbiaceae	*Bertya opponens*	V	LC	In Queensland this species is widely distributed within an area bounded by Emerald in the north and Charleville in the west, with outliers near Moranbah and Charters Towers (ALA 2017; DoEE 2017b). *Bertya opponens* has been recorded growing in a variety of community types including mixed shrubland, lancewood woodland, mallee woodland, eucalypt/acacia open forest with shrubby understorey, *Eucalyptus*/*Callitris* open woodland and the margins of semi-evergreen vine-thicket (SEVT) on shallow and rocky or much deeper and well-drained soils (DoEE 2017b, DEHP 2017). The species has been recorded at several locations within the Fairview gas field and at Lonesome Holding at the southern end of the Arcadia Valley (ALA 2017).	Potentially present. Suitable habitat on sandstone hills exists within the Site. The species has been recorded in suitable habitat on Lonesome Holding (807PH1979) in close proximity to the Site.	Not recorded within the Site.
Fabaceae	*Daviesia discolor*	V	V	Disjunct populations occur within Blackdown Tableland, Salvator Rosa section of Carnarvon National Park and the Mt. Walsh area near Biggenden (ALA 2017; TSSC 2008b) where it grows on sandy to clay loam soils, typically well drained, on sandstones, laterite and metamorphic or acid volcanic rocks (DEHP 2017b). This species grows in open forest dominated by *Eucalyptus* and/or *Corymbia* spp. or mixed shrubland with scattered *Triodia* sp. hummocks and *Angophora* sp. trees (TSSC 2008a).	Potentially present. Suitable habitat on sandstone hills is present within the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
Fabaceae	*Swainsona murrayana* Slender Darling-pea	V	V	This herbaceous species often grows in heavy soils, especially depressions, and is also found on grey and red to brown clay and clay-loam soils in Bladder Saltbush (*Atriplex vesicaria*) herbland, Black Box (*Eucalyptus largiflorens*) woodland and grassland communities and is frequently associated with *Maireana* species (DoEE 2017b). This species is known in Queensland from five specimens; one collected south of Surat in Brigalow Belt subregion 29 (Weribone High); and four from central western Queensland between Boulia, Birdsville and Longreach (ALA 2017).	Unlikely to be present. Suitable habitat (heavy soils associated with drainage depressions) is present to only a very limited extent within the Site, and the Site is outside the known range of this species (ALA 2017).	Not recorded within the Site.
Lamiaceae	*Westringia parvifolia*	V	V	This species of low shrub is known to occur on stony and sandy soils supporting mallee woodland (Baker's Mallee *Eucalyptus bakeri*, Green Mallee *E. viridis*) with a Spinifex (*Triodia* sp.) ground layer (DoEE 2017b). It is only known from a relatively small area in the Goondiwindi - Inglewood – Yelarbon area of the southern Darling Downs in Queensland, extending south to the Yetman area of New South Wales (ALA 2017, DoEE 2017b).	Unlikely to be present. Though some suitable habitat (*E. bakeri* mallee woodland on sandstone hills) is present in limited amounts within the Site, the Site is distant from the nearest record of the species with an apparently limited distribution.	Not recorded within the Site.
Mimosaceae	*Acacia curranii* Curly-bark Wattle	V	V	This species has a disjunct distribution in western New South Wales (NSW) and south-eastern Queensland. The species is reported in Queensland from the Barakula and Gurulmundi areas (ALA 2017; DSITI 2017d) where it occurs on sandy soils of deeply weathered lateritic plateaus in widely scattered thickets in patches of diverse heath scrub with emergent trees (DoEE 2017b).	Unlikely to be present. Suitable habitat (lateritic plateaus, Land Zone 7) is not present within the Site.	Not recorded within the Site.
Mimosaceae	*Acacia grandifolia*	V	LC	This species is geographically limited to the Gayndah, Mundubbera, Coulston Lakes and Proston areas (DoEE 2017b) with two outlying (non-specimen) records (ALA 2017) from Boxvale SF (Carnarvon Range) and one (specimen-based) from Dawson Range (ALA 2017, DSITI 2017d). It is recorded from a variety of land forms (hilly terrain of varying aspects and slope, on hillcrests, in gullies on plains) on sandy to clay loams derived from sandstone and acidic volcanic rocks (DEHP 2017b).	Potentially present. Suitable habitat exists within the Site.	Not recorded within the Site.
Myrtaceae	*Calytrix gurulmundensis*	V	V	This species is geographically limited to an area between Gurulmundi and Barakula State Forest in Queensland (ALA 2017, DSITI 2017d). It is recorded as occurring in open shrubland with sparse, stunted *Eucalyptus, Casuarina* and *Acacia* spp. and in *Triodia* hummock grassland with scattered shrubs on shallow red gravelly soil; and on sandstones (DoEE 2017b). The soils are usually well drained, usually shallow and either gravelly sandy clay or sandy in texture (DEHP 2017b). The habitat at Gurulmundi State Forest is consistent with RE 11.7.5 (DEHP 2017b; DoEE 2017b).	Unlikely to be present. Suitable habitat (lateritic plateaus, Land Zone 7) is not present within the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
Myrtaceae	*Eucalyptus beaniana* Bean's Ironbark	V	LC	This tree species is endemic to Queensland, where it is known from disjunct populations in the Isla Gorge area, sandstone uplands between Injune and Taroom and the Monogorilby/Allies Creek/Koko State Forest area southwest of Mundubbera (ALA 2017, DSITI 2017b). In these areas it grows on shallow sandy soils (lithosols) of sandstone cliff tops and ridges (DEHP 2017b) in eucalypt woodland or open forest, co-dominant or associated with Spotted Gum (*Corymbia citriodora* subsp. *variegata*), Gympie Messmate (*Eucalyptus cloeziana), E. suffulgens*, Large-fruited Yellowjacket (*C. watsoniana*), Brown Bloodwood (*C. trachyphloia*) and Narrow-leaved White Mahogany (*E. tenuipes*) (DEHP 2017b; TSSC 2008b). It is potentially present in suitable habitat within the Carnarvon Ranges subregion.	Potentially present. Suitable habitat (eucalypt woodlands on sandstone hills) is present within the Site.	Not recorded within the Site.
Myrtaceae	*Homoranthus decumbens*	E	V	This species is a low shrub occurring in tall shrubland or heath up to 800 m above sea level. It occurs on the edge of sandstone cliffs or in shallow sandy soils containing lateritic (iron-rich) pebbles (DEHP 2017b). This species is confined to Barakula State Forest (DSITI 2017d); a specimen from Blackdown Tableland referred to within ALA (2017) and DoEE (2017b) has been re-determined by Queensland Herbarium (DSITI 2017d) as *H. brevistylis*.	Unlikely to be present. Though some suitable habitat on sandstone hills is present within the Site, the Site is approximately 160km north-west of the nearest specimen-backed record.	Not recorded within the Site.
Orchidaceae	*Phaius australis* Swamp Orchid	E	E	This species is commonly associated with coastal wet heath/sedgeland wetlands, swampy grassland or swampy forest and is distributed from northern New South Wales to northern Queensland (DoEE 2017b). Typically, *Phaius australis* is restricted to the swamp-forest margins, where it occurs in sclerophyll forest of Broad-leaved Paperbark (*Melaleuca quinquenervia*) and/or Swamp Mahogany (*Lophostemon suaveolens*); swampy rainforest (often with sclerophyll emergents); or fringing open forest. It is often associated with rainforest elements such as Bangalow Palm (*Archontophoenix cunninghamiana*) or Cabbage Tree Palm (*Livistona australis*) (DoEE 2017b). Disjunct populations of the species are known from Blackdown Tableland and Carnarvon Gorge (DSITI 2017d).	Unlikely to be present. No suitable habitat (swamp forest) is present within the Site.	Not recorded within the Site.
Poaceae	*Aristida annua* A Wire-grass	V	V	This species is confined to grasslands and grassy woodlands on black clay and basalt soils between the Springsure/Emerald and Clermont areas (DoEE 2017b, ALA 2017).	Unlikely to be present. Suitable habitat (native grasslands and grassy woodlands on black clay soils) is not present within the Site.	Not recorded within the Site.
Poaceae	*Arthraxon hispidus* Hairy-joint Grass	V	V	Outlying and disjunct populations of this species associated with springs or spring-fed wetlands occur in the Carnarvon Range and Taroom area (DSITI 2017b). In Queensland, this species has been recorded growing in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps (TSSC 2008c).	Unlikely to be present. Suitable habitat (permanent wetlands) is present to a limited extent within the Site and these are artificial, being maintained by dams. No springs or spring-fed wetlands are known within the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
