



# Biodiversity Development Assessment Report

AVONLIE SOLAR FARM



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# CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>VIII</b>
<b>1 INTRODUCTION.....</b>	<b>10</b>
1.1 THE PROPOSAL.....	10
1.2 THE DEVELOPMENT SITE.....	11
1.2.1 Site location .....	11
1.2.2 Site description .....	11
1.3 STUDY AIMS .....	13
1.4 SOURCE OF INFORMATION USED IN THE ASSESSMENT .....	13
1.5 CONSULTATION.....	14
<b>2 LANDSCAPE FEATURES .....</b>	<b>15</b>
2.1 IBRA BIOREGIONS AND SUBREGIONS .....	15
2.2 NSW LANDSCAPE REGIONS AND AREA .....	15
2.3 NATIVE VEGETATION.....	15
2.4 CLEARED AREAS.....	15
2.5 RIVER AND STREAMS .....	17
2.6 WETLANDS .....	17
2.7 CONNECTIVITY FEATURES .....	18
2.8 AREAS OF GEOLOGICAL SIGNIFICANCE .....	18
2.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE.....	18
2.10 SITE CONTEXT COMPONENTS .....	18
<b>3 NATIVE VEGETATION .....</b>	<b>21</b>
3.1 NATIVE VEGETATION EXTENT .....	21
3.2 PLANT COMMUNITY TYPES (PCTS).....	24
3.2.1 Methods to assess PCTS.....	24
3.2.2 PCTS identified on the development site.....	24
3.3 VEGETATION INTEGRITY ASSESSMENT .....	33
3.3.1 Vegetation zones and survey effort.....	33
3.3.2 Paddock trees .....	33
3.3.3 Vegetation integrity assessment results.....	43
<b>4 THREATENED SPECIES .....</b>	<b>44</b>
4.1 ECOSYSTEM CREDIT SPECIES.....	44
4.1.1 Species excluded from the assessment .....	45

4.2	SPECIES CREDIT SPECIES.....	46
4.2.1	Candidate species to be assessed .....	46
4.2.2	Exclusions based on habitat quality.....	51
4.2.3	Candidate species requiring confirmation of presence or absence .....	51
4.3	THREATENED SPECIES SURVEY.....	53
4.4	ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS .....	59
4.4.1	Occurrences of karst, caves, crevices and cliffs .....	59
4.4.2	Occurrences of rock .....	59
4.4.3	Occurrences of human made structures and non-native vegetation.....	59
4.4.4	Hydrological processes that sustain and interact with the rivers, streams and wetlands .....	59
<b>5</b>	<b>MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE .....</b>	<b>60</b>
5.1	WETLANDS OF INTERNATIONAL IMPORTANCE .....	60
5.2	THREATENED ECOLOGICAL COMMUNITIES .....	60
5.3	THREATENED SPECIES .....	61
5.4	MIGRATORY SPECIES.....	61
<b>6</b>	<b>AVOID AND MINIMISE IMPACTS .....</b>	<b>62</b>
6.1	AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT.....	62
6.1.1	Site selection – consideration of alternative locations/routes.....	62
6.1.2	Proposal components – consideration of alternate modes or technologies.....	62
6.1.3	Proposal planning phase – detailed design .....	62
6.2	AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS.....	78
6.2.1	Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.....	78
6.2.2	Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.....	78
6.2.3	Impacts of development on the connectivity on movement of threatened species that maintains their lifecycle. ....	79
6.2.4	Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities. ....	79
6.2.5	Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.....	79
<b>7</b>	<b>IMPACTS UNABLE TO BE AVOIDED .....</b>	<b>80</b>
7.1	DIRECT IMPACTS .....	80
7.1.1	Loss of Native Vegetation .....	81
7.1.2	Loss of species credit species habitat .....	81
7.1.3	Loss of paddock trees .....	81



7.1.4	Loss of hollow-bearing trees.....	82
7.2	INDIRECT IMPACTS.....	82
7.3	PRESCRIBED IMPACTS .....	86
7.3.1	impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.....	86
7.3.2	impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.....	87
7.3.3	impacts of the development on movement of threatened species that maintains their life cycle ....	87
7.3.4	Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC ....	88
7.4	IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE .....	89
7.4.1	Threatened Ecological Communities .....	89
7.4.2	Threatened Species .....	89
7.4.3	Migratory species .....	92
7.5	LIMITATIONS TO DATA, ASSUMPTIONS AND PREDICTIONS .....	92
<b>8</b>	<b>MITIGATING AND MANAGING IMPACTS.....</b>	<b>93</b>
8.1	MITIGATION MEASURES .....	93
8.1.1	Impacts from the clearing of vegetation and habitats .....	93
8.1.2	Indirect impacts .....	93
8.1.3	Prescribed impacts .....	93
<b>9</b>	<b>SERIOUS AND IRREVERSIBLE IMPACTS (SAII).....</b>	<b>99</b>
9.1	POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT ENTITIES.....	99
9.1.1	Threatened ecological communities.....	99
9.1.2	Threatened species.....	99
9.1.3	Additional potential entities.....	99
9.2	ASSESSMENT OF SERIOUS AND IRREVERSIBLE IMPACTS .....	99
9.2.1	Oaklands Diuris (Diuris sp. Oakland, D.L. Jones 5380) .....	99
9.2.2	Sand-hill Spider Orchid (Caladenia arenaria) .....	102
9.2.3	Conclusion .....	105
<b>10</b>	<b>REQUIREMENT TO OFFSET .....</b>	<b>107</b>
10.1	IMPACTS REQUIRING AN OFFSET .....	107
10.1.1	Ecosystem credits .....	107
10.1.2	Paddock Tree Credits .....	107
10.1.3	Species credits .....	108
10.1.4	Offsets required under the EPBC Act.....	109
10.2	AREAS NOT REQUIRING ASSESSMENT .....	109

10.3	SUMMARY OF OFFSET CREDITS REQUIRED.....	110
<b>11</b>	<b>CONCLUSIONS.....</b>	<b>118</b>
<b>12</b>	<b>REFERENCES.....</b>	<b>119</b>
<b>APPENDIX A</b>	<b>PERSONNEL.....</b>	<b>A-I</b>
<b>APPENDIX B</b>	<b>PLOT PHOTOS.....</b>	<b>B-I</b>
<b>APPENDIX C</b>	<b>FLORA SPECIES LISTS.....</b>	<b>C-I</b>
<b>APPENDIX D</b>	<b>FIELD DATA SHEETS .....</b>	<b>D-I</b>
<b>APPENDIX E</b>	<b>PADDOCK TREES.....</b>	<b>E-I</b>
<b>APPENDIX F</b>	<b>FAUNA SURVEY RESULTS .....</b>	<b>F-I</b>
<b>APPENDIX G</b>	<b>EPBC PROTECTED MATTERS SEARCH .....</b>	<b>G-I</b>
<b>APPENDIX H</b>	<b>EPBC HABITAT ASSESSMENT .....</b>	<b>H-I</b>
<b>APPENDIX I</b>	<b>EPBC ASSESSMENTS OF SIGNIFICANCE.....</b>	<b>I-I</b>
<b>APPENDIX J</b>	<b>BAM CALCULATOR RESULTS.....</b>	<b>J-III</b>

## TABLES

Table 1-1	Consultation with relevant departments.....	14
Table 3-1	Description of PCT76 in the development site .....	25
Table 3-2	Description of PCT 80 in the development site .....	27
Table 3-3	Description of PCT 158 in the development site .....	29
Table 3-4	Vegetation zones within the development site .....	34
Table 3-5	Table of current vegetation integrity scores for each impacted vegetation zone within the development site. ....	43
Table 4-1	Ecosystem Credit Species.....	44
Table 4-2	Candidate species credit species requiring assessment .....	47
Table 4-3	Species credit species excluded based on habitat quality .....	51
Table 4-4	Summary of species credit species surveyed at the development site .....	52
Table 7-1	Potential impacts to biodiversity during the construction and operational phases.....	80
Table 7-2	Table of current and future vegetation integrity scores for each vegetation zone within the development footprint. ....	81
Table 7-3	Summary of species credit species loss at the development site.....	81
Table 7-4	Hollow Bearing Trees impacted by the proposal .....	82

Table 7-5 Potential impacts to biodiversity during the construction and operational phases.....	83
Table 7-6: Koala habitat assessment tool for inland areas (DoE 2014) .....	90
Table 8-1 Mitigation measures proposed to avoid and minimise impacts on native vegetation and habitat .....	94
Table 10-1 PCTs and vegetation zones that require offsets .....	107
Table 10-2 Paddock Trees that require offsets.....	108
Table 10-3 Species credit species that require offsets .....	108
Table 10-4 Credit requirement for the project .....	110

## FIGURES

Figure 1-1 Site Map.....	12
Figure 2-1 Examples of cleared landscapes within the development site.....	16
Figure 2-2 Irrigation canal within the development site, looking north.....	17
Figure 2-3 Farm Dam located within the development site .....	18
Figure 2-4 Location map .....	20
Figure 3-1 Native vegetation extent within the development site.....	22
Figure 3-2 Native Vegetation along Muntz Rd and Sandigo-Boree Creek Rd.....	23
Figure 3-3 Example of PCT76 in the development site.....	26
Figure 3-4 Example of PCT 80 along Muntz Road.....	28
Figure 3-5 Example of PCT80 within the development site.....	28
Figure 3-6 Example of PCT 158 within the development site.....	29
Figure 3-7 Example of PCT 158 within the development site.....	30
Figure 3-8 PCTs and TECs at the development site.....	31
Figure 3-9 PCTs and TECs along Muntz Rd and Sandigo-Boree Creek Rd.....	32
Figure 3-10 Vegetation zones within the development site.....	39
Figure 3-11 Vegetation zones along access Muntz Rd.....	40
Figure 3-12 Vegetation zones along Sandigo-Boree Creek Rd.....	41
Figure 3-13 Paddock tree classes within the development site .....	42
Figure 4-1 Threatened species polygons and targeted survey locations.....	57

Figure 4-2 Targeted survey locations along Muntz Rd and Sandigo-Boree Creek Rd.....	58
Figure 6-1 Final project footprint.....	64
Figure 6-2 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	65
Figure 6-3 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	66
Figure 6-4 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	67
Figure 6-5 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	68
Figure 6-6 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	69
Figure 6-7 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	70
Figure 6-8 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	71
Figure 6-9 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	72
Figure 6-10 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	73
Figure 6-11 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	74
Figure 6-12 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	75
Figure 6-13 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	76
Figure 6-14 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd.....	77
Figure 9-1 Potential habitat for serious and irreversible impacts .....	106
Figure 10-1 Impacts requiring offset.....	111
Figure 10-2 Impacts requiring offsets along Muntz Rd.....	112
Figure 10-3 Impacts requiring offsets along Muntz Rd.....	113
Figure 10-4 Impacts requiring offsets along Muntz Rd.....	114
Figure 10-5 Impacts requiring offsets along Muntz Rd and Sandigo-Boree Creek Rd.....	115
Figure 10-6 Impacts requiring offsets along Sandigo-Boree Creek Rd .....	116
Figure 10-7 Impacts requiring offsets along Sandigo-Boree Creek Road .....	117

## ACRONYMS AND ABBREVIATIONS

BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
BOM	Australian Bureau of Meteorology
BOS	Biodiversity Offsets Scheme (NSW)
CEEC	Critically Endangered Ecological Community
DBH	Diameter at Breast Height
DPE	(NSW) Department of Planning and Environment
EEC	Endangered Ecological Community
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Cwth)
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EIS	Environmental Impact Statement
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GHG	Greenhouse Gases
GIS	Geographic Information System
ha	hectares
HBT	Hollow-bearing Tree
km	kilometres
LRET	Large-scale renewable energy target
m	Metres
MNES	Matters of National environmental significance under the EPBC Act ( <i>c.f.</i> )
NSW	New South Wales
REAP	Regional Environmental Action Plan (NSW)
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PV	Photovoltaic
SSD	State Significant Development
SEARS	Secretary's Environmental Assessment Requirements
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy (NSW)
sp/spp	Species/multiple species
TEC	Threatened Ecological Community

## EXECUTIVE SUMMARY

Renewable Energy Systems (RES) is planning for the construction and operation of a 200 Megawatt solar photovoltaic plant and associated infrastructure at Sandigo, approximately 20km South East of Narrandera. The proposal plans to develop approximately 550 ha (development footprint) of the 802 ha subject land.

This Biodiversity Development Assessment Report (BDAR) has been prepared by NGH Environmental on behalf of AGL.

The aim of this BDAR is to address the biodiversity matters raised in the Secretary's Environmental Assessment Requirements (SEARs) and to address the requirements of the *Biodiversity Conservation Act 2016* (BC Act). This BDAR forms part of an Environmental Impact Statement (EIS) for a State Significant Development (SSD), prepared under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Biodiversity Assessment Methodology (BAM) is the current assessment methodology for SSD under the NSW Biodiversity Offsets Scheme prescribed by the NSW *Biodiversity Conservation Act 2016*. The BAM is established for accessing certain impacts on threatened species and threatened ecological communities and their habits. This report follows the BDAR format required by the BAM.

Field Surveys of the development site identified two plant community types (PCTs); Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion (PCT 76) and Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion (PCT 80). These vegetation communities form part of the Endangered Ecological Community (EEC): Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion. Sections of this community along Muntz Road (Rd) and Sandigo-Boree Creek Rd met the criteria for the *Environment Protection and Biodiversity Conservation Act 1999* listed community.

A planted paddock of Old Man Saltbush (*Atriplex nummularia*) occurs in the development site, which provides habitat for the White Fronted Chat (*Epthianura albifrons*). For the purpose of the BAM Calculations, this vegetation was assigned to the most representative PCT, which is PCT158 - Old Man Saltbush – mixed chenopod shrubland of the semi-arid (persistently dry) and arid climate zones

Consideration has been given to avoid and minimise impacts to native vegetation where possible. Site design options have been assessed against key environmental, social and economic criteria. Mitigation and management measures will be put in place to adequately address direct and indirect impacts associated with the proposal.

For biodiversity impacts that are unavoidable, the proposal would require the removal of up to 1.9 ha of Western Grey Box – White Cypress Pine tall woodland, 0.9ha of Planted Old Man Saltbush – mixed chenopod shrubland and 47 Paddock trees over exotic vegetation. Two ecosystem credit species, Grey crowned Babbler *Pomatostomus temporalis temporalis* (Vulnerable, BC Act) and White Fronted Chat *Epthianura albifrons* (Vulnerable, BC Act) were detected during the site survey. These species are accounted for in the ecosystem credit requirements of the development determined by the PCT and do not require targeted surveys.

Six species credit species, comprising four flora species and two fauna species were unable to be surveyed for during the recommended survey time and were assumed to occur on site. 1.6 ha of suitable habitat for the Sand-hill Spider Orchid (*Caladenia arenaria*), Oaklands Diuris (*Diuris* sp.), Pine Donkey Orchid (*Diuris tricolor*) and Spear Grass (*Austrostipa wakoolica*) occurs along Muntz Rd and Sandigo-Boree Creek Rd that



would be impacted by the development. 0.25 ha of habitat that could provide nesting opportunities for the Superb Parrot (*Polytelis swainsonii*) and Major Mitchell Cockatoo (*Lophochroa leadbeateri*) would be removed by the development.

Credits were calculated from the BAM Calculator for these entities and generated the following credits

- Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion- **83 ecosystem credits required**
- Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (Persistently dry) and arid climate zones (north western NSW) – **15 ecosystem credits required**
- Sand-hill Spider Orchid (*Caladenia Arenaria*) – **58 species credits required**
- Oaklands Diuris (*Diuris* sp.) – **58 species credits required**
- Pine Donkey Orchid (*Diuris tricolor*) - **29 species credits required**
- A Spear Grass (*Austrostipa wakoolica*) – **38 species credits required**
- Superb Parrot (*Polytelis swainsonii*) – **6 species credits required**
- Major Mitchell Cockatoo (*Lophochroa leadbeateri*) – **6 species credits required**

The retirement of these credits will be carried out in accordance with the NSW Biodiversity Offsets Scheme (BOS).

# 1 INTRODUCTION

The Avonlie Solar Farm proposal is classified as State Significant Development (SSD) under the State and Regional Development State Environmental Planning Policy (SEPP) and is therefore a 'major project'. This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the proposed Avonlie Solar Farm (the proposal) according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) for the proposal. NGH Environmental has prepared this report on behalf of the proponent, Renewable Energy Systems (RES) Ltd.

The following terms are used in this document:

- **Development footprint** – The area of land that is directly impacted on by the proposal. Including, solar array design, perimeter fence, access roads, transmission line footprint and areas used to store construction materials. The development footprint is approximately 534 ha.
- **Development site** – The area of land that is subject to a proposed development. The development site is approximately 581 ha. The development site is the area surveyed for this assessment.
- **Subject land** – All land within the affected lot boundaries (802 ha).
- **Buffer area** – All land within 1500 m of the outside edge of the boundary of the development footprint

## 1.1 THE PROPOSAL

The Avonlie Solar Farm development site covers approximately 581 ha of land and involves the construction of a ground-mounted photovoltaic solar array generating approximately 200MW of renewable energy.

Key development and infrastructure components would include:

- Solar arrays mounted on a single-axis tracking system.
- Power conversion units.
- A substation including an elevated busbar, switch room, a lightning protection system, current and voltage transformers and a dual-connection into the existing TransGrid overhead lines.
- A battery storage facility.
- Operations and maintenance buildings with associated car parking.
- Access points to the site via Muntz Road.
- Underground cabling.
- Internal access tracks.
- Emergency lighting.
- CCTV system including infrared (non-visible) lighting.
- Security fencing.

Approximately 670,000 solar panels would be mounted in rows on a single axis tracking system, with trackers likely to have a typical maximum tilt height of 4 metres. Ground cover would be established under the panels and would likely be managed using sheep grazing.

Two existing TransGrid 132 kV powerline runs through the subject land, enabling the substation to be sited within the proposal footprint. The substation would contain transformers, associated switchgear, control

and protection equipment, and may include a control building, switch room and drainage and oil containment system. It would be constructed on a gravel bench and surrounded by security fencing. Connection to the grid would be via both transmission lines (Figure 6-1).

An internal road system would be established for the construction and maintenance of both the solar farm and the Battery Storage Facility. Road upgrades are required to Sandigo-Boree Creek Road and Muntz Road to accommodate the increased number of heavy vehicle movements during construction and decommissioning.

The proposal is expected to operate for 30 years. The construction phase of the proposal is expected to take eighteen months and commence in Autumn 2019. After the initial operating phase, the proposal would either be decommissioned, removing all above ground infrastructure and returning the site to its existing land capability (12 months), or upgraded with new photo voltaic equipment.

## **1.2 THE DEVELOPMENT SITE**

### **1.2.1 Site location**

The proposed Avonlie Solar Farm is in the Narrandera Local Government Area (LGA) approximately 20 kilometres south east of Narrandera. The subject land is comprised of Lots 1 and 2 DP 606800, Lot 13 DP795880, Lot 7 DP254595 and Lots 13, 22, 26, 28, 30, 43, 53 DP 754538 (Figure 1-1).

Muntz Road runs along the southern boundary of the site and Quilters Road bounds the development site to the north.

### **1.2.2 Site description**

The development site is agricultural land comprising several large paddocks which are generally flat, largely cleared and cultivated for pastures and grazing. Scattered paddock trees remain within the paddocks and planted windbreaks occur throughout the site comprised of local and non-local native species. Remnant vegetation occurs on the South-western Corner of the development site and along Muntz Road and Sandigo-Boree Creek Road.

The development site is shown in Figure 1-1.

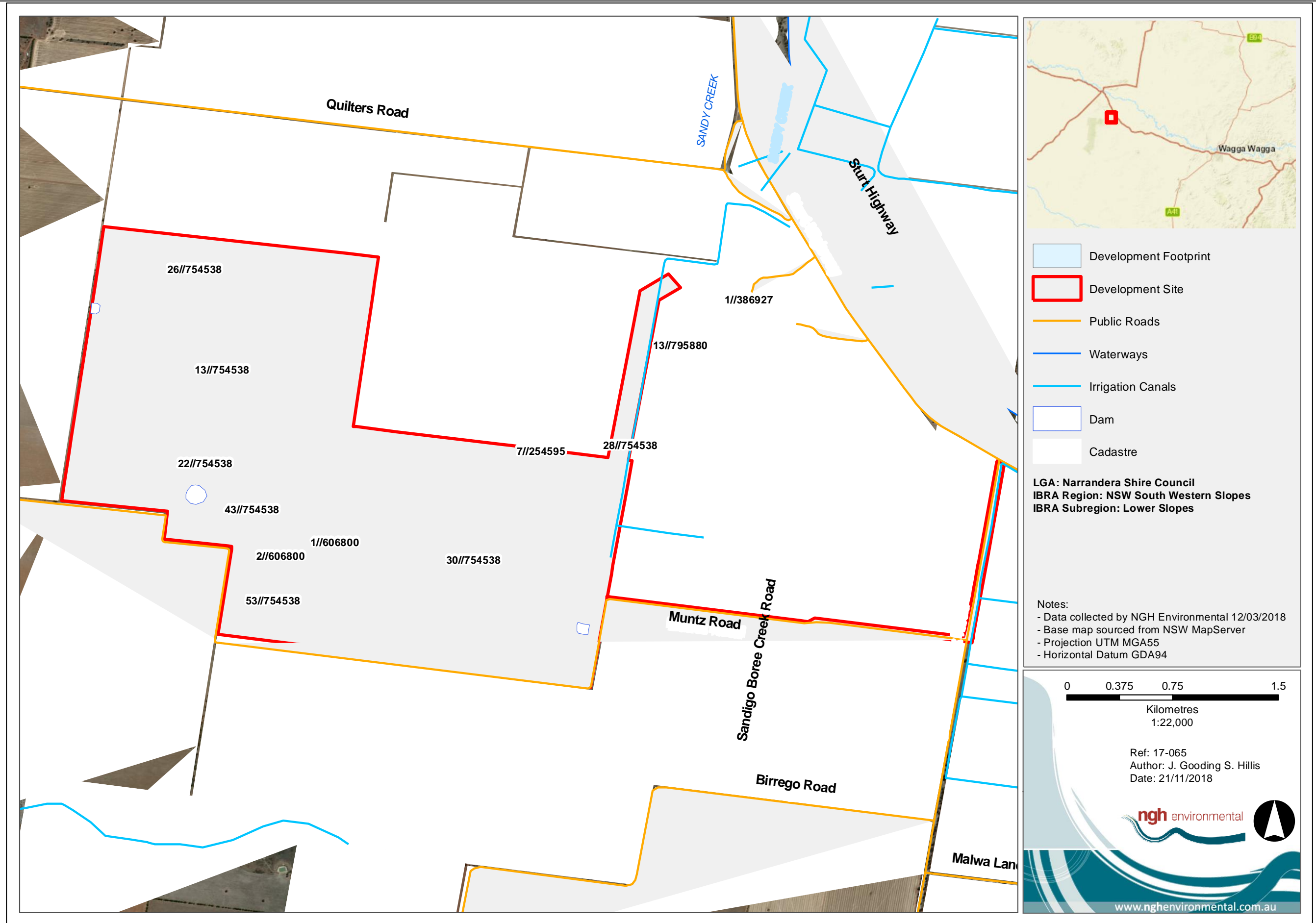


Figure 1-1 Site Map

### 1.3 STUDY AIMS

The aim of this BDAR is to address the requirements of the BAM, as required in the Secretary's Environmental Assessment Requirements (SEARs) and summarised below.

#### Secretary's Environmental Assessment Requirement

The EIS must address the following specific issues:

- **Biodiversity** – including an assessment of the likely biodiversity impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW), a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW).

Responses from the Office of Environment and Heritage (OEH) indicated The Biodiversity Assessment Method (BAM) must be used to assess impacts to biodiversity in accordance with the *Biodiversity Conservation Act 2016* (BC Act) and documented in a Biodiversity Development Assessment Report (BDAR).

This BDAR also addresses the assessment requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

### 1.4 SOURCE OF INFORMATION USED IN THE ASSESSMENT

The following information sources were used in the preparation of this report:

- Proposal layers, construction methodology and concept designs provided by RES
- Commonwealth Department of Environment and Energy (DoEE) Species Profiles and Threats database (SPRAT) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>.
- Commonwealth Department of Environment and Energy Protected Matters Search Tool  
Accessed online at <http://environment.gov.au/epbc/protected-matters-search-tool>
- NSW OEH's Biodiversity Assessment Method (BAM) calculator  
(<https://www.lmbc.nsw.gov.au/bamcalc>).
- NSW OEH's BioNet threatened biodiversity database  
Accessed online via login at <http://www.bionet.nsw.gov.au/>.
- OEH Threatened Species Profiles  
<http://www.environment.nsw.gov.au/threatenedSpeciesApp/> and  
[www.environment.nsw.gov.au/AtlasApp/UI\\_Modules/](http://www.environment.nsw.gov.au/AtlasApp/UI_Modules/)
- OEH BioNet Vegetation Classification Database (OEH 2017)  
Accessed online via login at <http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>
- OEH BioNet VIS Mapping  
Accessed online at <http://www.environment.nsw.gov.au/research/VISmap.htm>
- Office of Environment and Heritage (OEH) (2017). Biodiversity Assessment Method
- NSW Government SEED Mapping  
[https://geo.seed.nsw.gov.au/Public\\_Viewers/index.html?viewer=Public\\_Viewers&locale=en-AU](https://geo.seed.nsw.gov.au/Public_Viewers/index.html?viewer=Public_Viewers&locale=en-AU)

- NSW Biodiversity Values Map  
<https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap>

## 1.5 CONSULTATION

Consultation with relevant departments is shown in Table 1-1 Consultation with relevant departments

Table 1-1 Consultation with relevant departments.

Date	Contact	Reason	Response
10/05/18, 12/06/18 14/06/18	LMBC Support Mailbox, Miranda Kerr, OEH Chris Watson, OEH	Determining species credit calculations for paddock trees	Use the streamlined paddock tree assessment for paddock trees over exotic crop. Species credit calculations are not required for paddock trees.
11/05/18	Shannon Simpson, OEH Ecosystem Assessment Project Officer	Mapped Important areas for the Swift Parrot	The development site does not fall within an area of mapped important areas for the Swift Parrot.



## **2 LANDSCAPE FEATURES**

### **2.1 IBRA BIOREGIONS AND SUBREGIONS**

Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features, and flora and fauna communities. The development site is located within the NSW South Western Slopes Bioregion.

The IBRA subregion impacted by the proposal is the Lower Slopes subregion. This was entered into the BAM Calculator for the proposal.

### **2.2 NSW LANDSCAPE REGIONS AND AREA**

The development site is the Murrumbidgee – Tarcutta channels and floodplains Mitchell Landscape.

### **2.3 NATIVE VEGETATION**

As determined by GIS mapping from aerial imagery and Central Southern NSW Vegetation Mapping (ADS40\_VIS 3884), approximately 320ha of native vegetation occurs within the 1500m buffer area surrounding the site with varying overstory density (refer to Section 2.10). The vegetation within the buffer area is comprised mainly of Western Grey Box and White Cypress Pine Woodland, River Red Gum Forest and planted vegetation.

### **2.4 CLEARED AREAS**

Cleared areas in the subject land are primarily agricultural land used for cropping and grazing (Figure 2-1). These areas have been frequently cultivated and lack any native vegetation. Cleared areas provided very little in terms of native fauna habitat but could provide limited foraging habitat for common species such as raptors, parrots, cockatoos and macropods.

Approximately 565ha (93%) of cleared land occurs within the boundary of the development site.



Figure 2-1 Examples of cleared landscapes within the development site



## 2.5 RIVER AND STREAMS

One irrigation canal runs along the Eastern boundary of the development site. This canal was dry during the time of the site surveys. Exotic annual pasture grasses line the banks and base and the canal contains very little aquatic habitat features.

The nearest natural watercourse is Sandy Creek, 2.5km to the North East of the site which forms part of the Murrumbidgee River Catchment.



Figure 2-2 Irrigation canal within the development site, looking north.

## 2.6 WETLANDS

No wetlands occur in or adjacent to the development site. The nearest important wetland listed under the EPBC Act is Fivebough Swamp, located approximately 45km North West of the development site near Leeton.

Two farm dams are present within the site (Figure 2-3). These dams are grazed by stock and no aquatic or fringing vegetation is present. The vegetation surrounding the dam is dominated by exotic species such as Spear Thistle (*Cirsium vulgare*), Barley Grass (*Hordeum leporinum*) and Rye Grass (*Lolium perenne*).



Figure 2-3 Farm Dam located within the development site

## 2.7 CONNECTIVITY FEATURES

There are no connectivity features in or adjacent to the development site. The area within and surrounding the development site has been heavily cleared and lacks connectivity across the landscape. Scattered paddock trees and planted windbreaks could provide some habitat connectivity for more disturbance tolerant and mobile species to travel across the landscape.

## 2.8 AREAS OF GEOLOGICAL SIGNIFICANCE

No karsts, caves, crevices or cliffs or other areas of geological significance occur in or adjacent to the development site.

## 2.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE

Based on a search of the NSW Biodiversity Values Map, no areas of outstanding biodiversity value or other biodiversity value occur within the development site.

## 2.10 SITE CONTEXT COMPONENTS

### Method applied

The proposal conforms to the definition of a *site-based development* under the Biodiversity Assessment Methodology. The site-based development assessment methodology has been used in this BAM assessment.

### **Percent Native Vegetation Cover**

The 1500 m buffer area around the development site comprises an area of 4152 ha.

Native vegetation mapped within the 1500 m buffer area is calculated to be an area of 323 ha. This determines the percent native vegetation cover in the landscape to be 7.8%. This value was entered into the BAM Calculator for the assessment.