Poaceae	*Dichanthium queenslandicum* King Bluegrass	E	V	This grass occurs in tussock grasslands of sub-coastal eastern Queensland (DoEE 2017b) on heavy black cracking clays derived from basalt or fine-grained sedimentary rocks (DEHP 2017b). This species often grows in association with other species of blue grasses (*Dichanthium* and *Bothriochloa* spp.) and other grass species restricted to this soil type (DEHP 2017b). It is confined to natural grassland or Doolan (*Acacia salicina*) thickets in grassland and grassy eucalypt woodland communities (DEHP 2017b).	Unlikely to be present. Suitable habitat (grasslands and grassy woodlands on fertile black clay soils) is not present within the Site.	Not recorded within the Site.
Poaceae	*Dichanthium setosum* A bluegrass	V	LC	Occurs in Queensland and north-eastern NSW (ALA 2017). In Queensland, it is patchily recorded from Toowoomba in the south to the upper Burdekin River catchment in the north. It grows on basaltic black clays and hard-setting red-brown loams (DoEE 2017b) in woodland or open grassy woodland dominated by Brigalow (*Acacia harpophylla*) and/or eucalypt species (DSITI 2017d). In Queensland and NSW it has also been found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture (DoEE 2017b).	Potentially present. Suitable habitat (grasslands and grassy woodlands on red-brown clay loam soils) is present within the Site. Specimen records closest to the Site occur in Carnarvon NP and the Springsure / Emerald area (ALA 2017).	Not recorded within the Site.
Poaceae	*Homopholis belsonii* Belson's Panic	V	E	Occurs in northern NSW and the southern Brigalow Belt of Queensland (ALA 2017, DoEE 2017b). Within Queensland it principally occurs in Poplar Box (*Eucalyptus populnea*), Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) dominated communities where it grows preferentially in shaded areas (DoEE 2017b).	Unlikely to be present. Suitable habitat (Brigalow-dominated open forests and woodlands) is present within the Site. However, the Site is approximately 130km northwest and 130km north of the two nearest records for the species.	Not recorded within the Site.
Santalaceae	*Thesium australe* Austral Toadflax	V	V	This species of perennial herb is parasitic on grasses especially Kangaroo Grass (Themeda triandra) (DoEE 2017b). It is found in grasslands and grassy woodlands on basalt and fine-grained soils (DoEE 2017b). It is distributed from eastern Victoria to south central Queensland (DoEE 2017b). In Queensland it has been recorded from the Darling Downs, South Burnett and Carnarvon National Park (ALA 2017).	Unlikely to be present. Suitable habitat (grasslands and grassy woodlands on fine-grained soils) is present within the Site to a limited extent but much of this has been modified or cleared during development of non-native pastures.	Not recorded within the Site.
Surianaceae	*Cadellia pentastylis* Ooline	V	V	Occurs in northern NSW and southern Queensland (DoEE 2017b). Within Queensland it occurs patchily from near Rockhampton westward to near Blackall and southward to the State border (ALA 2017) where it occurs on undulating plains, valley slopes, hillsides and scarps, often in association with Brigalow and SEVT communities (DoEE 2017b, Santos 2012).	Confirmed present. The species is known to occur patchily in suitable habitat within the Site. It was detected on 6TR11 and 7TR39.	Recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
Zamiaceae	*Macrozamia platyrhachis*	E	E	This cycad species has a restricted distribution in the Blackdown Tableland – Planet Downs area of the Dawson Range in central Queensland where it occurs in eucalypt woodland or open forest on deep sandy soils derived from sandstone (Queensland Herbarium 2007). There is an outlying historical record (1973) from the Ceres Holding southeast of Springsure (DSITI 2017b). The species grows in eucalypt woodland or open forest with canopy dominants including Smooth-barked Apple (*Angophora leiocarpa*), Blackdown Yellowjacket (*Corymbia bunites*), Lemon-scented Gum (*C. citriodora* subsp. *citriodora*), Henderson's Bloodwood (*C. hendersonii*), Large-fruited Yellowjacket (*C. watsoniana*), Bailey's Stringybark (*Eucalyptus baileyana*), Gympie Messmate (*E. cloeziana*), Narrow-leaved Red Ironbark (*E. crebra*), Nanango Ironbark (*E. melanoleuca*), *E. suffulgens*, Swamp Mahogany (*Lophostemon suaveolens*) and Budgeroo (*Lysicarpus angustifolius*) on deep sandy soils derived from sandstone at altitudes between 300 and 780m (Forster and Holland 2007).	Potentially present. Some suitable habitat on sandstone hills is present within the Site, the northern-most end of which is within 35-40km of the nearest specimen-backed record.	Not recorded within the Site.
Birds	*Ardea ibis* Cattle Egret	Ma	LC	Widely distributed through coastal and near-coastal Australia but a scarce visitor to south central Queensland (Birdlife Australia 2017). Nests colonially in trees in or beside waterbodies but birds may be encountered in a variety of ephemeral wetland and pasture habitats (Birdlife Australia 2017).Parts of the Arcadia gas field with potentially suitable habitat can support the species at least periodically.	Potentially present. Some suitable habitat (permanent and ephemeral shallow wetlands) is present within the Site in the form of farm dams.	Not recorded within the Site.
	Ardea modesta Eastern Great Egret (as *A. modesta* Great Egret)	Ma	LC	Widely distributed in coastal and inland Australia, using artificial and natural ephemeral and permanent wetlands (Birdlife Australia 2017). Parts of the Arcadia gas field with potentially suitable habitat can support the species at least periodically.	Potentially present. Some suitable habitat (permanent and ephemeral shallow wetlands) is present within the Site in the form of farm dams.	Not recorded within the Site.
	Botaurus poiciloptilus Australasian Bittern	E	LC	This species is very rarely recorded in Queensland (Birdlife Australia 2017) with most records from southern Queensland. It is usually associated with densely vegetated wetlands (DoEE 2017b) and within the Santos gas field development area is most likely to be present on major watercourses where suitable wetlands may be present.	Potentially present. Some suitable habitat (permanent and ephemeral shallow wetlands) is present within the Site in the form of farm dams.	Not recorded within the Site.
	Erythrotriorchis radiatus Red Goshawk	V	V	A highly mobile species with a large home range; breeding habitat is in intact tall forest associated with major drainage lines, especially near permanent water bodies and where there is high avian prey diversity, but the species could potentially forage much further away from these areas (Marchant and Higgins 1993). Based on known occurrence (ALA 2017) the forested uplands of the Fitzroy and Dawson River catchments may potentially support this species.	Potentially present. Suitable breeding habitat (permanent water bodies and riparian habitat with tall trees) is absent within the Site but potential foraging habitat (open areas near water, forests and woodlands) is present at the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
	Geophaps scripta scripta Squatter Pigeon (southern subspecies)	V	V	Inhabits grassy woodlands with open areas for foraging habitat usually within proximity to a nearby water source (Higgins and Davies 1996).	Potentially present. The species is known from the Arcadia Valley, though recent records are lacking (ALA 2017). Suitable habitat (grassy woodland s) is present within the Site.	Not recorded within the Site.
	Lathamus discolor Swift Parrot	CE, Ma	E	This species is migratory, visiting Queensland in winter and known historically at least as far north as Duaringa (Higgins 1999) but now rarely recorded beyond the south-eastern corner of Queensland (Birdlife Australia 2017). There are no published records within the Arcadia gas field area and it is not considered to be present.	Unlikely to be present. Site is outside known migratory range of the species.	Not recorded within the Site.
	Merops ornatus Rainbow Bee-eater	Ma	LC	Common breeding spring-summer visitor to southern Queensland, including the Arcadia gas field area (Birdlife Australia 2017). Likely to be seasonally present.	Likely to be present. Woodlands on sandy or sandy loam soils are present within the Site.	Not recorded within the Site.
	Neochmia ruficauda ruficauda Star Finch	E	E	The range of this subspecies has contracted markedly and it may now be extinct (Maute and Legge 2012). It is considered to be no longer extant in the Arcadia gas field area.	Unlikely to be present. The species is considered extinct within the Arcadia gas field area.	Not recorded within the Site.
	Pandion cristatus Eastern Osprey (as *P. haliaetus* Osprey)	M, Ma	LC	A fish-eating raptor mostly found on the coast but occasionally reported on inland waterways (Birdlife Australia 2017, ALA 2017). Suitable habitat is limited within the Arcadia gas field area to reaches of permanent water in the Dawson River and its tributaries. Resident populations are unlikely and the presence of the species in the area is likely to be represented by vagrant individuals.	Unlikely to be present. No suitable habitat (permanent watercourses supporting fish populations) is present within the Site.	Not recorded within the Site.
	Pedionomus torquatus Plains-wanderer	CE	V	The few records of this taxon in eastern Queensland (ALA 2017) may not be reliable as they are well distant from all other known occurrences in the State and suitable habitat (Parker 2012) is not generally present. At best they would represent vagrants. The species is not considered to be present in the Arcadia gas field area.	Unlikely to be present. No suitable habitat (plains with short grasses and forbs) is present within the Site and the species is not considered to occur within the Arcadia gas field.	Not recorded within the Site.
	Plegadis falcinellus Glossy Ibis	M, Ma	LC	A nomadic waterbird using permanent and ephemeral shallow wetlands (Birdlife Australia 2017). The Arcadia gas field area is within the species range (ALA 2017).	Confirmed present. Some suitable habitat (permanent and ephemeral shallow wetlands) is present within the Site in the form of farm dams. Two birds were seen at a farm dam on Lot 7TR22 within the Site.	Recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
	Poephila cincta cincta Black-throated Finch	E	E	The range of this subspecies has contracted markedly northward (Grice 2012, Garnett *et al*. 2011) and it is considered to be no longer extant in the Arcadia gas field area.	Unlikely to be present. The species is considered extinct within the Arcadia gas field area.	Not recorded within the Site.
	Polytelis swainsonii Superb Parrot	V	LC	This species is very rarely recorded as a winter visitor to Queensland (Birdlife Australia 2017). There are no published records within the Santos gas field development area and it is not considered to be present.	Unlikely to be present. The Site is outside the known migratory range of the species.	Not recorded within the Site.
	Rostratula australis Australian Painted Snipe	E	V	Forages at shallow edges and adjacent vegetated margins of freshwater wetlands (DoEE 2017b) and is able to use both artificial and natural ephemeral and permanent wetlands (Marchant and Higgins 1993).	Potentially present. Some suitable habitat (permanent and ephemeral shallow wetlands) is present within the Site in the form of farm dams.	Not recorded within the Site.
Fish	*Maccullochella peelii* Murray Cod	V	-	In Queensland naturally-occurring populations of this species are confined to permanent water in riverine environments in the Condamine, Maranoa-Balonne, Weir, Moonie and Macintyre River catchments (Lintermans 2007).	Unlikely to be present. No suitable riverine habitat exists within the Site.	Not recorded within the Site.
Mammals	*Chalinolobus dwyeri* Large-eared Pied Bat	V	V	All known occurrences of this species are within or near forested landscapes with relatively high relief (DSITI 2017d). The species may be present in uplands with likely presence of appropriate geology (usually sandstone) providing essential habitat (caves, crevices, holes) and associated foraging habitat.	Potentially present. Potentially suitable habitat (i.e. rock holes/crevices in rocky hills) is present within the Site, which is within the known range of the species.	Not recorded within the Site.
	Dasyurus hallucatus Northern Quoll	E	LC	Formerly widespread in south-central Queensland this species has declined markedly and is now confined to rugged and remote areas throughout its distribution (Burnett 2012). Forested uplands with high relief and/or containing abundant rock outcrops may support the species.	Potentially present. The Site is within the species' historical range and areas of potentially suitable den sites (i.e. rock holes/crevices) are present within the Site. The nearest recent records are from the Carnarvon Range (ALA 2017).	Not recorded within the Site.
	Nyctophilus corbeni South-eastern Long-eared Bat	V	V	The distribution and habitat preferences of this species are very poorly known; it inhabits a range of dry forest types in south central Queensland (Reardon 2012). The species has been recorded in the Expedition Range (ALA 2017) which forms the eastern boundary of the Site.	Potentially present. Potentially suitable foraging and roosting habitat is present in remnant woodland within the Site. The Expedition Range forms the eastern boundary of the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
	Petrogale penicillata Brush-tailed Rock-wallaby	V	LC	The distribution of this taxon does not extend to the Santos gas field development area (Lundie-Jenkins 2012). The Rock-wallaby present in the area is the non-listed *P. herberti* (DEHP 2017b).	Unlikely to be present. The species is not known from the Site. The related Herbert's Rock-wallaby was recorded within the Site (on Lot 8TR23).	Not recorded within the Site.
	Phascolarctos cinereus Koala (combined populations of QLD, NSW and the ACT)	V	V	This species requires eucalypt woodland and forest habitat with suitable food trees (primarily *Eucalyptus* spp.) (DoEE 2017b). Woodlands containing food trees in riparian/alluvial areas are particularly favoured (Melzer *et al*. 2014). Potential food trees occurring within the Site include *Eucalyptus tereticornis*, *E. camaldulensis*, *E. populnea*, *E. melanophloia* and *E. crebra*. The Arcadia gas field area is within the known range of the species (ALA 2017).	Likely to be present. Suitable habitat (*Eucalyptus*-dominated woodlands and open forests) is present within the Site.	Not recorded within the Site.
Reptiles	*Anomalopus mackayi* Five-clawed Worm-skink	V	E	This species is confined in Queensland to the eastern Darling Downs, where it is known to inhabit grasslands on heavy cracking clay soils (Wilson 2015) and does not occur in the Arcadia gas field area.	Unlikely to be present. Suitable habitat (grasslands on heavy clay soils) is not present at the Site and the species does not occur within the Arcadia gas field area.	Not recorded within the Site.
	Delma torquata Collared Delma	V	V	Occupies a range of eucalypt woodlands and open forests; lives under surface rock and large woody debris (Wilson 2015). The Site is within the species' known range with several records from locations north-west of Roma (ALA 2017).	Potentially present. Eucalypt woodland with potentially suitable shelter sites (e.g. small rocks, woody debris) is present within the Site.	Not recorded within the Site.
	Denisonia maculata Ornamental Snake	V	V	Occurs in lowlands associated with the Dawson and Fitzroy catchments (DoEE 2017b). Known southerly distribution limit is approximately Lake Nuga Nuga (ALA 2017). Lives in woodland and grassland with cracking clay soils, usually in close proximity to wet or seasonally wet areas e.g. billabongs, gilgais, floodplains, riparian corridors (DoEE 2017b).	Potentially present. Habitat with preferred substrate (e.g. deep cracking clay, gilgais) and farm dams is present at the Site and the species is known to occur within 20km of the northern extent of the Site (ALA 2017).	Not recorded within the Site.
	Egernia rugosa Yakka Skink	V	V	Lives in a range of woodland and open forests dominated by *Eucalyptus*, *Acacia* and *Callitris* spp.; also grassland with regrowth trees (DoEE 2017b). Requires suitable soils for burrows or shelters in sinkholes, abandoned rabbit warrens or large fallen/piled woody material (Eddie 2012). There are historical records of the species from the Arcadia Valley (ALA 2017).	Potentially present. Eucalypt woodland and non-remnant areas with potentially suitable shelter sites (e.g. large logs, log piles) are present within the Site.	Not recorded within the Site.
	Furina dunmalli Dunmall's Snake	V	V	Occupies woodlands and open forests; may be reliant on presence of abundant fallen woody debris (Hobson 2012). The species has been recorded within 1km of the southern boundary of the Site (Lot 807PH1979) (BOOBOOK unpubl. data).	Likely to be present. Potentially suitable foraging and shelter habitat is present in remnant and regrowth REs within the Site.	Not recorded within the Site.