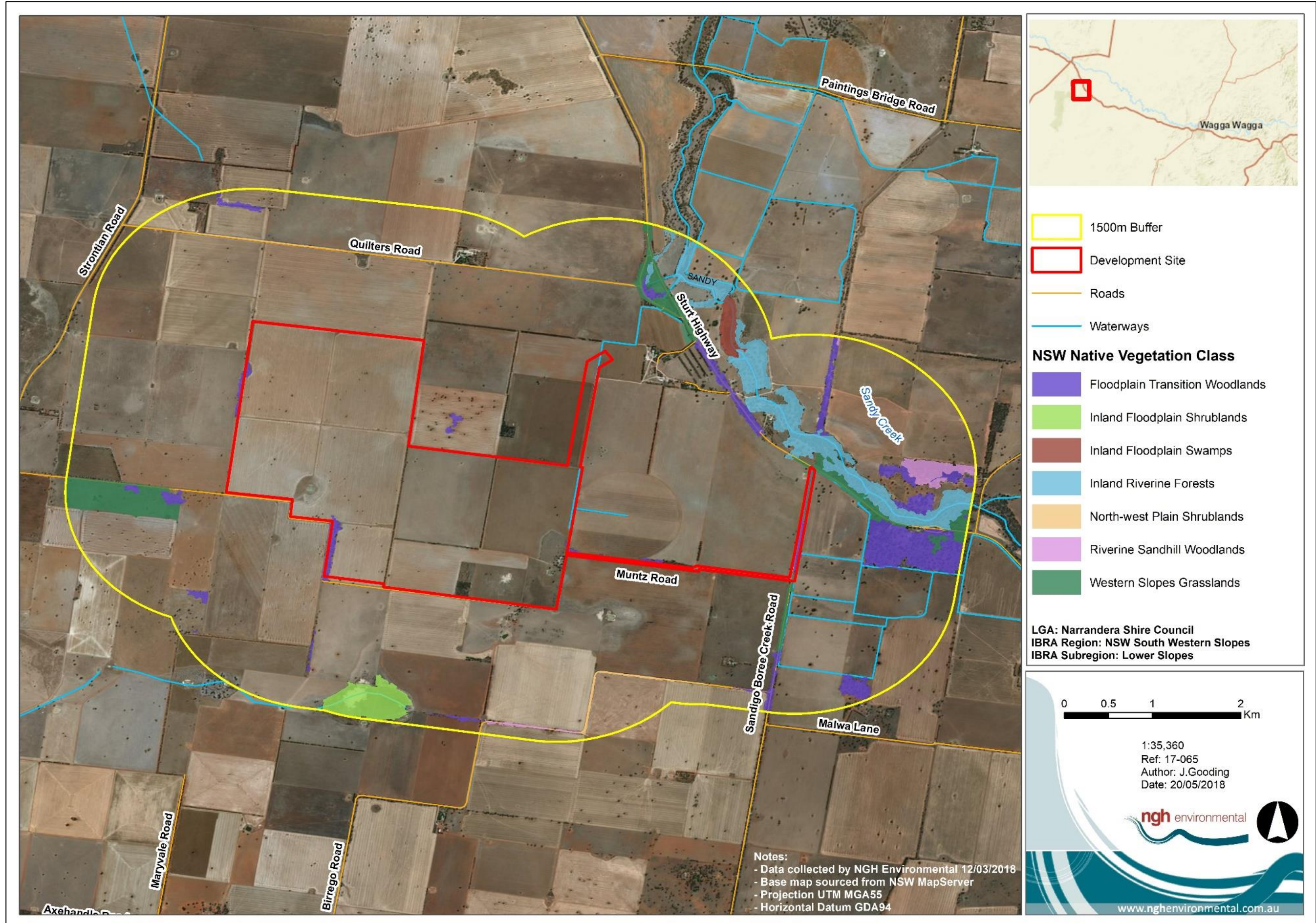


Figure 2-4 Location map



## 3 NATIVE VEGETATION

### 3.1 NATIVE VEGETATION EXTENT

Approximately 80ha of native vegetation occurs within the development site and along Muntz Road and Sandigo-Boree Creek Road (Figure 3-1). This is comprised of around:

- 6ha of remnant Grey Box (*Eucalyptus microcarpa*) on the Western side of the development site.
- 3ha of remnant Grey Box/White Cypress Woodlands along fence lines in the development site.
- 14ha of remnant Grey Box/White Cypress Woodlands along Muntz Road and Sandigo-Boree Creek Road.
- 16ha of planted native vegetation in the form of windbreaks along fence lines
- 42ha of planted Old Man Saltbush (*Atriplex nummularia*) used as fodder for sheep and cattle.

563ha of the development site occurs as cropped land. These areas are dominated by exotic vegetation such as Wheat (*Triticum aestivum*) and Barley (*Hordeum* sp.)

56 paddock trees occur throughout the development site (Figure 3-1). Paddock trees were defined as:

- a tree or a group of up to three trees less than 50 m apart from each other, and
- over an exotic groundcover, and
- more than 50 m away from any other living tree greater than 20 cm DBH, and
- on category 2 land surrounded by category 1 land (as defined by the BAM, 2017)<sup>+</sup>.

<sup>+</sup>Stage release of the regulatory land mapping is occurring under the new *Local Land Service Act 2016* (LLS Act). Stage 1b has not yet been published. During the transitional period, land categories are to be determined in accordance with the definitions of regulated land in the LLS Act. In this case, the paddock trees are located on land with native vegetation present since January 1990, surrounded by land that has been cleared of native vegetation since January 1990.

Paddock trees throughout the development site were assessed under the streamlined assessment module – clearing paddock trees (Appendix 1 of the BAM) and incorporated into this report. They are considered both in terms of ecosystem credits and as habitat for threatened species and any credits generated are additional to those created by applying the full BAM.

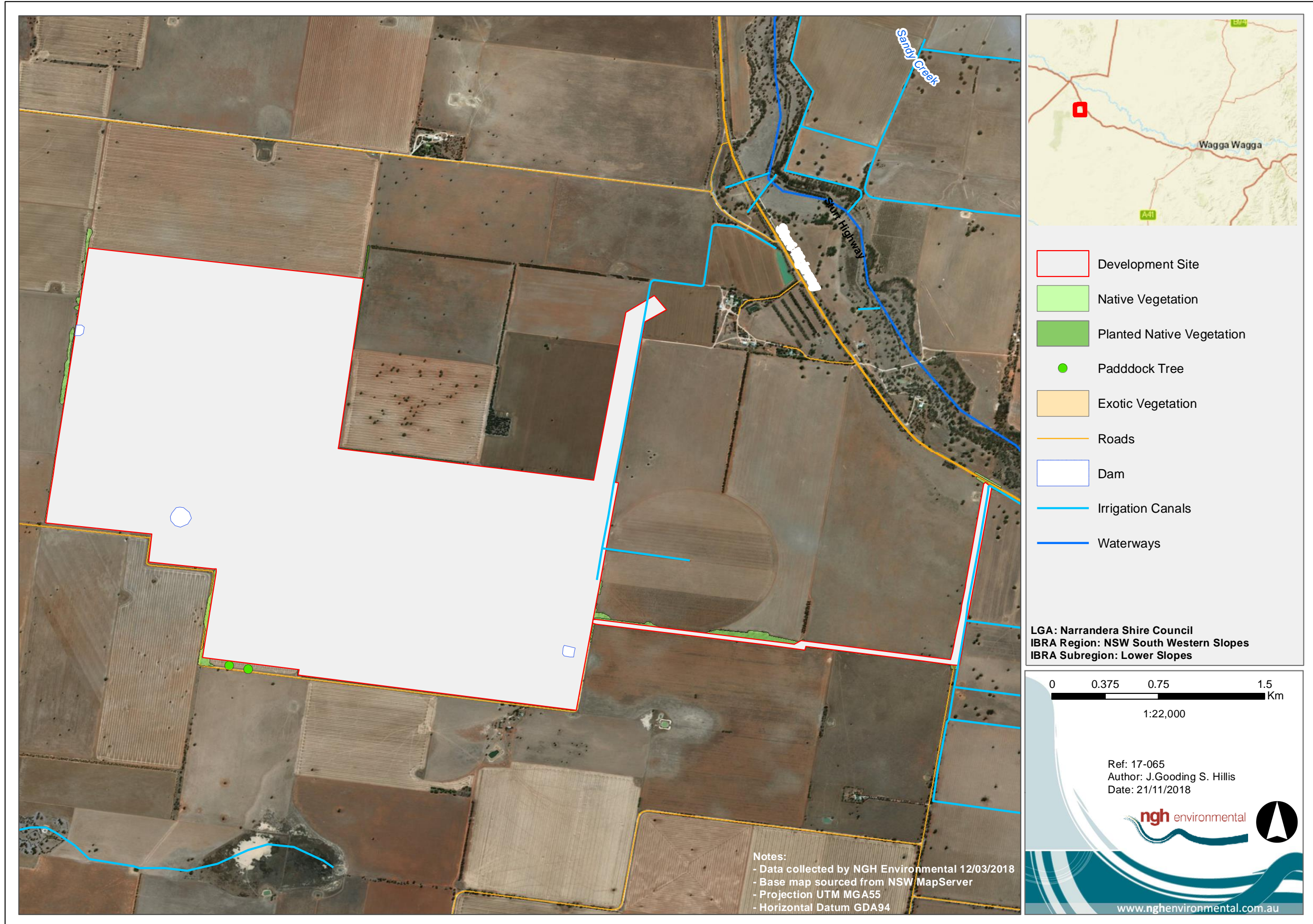


Figure 3-1 Native vegetation extent within the development site



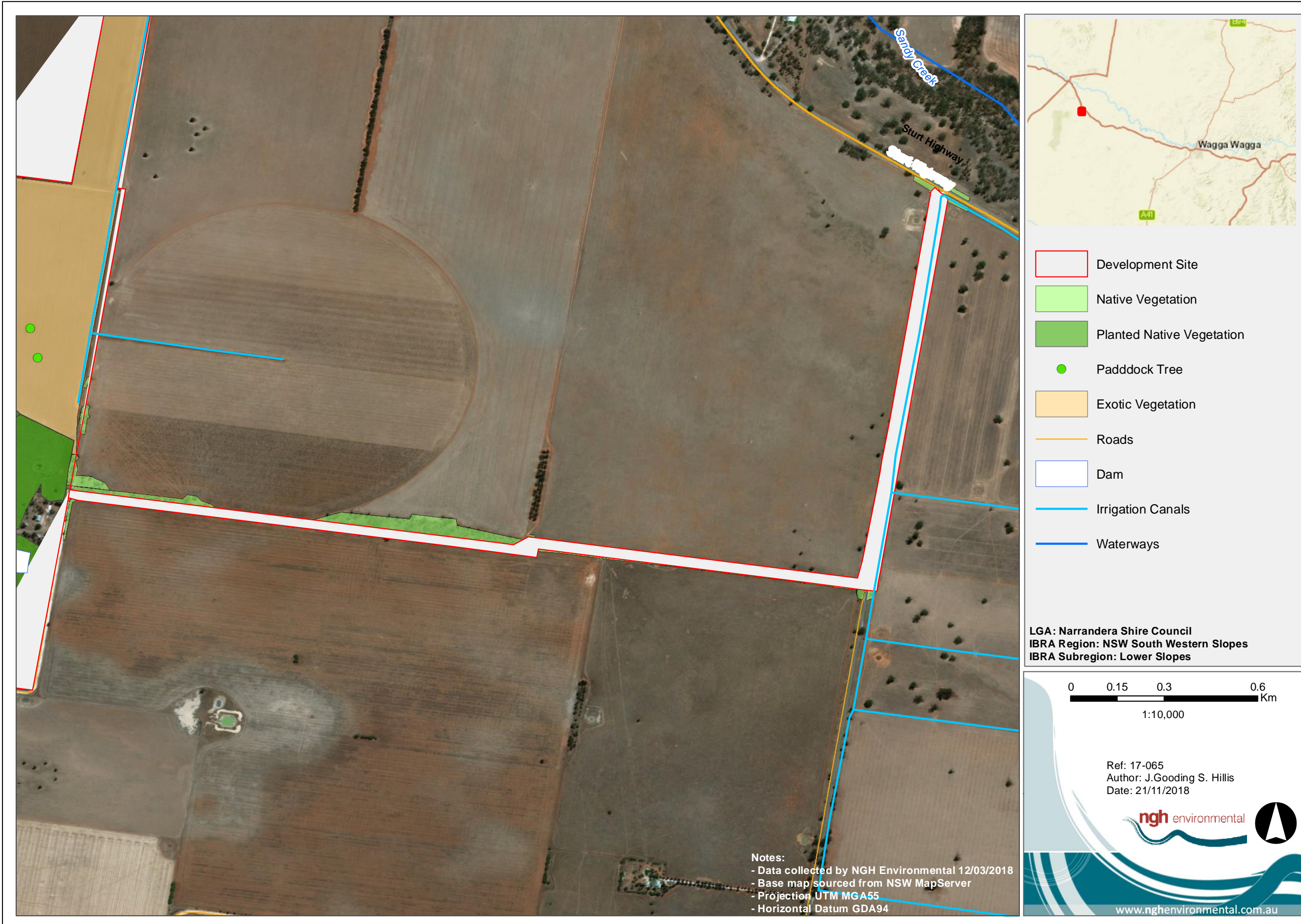


Figure 3-2 Native Vegetation along Muntz Rd and Sandigo-Boree Creek Rd

## 3.2 PLANT COMMUNITY TYPES (PCTS)

### 3.2.1 Methods to assess PCTs

#### Review of existing information

A search was undertaken of the OEH BioNet Vegetation Information System (BioNET VIS) database and the NSW Seed Mapping Portal to access existing vegetation mapping information within the development site. One relevant existing vegetation map provided comprehensive mapping of the development site.

- OEH (2011) Central Southern NSW\_ADS40\_VIS 3884. This identified two PCT's within and surrounding the development site. PCT76: *Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion* occurring on the South-Western Scornor of the development site and PCT 80: *Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion* occurring along Muntz Rd and Sandigo-Boree Creek Rd. Patches of planted woody vegetation are also shown occurring within the development site in linear plantings and a large patch in the South-Eastern corner of the development site.
- NSW Government Seed Mapping Portal showed similar PCT and native vegetation extent as the OEH Bionet VIS Mapping.

#### Floristic survey

A site overview was undertaken on the 15<sup>th</sup> November 2017. The entire subject land was surveyed by two ecologists. The aim of the survey was to confirm the plant community types (PCT's) present in the development site, along with their condition and extent. Random meander searches were conducted to gain an overview of the plant species present and determine variation within vegetation types. 400m<sup>2</sup> (20m by 20m) floristic plots were undertaken in areas of native vegetation to gain a comprehensive plant list. PCT's were identified using the BioNet VIS, based on the native species present, landform, physiography and location in the IBRA subregion. The PCTs were then stratified into areas of similar condition class to determine vegetation zones for each PCT.

Detailed floristic surveys were undertaken on the 28<sup>th</sup> February 2018 and the 7<sup>th</sup> May 2018 by two ecologists. The surveys were undertaken using the methodology presented in the BAM (2017). The required number of vegetation integrity plots of 20m by 50m were established in each vegetation zone. Data was collected on the composition, structure and function of the vegetation. Personnel undertaking the field work have been trained in the BAM and were directed by persons accredited under the BAM (Appendix A).

### 3.2.2 PCTs identified on the development site

Three Plant Community Types (PCT) were identified in the development site. These are:

- PCT 76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion;
- PCT 80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion;
- PCT 158 - Old Man Saltbush – mixed chenopod shrubland of the semi-arid (persistently dry) and arid climate zones. A paddock of Old Man Saltbush (*Atriplex nummularia*) planted as



fodder for sheep and cattle is present in the South East Development site. For the purpose of the BAM Calculations, this vegetation was assigned the most representative which is PCT158.

A description of each of these PCTs follows in Table 3-1 Table 3-2.

Table 3-1 Description of PCT76 in the development site

PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion		
<b>Vegetation formation</b>	Grassy Woodland	
<b>Vegetation class</b>	Floodplain Transition Woodlands	
<b>Vegetation type</b>	<b>PCT ID</b>	76
	<b>Common Community Name</b>	Western Grey Box tall grassy Woodland
<b>Approximate extent within development site</b>	5.94 Ha occurs along the South-Western edge of the development site.	
<b>Species relied upon for PCT identification</b>	<b>Species name</b>	<b>Relative abundance</b>
	Grey Box ( <i>Eucalyptus microcarpa</i> )	20%
	Creeping Saltbush ( <i>Atriplex semibaccata</i> )	1%
	Climbing Saltbush ( <i>Einadia nutans</i> )	1%
	Wallaby Grass ( <i>Rytidosperma</i> sp.)	1%
<b>Justification of evidence used to identify the PCT</b>	<p>Grey Box is the dominant overstory species in this vegetation community. Despite the understory being heavily grazed the overstory is relatively intact. One 20m * 20m floristic plot was undertaken in this community.</p> <p>There are five PCT's where Grey Box is a dominant overstory species that can occur the NSW South Western Slopes. These are PCT 76, PCT 80, PCT 81, PCT 82 &amp; PCT 110.</p> <p>PCT 76 is considered to be the most appropriate PCT based on:</p> <ul style="list-style-type: none"> <li>• Grey Box as the only trees species occupying 90% of the canopy cover</li> <li>• Understory was highly degraded but species that were present are characteristic of this PCT (Listed above)</li> <li>• Location within the Lower Slopes IBRA subregion</li> <li>• Located on alluvial plain</li> <li>• Clay-Loam Soils</li> <li>• OEH mapping showing this PCT (Central Southern NSW_ADS40_VIS 3884).</li> </ul> <p>Based on these factors, PCT 76 was selected for this vegetation community</p>	

**PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion**

**TEC Status**

Forms part of the *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penneplain, Nandewar and Brigalow Belt South Bioregion* EEC listed under the BC Act.

**Estimate of percent cleared in Bioregion**

83%

**Examples**



Figure 3-3 Example of PCT76 in the development site



Table 3-2 Description of PCT 80 in the development site

PCT 80 Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion		
<b>Vegetation formation</b>	Grassy Woodland	
<b>Vegetation class</b>	Floodplain Transition Woodlands	
<b>Vegetation type</b>	<b>PCT ID</b>	80
	<b>Common Community Name</b>	Western Grey Box - White Cypress Pine tall woodland
<b>Approximate extent within the development site</b>	14ha occurs along Muntz Road and Sandigo-Boree Creek Road 2.8ha occurs within the development site	
<b>Species relied upon for PCT identification</b>	<b>Species name</b>	<b>Relative abundance</b>
	Grey Box ( <i>Eucalyptus microcarpa</i> )	10%
	White Cypress ( <i>Callitris glaucophylla</i> )	20%
	Yellow Box ( <i>Eucalyptus melliodora</i> )	5%
	Bulloak ( <i>Allocasuarina luehmannii</i> )	<1%
	Desert Senna ( <i>Senna artemisioides</i> )	2%
	Wingless Fissure-weed ( <i>Maireana enchylaenoides</i> )	1%
	Corrugated Sida ( <i>Sida corrugata</i> )	1%
	Spear Grass ( <i>Austrostipa scabra</i> )	5%
	Purple Burr-daisy ( <i>Calotis cuneifolia</i> )	<1%
	Rock Fern ( <i>Cheilanthes sieberi</i> )	<1%
	( <i>Lomandra filiformis</i> )	<1%
	Wheat Grass ( <i>Elymus scaber</i> )	1%
	Purple Love-Grass ( <i>Eragrostis lacunaria</i> )	1%
	Curly Windmill Grass ( <i>Enteropogon acicularis</i> )	5%
<b>Justification of evidence used to identify the PCT</b>	<p>Seven 20m x 20m floristic plots were undertaken in this community. The overstory is dominated by White Cypress (<i>Callitris glaucophylla</i>) with scattered remnant Grey Box (<i>Eucalyptus microcarpa</i>).</p> <p>PCT 80 is considered to be the most appropriate PCT based on:</p> <ul style="list-style-type: none"> <li>• The co-dominance of White Cypress and Grey Box in the overstory</li> <li>• The presence of less dominant overstory species characteristic of this PCT (Yellow Box and Bulloak)</li> <li>• Understory species characteristic of this PCT (Listed above)</li> <li>• Location within the Lower Slopes IBRA subregion</li> <li>• Located on alluvial plain</li> <li>• OEH mapping showing this PCT in the area (Central Southern NSW_ADS40_VIS 3884)</li> </ul> <p>Based on these factors, PCT 80 was selected for this community</p>	

**PCT 80 Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion**

**TEC Status**

Forms part of the *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregion* EEC listed under the BC Act.

**Estimate of percent cleared in Bioregion.**

83%

**Examples**




Figure 3-4 Example of PCT 80 along Muntz Road.



Figure 3-5 Example of PCT80 within the development site

Table 3-3 Description of PCT 158 in the development site

PCT 158 - Old Man Saltbush – mixed chenopod shrubland of the semi-arid (persistently dry) and arid climate zones.		
<b>Vegetation formation</b>	Arid Shrublands	
<b>Vegetation class</b>	Riverine Chenopod shrublands	
<b>Vegetation type</b>	<b>PCT ID</b>	158
	<b>Common Community Name</b>	Old Man Saltbush – mixed chenopod shrubland
<b>Approximate extent within the development site</b>	42.2ha occurs in the South-Eastern Corner of the development site.	
<b>Species relied upon for PCT identification</b>	<b>Species name</b>	<b>Relative abundance</b>
	Old Man Saltbush ( <i>Atriplex nummularia</i> )	50%
	Windmill Grass ( <i>Chloris truncata</i> )	1%
	Curly Windmill Grass ( <i>Enteropogon acicularis</i> )	1%
<b>Justification of evidence used to identify the PCT</b>	One 20m x 50m floristic plot was undertaken in this community. This is a constructed community and is not representative of the naturally occurring shrubland. For the purposes of the BAM Calculator, PCT 159 is considered to be the most appropriate PCT based on the dominance of Old Man Saltbush in the shrub layer.	
<b>TEC Status</b>	Does not form part of a TEC.	
<b>Estimate of percent cleared in Bioregion.</b>	92%	
<b>Examples</b>		
	Figure 3-6 Example of PCT 158 within the development site	

**PCT 158 - Old Man Saltbush – mixed chenopod shrubland of the semi-arid (persistently dry) and arid climate zones.**



Figure 3-7 Example of PCT 158 within the development site



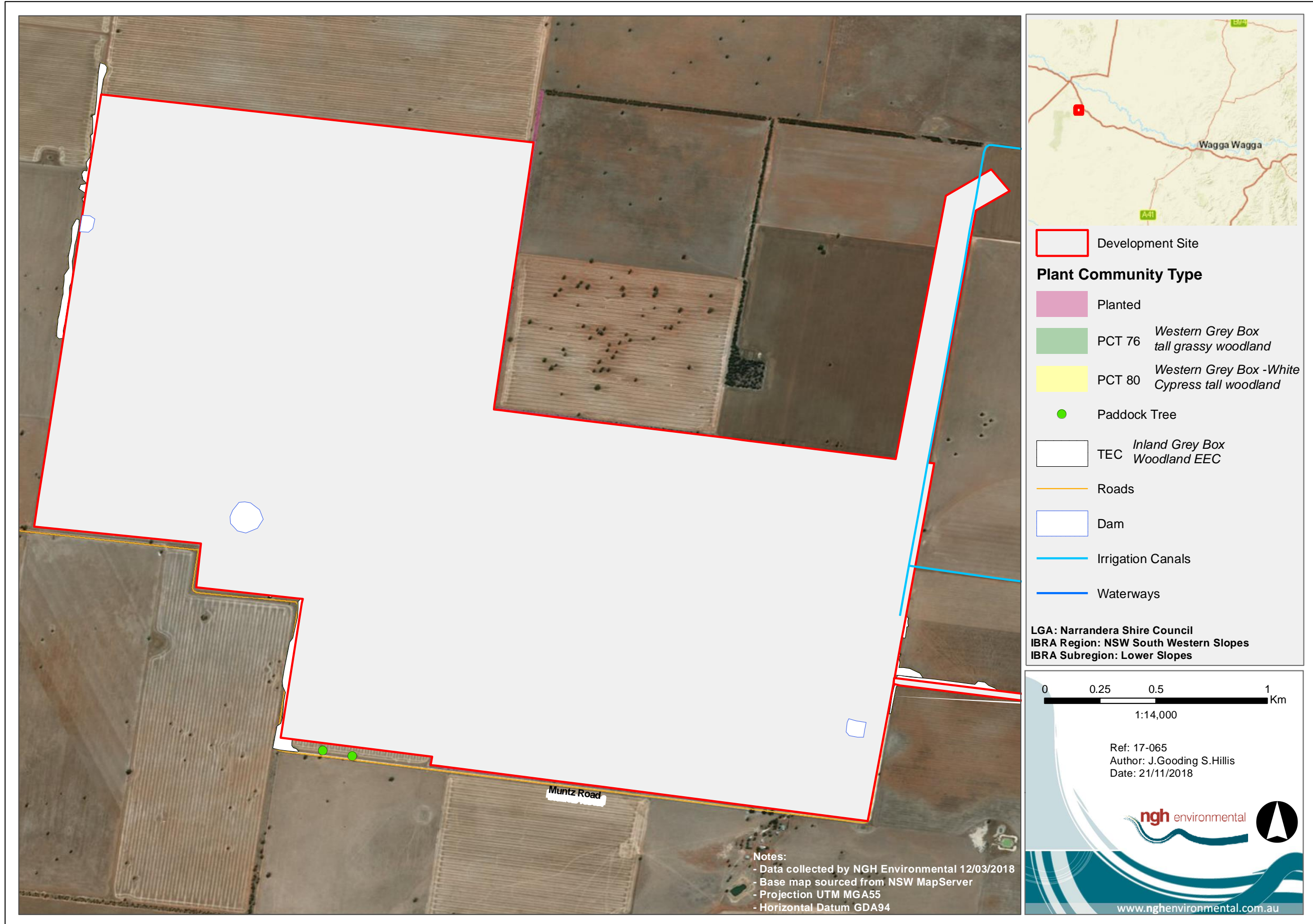


Figure 3-8 PCTs and TECs at the development site



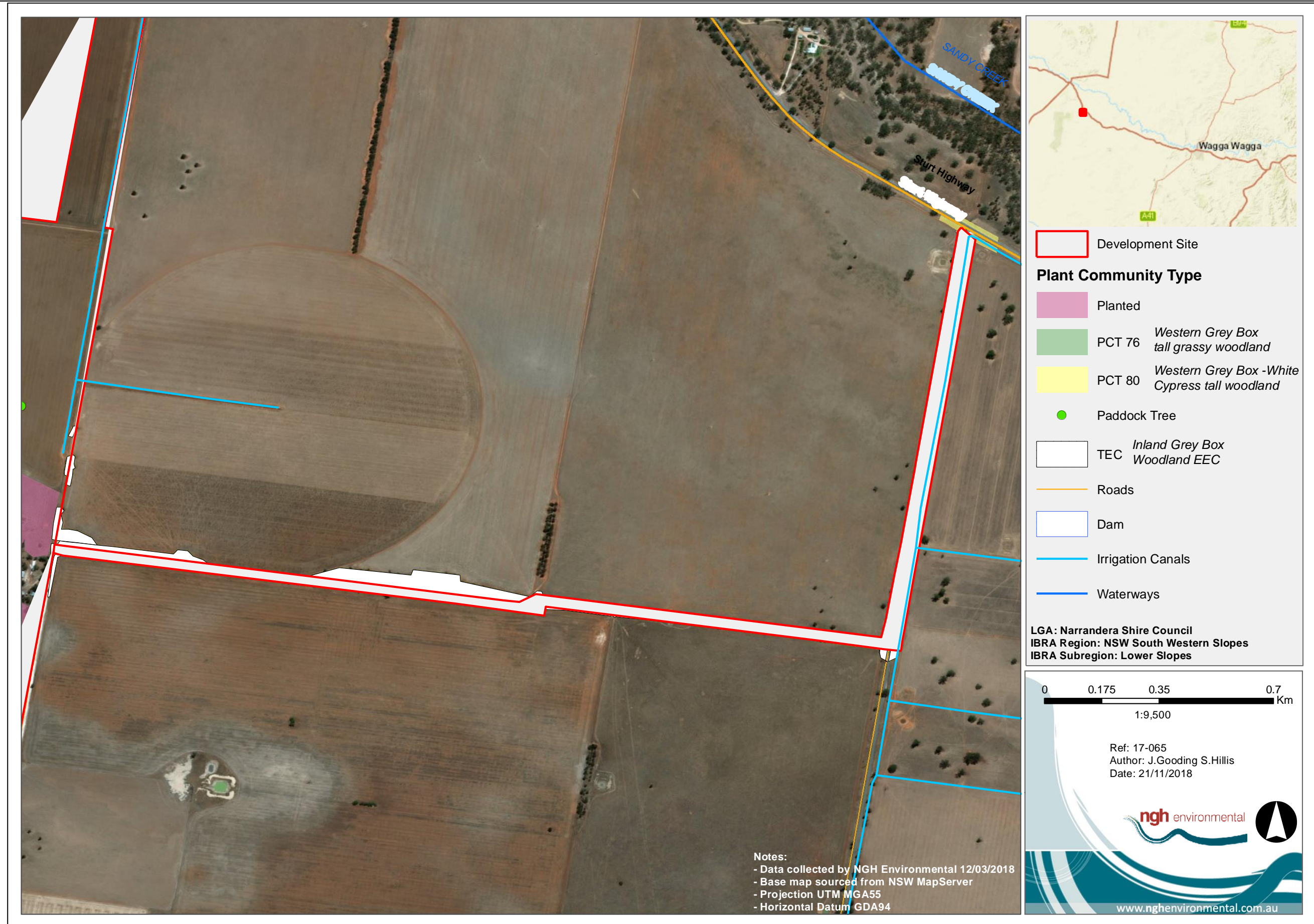


Figure 3-9 PCTs and TECs along Muntz Rd and Sandigo-Boree Creek Rd.

### 3.3 VEGETATION INTEGRITY ASSESSMENT

#### 3.3.1 Vegetation zones and survey effort

The random meander, overview inspection and detailed floristic plots have been used to assist the delineation of zones. Three PCT's were identified in the development site. Each of these PCTS were stratified into zones with a similar broad condition state. These zones were defined based on the overstorey condition, understorey condition and observed land management practices and described in Table 3-4. Nine zones were identified within the development site. These are mapped in Figure 3-10.

Thirteen vegetation integrity plots were conducted throughout the nine zones (Figure 3-10). The number of floristic plots undertaken in each zone was in line with the minimum plot requirements per zone area as specified in the BAM (2017). An extra plot was undertaken in each of Zone 1 and Zone 2 to account for variation along the roadside vegetation. Two plots (Plot 3 & Plot 4) were undertaken in an area that were subsequently avoided by the proposal and now occur outside the development site.

#### 3.3.2 Paddock trees



Fifty -Six paddock trees occur in the development site within the exotic vegetation in Zone 8. These were predominantly a mix of Grey Box (*Eucalyptus microcarpa*) and White Cypress (*Callitris glaucophylla*) with an occasional Yellow Box (*Eucalyptus melliodora*). As both Grey Box and White Cypress are co-dominant, PCT 80 - Western Grey Box - White Cypress Pine tall woodland were assigned to the paddock trees. Threatened species that would use the paddock trees are assumed to be the same threatened species that are returned by the BAM Calculator for the vegetation zones. Where targeted fauna surveys were required by the BAM Calculations, paddock trees were also included in the surveys. Assessments of threatened species that would use the paddock trees as habitat has been incorporated into this BDAR under Section 4 and 5.

All paddock trees were mapped in the field using a handheld GIS Tablet. Trees were identified to genus and species. The Diameter at Breast Height (DBH) of the tree was assessed and assigned a paddock tree class relevant to the large tree benchmark. The Large tree benchmark for PCT 80 is 50cm DBH. The trees were visually assessed from the ground to determine whether any hollows were present. Twenty-seven of the paddock trees contained hollows, ranging in size from small to large.



The paddock trees occurring in the development site are shown in Figure 3-13 and detail provided in Appendix E.







Table 3-4 Vegetation zones within the development site


Zone ID	PCT ID	Stratification unit / condition	Area impacted (ha)	Survey effort (# plots)	Zone size (ha)	Example
1	80	<p><b>Good</b></p> <p>This zone occurs along Muntz Rd and Sandigo-Boree Creek Rd. These areas are comprised of remnant woodland with overstory of White Cypress, Grey Box, and Yellow Box. The understory is dominated by native grasses and forbs and some exotic annual species.</p> <p>This vegetation zone forms part of the Inland Grey Box Woodland EEC listed under the BC Act.</p>	1.1	2	10.0	
2	80	<p><b>Good_immature overstory</b></p> <p>This zone occurs along Muntz Rd and Sandigo-Boree Creek Rd. These areas are comprised of good condition native understory and midstory similar to Zone 1 however are lacking a mature overstory. Overstory species of White Cypress or occasional Grey Box are present but are immature (DBH &lt; 20cm). Shrubs such as Desert Senna (<i>Senna artemisioides</i>) are common.</p> <p>This vegetation zone forms part of the Inland Grey Box Woodland EEC listed under the BC Act.</p>	0.5	2	2.0	



Zone ID	PCT ID	Stratification unit / condition	Area impacted (ha)	Survey effort (# plots)	Zone size (ha)	Example
3	80	<p><b>Moderate_Grazed understory</b></p> <p>This zone is comprised of a mature overstory of White Cypress (with occasional Grey Box and Bulloak (<i>Allocasuarina luehmannii</i>). The overstory is relatively intact however heavy grazing by cattle and sheep has degraded the understory. Very little understory species remain.</p> <p>This vegetation zone forms part of the Inland Grey Box Woodland EEC listed under the BC Act.</p>	0.1	1	2.8	
4	80	<p><b>Low Condition</b></p> <p>This zone is dominated by exotic species, including high threat weeds such as <i>*Paspalum dilatatum</i>. Native grasses are present but occupy less than 50% of the projected foliage cover. No overstory species are present.</p> <p>These areas show signs of past disturbance such as stockpiling of soil along the roadside.</p>	0.05	2	0.5	

Zone ID	PCT ID	Stratification unit / condition	Area impacted (ha)	Survey effort (# plots)	Zone size (ha)	Example
5	80	<p><b>Planted Vegetation</b></p> <p>This zone is comprised of planted native vegetation about 20 years old. Plantings are in rows about 20m wide and fenced from stock. Plantings are comprised of a mix of local species such as Grey Box and Mugga Ironbark (<i>Eucalyptus sideroxylon</i>) as well as non-endemic species to the surrounding community such as Red Mallee (<i>Eucalyptus oleosa</i>) and Green Mallee (<i>Eucalyptus viridis</i>).</p> <p>This is a constructed vegetation type. For the purposes of the BAM calculator and calculating offsets, this zone was assigned to PCT 80 as this was likely the original vegetation type.</p>	0.1	2	16.1	
6	158	<p><b>Planted Oldman Saltbush</b></p> <p>This zone is comprised of planted Old Man saltbush (<i>Atriplex nummularia</i>) used for fodder for sheep and cattle. The plants are planted in rows with little other understory species.</p> <p>This is a constructed vegetation type. For the purposes of the BAM calculator and calculating offsets this zone was assigned to PCT158 - (<i>Old man saltbush – mixed chenopod shrubland of the semi-arid hot and arid climate zones</i>) as it was most similar to this community.</p>	0.9	1	42.2	

Zone ID	PCT ID	Stratification unit / condition	Area impacted (ha)	Survey effort (# plots)	Zone size (ha)	Example
7	76	<p><b>Moderate_grazed understory</b></p> <p>This zone is comprised of a Grey Box overstory (<i>Eucalyptus microcarpa</i>). The overstory is relatively intact however heavy grazing by cattle and sheep has degraded the understory. Native understory plants persist but in low density.</p> <p>This woodland is a TEC– Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion</p>	0 (Avoided by footprint)	1	5.9	
8	n/a	<p><b>Exotic</b></p> <p>Vegetation dominated by crops such as Wheat (<i>*Triticum aestivum</i>). These areas have been frequently cultivated and no native plants remain.</p>	523	1	565	

Zone ID	PCT ID	Stratification unit / condition	Area impacted (ha)	Survey effort (# plots)	Zone size (ha)	Example
9	80	<b>Paddock trees</b>  Scattered paddock trees of Grey Box ( <i>Eucalyptus microcarpa</i> ) and White Cypress ( <i>Callitris glaucophylla</i> ) over an exotic crop. Paddock trees are more than 50m apart. This zone is assessed under the streamlined paddock tree assessment (section 3.3.2).	n/a	Paddock tree assessment	n/a	



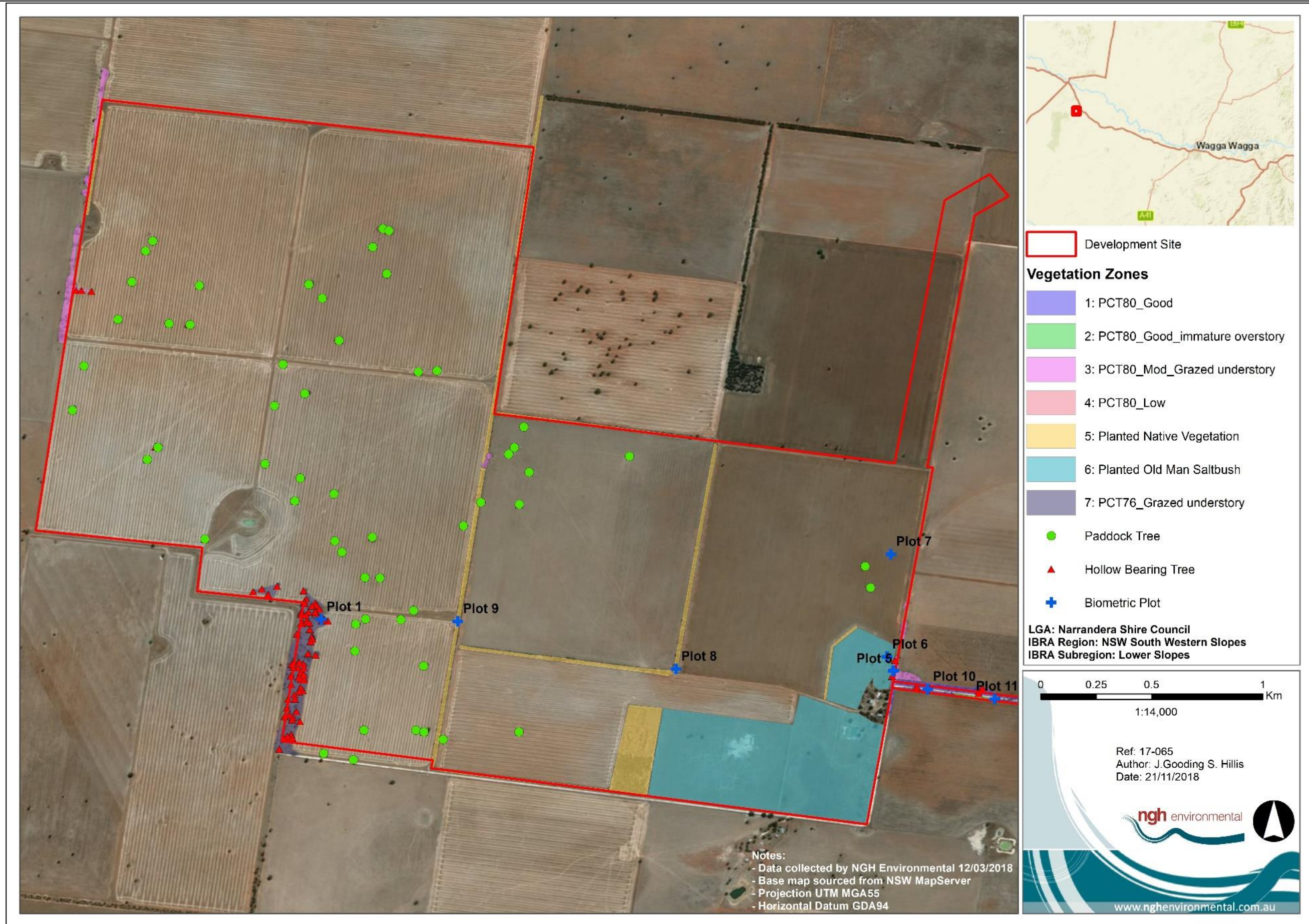


Figure 3-10 Vegetation zones within the development site



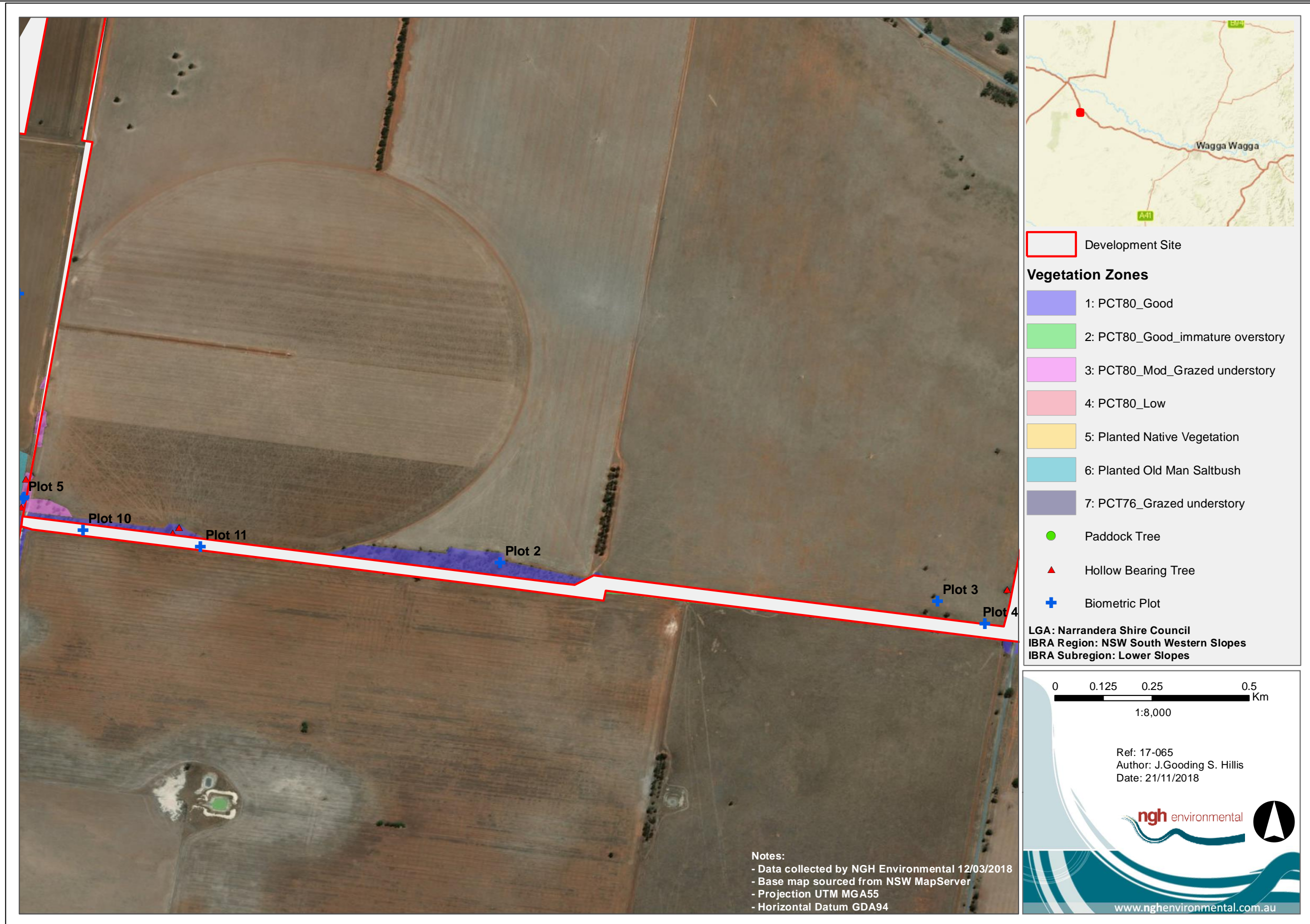


Figure 3-11 Vegetation zones along access Muntz Rd



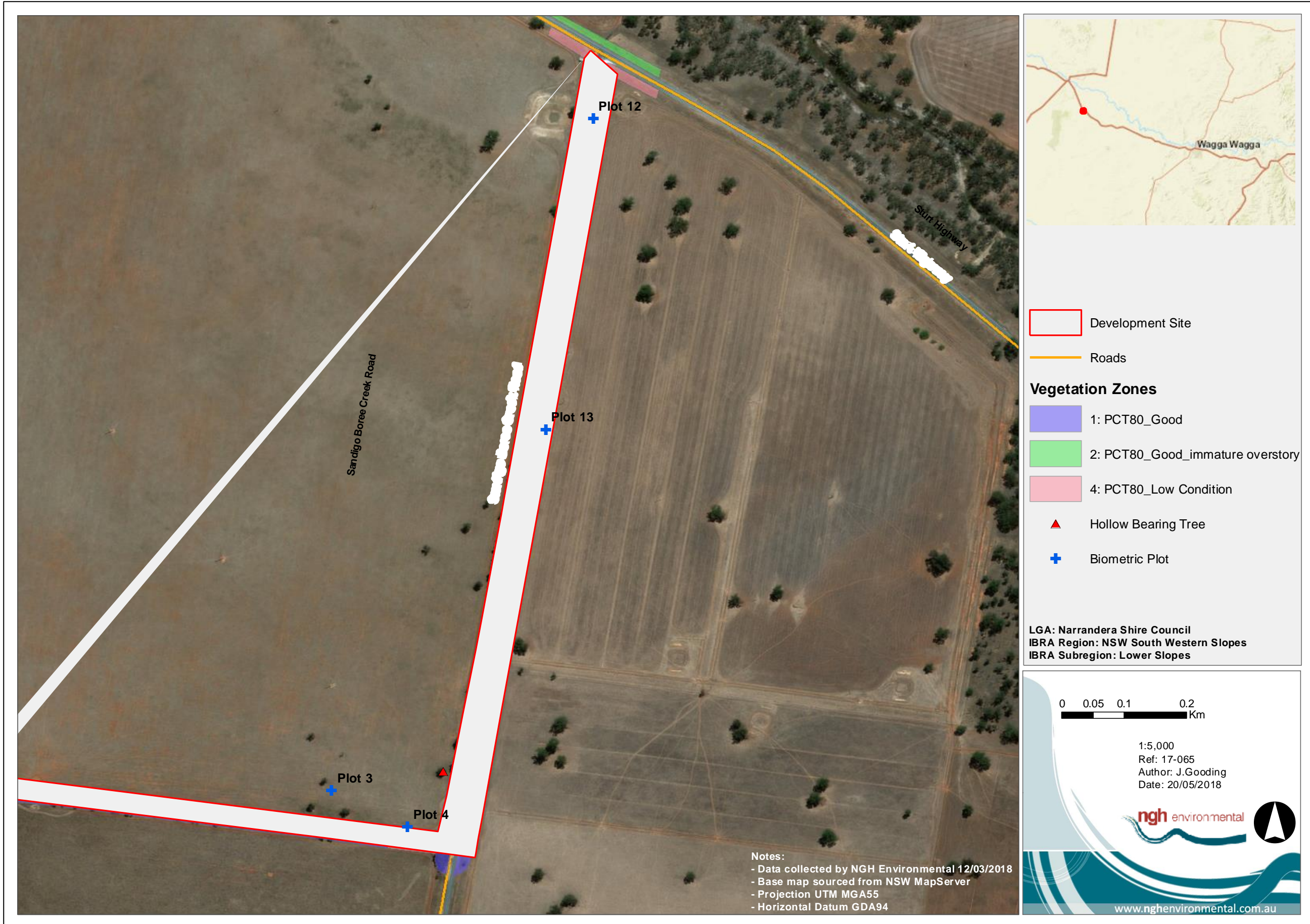


Figure 3-12 Vegetation zones along Sandigo-Boree Creek Rd



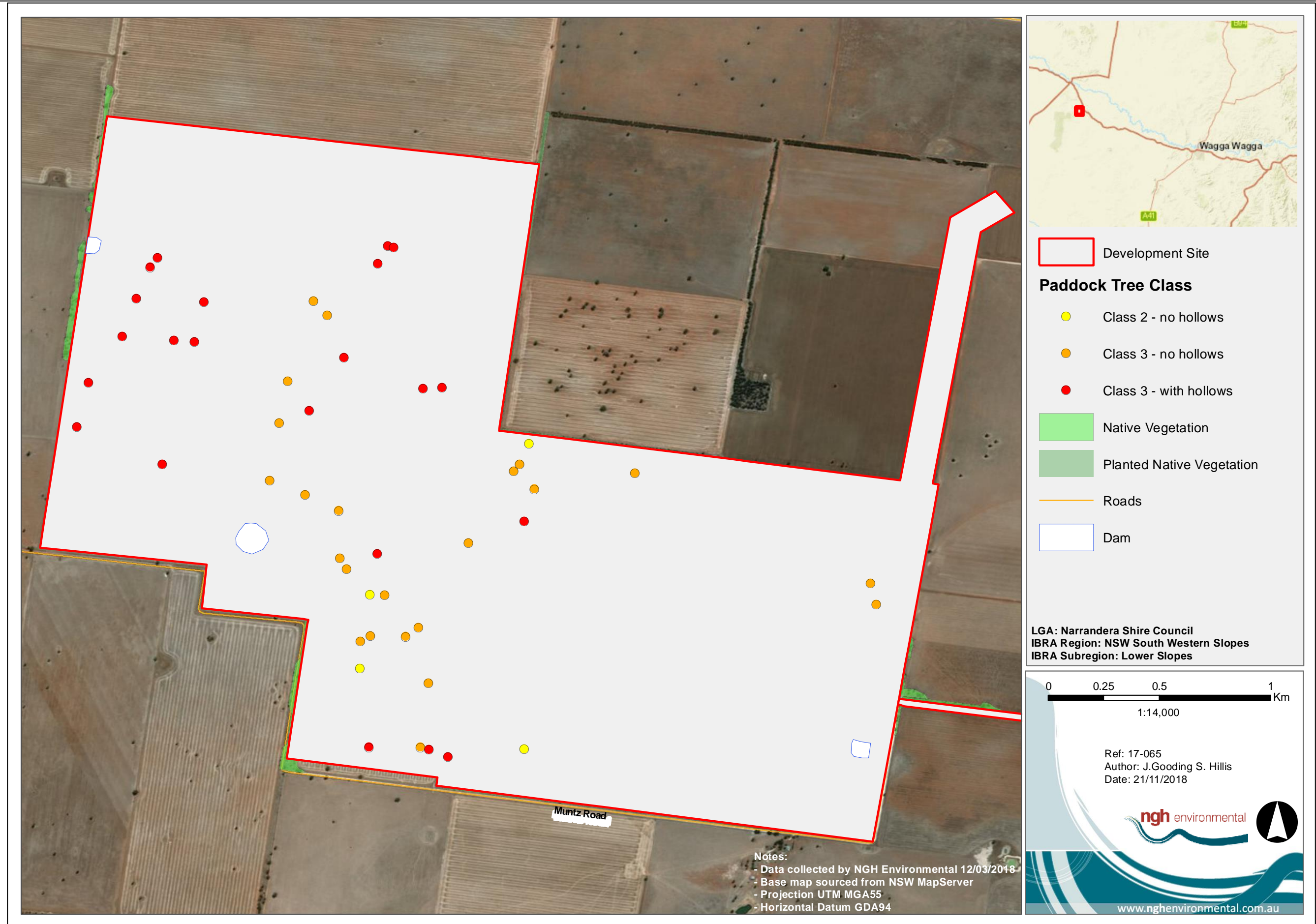


Figure 3-13 Paddock tree classes within the development site



### 3.3.3 Vegetation integrity assessment results

88 plant species were identified within the 13 vegetation integrity survey plots comprising 54 native species and 34 exotic species. The results of the plot field data and photos of each plot can be found in Appendix B and Appendix C.

The plot data from the vegetation integrity survey plots were entered into the BAM calculator by accredited assessor (Julie Gooding- BAAS18074). The results of the vegetation integrity assessment are summarised in Table 3-5 for the vegetation zones that are impacted.

Table 3-5 Table of current vegetation integrity scores for each impacted vegetation zone within the development site.

Zone ID	Composition score	Structure score	Function score	Vegetation Integrity Score
<b>1.</b> <b>PCT80_Good</b>	50.8	85.8	31.9	<b>51.8</b>
<b>2</b> <b>PCT80_Good_immatureoverstory</b>	69.3	51.2	19.2	<b>39.6</b>
<b>3</b> <b>PCT80_moderate_grazed</b>	14.7	49.3	64.5	<b>36</b>
<b>4</b> <b>PCT80_low</b>	24.4	40.3	9.3	<b>20.9</b>
<b>5</b> <b>PCT80_planted</b>	30.9	59.7	27.9	<b>37.2</b>
<b>6</b> <b>PCT158_planted</b>	21.3	54.4	n/a	<b>34.1</b>

## 4 THREATENED SPECIES

### 4.1 ECOSYSTEM CREDIT SPECIES

The following ecosystem credit species were returned by the calculator as being associated with the PCTs present on the development site (Table 4-1). These species are assumed to occur on site and contribute to ecosystem credits. The Grey Crowned Babbler and White-fronted Chat were observed on site during the field surveys.

Table 4-1 Ecosystem Credit Species

Ecosystem credit species	Vegetation type(s)	NSW Listing Status	National Listing Status
<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion 158 – Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Vulnerable	Not Listed
<i>Calyptrorhynchus lathamii</i> Glossy Black Cockatoo	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Chthonicola sagittata</i> Speckled Warbler	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Epthianura albifrons</i> White-fronted Chat	158– Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Vulnerable	Not listed
<i>Falco hypoleucos</i> Grey Falcon	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion 158 - Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Endangered	Not listed
<i>Grus rubicunda</i> Brolga	158– Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Vulnerable	Not listed
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Hamirostra melanosternon</i> Black-breasted Buzzard	158– Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Vulnerable	Not listed

Ecosystem credit species	Vegetation type(s)	NSW Listing Status	National Listing Status
<i>Lathamus discolor</i> Swift Parrot	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Endangered	Critically Endangered
<i>Lophochroa leadbeateri</i> Major Mitchell's Cockatoo	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion 158– Old Man Saltbush – mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (North Western NSW).	Vulnerable	Not listed
<i>Melanodryas cucullata cucullata</i> Hooded Robin (south-eastern form)	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Petroica boodang</i> Scarlet Robin	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Petroica phoenicea</i> Flame Robin	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Phascolarctos cinereus</i> Koala (Foraging)	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Vulnerable
<i>Polytelis swainsonii</i> Superb Parrot (Foraging)	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Vulnerable
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed
<i>Stagonopleura guttata</i> Diamond Firetail	PCT80 - Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Vulnerable	Not listed

#### 4.1.1 Species excluded from the assessment

No ecosystem credit species were excluded from the assessment; all are assumed to occur and contribute to ecosystem credits.

## **4.2 SPECIES CREDIT SPECIES**

### **4.2.1 *Candidate species to be assessed***

The BAM Calculator predicted the following species credit species to occur at the development site (Table 4-2). Species excluded based on the absence of suitable habitat within the development site are highlighted in Table 4-2. The potential for indirect habitats on all species is considered in Section 7.2.



Table 4-2 Candidate species credit species requiring assessment

Species Credit Species	Habitat components and geographic restrictions. <sup>1</sup>	Sensitivity to gain class	NSW listing status	National listing status	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
<b>FAUNA</b>							
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo (Breeding)	Outside Narrandera, Leeton and Griffith LGAs. Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	High	Vulnerable	Not Listed	Not within geographic restrictions.	Excluded	Within Narrandera LGA.
<i>Crinia sloanei</i> Sloane's Froglet	Semi-permanent/ephemeral wet area containing relatively shallow sections with submergent and emergent vegetation, or within 500 m of wet area or Swamps Within 500 m of swamps or Waterbodies	Moderate	Vulnerable	Not Listed	Two farm dams outside development footprint	Excluded	No Waterbodies or swamps within development footprint
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle (Breeding)	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	High	Vulnerable	Not Listed	Absent - Over 2km to nearest watercourse. (Sandy creek)	Excluded	No suitable habitat in development site
<i>Hamirostra melanosternon</i> Black-breasted Buzzard (Breeding)	Land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts	Moderate	Vulnerable	Not Listed	Absent - Over 2km to nearest watercourse (Sandy creek)	Excluded	No suitable habitat in development site

Species Credit Species	Habitat components and geographic restrictions. <sup>1</sup>	Sensitivity to gain class	NSW listing status	National listing status	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
<i>Lathamus discolor</i> Swift Parrot (Breeding)	Mapped Important Areas (OEH)	Moderate	Endangered	Critically Endangered	Development site not within mapped important area (OEH).	Excluded	Excluded – not within mapped important areas
<i>Lophochroa leadbeateri</i> Major Mitchell's Cockatoo (Breeding)	Living or dead tree with hollows greater than 10cm diameter	High	Vulnerable	Not Listed	Suitable hollow bearing trees present in development site	Included	Habitat components on site
<i>Petaurus norfolcensis</i> Squirrel Glider	Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart).	High	Vulnerable	Vulnerable	Remnant vegetation along Muntz Rd.	Included	Habitat components on site
<i>Phascolarctos cinereus</i> Koala (Breeding)	Areas identified via survey as important habitat based on density of Koalas and quality of habitat	High	Vulnerable	Vulnerable	Survey required to identify	Included	Survey required
<i>Polytelis swainsonii</i> Superb Parrot (Breeding)	Living or dead <i>E. blakelyi</i> , <i>E. melliodora</i> , <i>E. albens</i> , <i>E. camaldulensis</i> , <i>E. microcarpa</i> & <i>E. polyanthemos</i> with hollows greater than 5cm diameter; greater than 4m above ground or trees with a DBH of greater than 30cm.	High	Vulnerable	Vulnerable	Suitable hollow bearing Trees present in development site	Included	Habitat components on site

Species Credit Species	Habitat components and geographic restrictions. <sup>1</sup>	Sensitivity to gain class	NSW listing status	National listing status	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
<i>Tyto novaehollandiae</i> Masked Owl	Living or dead trees with hollows greater than 20cm diameter.	High	Vulnerable	Not listed	Suitable hollow bearing trees present in the development site	Included	Habitat components on site
<b>FLORA</b>							
<i>Austrostipa wakoolia</i> A spear-grass	South of Narrandera	Moderate	Endangered	Endangered	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Brachyscome papillosa</i> Mossgiel Daisy	South and West of Coolamon-Ardlethan Road, West of Lockhart and north of Rand	High	Vulnerable	Vulnerable	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Caladenia arenaria</i> Sand-hill Spider Orchid	West of Lockhart and north of Rand	High	Endangered	Endangered	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Diuris tricolor</i> Pine Donkey Orchid	None	Moderate	Vulnerable	Not Listed	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Diuris</i> sp. (Oaklands, D.L. Jones5380) Oaklands Diuris	None	High	Endangered	Not Listed	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Eleocharis obicis</i> Spike-Rush	Semi-permanent/ephemeral wet areas Periodically waterlogged sites (including table drains and farm dams)	High	Vulnerable	Vulnerable	None	Excluded	No ephemeral wet or waterlogged areas within development footprint
<i>Lepidium monoplacoides</i> Winged Peppergrass	Semi-permanent/ephemeral wet areas Land containing seasonally damp or waterlogged sites	High	Endangered	Endangered	None	Excluded	No ephemeral wet or waterlogged areas within

Species Credit Species	Habitat components and geographic restrictions. <sup>1</sup>	Sensitivity to gain class	NSW listing status	National listing status	Habitat components and abundance on site	Included or excluded	Reason for inclusion or exclusion
							development footprint
<i>Swainsona murrayana</i> Slender Darling Pea	Western half of sub-CMA	Moderate	Vulnerable	Vulnerable	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution
<i>Swainsona sericea</i> Silky Swainson-pea	None	High	Vulnerable	Not Listed	Suitable habitat within Zone 1 & 2.	Included	Within Geographic Distribution



#### 4.2.2 Exclusions based on habitat quality

Under Section 6.4.1.17 of the BAM, a species credit species can be considered unlikely to occur on a development site (or within specific vegetation zones) if following field assessment, it is determined that the habitat is substantially degraded such that the species is unlikely to utilise the development site (or specific vegetation zones). These species are identified in Table 4-3 along with justification regarding the habitats present.

Table 4-3 Species credit species excluded based on habitat quality

Species Credit Species	Zones excluded	Reason for exclusion
Silky Swainson Pea Slender Darling Pea Pine Donkey Orchid Oaklands Diuris Sandhill Spider Orchid Mossgiel Daisy <i>Austrostipa wakoolica</i>	Zone 3: PCT80_Moderate_grazed understory Zone 4: PCT80_Low condition Zone 5: PCT80_Planted Vegetation Zone 6: PCT158_Planted Old Man Saltbush Zone 7: PCT76_Moderate_grazed understory Zone 8: Exotic Zone 9: Scattered Paddock Trees	These zones have undergone significant understory disturbance either through cropping, deep ripping or heavy grazing. Understory is dominated by exotic crops species or bare ground. Very few native understory species are present, and those that are present are disturbance tolerant such as Black Rolypoly ( <i>Sclerolaena muricata</i> ) and Curly Windmill Grass ( <i>Enteropogon acicularis</i> ). Habitat is sufficiently degraded for native understory species and these species are unlikely to occur in these zones.
Major Mitchell Cockatoo (Breeding) Superb Parrot (Breeding) Masked Owl (Breeding)	Zone 2: PCT80_Good_immature overstory Zone 4: PCT80_Low condition Zone 5: PCT 80_Planted Vegetation Zone 6: PCT158_Planted Old Man Saltbush Zone 8: Exotic	These zones do not have any mature trees present. These zones are not suitable habitat for the breeding birds listed, as there are no suitable hollow bearing trees for nesting. The species is unlikely to utilise these zones for breeding.

#### 4.2.3 Candidate species requiring confirmation of presence or absence

The species listed in

Table 4-4 are those that are considered to have habitats present in the development site. Where possible within the targeted period, surveys have been conducted for these species. Seven species were unable to be surveyed for during the appropriate survey period. These species were assumed to be present within areas of potential habitat for the purpose of this assessment.

The results are summarised in Table 4-4 below. Details of the survey methodologies and results are provided for each surveyed species below.

Targeted survey locations and species polygons defined for the species present on the site are mapped on Figure 4-1 and Figure 4-2.