Plant Family/ Animal Class	Scientific & Common Name	EPBC Act Status[i]	NC Act Status	Distribution and Known Habitat Use	Likelihood of Occurrence	Field Survey Results
	Rheodytes leukops Fitzroy River Turtle	V	V	The species is confined to the Fitzroy and Dawson River catchments where it requires permanent water in riverine environments (Limpus *et al*. 2011).	Unlikely to be present. No suitable riverine habitat is present within the Site.	Not recorded within the Site.

3.2.2. Habitat Assessment and Predictive Habitat Mapping

Twenty-four (24) microhabitat assessments were conducted for a selection of threatened species as listed at Section 2.2.2. The results of these assessments were then combined with ecologist knowledge to develop predictive habitat mapping for those species. Mapping rules and the estimated total availability of General Habitat within the survey area for each species is given in Table 6.

The suitability of areas of vegetation as fauna habitat is determined by the presence and abundance of microhabitat features relevant to the needs of individual species or groups of species (e.g. terrestrial reptiles). In general, mature vegetation (remnant or advanced regrowth) is more likely to support appropriate levels of these microhabitat features, while their presence in younger regrowth and clearings is less likely. This is particularly the case where clearing for agriculture has involved the destruction of fallen timber and coarse woody debris, such that where young regrowth is present it lacks necessary microhabitat for ground-dwelling fauna. This scenario applies to much of the Site as most original vegetation on valley floors has been removed during development of improved pastures for cattle grazing and substantial areas are periodically treated (herbicide or blade-ploughing) to control woody regrowth. It is acknowledged that some areas of young regrowth may contain suitable habitat for some species (e.g. log piles used by reptiles). However, for the purposes of this report, General Habitat is assumed to be present only in remnant and advanced regrowth vegetation.

Habitat maps for the selected species are provided separately in the relevant spatial data files.

Table 6: Potentially suitable RE and estimated extent of General Habitat for nominated fauna and flora species potentially present at the Site.

Species name	Potentially Suitable REs	Mapped extent of General Habitat (ha)	Habitat Mapping Rules/Notes
Fauna			
Chalinolobus dwyeri Large-eared Pied Bat	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,582	This species is dependent on the presence of suitable shelter habitat in the form of caves and deep crevices in extensive rock formations (commonly sandstone). Mapped General Habitat includes all areas of remnant vegetation and advanced regrowth that may be suitable for foraging and are <5km from potentially suitable shelter habitat.
Dasyurus hallucatus Northern Quoll	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,146	This species is dependent on the presence of suitable shelter habitat in the form of caves and deep crevices in extensive rock formations (commonly sandstone) though it may forage at a distance from this habitat. A conservative (minimum) estimate of potential habitat should include areas of woodland or open forest vegetation contiguous with suitable shelter habitat. Mapped General Habitat includes all areas of remnant vegetation and advanced regrowth that may be suitable for foraging and contiguous with potentially suitable shelter habitat.
Nyctophilus corbeni South-eastern Long-eared Bat	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,786	Mapped General Habitat includes all areas of remnant vegetation and advanced regrowth that may be suitable for foraging or shelter.
Phascolarctos cinereus Koala	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.7, 11.9.10, 11.10.4, 11.10.7	1,414	Mapped General Habitat includes all remnant and advanced regrowth of RE dominated by Myrtaceae species.
Ardea ibis Cattle Egret	11.3.17, 11.3.2, 11.3.25, 11.3.4	554	Mapped General Habitat includes all remnant and regrowth RE 11.3.17, 11.3.2, 11.3.4 and 11.3.25. However, no mapping is available for preferred habitat within these RE (off-stream shallow vegetated wetlands). The species is also likely to use ephemeral wetlands in cleared gilgai areas, and the vegetated margins of farm dams. The species will also forage with cattle and other livestock at a distance from wetland habitat.

Species name	Potentially Suitable REs	Mapped extent of General Habitat (ha)	Habitat Mapping Rules/Notes
Ardea modesta Eastern Great Egret	11.3.17, 11.3.2, 11.3.25, 11.3.4	554	Mapped General Habitat includes all remnant and regrowth RE 11.3.17, 11.3.2, 11.3.4 and 11.3.25. However, no mapping is available for preferred habitat within these RE (off-stream shallow vegetated wetlands). The species is also likely to use ephemeral wetlands in cleared gilgai areas, and the vegetated margins of farm dams.
Erythrotriorchis radiatus Red Goshawk	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,786	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Geophaps scripta scripta Squatter Pigeon (southern)	11.3.2, 11.3.4, 11.3.18, 11.3.25, 11.3.39, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	1,208	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Merops ornatus Rainbow Bee-eater	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,786	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Plegadis falcinellus Glossy Ibis	11.3.17, 11.3.2, 11.3.25, 11.3.4	554	Mapped General Habitat includes all remnant and regrowth RE 11.3.17, 11.3.2, 11.3.4 and 11.3.25. However, no mapping is available for preferred habitat within these RE (off-stream shallow vegetated wetlands). The species is also likely to use ephemeral wetlands in cleared gilgai areas, and the vegetated margins of farm dams.
Rostratula australis Australian Painted Snipe	11.3.17, 11.3.2, 11.3.25, 11.3.4	554	Mapped General Habitat includes all remnant and regrowth RE 11.3.17, 11.3.2, 11.3.4 and 11.3.25. However, no mapping is available for preferred habitat within these RE (off-stream shallow vegetated wetlands). The species is also likely to use ephemeral wetlands in cleared gilgai areas, and the vegetated margins of farm dams.
Delma torquata Collared Delma	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,786	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Denisonia maculata Ornamental Snake	11.3.17, 11.3.2, 11.3.25, 11.3.4, 11.9.5	303	Mapped General Habitat includes all remnant vegetation and advanced regrowth of the nominated REs except areas >360m elevation. The species is also likely to use ephemeral wetlands in cleared gilgai areas, and the vegetated margins of farm dams.
Egernia rugosa Yakka Skink	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	1,417	Mapped General Habitat includes all remnant vegetation and advanced regrowth of the nominated RE.
Furina dunmalli Dunmall's Snake	11.3.2, 11.3.4, 11.3.17, 11.3.18, 11.3.25, 11.3.39, 11.9.5, 11.9.5a, 11.9.7, 11.9.10, 11.10.3, 11.10.4, 11.10.7	2,786	Mapped General Habitat includes all remnant vegetation and advanced regrowth of the nominated RE.

Species name	Potentially Suitable REs	Mapped extent of General Habitat (ha)	Habitat Mapping Rules/Notes
Flora			
Acacia grandifolia	11.3.39, 11.10.3, 11.10.4, 11.10.7	805	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Bertya opponens	11.10.4	770	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Cadellia pentastylis Ooline	11.9.5a	785	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Daviesia discolor	11.10.7, 11.10.4	775	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Dichanthium setosum	11.3.2, 11.9.7, 11.9.10	125	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Eucalyptus beaniana Bean's Ironbark	11.10.4	770	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Macrozamia platyrhachis	11.10.4, 11.10.7	775	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.
Xerothamnella herbacea Xerothamnella	11.3.17, 11.9.5	794	Mapped General Habitat includes all areas of remnant and advanced regrowth of the nominated RE.

4. Conclusions

The desktop assessment and field survey identified the following potential ecological values and/or constraints within the Site:

- Approximately 553 ha of Brigalow (*Acacia harpophylla* dominant and dominant) TEC.
- Presence of two Endangered RE, being 584.66 ha of RE 11.9.5 and 784.72 ha of RE 11.9.5a as remnant or advanced regrowth equivalent to remnant vegetation.
- Presence of two EPBC Act and NC Act listed flora species, namely Ooline (*Cadellia pentastylis*) and Xerothamnella (*Xerothamnella herbacea*).
- Presence of two EPBC Act listed Migratory Fauna species, namely Glossy Ibis (*Plegadis falcinellus*) and Rufous Fantail (*Rhipdura rufifrons*).
- Indicative General Habitat for the following threatened species:
    - *Ardea ibis* (Cattle Egret);
    - *Ardea modesta* (Eastern Great Egret);
    - *Erythrotriorchis radiatus* (Red Goshawk);
    - *Geophaps scripta scripta* (Squatter Pigeon (southern));
    - *Merops ornatus* (Rainbow Bee-eater);
    - *Plegadis falcinellus* (Glossy Ibis);
    - *Rostratula australis* (Australian Painted Snipe);
    - *Chalinolobus dwyeri* (Large-eared Pied Bat);
    - *Dasyurus hallucatus* (Northern Quoll);

- *Nyctophilus corbeni* (South-eastern Long-eared Bat, Corben's Long-eared Bat);
- *Phascolarctos cinereus* (Koala);
- *Delma torquata* (Collared Delma;
- *Denisonia maculata* (Ornamental Snake);
- *Egernia rugosa* (Yakka Skink);
- *Furina dunmalli* (Dunmall's Snake);
- *Acacia grandifolia*;
- *Bertya opponens*;
- *Cadellia pentastylis* (Ooline);
- *Daviesia discolor*;
- *Dichanthium setosum*;
- *Eucalyptus beaniana* (Bean's Ironbark);
- *Macrozamia platyrhachis*; and
- *Xerothamnella herbacea*.