Table 4-4 Summary of species credit species surveyed at the development site

Species Species	Credit	Biodiversity risk weighting	Survey Period	Assumed to occur/survey/ expert report	Present on site?	Species polygon area or count
FAUNA						
<i>Lophochroa leadbeateri</i> Major Mitchell's Cockatoo	2.00	Sept – Dec	Surveyed March 2018 Not surveyed for during survey period	Assumed Present	0.25 ha (HBT in Zone 1 & Zone 3)	
<i>Petaurus norfolcensis</i> Squirrel Glider	2.00	All	Surveyed March & May 2018	No		
<i>Phascolarctos cinereus</i> Koala	2.00	All	Surveyed March & May 2018	No	-	
<i>Polytelis swainsonii</i> Superb Parrot	2.00	Sept – Nov	Surveyed March 2018 Not surveyed for during survey period	Assumed Present	0.25 ha (HBT in Zone 1 & Zone 3)	
<i>Tyto novaehollandiae</i> Masked Owl	2.00	May – August	Surveyed May 2018	No	-	
FLORA						
<i>Austrostipa wakoolica</i> A spear-grass	2.00	Sept – Dec	Not surveyed for	Assumed Present	1.4 Ha (Zone 1 & 2)	
<i>Brachyscome papillosa</i> Mossgiel Daisy	2.00	Sept – Nov	Surveyed Nov 2018	No	No	
<i>Caladenia Arenaria</i> Sand-hill Spider Orchid	3.00	Aug – Oct	Not surveyed for	Assumed Present	1.4 Ha (Zone 1 & 2)	
<i>Diuris</i> sp. (Oaklands, D.L. Jones 5380) Oaklands Diuris	3.00	Nov	Not surveyed for	Assumed Present	1.4 Ha (Zone 1 & 2)	
<i>Diuris tricolor</i> Pine Donkey Orchid	1.50	Sept – Oct	Not surveyed for	Assumed Present	1.4 Ha (Zone 1 & 2)	

Species	Credit Species	Biodiversity risk weighting	Survey Period	Assumed occur/survey/ to expert report	Present on site?	Species polygon area or count
	<i>Swainsona murrayana</i> Slender Darling Pea	1.50	Sept – Feb	Surveyed Feb 2018	No	-
	<i>Swainsona sericea</i> Silky Swainson-pea	2.00	Sept – Feb	Surveyed Feb 2018	No	-

### 4.3 THREATENED SPECIES SURVEY

Targeted surveys were undertaken over a number of days and months. A general biodiversity survey was undertaken on the 15<sup>th</sup> November 2017. Threatened Fauna Surveys and Nocturnal Surveys were undertaken on the 28<sup>th</sup> February, 2<sup>nd</sup> & 6<sup>th</sup> March and 4<sup>th</sup> & 7<sup>th</sup> May 2018. Threatened Flora surveys were undertaken on the 28<sup>th</sup> February and 5<sup>th</sup> November 2018. Weather conditions recorded for these dates from the Bureau of Meteorology (BOM) at the Narrandera Weather Station are as follows:

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)	Max Wind Gust (km/h)
15 <sup>th</sup> November 2017	19.4	34.4	0	59
28 <sup>th</sup> February 2018	17.7	37.5	0	54
2 <sup>nd</sup> March 2018	14.0	32.7	0	30
6 <sup>th</sup> March 2018	16.4	31.5	0	-
4 <sup>th</sup> May 2018	13.4	17.3	10.2	-
7 <sup>th</sup> May 2018	5.0	24.4	0	44
5 <sup>th</sup> Nov 2018	30.1	17.1	0	67

#### Nocturnal Mammals (Koala and Squirrel Glider)

##### SURVEY EFFORT

Targeted spotlighting surveys were undertaken on the evenings of the 2<sup>nd</sup> & 6<sup>th</sup> March 2018 and 4<sup>th</sup> & 7<sup>th</sup> May 2018 by two consultants for a total of approximately two hours each night. A 100-watt spotlight was used in both vehicle-based and foot surveys within planted vegetation, remnant vegetation, and isolated paddock trees. Targeted searches for Koalas during the day were undertaken on the 28<sup>th</sup> February for approximately 5 hours. Mature feed trees were searched for signs of Koalas such as scats and scratches.

##### SURVEY RESULTS

No Koalas (or signs of Koalas) or Squirrel Gliders were observed during the surveys. They are not considered to occur within the development site.

## Nocturnal Birds (Masked Owl)

### SURVEY EFFORT

Targeted surveys were undertaken on the evenings of 4th and 7th May 2018 by two ecologists for a total of approximately two hours each night. A 100-watt spotlight was used in both a slow-moving vehicle within planted vegetation, remnant vegetation, and isolated paddock trees. Call playback of the Masked Owl was undertaken at three separate locations within the development site at the locations shown in Figure 4-1. Call playback was undertaken for a period of 5 minutes with a ten-minute listening period following.

### SURVEY RESULTS

No masked owls were observed or vocalisations heard during the site surveys and they are not considered to occur on the development site. Three common nocturnal birds, a Barn Owl (*Tyto alba*), Southern Boobook Owl (*Ninox novaeseelandiae*) and Tawny Frogmouth (*Podargus strigoides*) were observed during the nocturnal surveys.

## Diurnal Birds (Superb Parrot, Major Mitchell Cockatoo)

### SURVEY EFFORT

A woodland bird census was completed on the evening of the 2<sup>nd</sup> March 2018. Three 20-minute point surveys for birds were carried out, as well as opportunistic surveys throughout the site visit including traversing the site by car and on foot. Opportunistic surveys were also undertaken during the six days of field surveys.

Targeted hollow bearing Trees surveys were carried out on the 28<sup>th</sup> February and 2<sup>nd</sup> March to identify trees with suitable hollows that may be used by the Superb Parrot or Major Mitchell Cockatoo. All trees were surveyed for the presence of hollows. The number, size and height of hollows were recorded for each tree along with any evidence of use. Hollows were categorised as small (< 10 cm), medium (10 – 20 cm), and large (> 20 cm).

### SURVEY RESULTS

No sighting of these threatened birds were seen over the six days of field visits. The surveys occurred outside the survey period for the Major Mitchell Cockatoo and Superb Parrot. As surveys were not undertaken for these species during the recommended survey time, these two species are assumed to occur on site.

115 hollow bearing trees occur within the development site. 11 paddock trees would be impacted that are considered suitable breeding habitat for the Major Mitchell Cockatoo (Figure 4-1). Suitable breeding habitat for the Major Mitchell Cockatoo was considered to be living or dead trees with hollows greater than 10cm diameter (Bionet, 2018). As per consultation with OEH, paddock trees assessed under the streamlined paddock tree assessment are not considered as species credit polygons. 0.1ha of Zone 3 (PCT 80\_mod\_grazed understory) would be impacted by the development that contained three hollow bearing trees that were considered potential breeding habitat for the Major Mitchell Cockatoo. Two hollow bearing trees would be removed in Zone 1 that covered an area of 0.15 ha. As surveys were not undertaken during the specified time period, the Major Mitchell Cockatoo was presumed to occur and Zone 3 was entered into the BAM calculator as Major Mitchell Cockatoo breeding habitat.

57 hollow bearing trees within the development site were considered to be suitable breeding habitat for the Superb Parrot. Eight paddock trees would be impacted by the development footprint (Figure 4-1). Suitable breeding habitat was considered to be hollows 10-25cm in diameter and located 4-9m above the ground (Rayner et al, 2016). As per consultation with OEH, paddock trees assessed under the streamlined



paddock tree assessment are not considered as species credit polygons. 0.1ha of Zone 3, would be impacted by the development that contained three hollow bearing trees that were considered potential breeding habitat for the Superb Parrot. Two hollow bearing trees would be removed in Zone 1 that covered an area of 0.15 ha. As surveys were not undertaken during the specified time period, the Superb Parrot was presumed to occur and 0.25 ha was entered into the BAM calculator as Superb Parrot Breeding habitat.

A full list of bird species observed during the surveys are shown in Appendix F.

### Threatened Flora (*Austrostipa wakoolica*, *Caladenia Arenaria*, *Diuris tricolor*)

#### SURVEY EFFORT

Surveys for these threatened plant species were unable to be undertaken during the specified time period in Spring.

#### SURVEY RESULTS

Suitable habitat for these species occur in the Remnant Vegetation along Muntz Rd and Sandigo-Boree Creek Rd (Zones 1 and Zone 2). The remaining vegetation zones (Zones 3 –9) are either planted, exotic vegetation or lack an understory from frequent trampling and grazing by stock and are not suitable habitat for these threatened flora species. As surveys were not undertaken during the specified time period these species are presumed to occur within Zones 1 and 2.

### Threatened Flora (*Diuris* sp. (Oaklands, D.L. Jones 5380)

#### SURVEY EFFORT

Suitable habitat for these species occur in the Remnant Vegetation along Muntz Rd and Sandigo-Boree Creek Rd (Zones 1 and Zone 2). The remaining vegetation zones (Zones 3 –9) are either planted, exotic vegetation or lack an understory from frequent trampling and grazing by stock and are not suitable habitat for these threatened flora species. Targeted searches for these species were undertaken on the 5<sup>th</sup> November 2018 for a period of approximately 4 hours. Areas of suitable habitat within the development footprint were surveyed using the parallel field traverse survey technique in the accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016).

#### SURVEY RESULTS

This species was not detected within the survey area. However, unusually dry seasonal conditions were not considered appropriate for the Oaklands *Diuris* to occur and according to the BAM, this species was assumed to occur in zones 1 and 2.

### Threatened Flora (*Brachyscome papillosa*)

#### SURVEY EFFORT

Suitable habitat for these species occur in the Remnant Vegetation along Muntz Rd and Sandigo-Boree Creek Rd (Zones 1 and Zone 2). The remaining vegetation zones (Zones 3 –9) are either planted, exotic vegetation or lack an understory from frequent trampling and grazing by stock and are not suitable habitat for these threatened flora species. Targeted searches for these species were undertaken on the 5<sup>th</sup> November 2018 for a period of approximately 4 hours. Areas of suitable habitat within the development footprint were surveyed using the parallel field traverse survey technique in the accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016).

#### SURVEY RESULTS

This species was not detected within the survey area. No other *Brachyscome* species were detected within the survey area.

### Threatened peas (*Swainsona murrayana* & *Swainsona sericea*)

#### SURVEY EFFORT

Suitable habitat for these species occur in the Remnant Vegetation along Muntz Rd and Sandigo-Boree Creek Rd (Zones 1 and Zone 2). The remaining vegetation zones (Zones 3 –9) are either planted, exotic vegetation or lack an understory from frequent trampling and grazing by stock and are not suitable habitat for these threatened flora species. Targeted searches for these species were undertaken on the 28<sup>th</sup> February 2018 for a period of approximately 4 hours. Areas of suitable habitat within the development footprint were surveyed using the parallel field traverse survey technique in the accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016).

#### SURVEY RESULTS

No *Swainsona murrayana* or *Swainsona sericea* were detected within the survey area. They are not considered to occur within the development site.

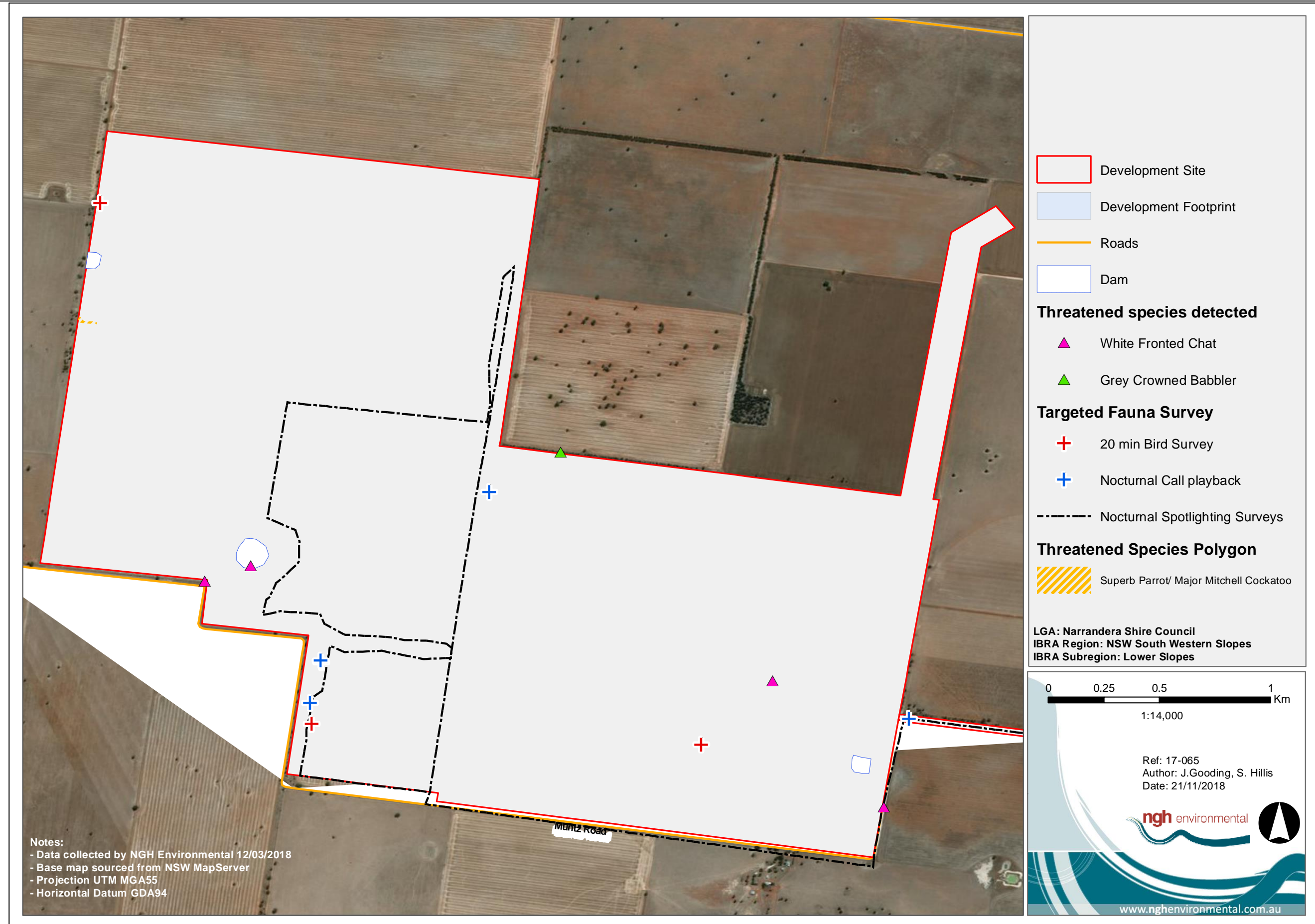


Figure 4-1 Threatened species polygons and targeted survey locations



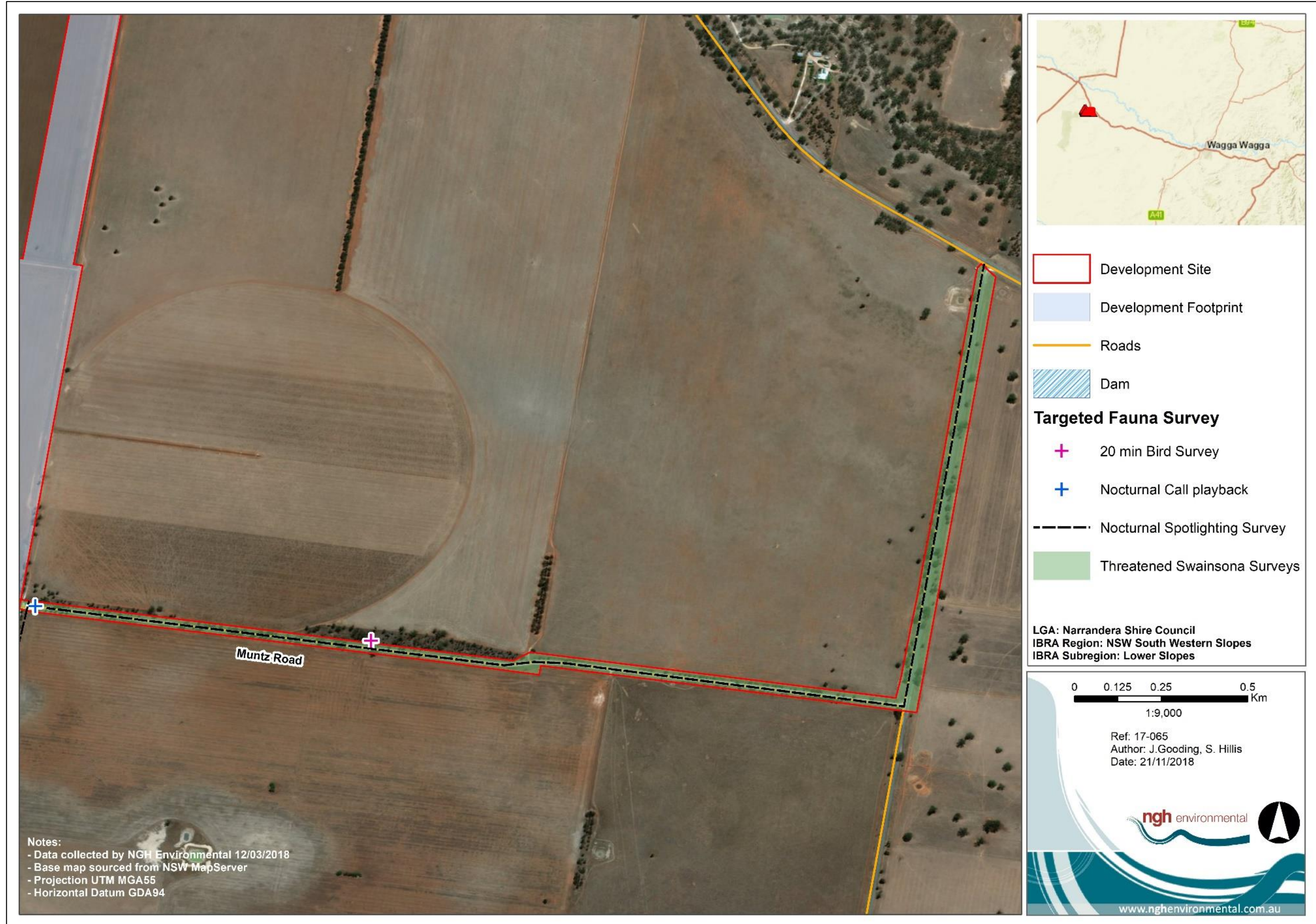


Figure 4-2 Targeted survey locations along Muntz Rd and Sandigo-Boree Creek Rd.



## 4.4 ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS

### 4.4.1 Occurrences of karst, caves, crevices and cliffs

No karsts, caves, crevices and cliffs occur within the development site.

### 4.4.2 Occurrences of rock

No surface rocks or rocky outcrops occur within the development site

### 4.4.3 Occurrences of human made structures and non-native vegetation

No human made structures that could be utilised by threatened species occur within the development site.

563ha of non-native vegetation occur within the development site as shown in Figure 3-1. A flock of about 40 White Fronted Chats (*Epthianura albifrons*) were observed foraging within the harvested wheat field during the field surveys. They had been previously sighted foraging in the adjacent planted Old Man Saltbush (*Atriplex nummularia*) crop on three occasions during the site visits.

### 4.4.4 Hydrological processes that sustain and interact with the rivers, streams and wetlands

The development site is located on flat, low-lying land. No rivers, streams or wetlands occur within or adjacent to the development site. The nearest natural water course is Sandy Creek, 2km north of the site, which runs south-north to its confluence with the Murrumbidgee River. One man-made irrigation canal is also present on site that can supply water from Sandy Creek.

Two farms dams are present within the development site that provide a water catchment for drainage. These farm dams, although lacking vegetation could still provide potential habitat for the Sloane's Froglet (*Crinia sloanei*). The Sloane's froglet can be associated with highly disturbed areas (OEH, 2017). The farm dams would not be impacted by the development.

## 5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

An EPBC protected matters report was undertaken on the 13<sup>th</sup> November 2017 (10km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site (refer to Appendix G). Those relevant to biodiversity include:

- Wetlands of International Importance
- Threatened Ecological Communities
- Threatened species
- Migratory species

The potential for these MNES to occur at the site are discussed below.

### 5.1 WETLANDS OF INTERNATIONAL IMPORTANCE

Four wetlands of international importance were returned from the protected matters report. All four are over 300km for the development site not connected to the proposal site. The nearest of these, the Hattah Kulkyne Lakes are around 350km West of the development site. It is fed by the Murray River. Based on the lack of watercourses within the development site and distance from these wetlands, the proposal is unlikely to impact on any wetland of international importance.

### 5.2 THREATENED ECOLOGICAL COMMUNITIES

Four threatened ecological communities were identified from the protected matters report. These are:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EEC)
- Natural Grasslands of the Murray Valley Plains (CEEC)
- Weeping Myall Woodlands (EEC)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. (CEEC).

Remnant Grey Box occurs within the development site. An assessment of whether the Grey Box woodland meets the condition threshold (DoSEWPC, 2012) for the EPBC listed community was undertaken.

Within the development site, only Zone 1, 2, and 7 were considered to meet the EPBC condition threshold (Figure 3-10 - Figure 3-12). These zones had either a good overstory cover with a large number of trees containing hollows (Zone 7) or a good understory cover with greater than 50% of the plant cover in the ground layer made up of native species (Zone 1 & 2). Zone 3 and 4 were considered degraded with too few native species and insufficient native species cover in ground layer to meet the criteria for the EPBC listed community.

No other TEC communities were considered to occur in the development site due to the lack of diagnostic species present for these communities.

### 5.3 THREATENED SPECIES

Twenty-two threatened species were returned from the protected matters report, comprising nine birds, three fish, one frog, three mammals, five plants and one reptile species. Based on a habitat assessment (**Appendix H**), seven of these species are considered to have the potential to use the habitats at the development site. These are the:

- Swift Parrot *Lathamus discolor*
- Superb Parrot *Polytelis swainsonii*
- Corben's Long-eared Bat *Nyctophilus corbeni*
- Koala *Phascolarctos cinereus*
- A spear-grass *Austrostipa wakoolica*
- Sand-hill Spider-Orchid *Caladenia arenaria*
- Slender Darling Pea *Swainsona murrayana*

Targeted surveys were undertaken for the Koala and the Slender Darling Pea (as described in section 4.3) and were not detected. These two species are not considered to occur within the development site.

The remaining five species were not detected within the development site however timing for these species survey was not considered optimal and they are assumed to occur onsite.

### 5.4 MIGRATORY SPECIES

Ten listed migratory species were returned from the protected matters report. Based on a habitat assessment (Appendix H), two of these species could occur on the site on occasion. – the Fork-tailed Swift and the White-throated Needletail. However, as these species are almost exclusively aerial (DoE, 2015) they are considered unlikely to rely on the habitats present within the development site.

## 6 AVOID AND MINIMISE IMPACTS

### 6.1 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT

#### 6.1.1 Site selection – consideration of alternative locations/routes

RES has reviewed the solar generation potential of many areas in NSW using a GIS (Geographic Information System) model. Other project locations are also being explored by RES in other areas of NSW.

The proposed site was selected because;

- The land has been heavily disturbed from past and current agricultural activities.
- Low ecological constraints (predominantly cleared cropping land with minimal vegetation removal).
- It is located within close proximity to existing electricity infrastructure reducing impacts to native vegetation associated with transmission line easements
- The development site is not subject to land hazards such as flooding or bush fire and is not known to hold land contamination.
- The proposal is not likely to generate land use conflicts with surrounding land uses.

The site is of a scale that allows for flexibility in the design, allowing RES to avoid or effectively mitigate the ecological constraints that have been identified during the biodiversity assessment process. The development site is considered to be suitable for the proposal

#### 6.1.2 Proposal components – consideration of alternate modes or technologies

In 2013, the NSW Government released the NSW Renewable Energy Action Plan to guide NSW's renewable energy development (NSW Government, 2013). The Government's vision is for a secure, affordable and clean energy future for NSW. The Plan positions the state to increase energy from renewable sources, at least cost to the energy customer and with maximum benefits to NSW. The strategy is to work closely with NSW communities and the renewable energy industry to increase renewable energy generation in NSW. Other forms of largescale renewable energy accounted for in the LRET (Large-scale renewable energy target) include wind, hydro, biomass, and tidal energy. The feasibility of wind, solar, biomass, hydro and tidal projects depend on the availability of energy resources and grid capacity.

Photovoltaic solar technology was chosen because it is cost-effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology which is readily available for broad scale deployment at the site. In terms of its impacts on biodiversity, PV solar has minimal construction footprint, mounts being either pile driven or on small footings. The largest footprint components are the perimeter tracks and inverter and switch station footings. The layout can be flexible to minimising impacts on site constraints.

#### 6.1.3 Proposal planning phase – detailed design

A preliminary constraints analysis was conducted by NGH Environmental (NGH 2018), which was revised further in May/June of 2019. This constraints analysis informed the site layout design by avoiding as well



as further minimising impacts to areas of high biodiversity value as far as practicable to meet safety requirements.

Vegetation constituting the highest ecological constraints such as forming components of EECs and providing threatened flora and fauna habitat were avoided and minimised. This was done by:

- Designing the point of connection to the transmission line to occur within a cleared area in the development site. An alternative option to create a point of connection on the corner of Muntz Rd and Sandigo-Boree Creek Rd would have required clearing of native vegetation and was avoided in the final design.
- Excluding the remnant moderate condition, Western Grey Box tall grassy Woodland (Zone 7) and Western Grey Box – White Cypress Pine tall woodland (Zone 3) from the development footprint.
- Excluding the majority of planted vegetation (Zone 5) from the development footprint
- Minimising impacts to the Planted Old Man Saltbush Crop (Zone 6) which provides threatened species habitat for the White Fronted Chat (*Epthianura albifrons*). This area is excluded from the development footprint apart from construction of an access track into the solar farm.
- Minimising impacts to native vegetation along Muntz Rd and Sandigo-Boree Creek Rd by designing the road to the minimum width necessary, as specified by Narrandera Shire Council.
- Locating ancillary facilities in areas where there are no biodiversity values
- Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.

The final site layout and location has not been able to completely avoid all areas of biodiversity value. In particular due to the size constraints of the individual solar panel arrays, scattered paddock trees were unable to be avoided.

The final design footprint for the proposal is detailed in Figure 6-1. The final footprint and limits for clearing associated with the road upgrades specified by Narrandera Shire Council to Sandigo-Boree Creek and Muntz Roads can be seen in Figure 6-2 to Figure 6-14.



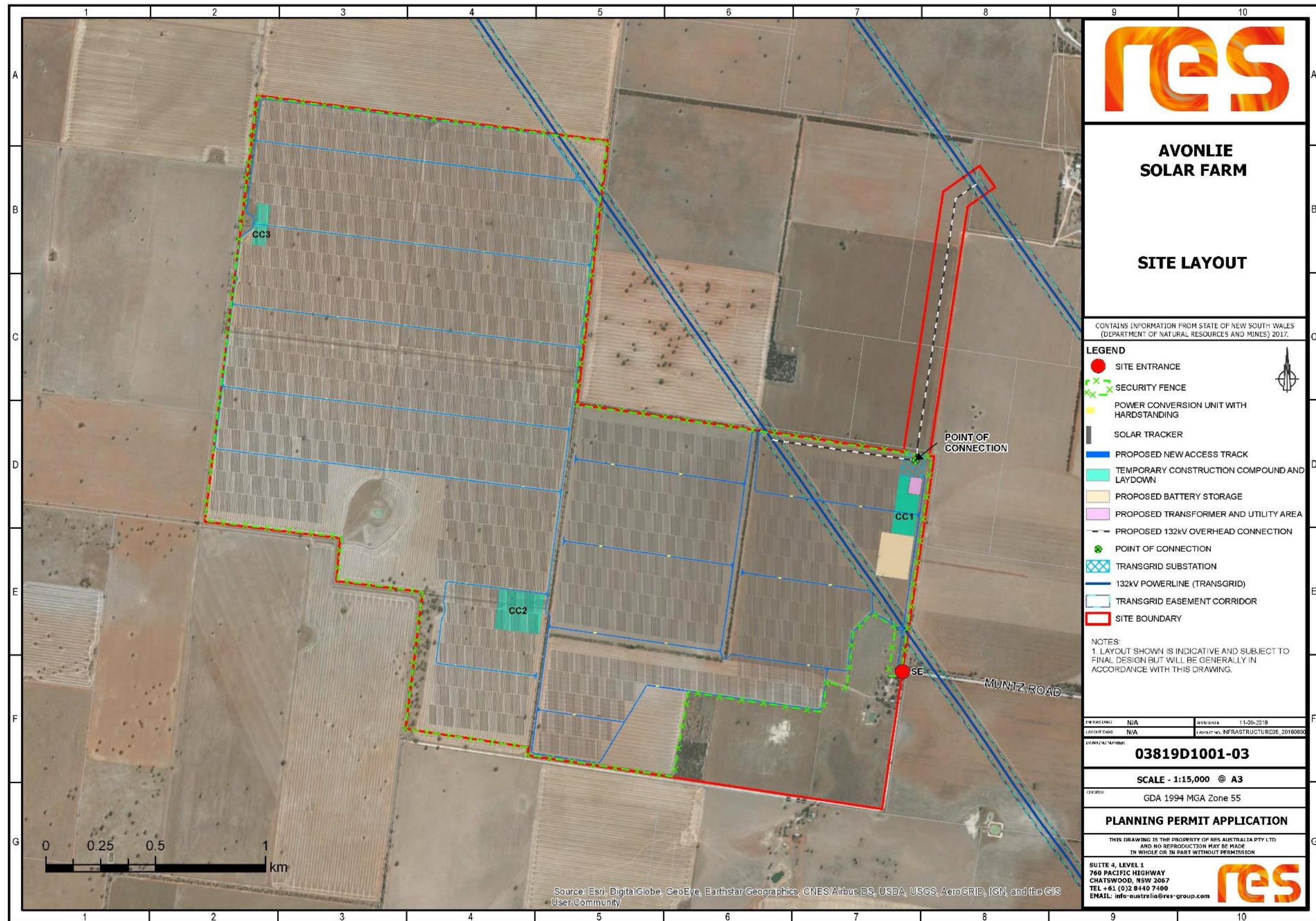


Figure 6-1 Final project footprint



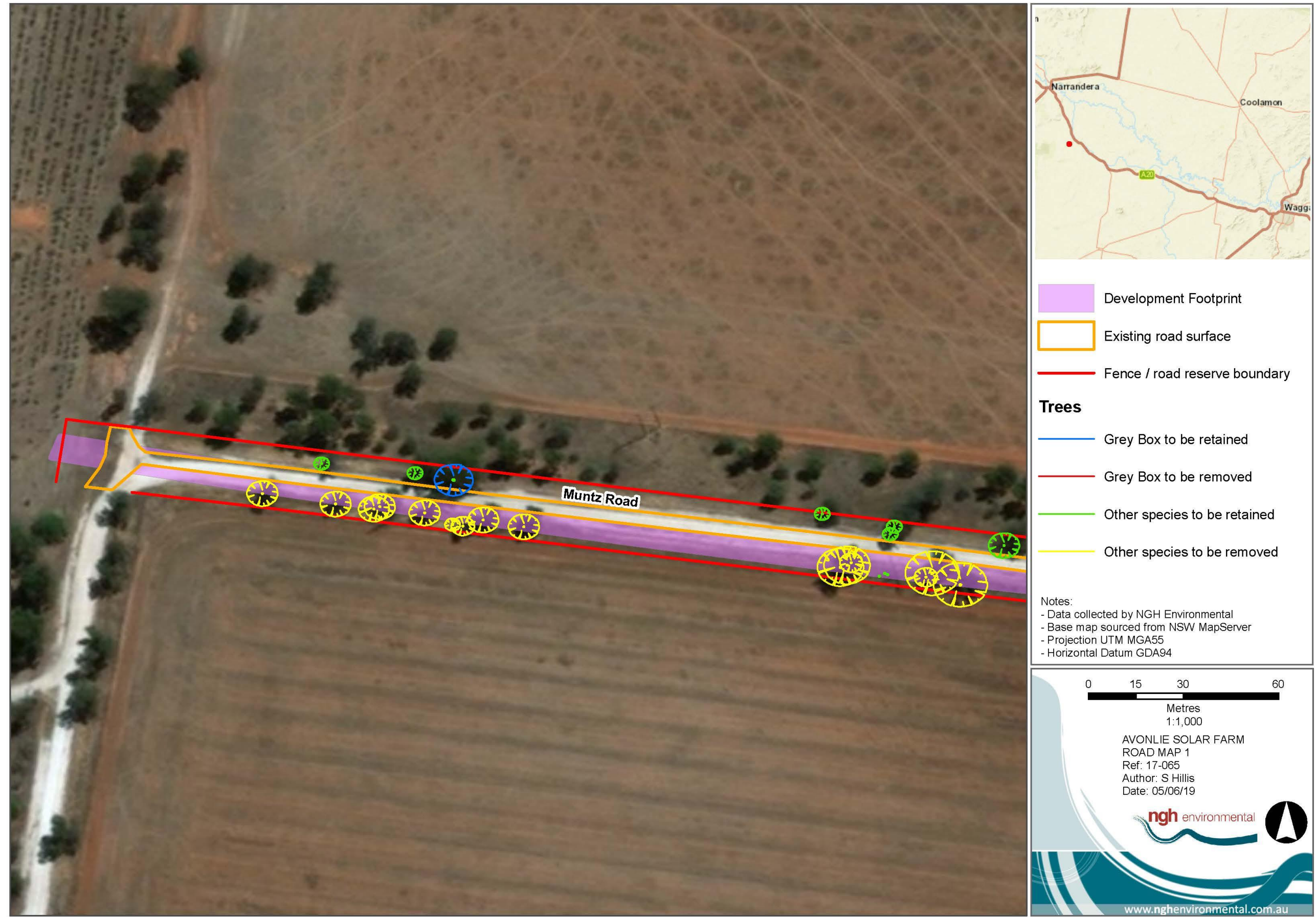


Figure 6-2 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd





Figure 6-3 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



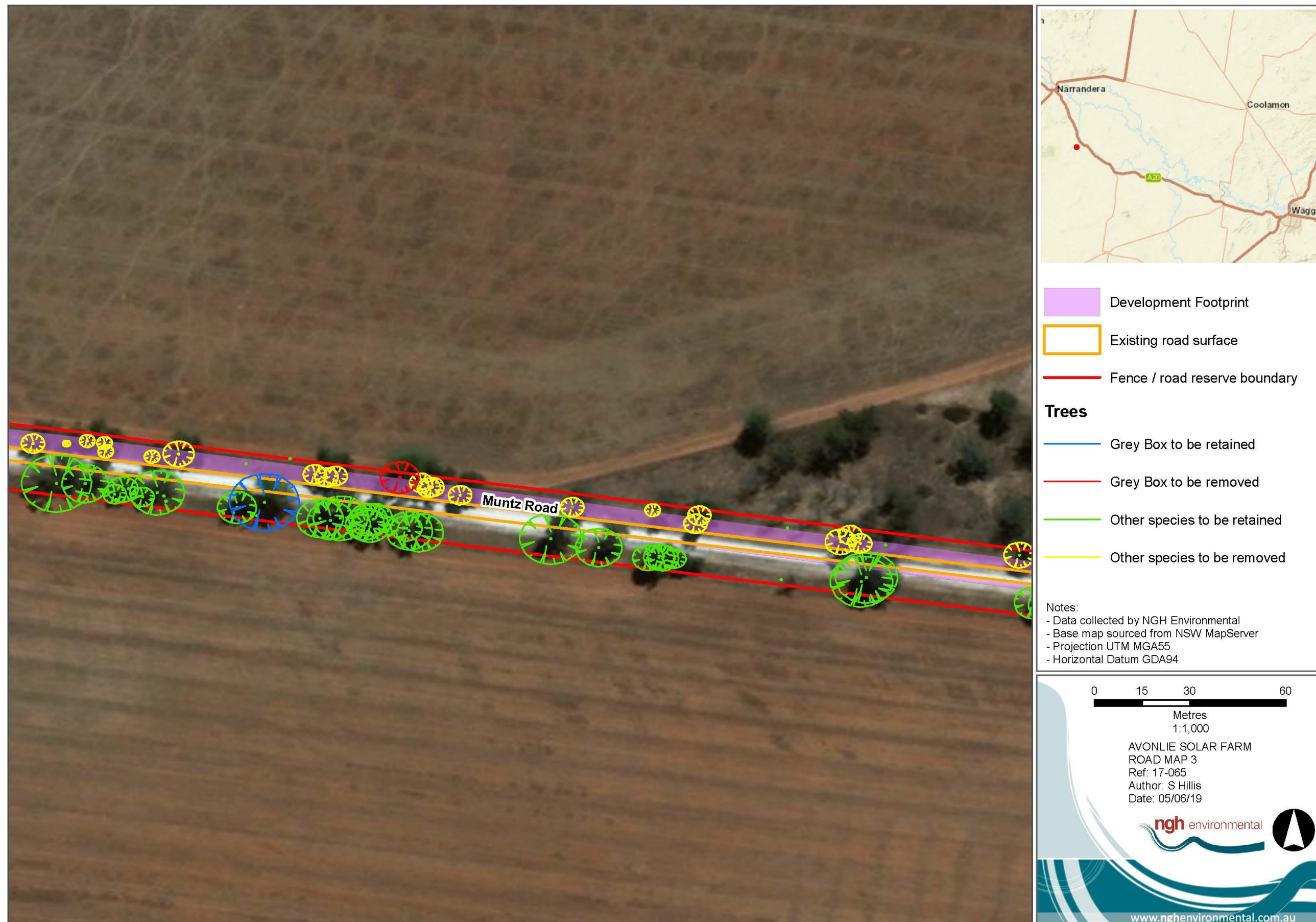


Figure 6-4 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



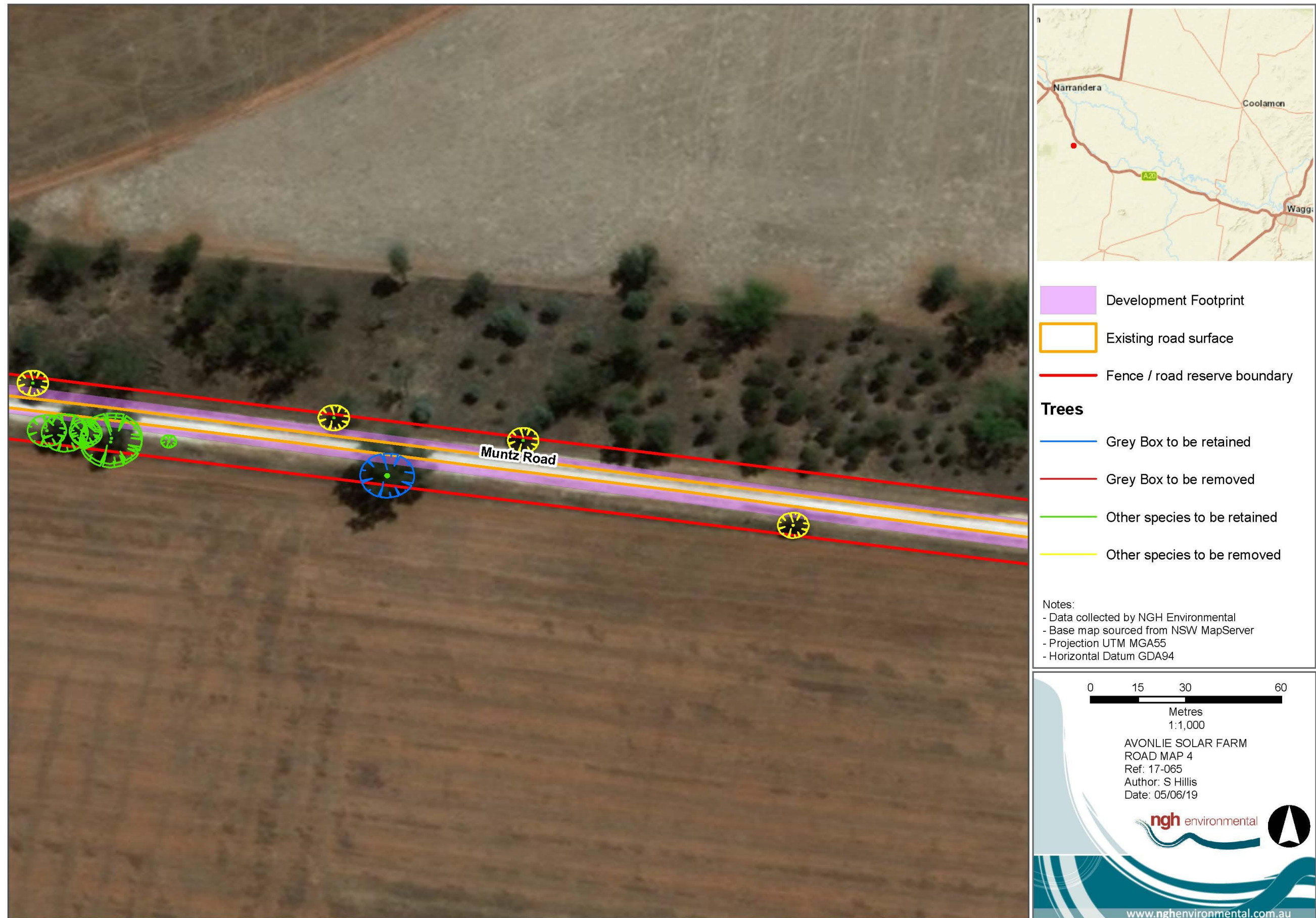


Figure 6-5 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



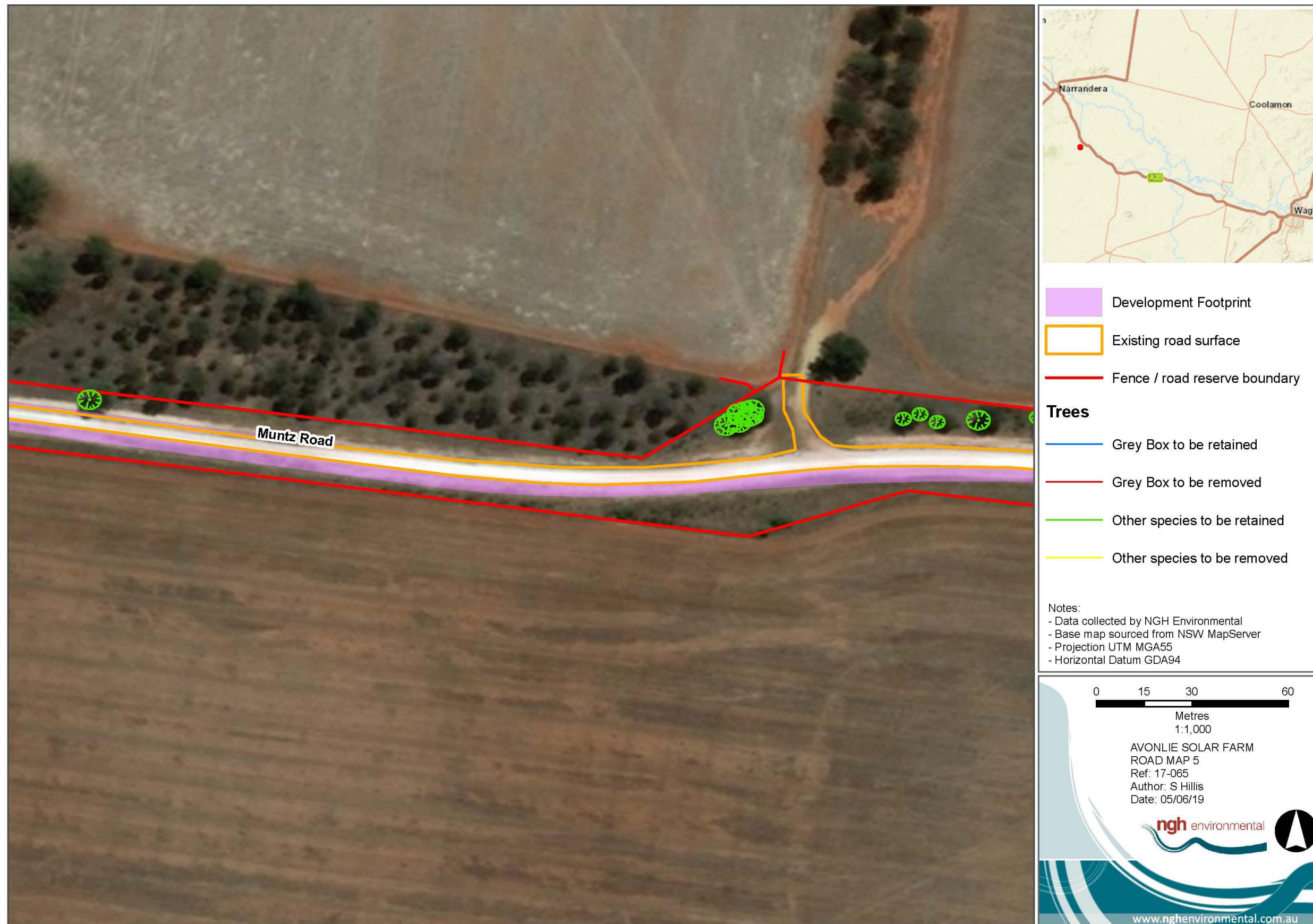


Figure 6-6 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd





Figure 6-7 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd





Figure 6-8 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd





Figure 6-9 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



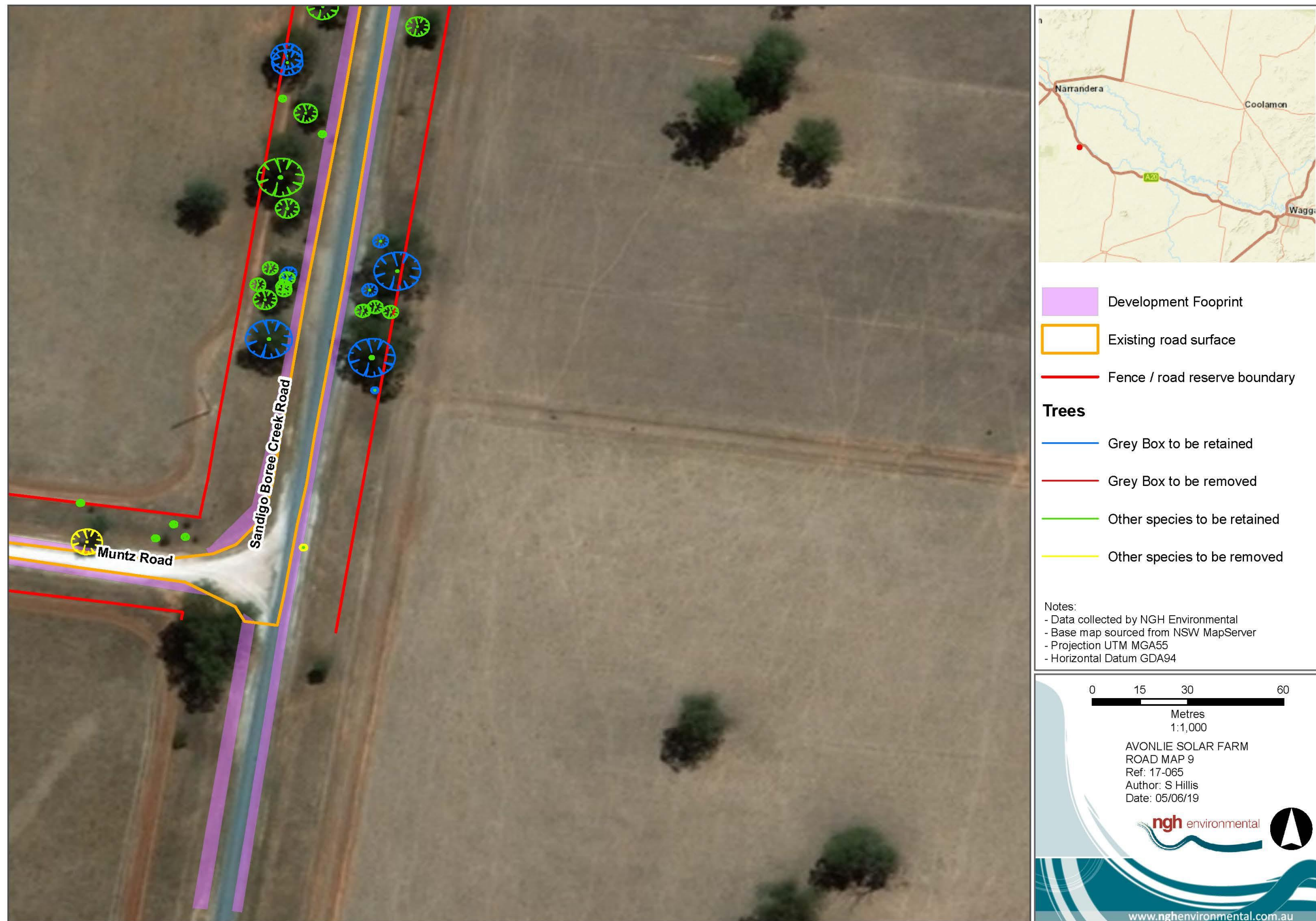


Figure 6-10 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



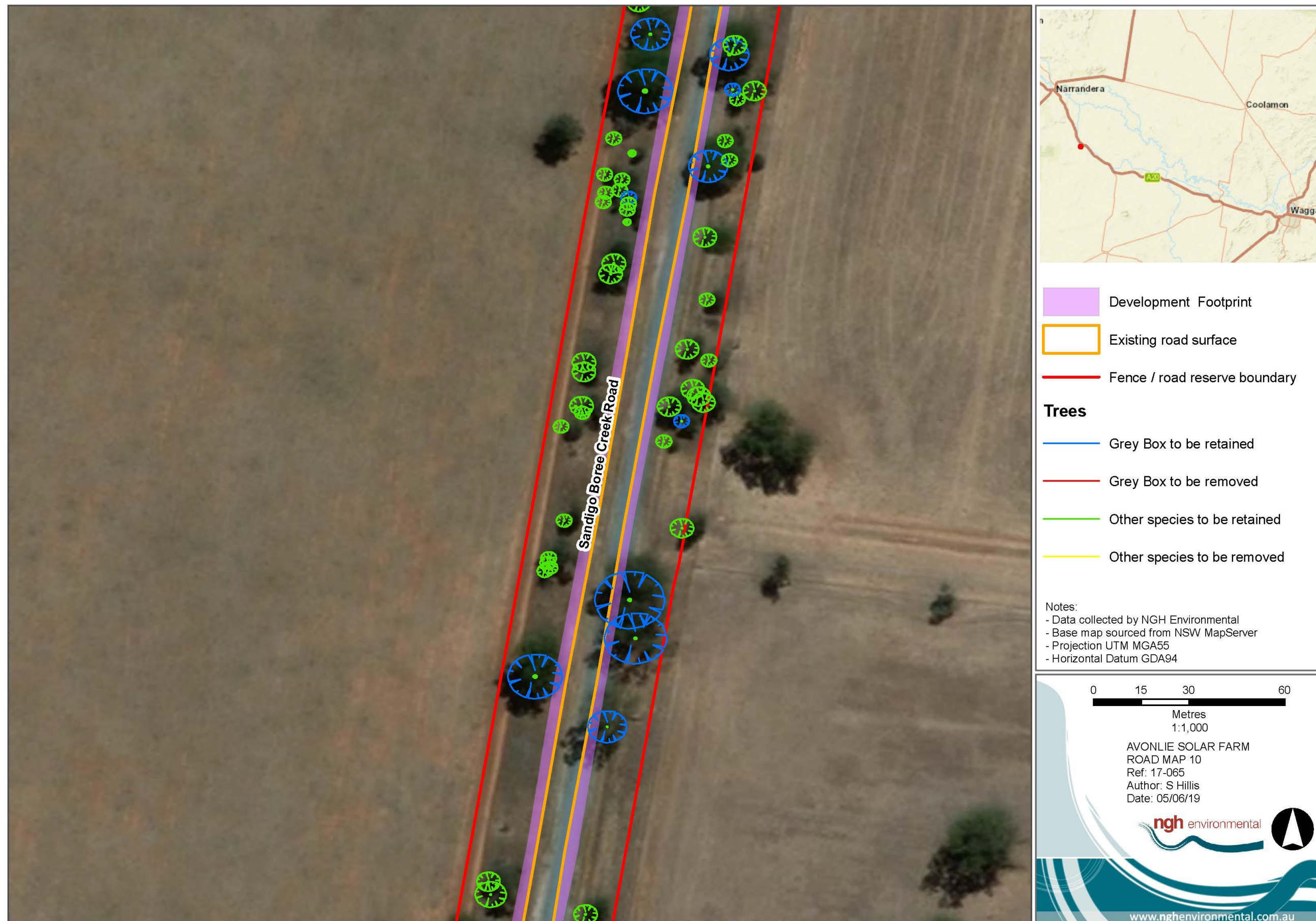


Figure 6-11 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



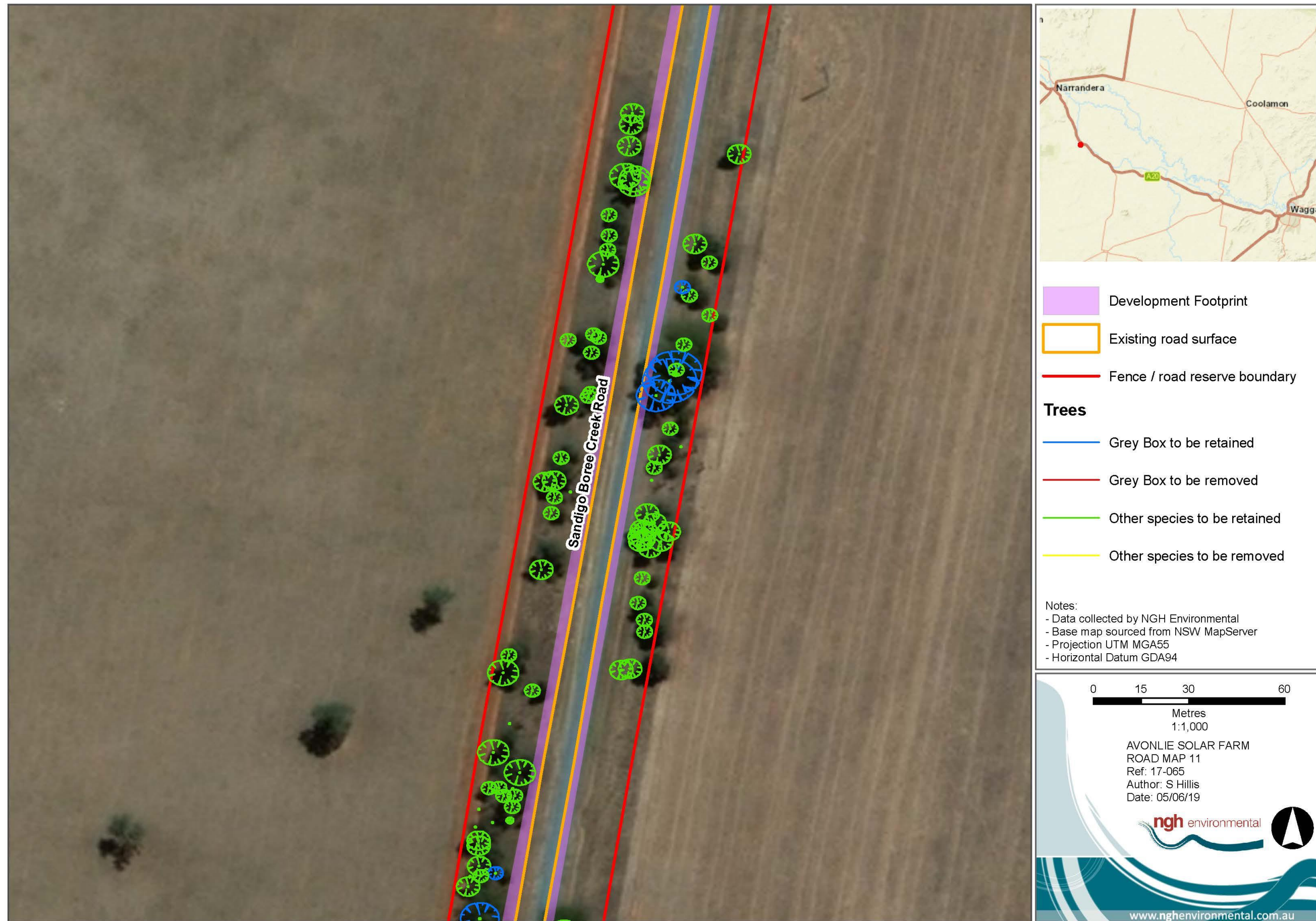


Figure 6-12 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



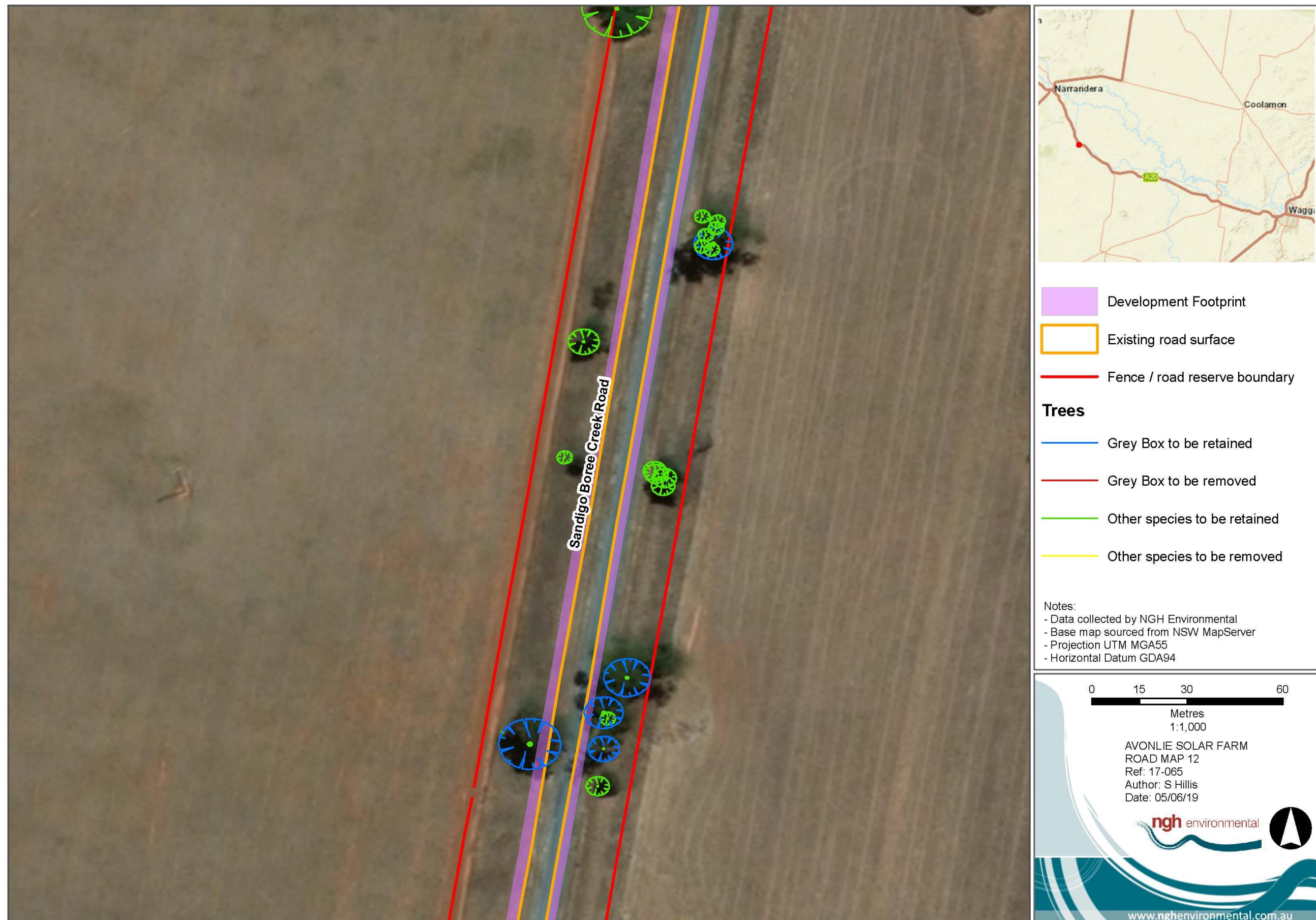


Figure 6-13 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd



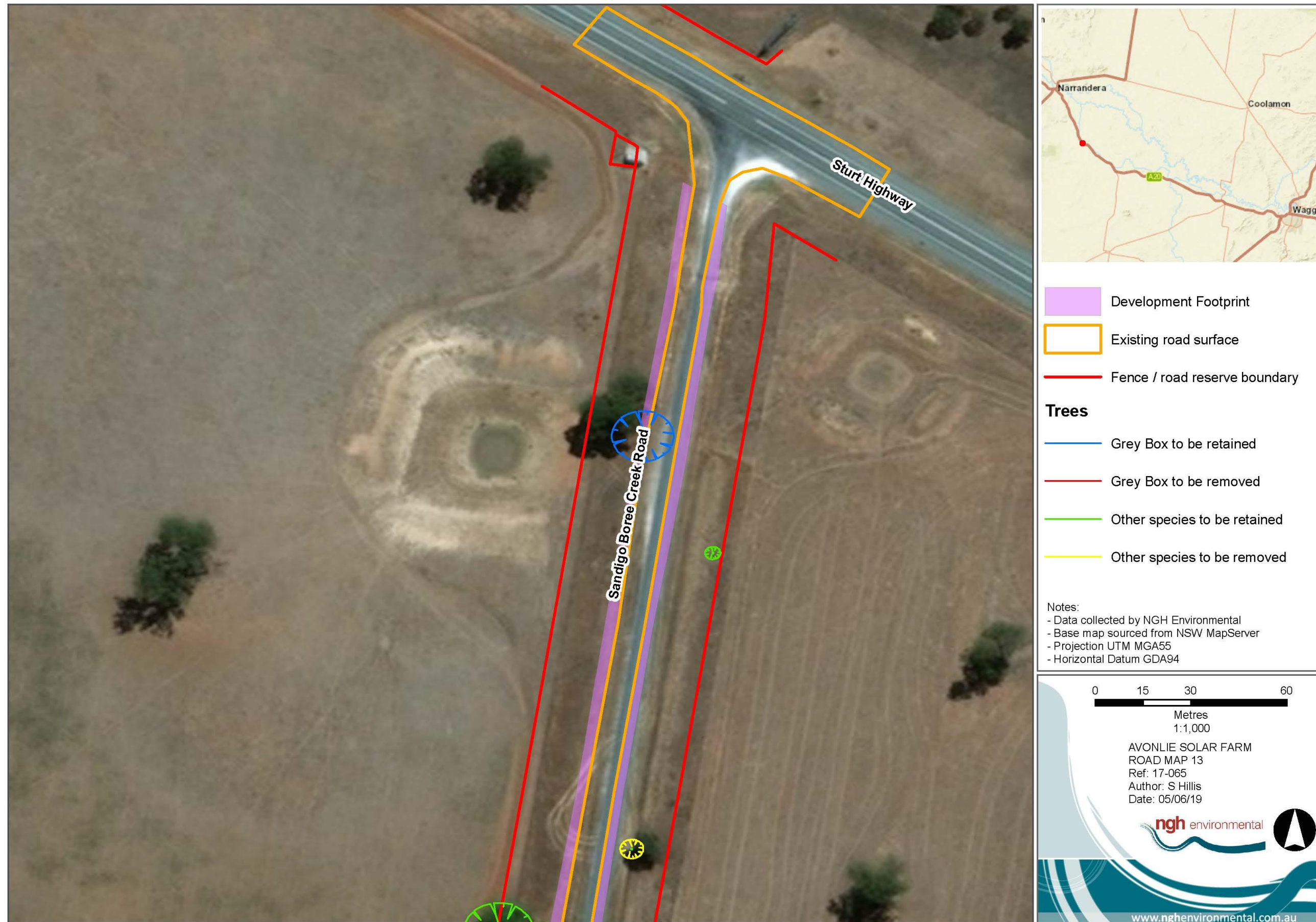


Figure 6-14 Development footprint along Muntz Rd and Sandigo-Boree Creek Rd

## 6.2 AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS

The BC Regulation (clause 6.1) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme. The following prescribed impacts are relevant to the proposal:

- Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation
- Impacts of development on the connectivity on different areas of habitat of threatened species that facilitates the movement of those species across their range.
- Impacts of development on the connectivity on movement of threatened species that maintains their life cycle
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

How these prescribed impacts have been avoided and minimised by the proposal is detailed below.