5. Recommendations

It is recommended that:

- Pre-clearance surveys for threatened fauna microhabitat and threatened flora are conducted prior to any infrastructure development in vegetation within the Site.

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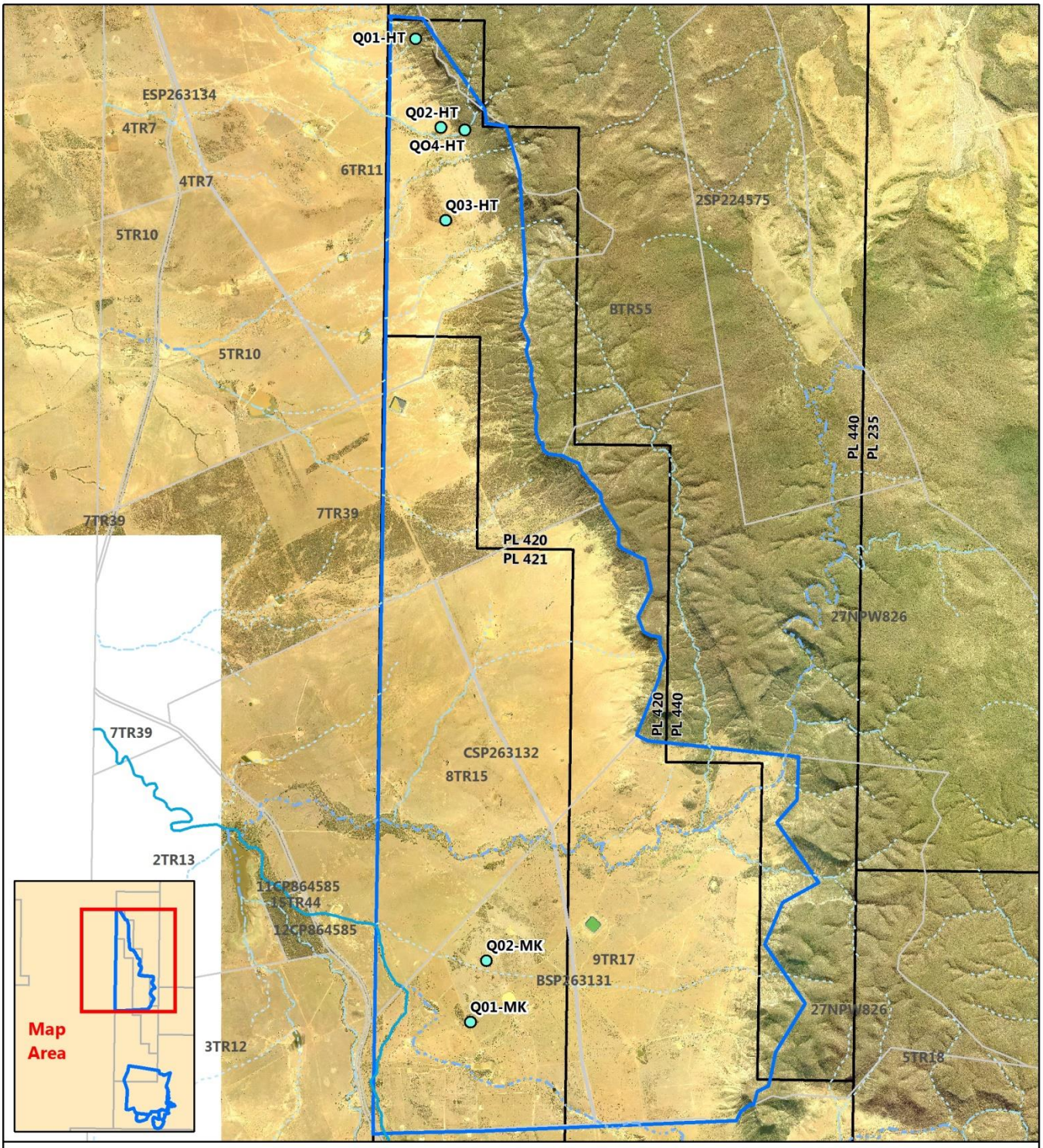
Appendix A. Location of ‘the Site’ & Assessment Sites.



Appendix A1: Location of the Project Site & Assessment Sites.

Legend

- Quaternary Survey Site
- Survey Area
- Lot on Plan Boundary
- Tenement Boundary

Ordered Streams

- 1
- 2
- 3
- 5

0 0.5 1 2 3 km

Boobook

Project: Arcadia Broad-scale EA

Map No:	ARC_AppA01
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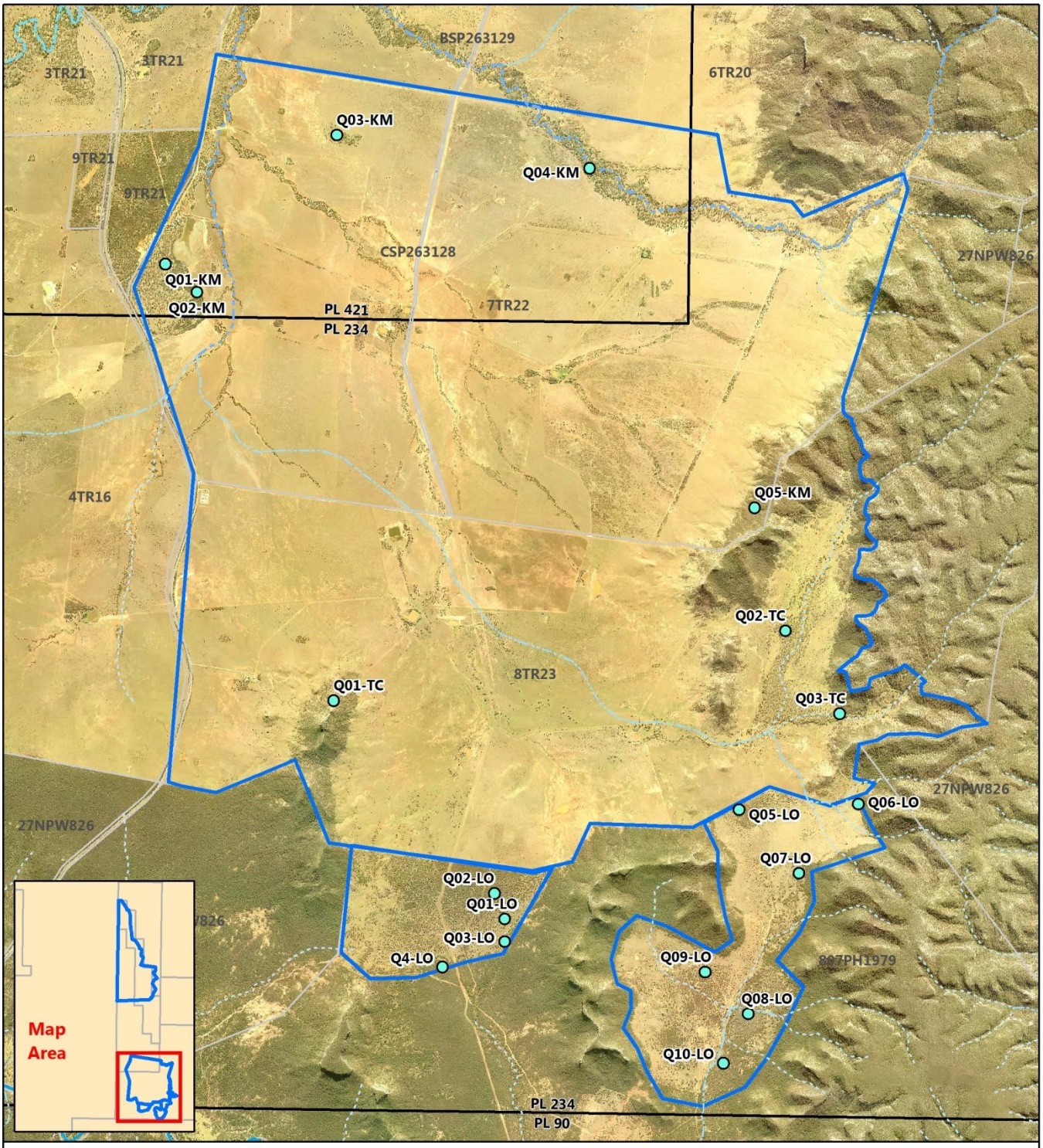
Approved:	C. Eddie
Scale:	1:90,000 @ A4
Datum:	GDA94



Appendix A2: Location of the Project Site & Assessment Sites.

Legend

- Quaternary Survey Site
- Survey Area
- Lot on Plan Boundary
- Tenement Boundary

Ordered Streams

1
2
3
4
5

0 0.5 1 2 3 km

Boobook

Project:	Arcadia Broad-scale EA
Map No:	ARC_AppA02
Date:	7/12/2017
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Approved:	C. Eddie
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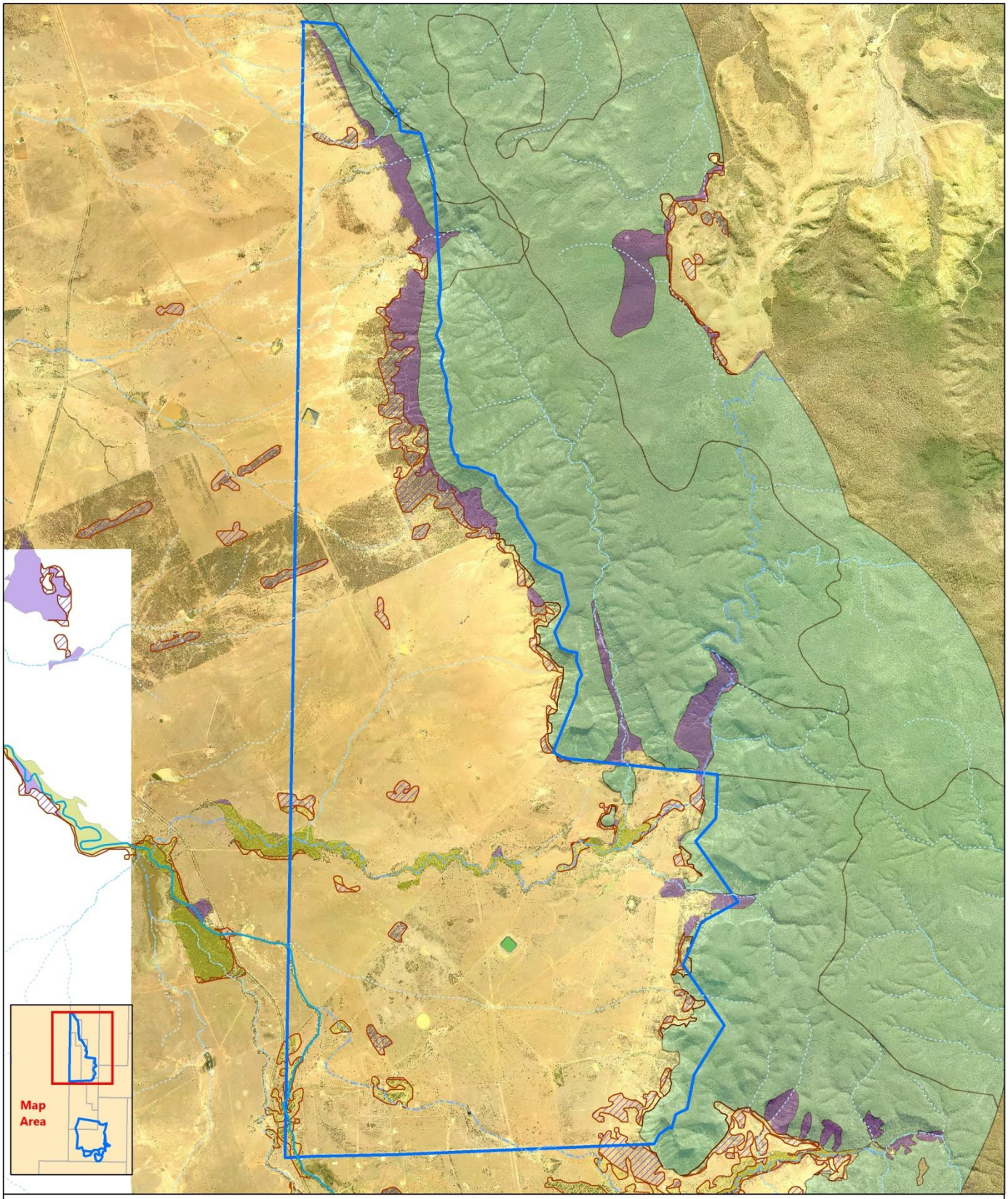
Appendix B. State Government Remnant & Mature Regrowth RE.



Appendix B1: State Government Remnant & Mature Regrowth RE Mapping.

Legend

Survey Area

Remnant RE (Biodiversity Status)

Endangered - Dominant

Of Concern - Dominant

No concern at Present

Mature Regrowth RE (Biodiversity Status)

Contains Endangered Dominant RE

Contains Of Concern Dominant RE

Not of Concern RE

Ordered Streams

1

2

3

5

0 0.5 1 2 3 km

Boobook

Arcadia

Project: Broad-scale EA

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Drawn:	L.Hardwick
Approved:	C. Eddie
Scale:	1:60,000 @ A3
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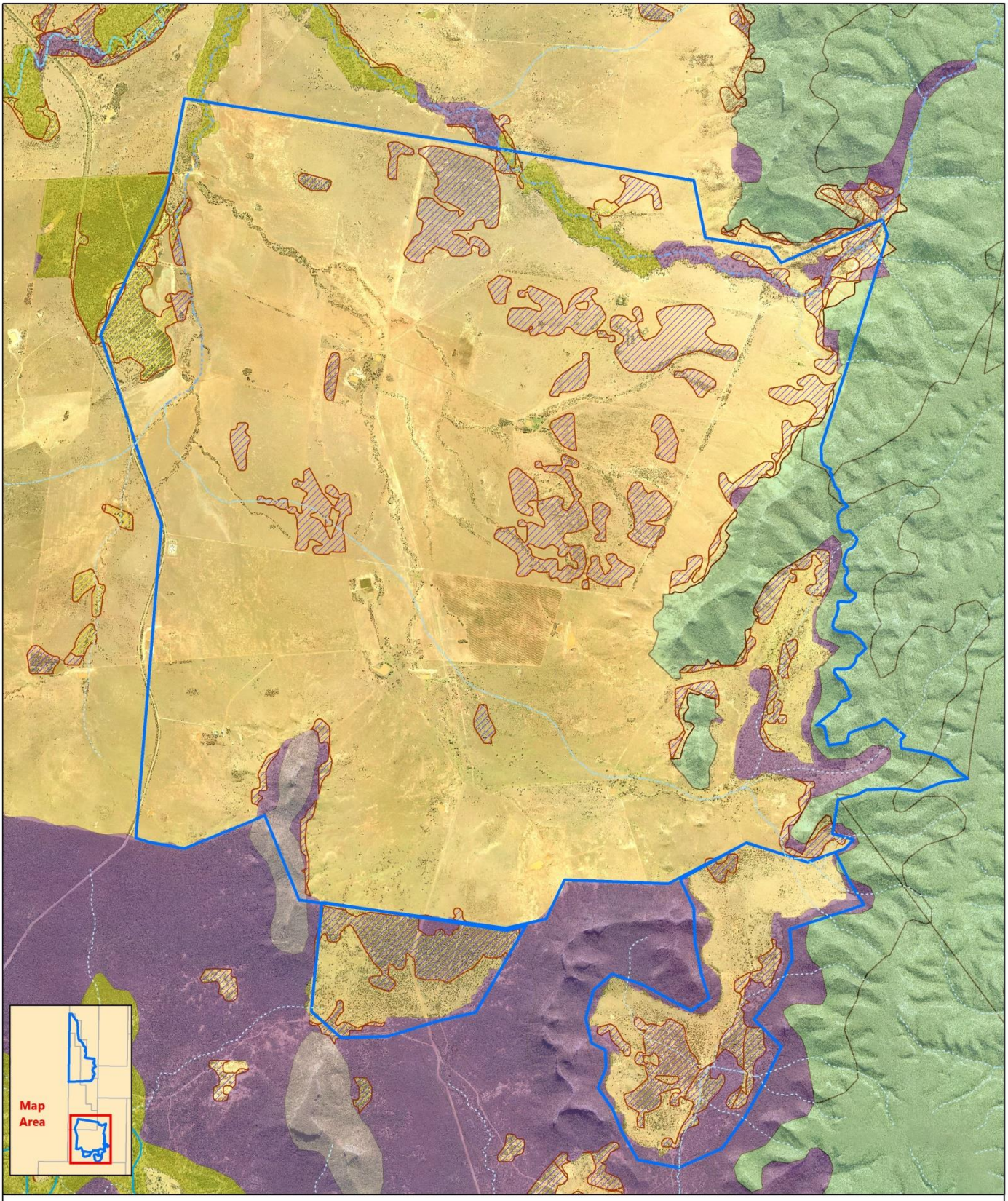