### 6.2.1 *Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.*

White-fronted chats (*Epthianura albifrons*) were observed on four separate occasions within the development site. White-fronted chats are listed as a vulnerable species under the BC Act.

A flock of about 20 White-fronted chats were observed foraging within and surrounding the paddocks of Old Man Saltbush (*Atriplex nummularia*). These birds were observed foraging close to the ground in the exotic vegetation of the cropped paddocks. A flock of about 10 White-fronted chats were observed surrounding the farm dam in the South West Corner. The farm dam is dominated by non-native vegetation.

White-fronted Chat forage on insects close to the ground in bare or grassy vegetation near wetland areas. They breed in open cup nests in low vegetation such as Old Man Saltbush shrubland.

The three farm dams in the development site have been avoided by the development footprint and would remain within the site. The farm dams would continue to provide foraging habitat for the White-fronted Chat. Breeding habitat would be retained within the development site, with the majority of Old Man Saltbush crop retained within the development site. Only 0.9ha (2% of the existing 42ha patch) would be removed for the track access.

The cropped paddocks that are foraging habitat for White-fronted Chat would be impacted by the construction of the solar arrays. These areas are unable to be avoided as they constitute the lowest biodiversity value in terms of native vegetation. PV solar has minimal construction footprint with mounts being either pile driven or on small footings. Groundcover vegetation would still be maintained underneath the solar panels that may provide foraging habitat.

### 6.2.2 *Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.*

The development footprint was designed to avoid and minimise impacts to native vegetation. Linear strips of planted vegetation that may provide corridors for movement were avoided by the proposal. Remnant Grey Box Woodland on the West of the development site that may provide an important refuge for movement across the landscape was avoided by the proposal.

The access road upgrade was designed to minimise clearing of mature overstorey along Muntz Rd and Sandigo-Boree Creek Rd by limiting construction and road widening to mostly within the existing disturbed footprint of the table drains. Minor clearing of good to low quality disturbed understorey and grassland would be required within the existing table drains on Sandigo-Boree Creek Road, with minor clearing of moderate quality vegetation required on Muntz Road to achieve the proposed design. Connectivity of vegetation would be maintained along these roads with remaining vegetation in addition to rehabilitation and supplementary plantings outside of disturbed areas.

### ***6.2.3 Impacts of development on the connectivity on movement of threatened species that maintains their lifecycle.***

As discussed in Section 6.2.2 above, the proposal has been designed to maintain connectivity where possible. This would include migratory species that rely on seasonal movements to maintain their lifecycle.

The development footprint was designed to avoid impacts on areas that may provide breeding habitat for threatened species. Remnant woodland containing many hollow bearing trees on the West of the development site was avoided by the proposal. This area may provide an important refuge for movement across the landscape and would remain with the development site.

The access road upgrade was designed to minimise clearing of mature overstorey along Muntz Rd and Sandigo-Boree Creek Rd by limiting construction and road widening to within the existing disturbed footprint of the table drains as much as practicable. Two mature Grey Box trees require clearing on Muntz Road, with a commitment made to avoid all mature Grey Box trees on Sandigo-Boree Creek road.

### ***6.2.4 Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.***

The development footprint was designed to avoid impacts to the two farms dams and irrigation channel. No direct impacts to these waterbodies would occur and thus no direct impacts to the Sloane's froglet (*Crinia sloanei*) if it occurs on site are considered to occur.

Hydrological processes across the site would not be modified and current drainage across the site would be maintained. Sediment and erosion and pollution control measures will be put in place to maintain water quality moving outside of the development footprint. No indirect impacts to the onsite dams or the wetlands or rivers downstream are considered to likely.

### ***6.2.5 Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.***

The location of the access roads were chosen as they are already existing roads that are used regularly by trucks and vehicles. As such, the risk of vehicle strike is already present however, an increase in vehicle traffic during construction may slightly increase the risk of vehicle strike on threatened species occurring in or near the development site.

The road upgrade was designed to minimise clearing of mature overstorey along Muntz and Sandigo-Boree Creek Roads. Lower speed limits would be enforced on these roads during construction. The roads are straight and provides excellent sight vision ahead. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes.



No barriers to movement would be created that could funnel any threatened species into these transport corridors.

## 7 IMPACTS UNABLE TO BE AVOIDED

### 7.1 DIRECT IMPACTS

The construction and operational phases of the proposal has the potential to impact biodiversity values at the site that cannot be avoided. This would occur through direct impacts such as habitat clearance and the installation and ongoing existence of infrastructure as detailed in Table 7-1.

Table 7-1 Potential impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	Consequence
<b>Direct impacts</b>				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, transmission lines, compound sites, stockpile sites, access tracks)	2.8ha.	One-off	Construction phase: Short-term	<ul style="list-style-type: none"> <li>• Direct loss of native flora and fauna habitat</li> <li>• Potential over-clearing of habitat outside proposed development footprint</li> <li>• Injury and mortality of fauna during clearing of fauna habitat and habitat trees</li> <li>• Disturbance to stags, fallen timber, and bush rock</li> </ul>
Displacement of resident fauna	Unknown	Regular	Construction & Operational Phase: Long-term	<ul style="list-style-type: none"> <li>• Direct displacement of native fauna</li> <li>• Potential decline in local fauna populations</li> </ul>
Injury or death of fauna	Unknown	Irregular	Construction Phase: Short-term	<ul style="list-style-type: none"> <li>• Direct loss of native fauna</li> <li>• Decline in local fauna populations</li> </ul>
Removal of habitat features e.g. HBTs	25 HBTs	One-off	Construction Phase: long-term	<ul style="list-style-type: none"> <li>• Direct loss of native fauna habitat</li> <li>• Injury and mortality of fauna during clearing of habitat features</li> </ul>
Shading by solar infrastructure	150 ha (33%)	Constant	Operational Phase: Long-term	<ul style="list-style-type: none"> <li>• Modification of native fauna habitat</li> <li>•</li> </ul>
Existence of permanent solar infrastructure	450 ha	Constant	Operational Phase: long-term	<ul style="list-style-type: none"> <li>• Modification of habitat beneath array (mostly non-native)</li> <li>• Reduced fauna movements across landscape due to fencing</li> <li>• Collision risks to birds and microbats (Fencing)</li> </ul>

### 7.1.1 Loss of Native Vegetation

Up to 1.9ha of native vegetation would be removed by the proposal. The changes in vegetation integrity scores as a result of clearing are documented for each vegetation zone in Table 7-2 below.

Table 7-2 Table of current and future vegetation integrity scores for each vegetation zone within the development footprint.

Zone ID	PCT/Condition	EEC and/or threatened species habitat?	Area (ha)	Current vegetation Integrity Score	Future vegetation Integrity Score
<b>Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion</b>					
1	80_Good	Inland Grey Box Woodland EEC	1.1	51.8	0
2	80_Good_understory	Inland Grey Box Woodland EEC	0.5	39.6	0
3	80_Moderate_grazed	Inland Grey Box Woodland EEC	0.1	36	0
4	80_Low	Not EEC or threatened species habitat	0.05	20.9	0
5	80_Planted	Not EEC or threatened species habitat	0.1	37.2	0
<b>Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)</b>					
6	158_Planted	White fronted chat ( <i>Epthianura albifrons</i> ) habitat	0.9	34.1	0

### 7.1.2 Loss of species credit species habitat

The loss of species credit species habitat or individuals as a result of clearing is documented in Table 7-3 below.

Table 7-3 Summary of species credit species loss at the development site

Species Credit Species	Biodiversity weighting	risk	Area of habitat (ha)
<i>Austrostipa wakoolica</i> – A spear Grass (Flora)	2		16
<i>Caladenia arenaria</i> Sand-hill Spider Orchid (Flora)	3		1.6
<i>Diuris</i> sp. (Oaklands, D.L. Jones 5380) Oaklands Diuris (Flora)	3		1.6
<i>Diuris tricolor</i> Pine Donkey Orchid (Flora)	1.5		1.6
<i>Lophochroa leadbeateri</i> Major Mitchell's Cockatoo (Fauna)	2		0.3
<i>Polytelis swainsonii</i> Superb Parrot (Fauna)	2		0.3

### 7.1.3 Loss of paddock trees

Fifty-Six scattered paddock trees occur in the development site comprised of Grey Box (*Eucalyptus microcarpa*), White Cypress (*Callitris glaucophylla*) and occasional Yellow Box (*Eucalyptus melliodora*). The

proposal would require the removal of 49 of these paddock trees over the 608ha development site (Appendix E). A large number of these paddock trees are suffering dieback from frequent damage at the trunk by tractors and machinery.

#### 7.1.4 Loss of hollow-bearing trees

112 Hollowing bearing trees (HBTs) were recorded within the development site. 25 of these hollow bearing trees occur within the development footprint and would be removed by the proposal (Table 7-4).

Table 7-4 Hollow Bearing Trees impacted by the proposal

ZONE	HBTs within zone	HBTs impacted
Zone 1: 80_good	5	0
Zone 2: 80_good_immature overstory	0	0
Zone 3: 80_moderate_grazed understory	5	3
Zone 4: 80_lowcondition	0	0
Zone 5: 80_Planted Vegetation	0	0
Zone 6: 158_Planted Old Man saltbush	0	0
Zone 7: 76_Moderate_grazed understory	75	0
Zone 8: Exotic	0	0
Zone 9: Paddock Trees	27	22
<b>TOTAL</b>	<b>112</b>	<b>25</b>

## 7.2 INDIRECT IMPACTS

Indirect impacts of the proposal include soil and water contamination, creation of barriers to fauna movement, or the generation of excessive dust, light or noise. Section 9.1.4.2 of the BAM identifies the specific indirect impacts that must be considered. Table 7-5 below details the type, frequency, intensity, duration and consequence of the indirect impacts that may occur as a consequence of the proposal as identified by Section 9.1.4.2 of the BAM. Given the current land management practices and degraded nature of the development site, indirect impacts that are unlikely to occur or be exacerbated as a result of the proposal include:

- Inhibition of nitrogen fixation and increased soil salinity
- Fertiliser drift
- Wood collection
- Bush rock removal and disturbance
- Increase in predatory species populations
- Increase in pest animal populations
- Increased risk of fire
- Disturbance to specialist breeding and foraging habitat



Table 7-5 Potential impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
<b>Indirect impacts (those listed below are included in the BAM)</b>					
Inadvertent impacts on adjacent habitat or vegetation	Unknown	Rare	Construction Phase: Short-term	<ul style="list-style-type: none"> <li>Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Bely South Bioregion</li> <li>White fronted Chat (<i>Epthianura albifrons</i>)</li> <li>Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)</li> <li>Superb Parrot (<i>Polytelis swainsonii</i>)</li> <li>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Minor direct loss of native flora and fauna habitat</li> <li>Low potential for Injury and mortality of fauna during clearing of fauna habitat and habitat trees</li> <li>Minor disturbance to stags, fallen timber, and bush rock</li> <li>Increased edge effects</li> </ul> <p>The combined impacts are likely to be minor in nature if they occur at all and would result in a negligible consequence for bioregional persistence</p>
Reduced viability of adjacent habitat due to edge effects	Unknown	Constant	Operational Phase: Long-term	<ul style="list-style-type: none"> <li>Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Bely South Bioregion</li> <li>White fronted Chat (<i>Epthianura albifrons</i>)</li> <li>Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)</li> <li>Superb Parrot (<i>Polytelis swainsonii</i>)</li> <li>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of Inland Grey Box Woodland EEC.</li> <li>Minor loss of native flora and fauna habitat</li> </ul> <p>The combined impacts are likely to be minor in nature if they occur at all and would result in a negligible consequence for bioregional persistence</p>
Reduced viability of adjacent habitat due to noise, dust or light spill	Unknown	Rare	Operational Phase: Short-term	<ul style="list-style-type: none"> <li>White fronted Chat (<i>Epthianura albifrons</i>)</li> <li>Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)</li> </ul>	<ul style="list-style-type: none"> <li>May alter fauna activities and/or movements</li> <li>Minor loss of foraging or breeding habitat</li> </ul>

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
				<ul style="list-style-type: none"> <li>Superb Parrot (<i>Polytelis swainsonii</i>)</li> <li>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</li> </ul>	The combined impacts are likely to be minor in nature if they occur at all and would result in a negligible consequence for bioregional persistence
Transport of weeds and pathogens from the site to adjacent vegetation	Unknown	Irregular	Construction & Operational Phase: Long-term	<ul style="list-style-type: none"> <li>Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penneplain, Nandewar and Brigalow Bely South Bioregion</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of Inland Grey Box Woodland EEC through weed encroachment</li> <li>Minor loss of native flora and fauna habitat.</li> </ul> <p>The combined impacts are likely to be minor in nature if they occur at all and would result in a negligible consequence for bioregional persistence</p>
Increased risk of starvation, exposure and loss of shade or shelter	Unknown	Rare	Construction & Operational Phase: Long-term	<ul style="list-style-type: none"> <li>White fronted Chat (<i>Epthianura albifrons</i>)</li> <li>Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)</li> <li>Superb Parrot (<i>Polytelis swainsonii</i>)</li> <li>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Minor loss of foraging Habitat</li> </ul>
Loss of breeding habitats	25 HBT and 1.9ha of habitat	Constant	Construction Phase: Long-Term	<ul style="list-style-type: none"> <li>White fronted Chat (<i>Epthianura albifrons</i>)</li> <li>Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)</li> <li>Superb Parrot (<i>Polytelis swainsonii</i>)</li> <li>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Minor loss of potential breeding habitat.</li> </ul>
Trampling of threatened species	Unknown	Rare	Construction Phase: Short-term	<p>Threatened species assumed present;</p> <ul style="list-style-type: none"> <li><i>Brachyscome papillosa</i> Mossgiel Daisy</li> </ul>	<ul style="list-style-type: none"> <li>Minor loss of threatened species and genetic diversity</li> </ul>

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
				<ul style="list-style-type: none"> <li><i>Caladenia arenaria</i> Sand-hill Spider Orchid</li> <li><i>Diuris</i> sp. (Oaklands, D.L. Jones 5380) Oaklands Diuris</li> <li><i>Diuris tricolor</i> Pine Donkey Orchid</li> </ul>	
Earthworks mobilisation and of sediments	Unknown	Regular	Construction	<ul style="list-style-type: none"> <li>Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Bely South Bioregion</li> <li>Sloane's Froglet (<i>Crinia sloanei</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Erosion and sedimentation and/or pollution of soils, dams and downstream habitats.</li> <li>Potential loss of ground cover resulting in unstable ground surfaces and sedimentation of adjacent waterways.</li> </ul>
Rubbish dumping	Unknown	Regular	Construction & Operational	<ul style="list-style-type: none"> <li>Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Bely South Bioregion</li> </ul>	<ul style="list-style-type: none"> <li>Degradation of Inland Grey Box Woodland EEC</li> </ul>



## 7.3 PRESCRIBED IMPACTS

The following prescribed biodiversity impacts are relevant to the proposal:

- Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- Impacts of development on the connectivity on movement of threatened species that maintains their life cycle
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

These are discussed in detail below and the necessary information required by Section 9.2 of the BAM provided.

### 7.3.1 *impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation*

A flock of about 20 White-fronted Chat (*Epthianura albifrons*) were observed foraging in the cropped paddocks adjacent to the Old Man Saltbush (*Atriplex nummularia*) and farm dams. White-fronted Chat forage on insects close to the ground in bare or grassy vegetation near wetland areas. They breed in open cup nests in low shrubs.

523ha of non-native vegetation would be removed by the proposal, which exist as cropped paddocks of Wheat, Canola and pasture grasses. 21 ha of non-native vegetation would remain around the Dam in the South-Western Corner of the development site.

The White-fronted chat breeds in low shrubland vegetation. The exotic vegetation to be removed is comprised of exotic pasture grasses and crop species such as Wheat and Canola. This vegetation is not considered to be suitable as breeding habitat for the species. The area of Old Man Saltbush provides potential breeding habitat which is accounted for in the ecosystem assessment of PCT 158. Following construction, breeding habitat would remain within the subject site in the Old Man Saltbush crop (41 ha), as would roadside vegetation containing tussock grasses along the Western end of Muntz Rd. Therefore, breeding resources would remain in close proximity to the foraging resource provided by the non-native vegetation.

Once construction of the solar farm is complete, potential foraging habitat would remain underneath the solar panels as, it is unknown how the foraging behaviour of the species may change due to the presence of infrastructure. Groundcover underneath the solar panels would however, be maintained. 150ha (33% of the non-native vegetation) would be affected by shading, varying according to time of day and year. Mitigation measures to develop a groundcover management plan would ensure vegetation is retained underneath the solar panels providing potential ongoing foraging habitat for the White-fronted chat.

During construction, impacts may occur to the White-fronted chat through disturbance. Studies have shown White-fronted chats are sensitive to human disturbance and flush at greater distances to disturbance compared to other small woodland birds (Jenner et al, 2011). Disturbance within 25m may cause a White-fronted Chat to retreat. Higher flush rates may result in increased energy costs associated with retreating and relocating to a different foraging area.

Extensive areas of similar non-native vegetation surround the development site that may be used as foraging habitat. These areas are more than 25m from the construction activities and would allow for areas

of foraging to occur within continuous disturbance. The majority of the Old Man Saltbush habitat would be avoided by the proposal. Only 0.9ha (2% of the existing 42ha patch) would be removed for the track access in the North-East corner of the patch. Most of the large area of Old Man Saltbush crop remaining, occurs more than 25m from the development footprint and construction activities allowing for retreat and foraging and potentially breeding, to occur without continuous disturbance.

Based on these factors, the proposal is unlikely to have a substantive impact on the local and bioregional persistence of the White-fronted Chat.

### **7.3.2 impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range**

The development site occurs within a highly cleared landscape and no major connectivity links occur across the site. Linear strips of planted vegetation and scattered paddock trees provide low quality connectivity for disturbance tolerant species. Vegetation along Muntz Rd and Sandigo-Boree Creek Rd, provide connectivity across the landscape to Sandy Creek, however are met with the barrier of the Sturt Highway.

Threatened species that are moving across the site would be highly mobile species capable of crossing over large areas of cleared landscapes. The proposal would impact on connectivity through the removal of 49 scattered paddock trees over the 608 ha development site. These trees may provide some 'stepping stone' connectivity for highly mobile aerial species such as the Superb Parrot (*Polytelis swainsonii*), Grey Falcon (*Falco hypoleucos*), and Major Mitchell Cockatoo (*Lophochroa leadbeateri*). These species are capable of flying over cleared areas and their movement across the landscape would unlikely be impeded by the removal of these trees. Connectivity for aerial species that rely on connected vegetation such as the Grey Crowned Babbler (*Pomatostomus temporalis temporalis*) would be maintained in the linear strips of planted vegetation and native vegetation along Muntz Rd and Sandigo-Boree Creek Rd that would remain in the development site.

Boundary security fencing would create a barrier for movement to threatened species that traverse along the ground, such as the Koala. However, no impediments such as busy roads or barriers occur outside the development site and species travelling along the ground could move across the landscape in the similar cleared habitats surrounding the development site.

Based on these factors, the proposal is unlikely to have a substantive impact on movement of threatened species across their range.

### **7.3.3 impacts of the development on movement of threatened species that maintains their life cycle**

No known migratory routes occur within the development site. The development site occurs within a highly cleared landscape and threatened species that may move within or through the development site would be tolerant of existing disturbances.

One migratory species, Swift Parrot, was identified as a potential candidate species in the BAM calculator. The Swift Parrot breeds in Tasmania during Summer and the entire population migrates north to the mainland in winter (TSSC, 2016). In NSW, the Swift Parrot migrates to the South Western Slopes and the Coast to forage. Swift Parrots forage on winter flowering Eucalyptus species and lerp infested Eucalypts. The Swift Parrot was not detected within the development site however the site provides potential foraging habitat. 0.9ha of potential foraging habitat would be removed by the development. The quality of potential habitat for these species is low, being largely cleared and highly disturbed by agriculture. The development

site does not fall within an area of mapped important habitat. Given the relatively small amount of habitat to be removed and low quality of potential habitat, the development is unlikely to have a substantive impact on the movement of the Swift Parrot across its range.

Impacts to threatened species lifecycle may arise from the removal of Hollow Bearing Trees. 115 Hollow Bearing Trees occur within the development site, the majority occurring in the Grey Box Woodland patch on the Western edge of the development site (Zone 7). 25 Hollow bearing trees would be removed by the development that could be used by threatened fauna such as the Major Mitchell Cockatoo, Superb Parrot or Corben's Long-eared Bat. These hollow bearing trees occur as scattered paddock trees over the 534ha development site.

Corben's Long-eared Bat is a highly mobile species and can travel large distances up to 10km or more (Bionet, 2018). It can relocate between multiple roost locations over successive nights (TSSC, 2016). Ninety hollow bearing trees would remain within the development site, providing suitable roosting habitat should the species move into the area. Mitigation measures to time works to avoid clearing during the breeding season and hibernation season would minimise impacts to the life cycle of this species. Movement and foraging habitat would still be maintained within the development site.

The Superb Parrot and Major Mitchell Cockatoo are highly mobile species that use hollow bearing trees for nesting and breeding. Ninety hollow bearing trees would remain in the immediate area that may be used by these species should they move into the area to breed. Mitigation measures to time works to avoid clearing during the breeding season would minimise impacts to the life cycle of this species. As these species are capable of flying over cleared areas, movement across the landscape to breeding hollows will still be maintained within the development site.

No impacts to movement of other threatened species that maintain their life cycle are considered to occur. Aerial species would be able to continue to move across the development site. Boundary security fencing would create a barrier for movement to threatened species that travel along the ground, such as the Koala. However, as no impediments such as busy roads or barriers occur outside the development site, species could continue to move across the landscape in the similar cleared habitats surrounding the development site. Based on these factors, the proposal is unlikely to have a substantive impact on movement of threatened species that maintains their lifecycle.

#### **7.3.4 Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC**

The construction of the solar farm would increase traffic along Muntz Rd and Sandigo-Boree Creek Rd. Current daily traffic volume is estimated to be 42 vehicles per day along Sandigo-Boree Creek Rd and a lower amount along Muntz Rd (TDG, 2018). During peak construction times, it is estimated that 32 heavy vehicles and 149 passenger vehicles per day will travel along Muntz Rd and Sandigo-Boree Creek Rd (TDG, 2018).

Threatened species that were recorded on the development site were the Grey Crowned Babbler (*Pomatostomus temporalis temporalis*) and White-fronted Chat (*Epthianura albifrons*). White-fronted Chat were commonly observed around Muntz Rd at its Western End. No increase in traffic will occur to the Western End of Muntz Rd. The Grey Crowned Babbler tends to fly low in the canopy and glide down to trees. It may use the native vegetation along Muntz Rd and could fly at vehicle height along the access roads.

The Superb Parrot (*Polytelis swainsonii*) and Major Mitchell Cockatoo (*Lophochroa leadbeateri*) were assumed to occur on site due to inadequate survey timing. Superb Parrots are particularly vulnerable to



vehicle strike when feeding on spilled grain along roadsides (Baker-Gabb, 2011). Muntz Rd and Sandigo-Boree Creek Rd are not major grain transport routes, and there is minimal foraging habitat for Super Parrot on the roadsides.

Major Mitchell Cockatoos forage on the ground on seeds of Cypress Pines. Cypress Pines are abundant along Muntz Rd and the Major Mitchell Cockatoo could be found foraging along the roadside.

All threatened species at risk of vehicle strike are highly mobile and agile species. Mitigation measures will be implemented to enforce a site speed limit. As Muntz Rd, will not be widened and only upgraded with passing bays, speed limits along Muntz Rd will be limited. With the recommended mitigation measures, it is not likely that there would be any notable increase in the risk of vehicle strike relevant to those that already exist.

## **7.4 IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE**

### **7.4.1 Threatened Ecological Communities**

One EPBC listed ecological community was present within the development site, Grey Box Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia EEC. 1.6 ha of this woodland would be impacted through the upgrading of Muntz Rd and Sandigo-Booree Creek Rd. An EPBC Assessment of significance was completed for this community (Appendix I and concluded that a significant impact was unlikely on the basis that:

1. The amount of habitat to be removed or disturbed by the proposal is relatively small and no mature trees would be removed.
2. No fragmentation or isolation of habitat would occur.
3. The proposal would not modify or destroy abiotic factors
4. The proposal would not cause a substantial change in the species composition
5. The proposal would not cause a substantial reduction in the quality of the ecological community

No referral is considered necessary to the Federal Department of Environment on the basis of impacts to this EEC.

### **7.4.2 Threatened Species**

No EPBC listed species were recorded during the field surveys, however five species (listed in section 5.3.) were considered to have the potential to occur within the development site. Assessments of significance were undertaken for these species, comprising three fauna species and two flora species.

#### **Swift Parrot, Superb Parrot and Corben's Long Eared Bat**

EPBC Assessments of significance were completed for the threatened Fauna: Swift Parrot, Superb Parrot and Corben's Long Eared Bat (Appendix I). These concluded that a significant impact was unlikely, on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of these species
- Affect habitat or introduce disease such that these species would decline
- Introduce invasive species harmful to the species

- Interfere with the recovery of these species.

No referral is considered necessary to the Federal Department of Environment for these species.

### Sandhill Spider Orchid & *Austrostipa wakoolica*

EPBC Assessments of Significance were completed for the Threatened Flora; Sandhill Spider Orchid (*Caladenia Arenaria*) and A Spear Grass (*Austrostipa wakoolica*). Suitable habitat for these species exists along Muntz Rd and Sandigo-Boree Creek Rd. Survey timing was considered unsuitable for these species and it is not known if they occur within the development site.

An EPBC Assessment of significance was completed for these species (Appendix I) and concluded that a significant impact was unlikely to;

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of these species
- Affect habitat or introduce disease such that these species would decline
- Introduce invasive species harmful to the species
- Interfere with the recovery of these species.

No referral is considered necessary to the Federal Department of Environment on the basis of impacts to this EEC.

### Koala

The EPBC Referral Guidelines for the Koala (DoE 2014) documents the 'Koala habitat assessment tool' to assist proponents in determining if a proposal may impact on habitat critical to the survival of the Koala. The tool is provided as Table 7-6 below as it applies to the proposal. Impact areas that score five or more using the habitat assessment tool contain habitat critical to the survival of the Koala. The assessment in Table 7-6 resulted in a score of 3 and as such habitat within the study area is not considered to be critical to the survival of the Koala. An assessment of significant impact is not required.

Table 7-6: Koala habitat assessment tool for inland areas (DoE 2014)

Attribute	Score	Inland	Applicable to the proposal?
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.	
	0 (low)	None of the above.	✓ No records within 2km within the last 10 years
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, <b>OR</b> 1 food tree species that alone accounts for	

Attribute	Score	Inland	Applicable to the proposal?
		>50% of the vegetation in the relevant strata.	
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.	✓ One food tree species present (Grey Box) co dominant with White Cypress.
	0 (low)	None of the above.	
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha.	
	+1 (medium)	Area is part of a <b>contiguous landscape</b> < 1000 ha, but ≥ 500 ha.	
	0 (low)	None of the above.	✓ Not part of a large contiguous landscape
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	✓ No Koala occurrence and no dog or vehicle threat
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, <b>OR</b> Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.	
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, <b>OR</b> Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	



Attribute	Score	Inland	Applicable to the proposal?
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	✓ Study area is not considered a habitat refuge nor does it provide important connectivity to large areas surrounding a habitat refuge
<b>Total</b>	<b>3</b>	<b>Decision: Habitat not critical to the survival of the Koala—assessment of significance not required</b>	

### 7.4.3 Migratory species

Two migratory species, the Fork-tailed Swift and the White-throated Needletail could occur on the site on occasion. However, as these species are almost exclusively aerial (DoE, 2015) impacts to these species are considered unlikely. The proposal is unlikely to impact on any EPBC listed Migratory Species.

## 7.5 LIMITATIONS TO DATA, ASSUMPTIONS AND PREDICTIONS

It is possible that some species were not recorded during the survey due to the timing of the survey outside their recommended survey period. Where survey effort or timing is not consistent with the BAM or relevant guidelines, this is stated explicitly in the assessment and measures identified to address the limitation; i.e. assumption of occurrence for three species whose survey window could not be met.

The calculation of hollow-bearings trees, in particular the size and number of hollows, was made from ground level. It is possible that some hollows are present that were not visible from ground level, which may result in underestimates of the number of hollows (Gibbons and Lindenmayer, 2000). However, it was noted where it was considered likely that hollows were present but not visible from ground level.

## 8 MITIGATING AND MANAGING IMPACTS

### 8.1 MITIGATION MEASURES

A general summary of the key measures required to mitigate the impacts of the proposal is provided below. Mitigation measures proposed to manage impacts, including proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure and an analysis of the consequences of any residual impacts are provided in Table 8-1.

#### 8.1.1 *Impacts from the clearing of vegetation and habitats*

1. Time works to avoid critical life cycle events
2. Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler
3. Relocate habitat features (fallen timber, hollow logs) from within the development site to an adjacent area.
4. The proposed road upgrade along Sandigo-Boree Creek Road must be retained within the existing disturbance footprint of Sandigo-Boree Creek Road
5. Clearing of mature Eucalypt species outside of the two individual trees marked within the BDAR is not permitted
6. Preparation of a Biodiversity Management Plan

#### 8.1.2 *Indirect impacts*

1. Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed
2. Noise barriers or daily/seasonal timing of construction and operation activities to reduce impacts of noise
3. Adaptive dust monitoring programs to control air quality
4. Temporary fencing to protect significant environmental features such as riparian zones
5. Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas
6. Staff training and site briefing to communicate environmental features to be protected and measures to be implemented

#### 8.1.3 *Prescribed impacts*

1. Sediment barriers and spill management protocols to control the quality of water runoff from the site into the receiving environment
2. Enforce site speed limits to reduce impacts of vehicle strikes on threatened fauna.

Table 8-1 Mitigation measures proposed to avoid and minimise impacts on native vegetation and habitat

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>Direct impacts on Native Vegetation and Fauna Habitat</b>						
Timing works to avoid critical life cycle events such as breeding or nursing	<ul style="list-style-type: none"> <li>Hollow-bearing trees would not be removed during breeding and hibernation season (Winter to summer) to mitigate impacts on Superb Parrots, Major Mitchell Cockatoo and Corben's Long-eared Bat.</li> <li>Old Man Saltbush Shrubland would not be removed during the breeding season (July to March) of the White-fronted Chat to mitigate impacts to this species.</li> <li>If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken by an ecologist or suitably qualified person to ensure no impacts to fauna would occur</li> </ul>	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events	<ul style="list-style-type: none"> <li>Pre-clearing checklist</li> <li>Tree clearing procedure</li> </ul>	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Relocation of habitat features (fallen timber,	<ul style="list-style-type: none"> <li>Tree-clearing procedure including relocation of habitat features to</li> </ul>	Construction	Regular	Contractor	Low	None



Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>Direct impacts on Native Vegetation and Fauna Habitat</b>						
hollow logs) from within the development site.	adjacent area for habitat enhancement					
The proposed road upgrade along Sandigo-Boree Creek Road must be retained within the existing disturbance footprint of Sandigo-Boree Creek Road	<ul style="list-style-type: none"> <li>Clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing.</li> </ul>	Construction	Regular	Contractor	Low	Impacts to the TEC – Inland Grey Box Woodland in the NSW South West Slopes.
Clearing of mature Grey Box species outside of the two individual trees marked within the BDAR is not permitted	<ul style="list-style-type: none"> <li>Clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing.</li> </ul>	Construction	Regular	Contractor	Low	Impacts to the TEC – Inland Grey Box Woodland in the NSW South West Slopes.
Preparation and implementation of a Biodiversity management plan to regulate activity in vegetation	<ul style="list-style-type: none"> <li>Preparation of a Biodiversity management plan that would include protocols for: <ul style="list-style-type: none"> <li>Protection of native vegetation to be retained</li> <li>Best practice removal and disposal of vegetation</li> <li>Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist</li> <li>Weed management</li> <li>Unexpected threatened species finds</li> </ul> </li> </ul>	Construction	One-off	Contractor	Moderate	Impacts to native vegetation or threatened species for Biodiversity Management Plan not being followed.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>Direct impacts on Native Vegetation and Fauna Habitat</b>						
	<ul style="list-style-type: none"> <li>○ Rehabilitation of disturbed areas</li> <li>○ Rehabilitation and revegetation of linear corridors along Sandigo-Boree Creek Road to enhance connectivity value.</li> </ul>					
<b>Indirect impacts on native vegetation and habitat</b>						
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	<ul style="list-style-type: none"> <li>• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing.</li> <li>• No stockpiling or storage within dripline of any mature trees</li> <li>• In areas to clear adjacent to areas to be retained, chainsaws would be used rather than heavy machinery to minimise risk of unauthorised disturbance</li> </ul>	Construction	Regular	Contractor	Low	None
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	<ul style="list-style-type: none"> <li>• Construction Environmental Management Plan will include measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as possible.</li> </ul>	Construction	Regular	Contractor	Low	None
Light shields or daily/seasonal timing of construction and operational activities to	<ul style="list-style-type: none"> <li>• Avoid Night Works</li> <li>• Direct lights away from vegetation</li> </ul>	Construction/ Operation	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>Direct impacts on Native Vegetation and Fauna Habitat</b>						
reduce impacts of light spill						
Adaptive dust monitoring programs to control air quality	<ul style="list-style-type: none"> <li>Daily monitoring of dust generated by construction and operation activities</li> <li>Construction would cease if dust observed being blown from site until control measures were implemented</li> <li>All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site</li> </ul>	Construction	Regularly	Contractor	Moderate	Sedimentation in ephemeral waterways and dams.
Hygiene protocols to prevent the spread of weeds or Pathogens between infected areas and uninfected areas	<ul style="list-style-type: none"> <li>A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include: <ul style="list-style-type: none"> <li>Management protocol for declared priority weeds under the Biosecurity Act 2015 during and after construction</li> <li>Weed hygiene protocol in relation to plant, machinery, and fill</li> </ul> </li> <li>The weed management procedure would be incorporated into the Biodiversity Management Plan.</li> </ul>	Construction, Operation	Regular	Contractor	Moderate	Weed encroachment



Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
<b>Direct impacts on Native Vegetation and Fauna Habitat</b>						
staff training and site briefing to communicate environmental features to be protected and measures to be implemented	<ul style="list-style-type: none"> <li>• Site induction</li> <li>• Toolbox talks</li> </ul>	Construction	Regular	Contractor	Moderate	Impacts to native vegetation or threatened species for staff training not being followed
<b>Prescribed biodiversity impacts</b>						
Sediment barriers and spill management procedures to control the quality of water runoff released from the site into the receiving environment	<ul style="list-style-type: none"> <li>• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented</li> <li>• Spill management procedures would be implemented.</li> </ul>	Construction	Regular	Contractor	Moderate	Indirect impacts may occur to waterways if erosion and sedimentation control plan not implemented.
Staff training and site briefing to communicate impacts of traffic strikes on native fauna.	<ul style="list-style-type: none"> <li>• Awareness training during site inductions regarding enforcing site speed limits.</li> <li>• Site speed limits to be enforced to minimise fauna strike.</li> </ul>	Construction and Operation	Regular	Contractor	Moderate	Fauna strikes from vehicles

## 9 SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

The principles used to determine if a development will have serious and irreversible impacts, include impacts that:

- Will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- Will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

### 9.1 POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT ENTITIES

#### 9.1.1 *Threatened ecological communities*

There are no SAII candidate species recorded within the development site.

#### 9.1.2 *Threatened species*

Two threatened orchids, Oaklands Diuris (*Diuris* sp. Oakland, D.L. Jones 5380) and Sandhill Spider Orchid (*Caladenia arenaria*) are listed as potential SAII entities in the *Guidance to assist a decision-maker to determine a serious and irreversible impact* (OEH, 2017). These species were generated as potential candidate species by the BAM Calculator. These species were not surveyed for prior to submission of the EIS and were assumed to be present on site within the BAM calculator. Further assessment of these species was undertaken in November 2018.

#### 9.1.3 *Additional potential entities*

No further entities were identified as being impacted on by the proposal with the potential to becoming a serious and irreversible impact.

### 9.2 ASSESSMENT OF SERIOUS AND IRREVERSIBLE IMPACTS

#### 9.2.1 *Oaklands Diuris (Diuris sp. Oakland, D.L. Jones 5380)*

Oaklands Diuris is associated with White Cypress Pine Woodland on Sandy Loam soils. Suitable habitat for Oaklands Diuris occurs within the Grey Box-White Cypress Woodland along Muntz Rd and Sandigo-Boree Creek Rd. 1.6 ha of this vegetation type would be impacted by the proposal.

Diuris Orchid is only visible above ground between Autumn and Spring, with the plant persisting as an underground tuber during summer (LLS, 2016).

A targeted survey was undertaken on the 5<sup>th</sup> November in 2018 in suitable habitat along Muntz Rd and Sandigo-Boree Creek Road. Oaklands Diuris was not detected within the development site during these surveys however due to a very dry winter, very few of the known population of Oaklands Diuris had

emerged this Spring (OEH, pers com.). As defined by the BAM, if surveys are unable to be undertaken in appropriate condition, the species is assumed to be present in the development site.

- a. *The actions and measures taken to avoid the direct and indirect impact on the potential entity for an SAIL.*

The access roads are required to be upgraded by the Narrandera Shire council. The closest access point was selected to minimise impacts to roadside vegetation. The minimum road widening needed to safely allow passing trucks was designed to avoid impacts to roadside vegetation as far as practicable. The majority of vegetation clearing required (understorey and grassland) is within the already disturbed table drains of both roads, with minor clearing of moderate quality vegetation (both overstorey and understorey) required on Muntz Road.

- b. *The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification.*

No known population occurs in the development site. Surveys were unable to be undertaken during Spring 2018 due to drought conditions. The nearest known population is about 50km to the South East near Urana.

- c. *The extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact*

No threshold has yet been defined by OEH (Bionet, 04.02.19).

- d. *The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to;*

- I. *An estimate of the change in habitat available to the local population as a result of the proposed development*

1.6 ha of potential habitat in the form of White Cypress – Grey Box Woodland would be permanently removed for the widening of Muntz and Sandigo-Boree Creek road. 1.2 ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and is unlikely to host a population of Diuris Orchid. 6.3 ha of potential habitat would remain in the roadside reserve that would not be impacted. No impacts would occur to the known populations near Urana.

- II. *The proposed loss, modification, destruction or isolation of the available habitat used by the local population.*

1.6 ha of potential habitat would be removed. It is not known whether a population occurs within the roadside vegetation, however 1.2 ha of this vegetation has previously been disturbed through the construction and maintenance of the road and table drain. No impacts would occur to the known populations near Urana.

- III. *Modification of habitat required for the maintenance of processes important to the species life cycle, genetic diversity and long-term evolutionary development.*

1.6 ha of potential habitat would be removed. 1.2 ha of this habitat has previously been disturbed through the prior construction and maintenance of the road and table drain. It is not known whether a population occurs within the roadside reserve. However, the small area impacted (8%) would unlikely impact the species life cycle or genetic diversity if present. No impacts would occur to the known populations near Urana.

- e. *The likely impact on the ecology of the local population on*

*Pollination cycle* – The Diuris Orchid is pollinated by native bees (LLS, 2016). It is not known whether a population of Diuris Orchid occurs within the roadside reserve.



However, if the species did occur in the development site, impacts could occur to the pollination cycle through removal of some plants. However, the small area to be impacted is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction and maintenance activities (such as grading of table drains, weed control and slashing) and edge effects and is unlikely to provide ideal habitat. 6.3ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the known populations near Urana.

*Seedbanks* – The Diuris Orchid occurs as an underground tuber. It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, impacts could occur to the seedbanks through removal of soil and plants. However, the small area to be impacted is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction and maintenance activities (such as grading of table drains, weed control and slashing) and edge effects and is unlikely to provide ideal habitat. 6.3 ha of vegetation would remain that could provide a seedbank source if the species did occur in the development site. No impacts would occur to the known populations near Urana.

*Recruitment* - It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, impacts could occur to recruitment through removal of soil and plants. However, the development site is over 50km away from the known populations that are restricted to the Urana – Oaklands Area. 6.3 ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the known population near Urana

*Interactions with other species* – pollinator is by native bees (LLS, 2016). Native bees are unlikely to be impacted, 6.3 ha of vegetation would remain in the roadside vegetation.

- f. *A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development*

1.6 ha of vegetation would be removed along roadside. It is not known whether a population occurs within the roadside reserve. However, if the species did occur 6.3 ha of suitable native vegetation would remain along the roadside. Connectivity would be maintained along the roadside through remaining native vegetation as well as rehabilitation and supplementary revegetation and would be unlikely to isolate a population.

The known populations occur over 50km to the South West near Urana. The impact would not fragment or isolate the known populations.

- g. *The relationship of the local population to other populations of the species. This must include consideration of the interaction and importance of the local population to other populations for factors such as breeding, dispersal and genetic viability, and whether the local population is at the limit of the species range*

It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, there is no connection between the nearest known population in Urana. The seeds of Diuris Orchid are short lived and dispersal is reduced to small local area.

- h. *The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna that may in turn lead to a decrease in the viability of the local population.*

The roadside vegetation is already highly fragmented and exposed to invasive flora and fauna. Perennial grasses such as *Paspalum* occur in small sections along Muntz Rd and Sandigo-Boree Creek Rd. Exotic annual grasses such as Wild Oats, Rye Grass and Barley Grass are also dominant within the woodland vegetation. There is a risk that invasive weeds could be established in the development site via seeds or plant parts on machinery during construction. These impacts can be readily managed and minimised with the implementation of a weed management procedure. Hygiene protocols would reduce the introduction of new weed species.

- i. *An estimate of the area, or number and size of populations that is in the reserve systems in NSW, the IBRA Region and the IBRA subregion*

The *Diuris* orchid is only known from the Oaklands-Urana Region of Southern NSW (OEH, 2018). The three key populations are;

- Urana West Management Site – 210 plants
- Urana East Management Site– 112 plants
- Oaklands Management Site – 225 Plants

Only the Oaklands management site is on public land.

- j. *The measures proposed to contribute to the recovery of the species in the IBRA subregion.*  
58credits have been created for the *Diuris* orchid that will provide conservation funding for the species.

## Conclusion

Suitable habitat in the form of White Cypress- Grey Box Woodland exists along Muntz Rd and Sandigo-Boree Creek Rd. As seasonal conditions were considered unsuitable for these species, it is not known if they occur within the development site. The nearest known populations occur over 50km to the South West. Based on the small area of potential habitat impacted, suitable remaining habitat and no impact to the known population it is considered unlikely the proposal would have a serious and irreversible impact on the *Diuris* Orchid.

### 9.2.2 Sand-hill Spider Orchid (*Caladenia arenaria*)

The Sand-hill Spider Orchid was not detected within the development site however seasonal conditions was not considered suitable for this species. Sand-hill spider orchid is only visible above ground during Winter and Spring, with the plant persisting as an underground tuber during the rest of the year (DEC, 2004)

Six records of the Sand-hill Spider Orchid occur in Buckinbong State Forest about 6km West of the development site. Sand-hill Spider Orchid is associated with White Cypress Pine and suitable habitat for the Sand-hill Spider Orchid exists within the Grey Box -White Cypress Woodland along Muntz Rd and Sandigo-Boree Creek Rd. 1.6 ha of this vegetation would be impacted by the proposal.

As this species is highly restricted in its extent, a serious and Irreversible impact could occur to the Sand-hill Spider Orchid if it occurs within the development footprint on Muntz Rd and Sandigo-Boree Creek Rd.

Due to poor seasonal conditions of extremely dry year, surveys were unavailable to be conducted this year. Correspondence with OEH indicated none of the known populations of Sandhill Spider orchid had emerged

above ground. As defined by the BAM, if surveys are unable to be undertaken the species is assumed to be present in the development site.

- a. *The actions and measures taken to avoid the direct and indirect impact on the potential entity for an SAIL.*

The access roads are required to be upgraded by the Narrandera council. The closest access was selected to minimise impacts to roads. The minimum road widening needed to safely allow passing trucks was designed to avoid impacts to roadside vegetation as far as practicable. The majority of vegetation clearing required (understorey and grassland) is within the already disturbed table drains of the road, with minor clearing of moderate quality vegetation required on Muntz Road.

- b. *The size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification.*

No known population occurs in the development site. Surveys were unable to be undertaken during Spring 2018 due to drought conditions. The nearest known population is 6km to the West in Buckingbong State Forest. Correspondence with OEH indicated none of the known populations of Sandhill Spider orchid had emerged above ground this year due to lack of rain.

- c. *The extent to which the impact exceeds any threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact*

No threshold has yet been defined by OEH (Bionet, 07.11.18).

- d. *The likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to;*

- IV. *An estimate of the change in habitat available to the local population as a result of the proposed development*

1.6 ha of potential habitat in the form of White Cypress – Grey Box Woodland would be permanently removed for the widening of Muntz and Sandigo-Boree Creek Road. 1.2 ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and unlikely to host a population of Sandhill Spider Orchid. 6.3 ha of potential habitat would remain in the roadside reserve that would not be impacted. No impacts would occur to the nearest known population in Buckingbong State Forest.

- V. *The proposed loss, modification, destruction or isolation of the available habitat used by the local population.*

1.6 ha of potential habitat would be removed. It is not known whether a population occurs within the roadside vegetation, however 1.2 ha of this vegetation has previously been disturbed through the construction and maintenance of the road and table drain. No impacts would occur to the nearest known population in Buckingbong State Forest.

- VI. *Modification of habitat required for the maintenance of processes important to the species life cycle, genetic diversity and long-term evolutionary development.*

1.6 ha of potential habitat would be removed. 1.2 ha of this habitat has previously been disturbed through the prior construction and maintenance of the road and table drain. It is not known whether a population occurs within the roadside reserve. However, the small area impacted (8%) would unlikely impact the species life cycle or genetic diversity if present. No impacts would occur to the nearest known population in Buckingbong State Forest.



*e. The likely impact on the ecology of the local population on*

*Pollination cycle* – Self-fertile and cross pollination (DEC, 2014) - It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, impacts could occur to the pollination cycle through the removal of some plants. However, the small area to be impacted is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction and maintenance activities (such as grading of table drains, weed control and slashing) and edge effects and is unlikely to provide ideal habitat. 6.3 ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the nearest known population in Buckingbong State Forest.

*Seedbanks* – The seeds of the Sandhill Spider Orchid have a short longevity of one or two seasons (DEC, 2014). It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, impacts could occur to the seedbanks through removal of soil and plants. However, the small area to be impacted is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction and maintenance activities (such as grading of table drains, weed control and slashing) and edge effects and is unlikely to provide ideal habitat. 6.6ha of vegetation would remain that could provide a seedbank source if the species did occur in the development site. No impacts would occur to the nearest known population in Buckingbong State Forest.

*Recruitment* - The Sandhill Spider Orchid produces a new tuber each year (DEC, 2014). It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, impacts could occur to recruitment through removal of soil and plants. However, the small area to be impacted is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction and maintenance activities (such as grading of table drains, weed control and slashing) and edge effects and is unlikely to provide ideal habitat. 6.6ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the nearest known population in Buckingbong State Forest.

*Interactions with other species* – The pollinator for the Sandhill Spider Orchid is a male thynnid wasp (DEC, 2014). Germination require a fungal symbiont partner (DEC, 2014). Male thynnid wasp is unlikely to be impacted as 6.3 ha of vegetation would remain in roadside vegetation.

*e. A description of the extent to which the local population will become fragmented or isolated as a result of the proposed development*

1.6 ha of vegetation would be removed along roadside. It is not known whether a population occurs within the roadside reserve. However, if the species did occur 6.3 ha of suitable native vegetation would remain along the roadside. Connectivity would be maintained along the roadside through remaining native vegetation as well as rehabilitation and supplementary revegetation and would be unlikely to isolate a population. The known local population is scattered throughout Buckingbong State Forest. The impact would not fragment or isolate the known population.

*f. The relationship of the local population to other populations of the species. This must include consideration of the interaction and importance of the local population to other populations*

*for factors such as breeding, dispersal and genetic viability, and whether the local population is at the limit of the species range*

It is not known whether a population occurs within the roadside reserve. However, if the species did occur in the development site, there is no connection between the nearest known population in Buckingbong State Forest. Seeds of the Sandhill Spider Orchid are short lived and dispersal is reduced to small local area.

- g. *The extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna that may in turn lead to a decrease in the viability of the local population.*

The roadside vegetation is already highly fragmented and exposed to invasive flora and fauna. Perennial grasses such as Paspalum occur in small sections along Muntz Rd and Sandigo-Boree Creek Rd. Exotic annual grasses such as Wild Oats, Rye Grass and Barley Grass are also dominant within the woodland vegetation. There is a risk that invasive weeds could be established in the development site via seeds or plant parts on machinery during construction. These impacts can be readily managed and minimised with the implementation of a weed management procedure. Hygiene protocols would reduce the introduction of new weed species.

- h. *An estimate of the area, or number and size of populations that is in the reserve systems in NSW, the IBRA Region and the IBRA subregion*

The sand hill spider orchid is currently only known from the Riverina region between Urana and Narrandera. The 2004 recovery plan (DEC, 2004) estimated less than 2000 plants remain. The species is now only known to occur in 5 locations. Three of these locations are on public land in Lonesome Pine, Buckingbong and Yarrangerry State Forest.

Populations of plants in these areas are as follow:

- Yarrangerry State Forest – 1000 plants, NSW South West Slopes Bioregion
- Buckingbong State Forest – 100 plants NSW South west Slopes Bioregion
- Lonesome Pine – 240 plants in Riverina Bioregion

- i. *The measures proposed to contribute to the recovery of the species in the IBRA subregion.*

58 credits have been created for the Sandhill spider orchid that will provide conservation funding for the species.

### 9.2.3 Conclusion

Suitable habitat in the form of White Cypress- Grey Box Woodland exists along Muntz Rd and Sandigo-Boree Creek Rd. As seasonal conditions were considered unsuitable for these species, it is not known if they occur within the development site. Based on the small area of potential habitat impacted, suitable remaining habitat and that no impacts to the known populations would occur, it is considered unlikely the proposal would have a serious and irreversible impact on the Sandhill-Spider Orchid.





Figure 9-1 Potential habitat for serious and irreversible impacts



# 10 REQUIREMENT TO OFFSET

## 10.1 IMPACTS REQUIRING AN OFFSET

### 10.1.1 Ecosystem credits

An offset is required for all impacts of development on PCTs that are associated with:

- a) a vegetation zone that has a vegetation integrity score  $\geq 15$  where the PCT is representative of an endangered or critically endangered ecological community, or
- b) a vegetation zone that has a vegetation integrity score of  $\geq 17$  where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
- c) a vegetation zone that has a vegetation integrity score  $\geq 20$  where the PCT is not representative of a TEC or associated with threatened species habitat.

The PCTs and vegetation zones requiring offset and the ecosystem credits required are documented in Table 10-1 and mapped on Figure 10-1 - Figure 10-6.

Table 10-1 PCTs and vegetation zones that require offsets

Zone ID	PCT ID	Zone	Impact Area (ha)	Vegetation integrity score	Vegetation Integrity Loss	Ecosystem credits required
<b>Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion</b>						
1	80	Good	1.1	51.8	51.8	29
2	80	Good_ immature overstory	0.5	39.6	39.6	9
3	80	Moderate_ grazed understory	0.1	36	36	2
4	80	Low	0.05	20.9	20.9	1
5	80	Planted	0.1	37.2	37.2	2
		<b>Subtotal:</b>	<b>1.54 ha</b>		<b>Subtotal:</b>	<b>43</b>
<b>Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)</b>						
6	158	Planted	0.9	34.1	34.1	15
		<b>Subtotal:</b>	<b>0.9 ha</b>		<b>Subtotal:</b>	<b>15</b>
		<b>TOTAL</b>	<b>2.44 ha</b>		<b>TOTAL:</b>	<b>58</b>

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix J.

### 10.1.2 Paddock Tree Credits

Offsets are required for the clearing of Class 2 and Class 3 paddock trees. 47 class 2 and class 3 paddock trees would be removed by the proposal. The paddock trees form part of PCT80: *Western Grey Box - White Cypress Pine tall woodland*. Ecosystem credits are calculated as per the streamlined assessment defined in the BAM – Appendix 1 and Table 12. These ecosystem credits required are documented in Table 10-2.

41.25 Ecosystem credits are required for the clearing of the paddock trees.

Table 10-2 Paddock Trees that require offsets

Class of Paddock Tree being cleared	Hollows Present	Number of Paddock Trees to be cleared	Credits Required	Ecosystem credits required
Class 2 (>20cm DBH and < 50cm DBH)	No	4	0.5	2
Class 2 (>20cm DBH and < 50cm DBH)	Yes	0	0	0
Class 3 >50cm DBH	No	22	0.75	16.5
Class 3 >50cm DBH	Yes	21	1	21
			<b>TOTAL</b>	<b>40</b>

### 10.1.3 Species credits

An offset is required for the threatened species impacted by the development that require species credits. The species credits required are documented in Table 10-3.

These species were unable to be surveyed for during the recommended survey time and were therefore assumed to occur on site. Spring flora surveys have been recommended to determine the presence/absence of threatened flora along Muntz Rd and Sandigo-Boree Creek Rd. If surveys demonstrate these species did not occur onsite, the calculations could be updated to remove their offset requirements.

Table 10-3 Species credit species that require offsets

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species credits required
A Spear Grass ( <i>Austrostipa wakoolica</i> )	2	1.6	38
Sand-hill Spider Orchid ( <i>Caladenia arenaria</i> )	3	1.6	58
Oaklands Diuris ( <i>Diuris</i> sp.)	3	1.6	58
Pine Donkey Orchid ( <i>Diuris tricolor</i> )	1.5	1.6	29
Superb Parrot ( <i>Polytelis swainsonii</i> )	2	0.3	6
Major Mitchell Cockatoo	2	0.3	6
		<b>TOTAL</b>	<b>195</b>

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix J.

#### 10.1.4 Offsets required under the EPBC Act

##### Threatened Ecological Communities

No significant impact was considered to occur to the EPBC listed Grey Box Grassy woodland (Appendix I). As per the EPBC offsets policy, offsets are not required where the impacts of a proposed action are not thought to be significant. No offsets are required for the EPBC listed Grey Box Grassy Woodland EEC.

##### Threatened Species

Two EPBC listed flora species, *Caladenia arenaria* and *Austrostipa wakoolica* were unable to be surveyed for during the suitable survey period. It is recommended to survey for these species in Spring before construction begins to determine if these species are present in the development footprint. If detected, further assessment and any requirements under the EPBC Act, including offsets, would be implemented.

## 10.2 AREAS NOT REQUIRING ASSESSMENT

523ha of exotic vegetation, comprised of agricultural crops or planted exotic trees would be impacted by the proposal. These zones are not considered native vegetation and do not require offsetting or further assessment.

These areas are mapped on Figure 10-1.



### 10.3 SUMMARY OF OFFSET CREDITS REQUIRED

The following credit requirement is generated for the project.

Table 10-4 Credit requirement for the project

Ecosystem Credits	Offset credits required
PCT 80: Western Grey Box -White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	43
PCT 80: Paddock Trees – Western Grey Box -White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	40
PCT 158: Old Man Saltbush – mixed chenopod shrubland of the semi-arid (persistently dry) and arid climate zones.	15
<b>TOTAL</b>	<b>98</b>
Species Credits	Offset Credits Required
<b>A Spear Grass (<i>Austrostipa wakoolica</i>)</b>	38
<b>Sand-hill Spider Orchid (<i>Caladenia arenaria</i>)</b>	58
<b>Oaklands Diuris (<i>Diuris</i> sp.)</b>	58
<b>Pine Donkey Orchid (<i>Diuris tricolor</i>)</b>	29
<b>Superb Parrot (<i>Polytelis swainsonii</i>)</b>	6
<b>Major Mitchell Cockatoo (<i>Lophochroa leadbeateri</i>)</b>	6
<b>TOTAL</b>	<b>195</b>