Appendix B2: State Government Remnant & Mature Regrowth RE Mapping.

Legend

Survey Area

Remnant RE (Biodiversity Status)
- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- No concern at Present

Mature Regrowth RE (Biodiversity Status)
- Contains Endangered Dominant RE
- Contains Endangered Sub-dominant RE
- Contains Of Concern Dominant RE
- Not of Concern RE

Ordered Streams
- 1
- 2
- 3
- 4
- 5

0 0.5 1 2 3 km

Boobook

Arcadia

Project: Broad-scale EA

Map No:	ARC_AppB2
Date:	7/12/2017
Drawn:	L.Hardwick
Approved:	C. Eddie
Scale:	1:40,000 @ A3
Datum:	GDA94

Appendix C. Revised Remnant & Regrowth RE.

Map Area

Appendix C1: Revised Remnant & Regrowth RE.

Legend

Survey Area

Revised Remnant RE (Biodiversity Status)

- Endangered - Dominant
- Of Concern - Dominant
- No concern at Present

Revised Regrowth RE (Biodiversity Status)

- Endangered - Dominant
- Of Concern - Dominant
- No Concern at Present

Ordered Streams

- 1
- 2
- 3
- 5

0 0.5 1 2 3 km

Boobook

Project:	Arcadia Broad-scale EA
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Approved:	C. Eddie
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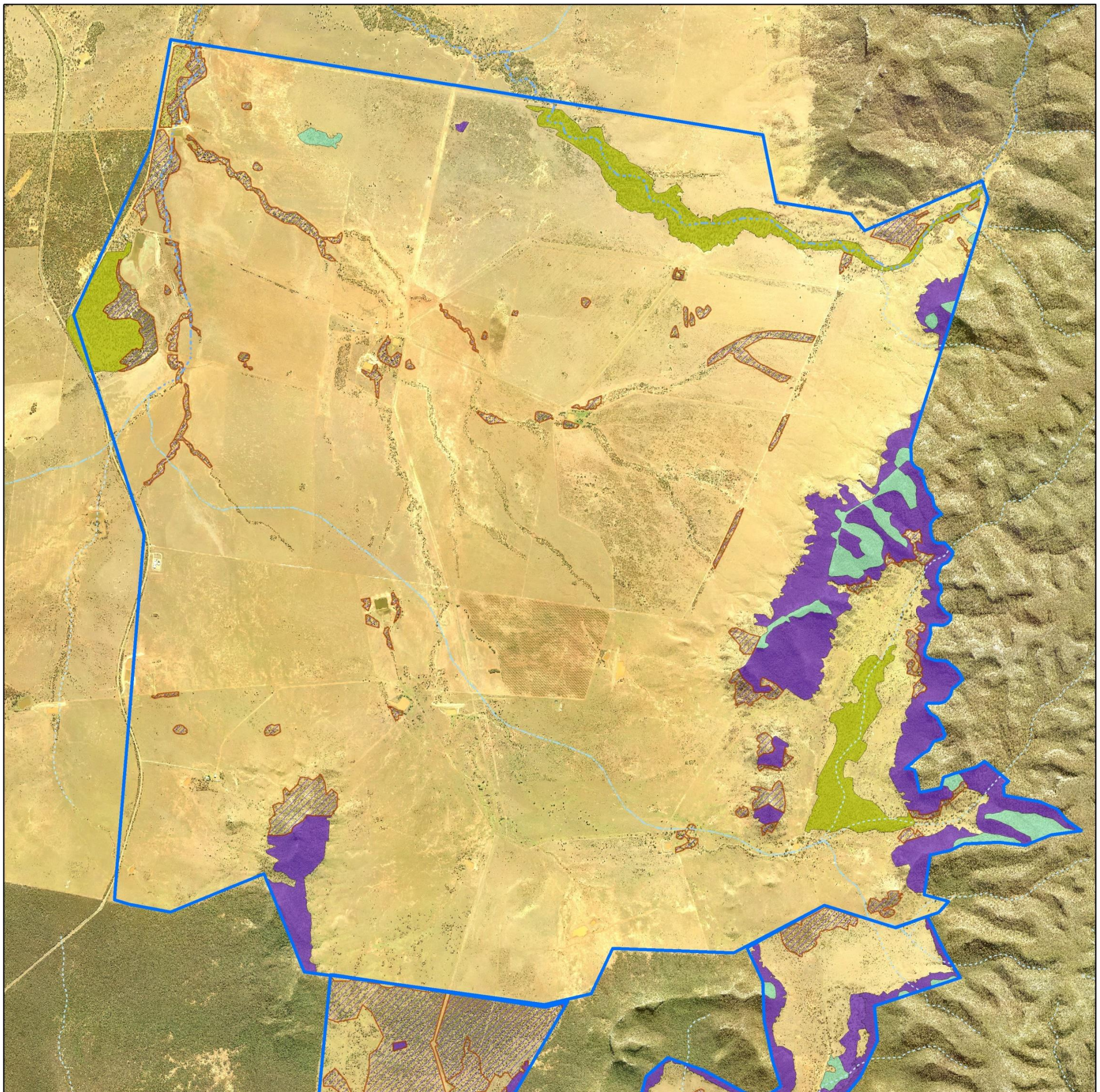

Appendix C2: Revised Remnant & Regrowth RE.

Legend

Survey Area

Revised Remnant RE (Biodiversity Status)

Endangered - Dominant

Of Concern - Dominant

No concern at Present

Revised Regrowth RE (Biodiversity Status)

Endangered - Dominant

Of Concern - Dominant

Ordered Streams

1

2

3

5

0 0.5 1 2 3 km

Boobook

	Arcadia
Project:	Broad-scale EA
Map No:	ARC_AppC2
Date:	7/12/2017
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Approved:	C. Eddie
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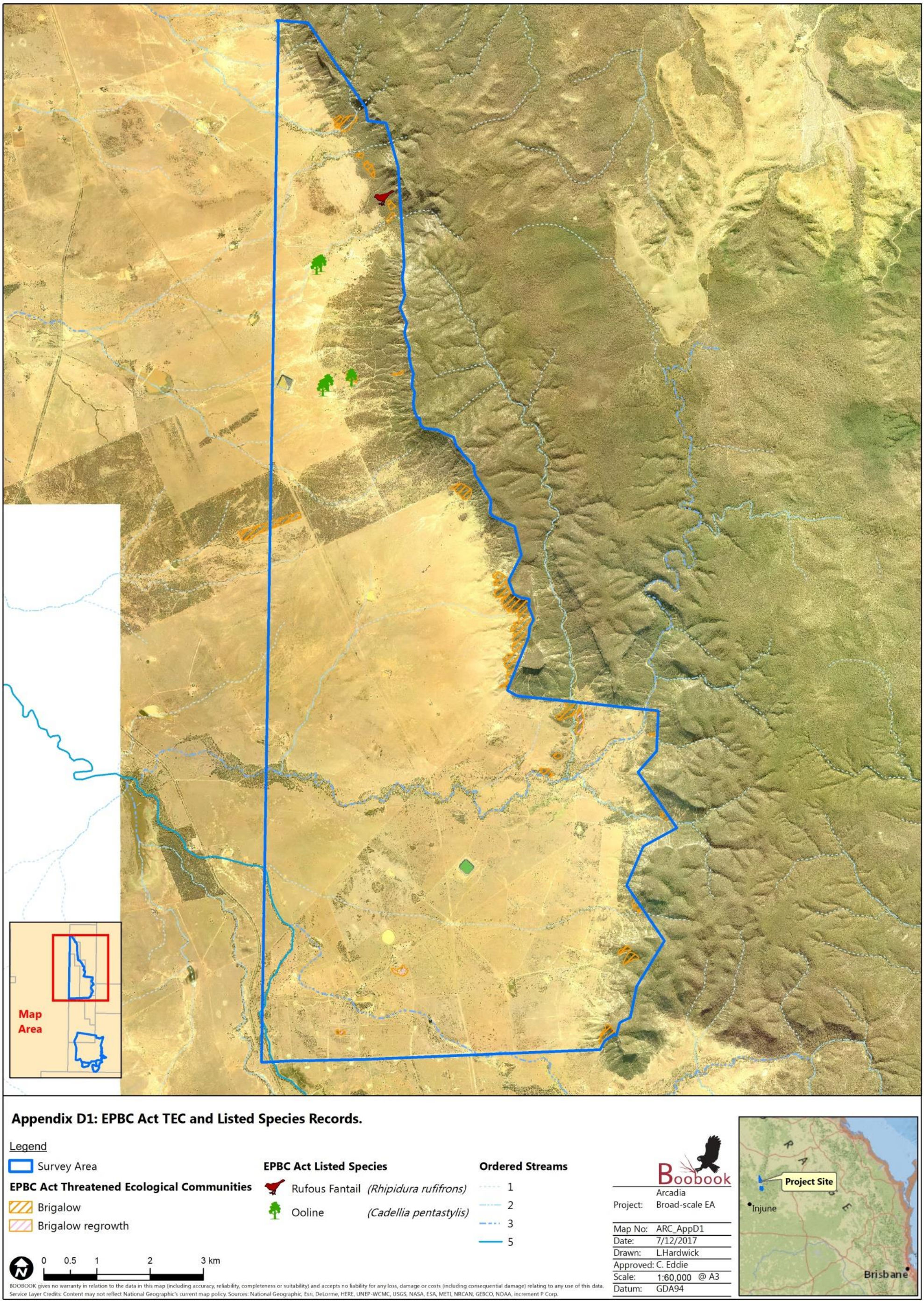
Appendix D. EPBC Act TEC and Listed Species Records.


Map Area
Appendix D1: EPBC Act TEC and Listed Species Records.
Legend
Survey Area
EPBC Act Threatened Ecological Communities
Brigalow
Brigalow regrowth
EPBC Act Listed Species
Rufous Fantail (Rhipidura rufifrons)
Ooline (Cadellia pentastylis)
Ordered Streams
1
2
3
5
0 0.5 1 2 3 km
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Arcadia
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Map No: ARC_AppD1
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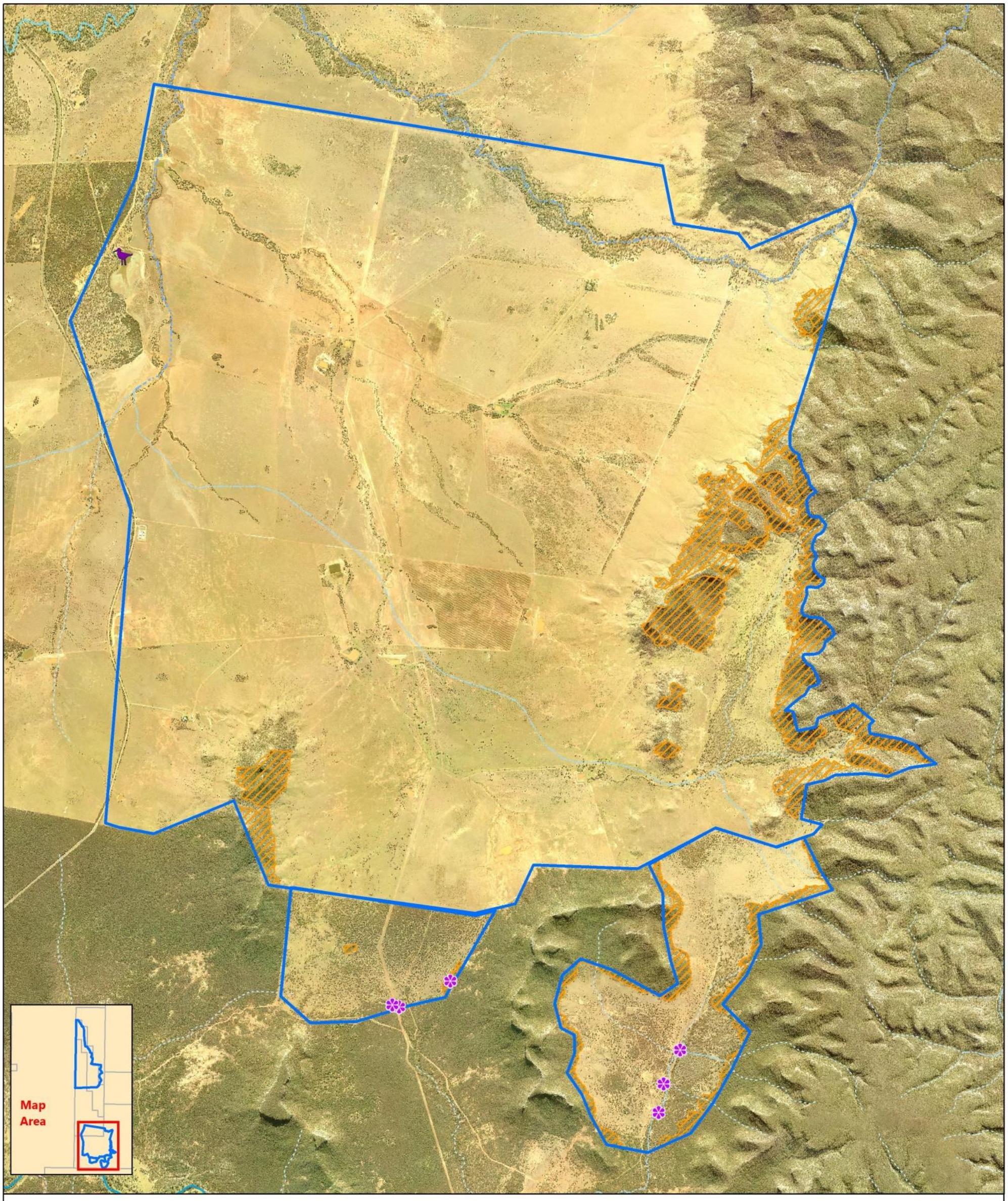
Approved: C. Eddie
Scale: 1:60,000 @ A3
Datum: GDA94
Project Site
Injune
Brisbane



Appendix D2: EPBC Act TEC and Listed Species Records.

Legend

- Survey Area
- **EPBC Act Threatened Ecological Communities**
  - Brigalow
- **EPBC Act Listed Species**
  - Glossy Ibis *(Plegadis falcinellus)*
  - Herbaceous Xerothamnella *(Xerothamnella herbacea)*
- **Ordered Streams**
  - 1
  - 2
  - 3
  - 4
  - 5

0 0.5 1 2 3 km

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Boobook

Project:	Arcadia Broad-scale EA
Map No:	ARC_AppD2
Date:	7/12/2017
Drawn:	L.Hardwick
Approved:	C. Eddie
Scale:	1:40,000 @ A3
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