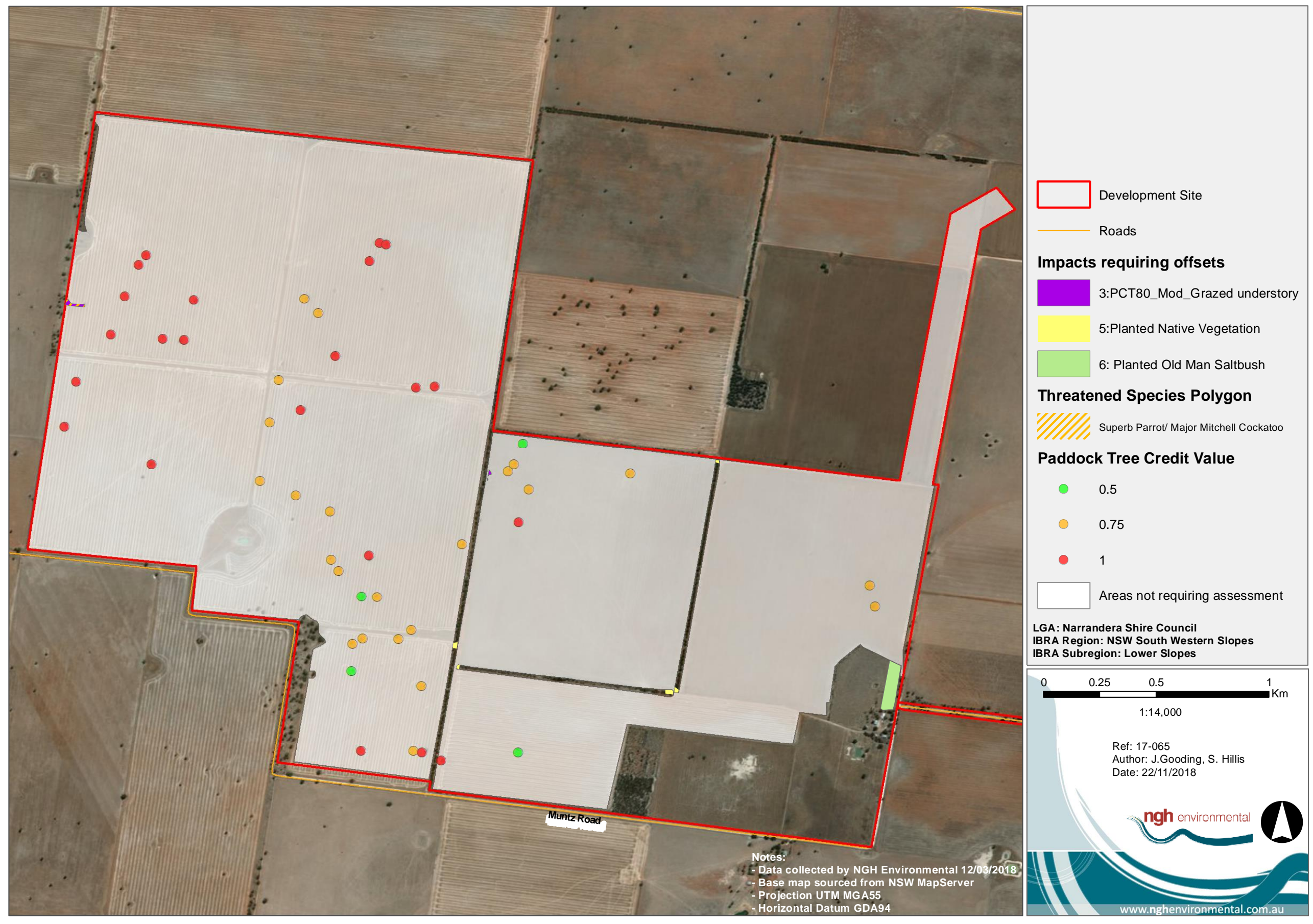


Figure 10-1 Impacts requiring offset



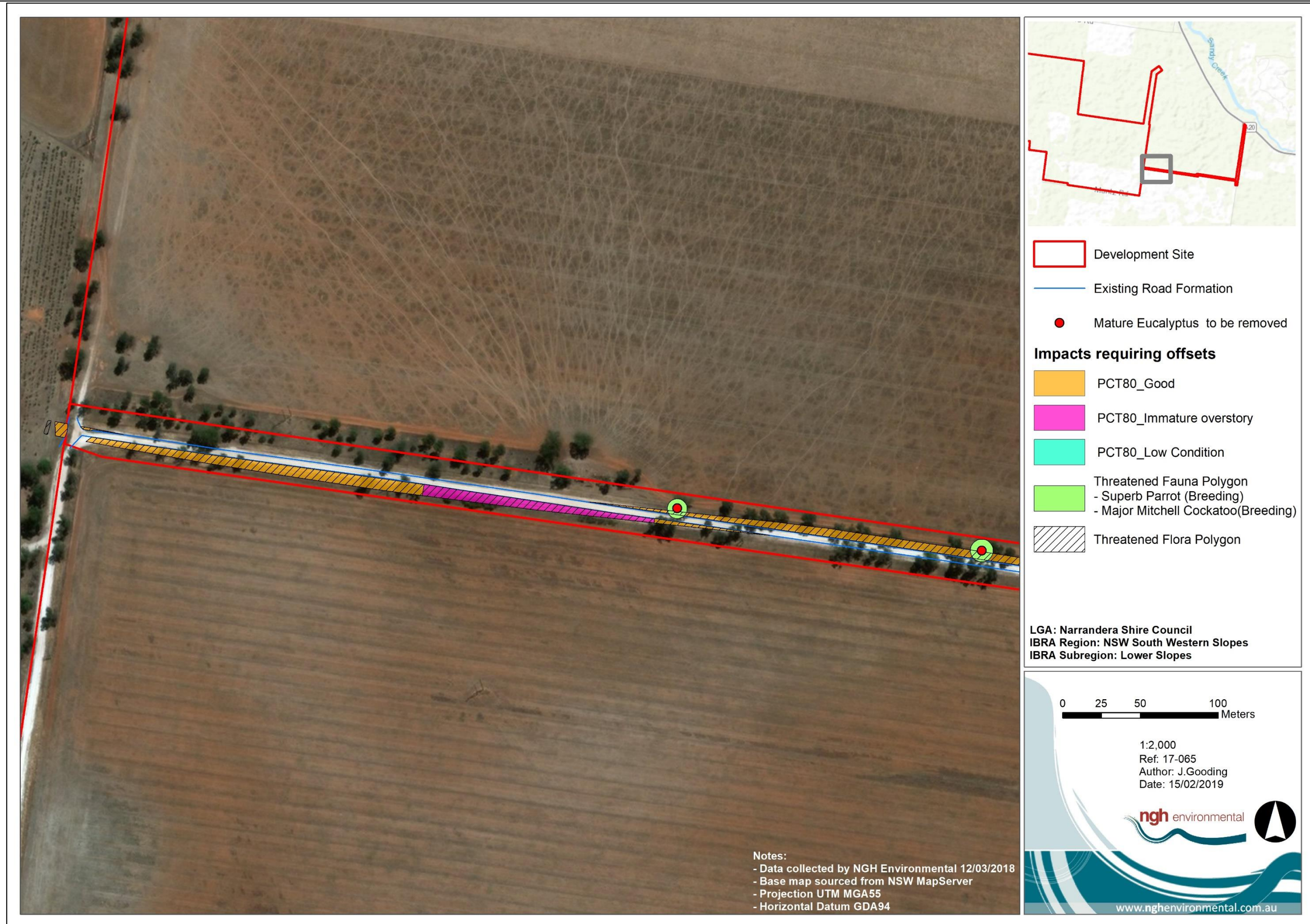


Figure 10-2 Impacts requiring offsets along Muntz Rd



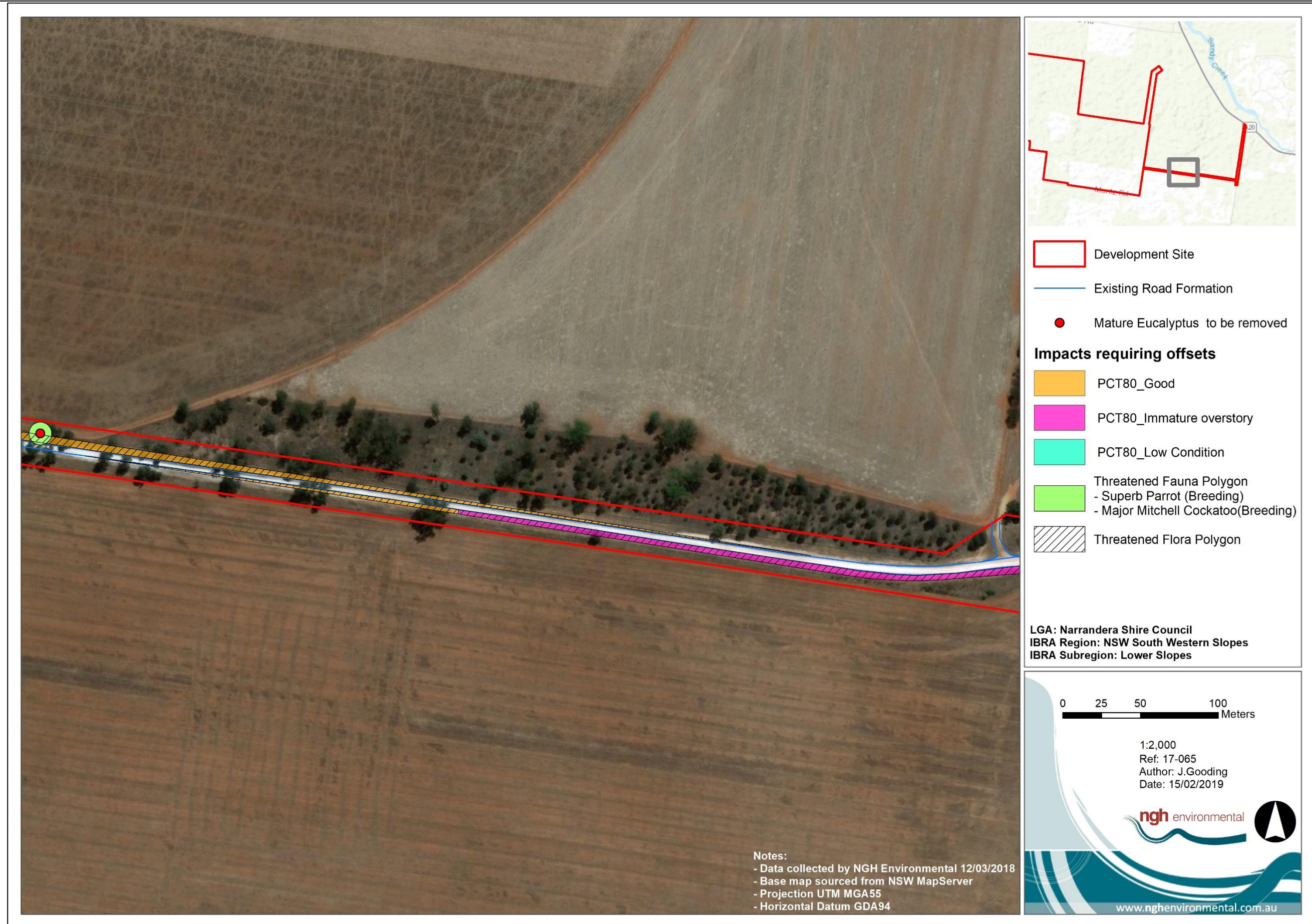


Figure 10-3 Impacts requiring offsets along Muntz Rd





Figure 10-4 Impacts requiring offsets along Muntz Rd



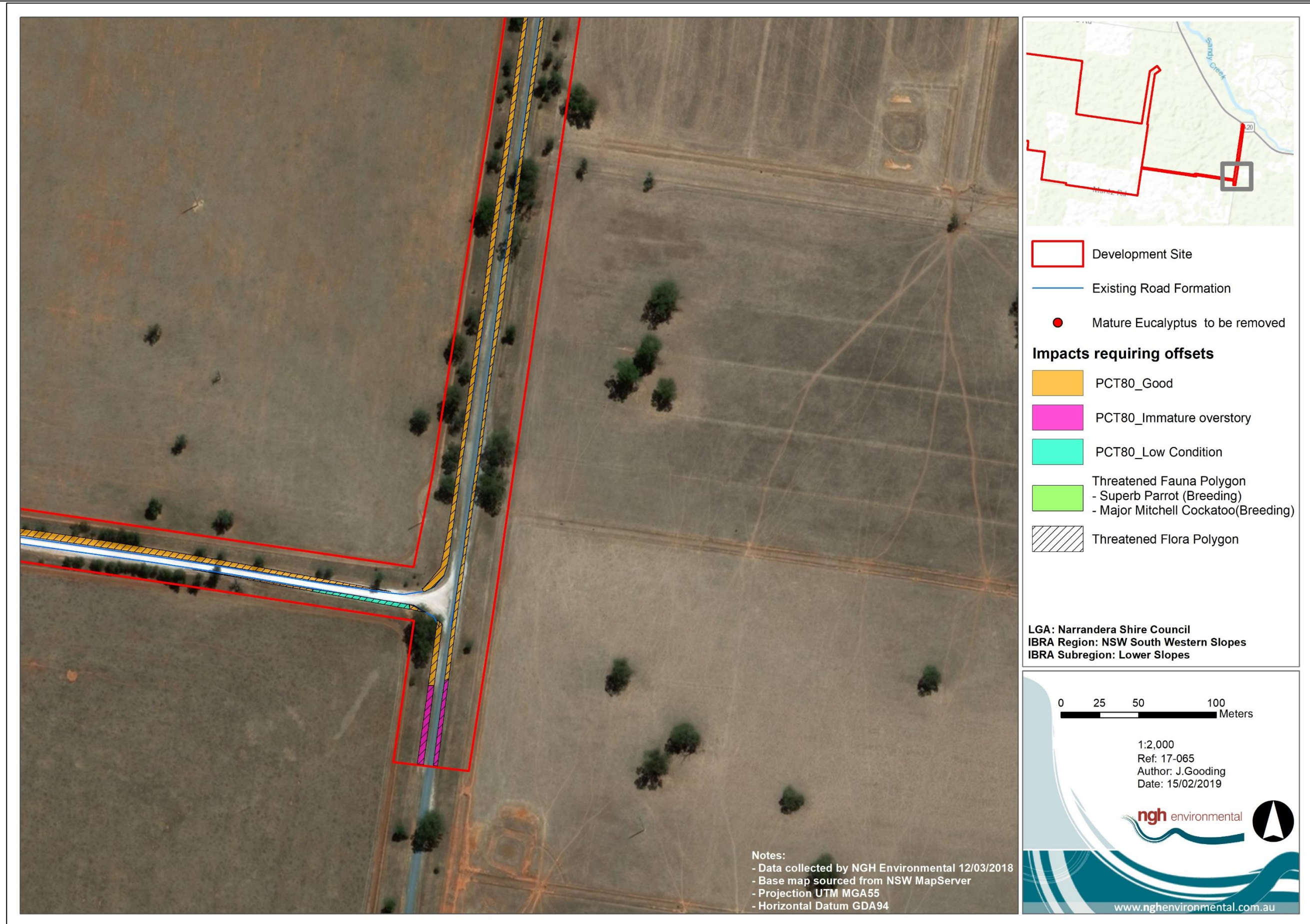


Figure 10-5 Impacts requiring offsets along Muntz Rd and Sandigo-Boree Creek Rd



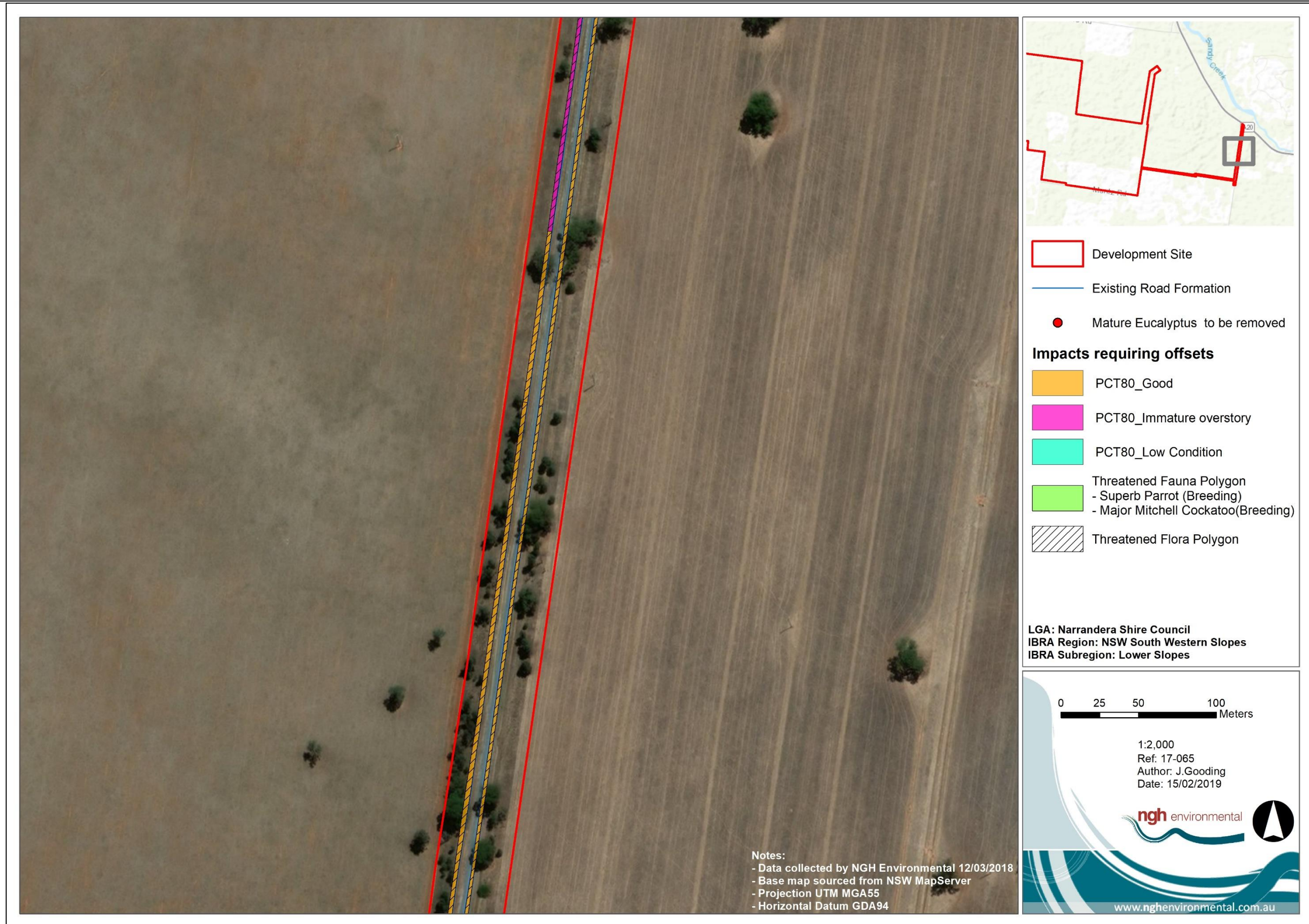


Figure 10-6 Impacts requiring offsets along Sandigo-Boree Creek Rd



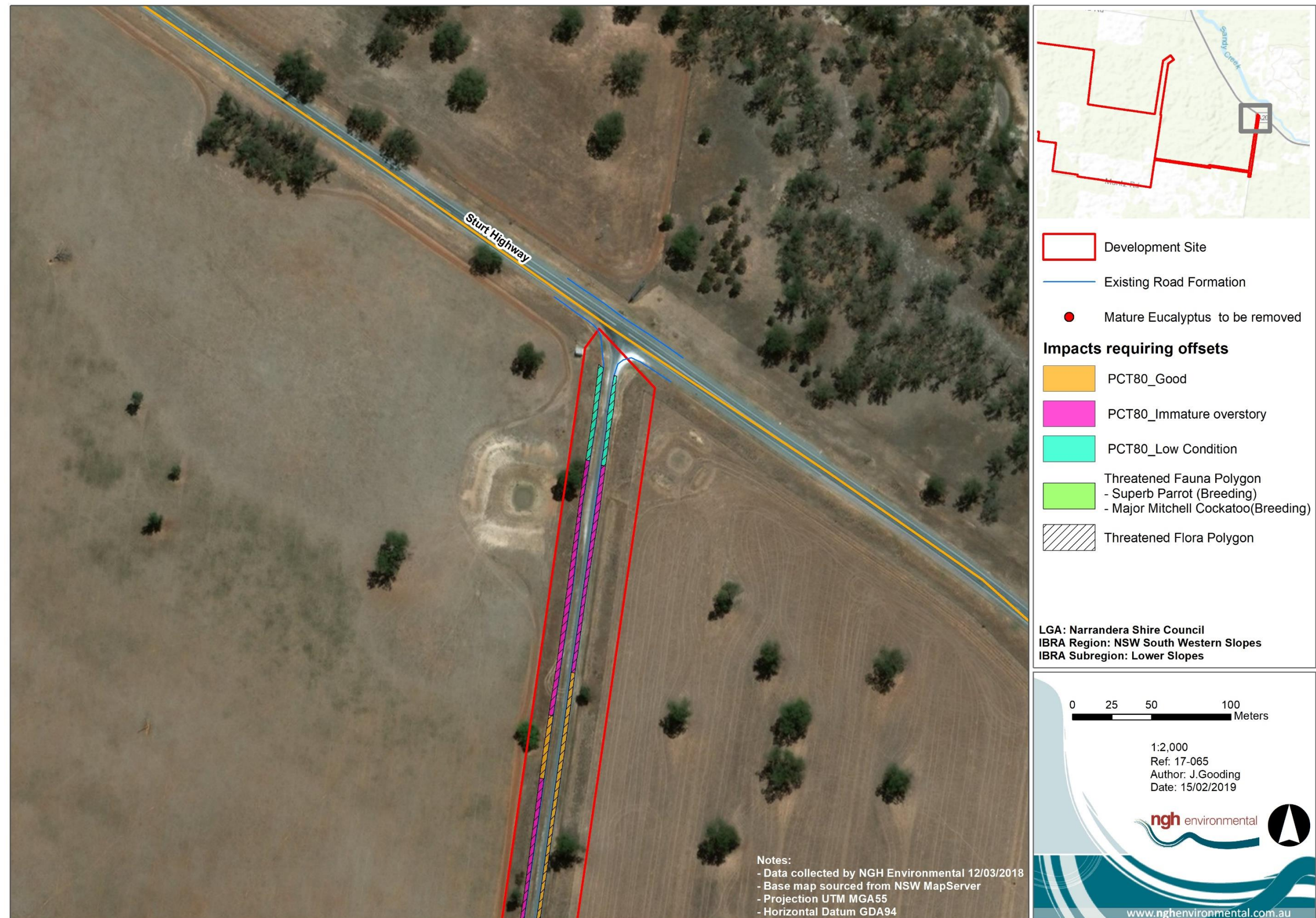


Figure 10-7 Impacts requiring offsets along Sandigo-Boree Creek Road



## 11 CONCLUSIONS

NGH Environmental has prepared this BDAR on behalf of RES for the proposed Avonlie Solar Farm in Sandigo, NSW. The purpose of this BDAR was to address the requirements of the BAM and to address the biodiversity matters raised in the SEARs.

In this BDAR:

- Biodiversity impacts have been assessed through comprehensive mapping and assessment completed in accordance with the BAM
- Mitigation measures which have been outlined to reduce the impacts to biodiversity
- The credit requirement has been defined as:
  - 83 Ecosystem Credits for impacts to Western Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion (PCT80)
  - 15 Ecosystem Credits for impacts to Old Man Saltbush – mixed chenopod shrubland of the semi-arid persistently dry) and arid climate zones.
  - 195 species credits for assumed impacts to the *Austrostipa wakoolica*, Sand-hill Spider Orchid, Oaklands Diuris, Pine Donkey Orchid, Superb Parrot and Major Mitchell Cockatoo that were unable to be surveyed for during the recommended survey period.

The retirement of these credits will be carried out in accordance with the NSW Biodiversity Offsets scheme, and will be achieved by either;

- (a) Retiring credits under the Biodiversity Offsets Scheme, or
- (b) Making payments into the Biodiversity Conservation Fund using the offset payments calculator, or
- (c) Funding a biodiversity action that benefits the threaten entity(ies) impacted by the development.



## 12 REFERENCES

- Bionet (2018) – Bionet: website for the Atlas of NSW Wildlife; accessed at [www.bionet.nsw.gov.au](http://www.bionet.nsw.gov.au)
- Baker-Gabb, D (2011) National Recovery Plan for the Superb Parrot *Polytelis swainsonii*. Victorian Government Department of Sustainability and Environment, Melbourne.
- DEC (2004) *Caladenia arenaria* Fitzg. Recovery Plan NSW Department of Environment and Conservation
- DECC (2002) Descriptions for NSW (Mitchell) Landscapes Version 2. NSW Department of Environment and Climate Change.
- DoC NSW Department of Environment and Conservation. (2004) *Caladenia arenaria* Fitzg. Recovery Plan Department of Environment and Conservation.
- DoE (2016). Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: <http://www.environment.gov.au/sprat>.
- DoE (2014) EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory), Commonwealth Department of Environment, 2014.
- DoSEWPC (2012) Grey Box (*Eucalyptus microcarpa*) Grassy woodlands and derived native grasslands of South Eastern Australia: A guide to the identification, assessment and management of a nationally threatened ecological community. Commonwealth of Australia
- Environment Australia (2001) A Directory of Important Wetlands in Australia. 3rd Edition. Environment Australia, Canberra.
- OEH (2011) Vegetation mapping by 3-D aerial photo interpretation: Vegetation of central-southern NSW. Office of Environment and Heritage
- Office of Environment and Heritage (OEH) (2017a) Biodiversity Assessment Methodology (BAM). Office of Environment and Heritage for the NSW Government, Sydney, NSW.
- Office of Environment and Heritage (OEH) (2017b) BioNet Vegetation Information System: Classification Database. Accessed online at <http://www.environment.nsw.gov.au/research/Visclassification.htm>
- OEH (2017c) Sloane's Froglet - NSW South Western Slopes: Distribution and vegetation associations. Accessed online at <http://www.environment.nsw.gov.au/threatenedspeciesapp/profileData.aspx?id=20088&cmaName=NSW+South+Western+Slopes>
- Jenner et al (2011) Population decline of the White-fronted Chat (*Epthianura albifrons*) in New South Wales, Australia, *EMU*, **111**: pg. 84 -91. CSIRO Publishing.
- LLS (Local Land Services, Murray) (2016), Oaklands Diuris *Diuris callitrophila* Fact Sheet, State of NSW

NSW Scientific Committee (2010) White-fronted Chat *Epthianura albifrons* – Vulnerable Species listing.  
Scientific determination

NSW Government (2017) NSW Government Sharing and Enabling Environmental Data (SEED) Mapping  
accessed at;  
[https://geo.seed.nsw.gov.au/Public\\_Viewers/index.html?viewer=Public\\_Viewers&locale=en-AU](https://geo.seed.nsw.gov.au/Public_Viewers/index.html?viewer=Public_Viewers&locale=en-AU)

NGH Environmental (2018) Preliminary Environmental Assessment – Avonlie Solar Farm

Rayner, Stojanovic, Heinsohn and Manning (2016) Breeding ecology of the superb parrot *Polytelis swainsonii* in northern Canberra, ANU accessed at:  
[https://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0006/906945/Breeding-ecology-of-the-superb-parrot.pdf](https://www.environment.act.gov.au/__data/assets/pdf_file/0006/906945/Breeding-ecology-of-the-superb-parrot.pdf)

TDG (2018) – Avonlie Solar Farm Traffic Access Assessment

TTSC (Threatened species scientific committee) - (2015) Conservation Advice *Caladenia arenaria* –  
Sandhill Spider Orchid.

TTSC – Threatened Species Scientific Committee (2016) – Conservation Advice: *Lathamus discolor*, Swift  
Parrot,

TTSC – Threatened Species Scientific Committee (2015) – Conservation Advice: *Nyctophilus corbeni* South-  
eastern long-eared bat

Vesk & McNally, (2006) The clock is ticking – Revegetation and habitat for birds and arboreal mammals in  
rural landscapes of Southern Australia *Agricultural ecosystems and Environment* 112; 356-366

Waudby, Cameron, Robertson, Caynes and Reiter (2015) Wild Orchids: saving three Endangered orchid  
species in Southern New South Wales chpt 17:pg159-168 in *Recovering Australian Threatened Species: A  
book of hope*






## APPENDIX A PERSONNEL

Personnel involved in the report are:







Name	Title	Qualifications	Roles
Dave Maynard	Principal Ecologist	<ul style="list-style-type: none"> <li>BAM Accredited Assessor</li> <li>B Science (Ecology, First Class Honours)</li> </ul>	Direction in BAM assessment and BDAR. Review and approval of BDAR
Mitch Palmer	Technical Lead - Ecology	<ul style="list-style-type: none"> <li>BAM Accredited Assessor</li> <li>B Science</li> </ul>	Review and approval of BDAR
Julie Gooding	Environmental Consultant - Ecologist	<ul style="list-style-type: none"> <li>BAM Accredited Assessor #BAAS18074</li> <li>B. Science (Biology)</li> </ul>	Field Work including PCT identification, vegetation mapping, vegetation integrity plots and threatened flora surveys. Main Author of BDAR GIS Mapping
Jess Murphy	Environmental Consultant - Ecologist	<ul style="list-style-type: none"> <li>B. Science</li> <li>Master Environmental Science and Management</li> </ul>	Field Work including targeted fauna surveys, HBT surveys and assistance with Vegetation Integrity Plots
Nicola Smith	Environmental Consultant - Graduate	<ul style="list-style-type: none"> <li>B. Science</li> <li>Master of Philosophy – Physical Geography</li> </ul>	Assistance with Field Work
Jesse Whieldon	Environmental Consultant - Graduate	<ul style="list-style-type: none"> <li>B. Environmental Science</li> </ul>	Assistance with Field Work
Erin Davies	Environmental Consultant - Graduate	<ul style="list-style-type: none"> <li>B. Science (Land and Heritage Management)</li> <li>Master Environmental Science</li> </ul>	Assistance with Field Work






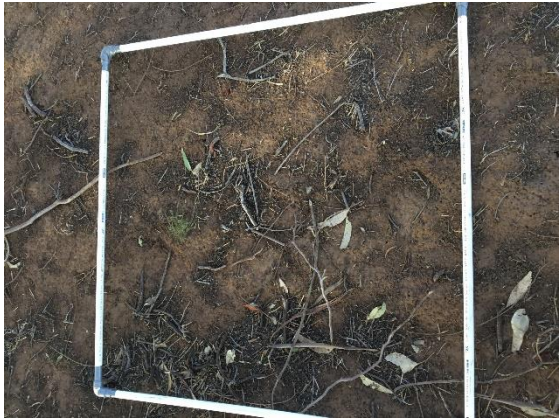


## APPENDIX B PLOT PHOTOS

Plot 1	Zone 7: PCT76 _ Grazed understory
	
Plot 2	Zone 1: PCT80_Good
	Not Available
Plot 3	Zone 4: PCT80_Low Condition
	









Plot 4	Zone 4: PCT 80_Low Condition
	
Plot 5	Zone 3: PCT80 _ Moderate_grazedunderstory
	
Plot 6	Zone 6: PCT158_Planted Old Man Saltbush
	





<b>Plot 7</b>	<b>Zone 8: Exotic</b>
	
<b>Plot 8</b>	<b>Zone 5: PCT80_Planted</b>
	
<b>Plot 9</b>	<b>Zone 5: PCT80_Planted</b>
	



<b>Plot 10</b>	<b>Zone 2: PCT80 _ Good_ immature overstory</b>
	
<b>Plot 11</b>	<b>Zone 2: PCT80 _ Good_ immature overstory</b>
	
<b>Plot 12</b>	<b>Zone 4: PCT 80_Low</b>
	



Plot 13	Zone 1: PCT80_Good Condition
	

## APPENDIX C FLORA SPECIES LISTS

### KEY

(%) - Foliage Cover in 20m x 20m plot

(#) - Number of individuals in 20m x 20m plot

\* - Introduced species

Δ - High Threat Exotic



	Scientific Name	Common Name	Plot 1 PCT 76 Zone 7		Plot 2 PCT 80 Zone 1		Plot 3 PCT 80 Zone 4		Plot 4 PCT 80 Zone 4		Plot 5 PCT 80 Zone 3		Plot 6 Planted Zone 6		Plot 7 Exotic Zone 8	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#
	<b>TREES</b>															
	<i>Allocasuarina luehmannii</i>	Bulloak									10	1				
	<i>Callitris glaucophylla</i>	White Cypress Pine			0.1	1	2.5	1			15	6				
	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum														
	<i>Eucalyptus melliodora</i>	Yellow Box			2	1										
	<i>Eucalyptus microcarpa</i>	Western Grey Box	15	1	30	4										
	<i>Eucalyptus oleosa</i>	Red Mallee														
	<i>Eucalyptus sideroxylon</i>	Mugga Ironbark														
	<i>Eucalyptus viridis</i>	Green Mallee														
	<b>SHRUBS</b>															
	<i>Acacia baileyana</i>	Cootamundra Wattle														
	<i>Acacia melanoxylon</i>	Blackwood			3	1										
	<i>Atriplex nummularia</i>	Old Man Saltbush											30	50		
	<i>Atriplex semibaccata</i>	Creeping Saltbush	0.1	1												
	<i>Hakea tephrosperma</i>	Hooked Needlewood			0.5	1										
	<i>Rhagodia spinescens</i>	Thorny Saltbush														
	<i>Senna artemisioides</i>	Desert Senna														
	<i>Sclerolaena muricata</i>	Black Rolypoly	0.1	5			0.1	1	0.4	5	3	40	0.2	10		
	<b>VINES AND CLIMBERS</b>															
	<i>Convolvulus angustissimus</i>	Desert Bindweed														
	<b>FERNS</b>															
	<i>Cheilanthes sieberi</i>	Rock Fern														
	<i>Marsilea drummondii</i>	Common Nardoo	0.1	30												
	<b>FORBS</b>															

	Scientific Name	Common Name	Plot 1 PCT 76 Zone 7		Plot 2 PCT 80 Zone 1		Plot 3 PCT 80 Zone 4		Plot 4 PCT 80 Zone 4		Plot 5 PCT 80 Zone 3		Plot 6 Planted Zone 6		Plot 7 Exotic Zone 8	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#
	<i>Alternanthera denticulata</i>	Lesser Joyweed														
	<i>Atriplex spinibractea</i>	Spiny-fruit Saltbush					10	200	25	100						
*	<i>Brassica spp.</i>	Brassica	0.1	1	0.5	100										
	<i>Calotis cuneata</i>	Mountain Burr-Daisy														
* Δ	<i>Carthamus lanatus</i>	Saffron Thistle					0.1	1								
*	<i>Chenopodium album</i>	Fat Hen											0.4	50		
*	<i>Chondrilla juncea</i>	Skeleton Weed														
*	<i>Cirsium vulgare</i>	Spear Thistle														
*	<i>Citrullus lanatus var. lanatus</i>	Camel Melon					0.1	5	0.1	5						
*	<i>Cucumis myriocarpus subsp. leptodermis</i>	Paddy Melon														
	<i>Dysphania pumilio</i>	Small Crumbweed							0.5	200						
*	<i>Echium plantagineum</i>	Patterson's Curse			0.1	30			0.2	50						
	<i>Eclipta platyglossa</i>															
	<i>Einadia nutans</i>	Climbing Saltbush	0.1	1	10	100										
	<i>Epilobium billardierianum</i>	Willowherb														
	<i>Euphorbia drummondii</i>	Caustic Weed					0.1	30								
*	<i>Gomphrena celosioides</i>	Gomphrena Weed														
*	<i>Heliotropium europaeum</i>	Potato Weed					10	300	10	100						
*	<i>Hypochaeris glabra</i>	Smooth Catsear														
*	<i>Lactuca serriola</i>	Prickly Lettuce			0.2	100			0.1	1						
	<i>Lepidium pseudohyssopifolium</i>	Peppercress											0.2	50		
*	<i>Limonium sinuatum</i>	Perennial Sea Lavender														
	<i>Maireana enchylaenoides</i>	Wingless Fissure-weed									0.2	7				
*	<i>Malva parviflora</i>	Small-flowered Mallow									0.1	10				

	Scientific Name	Common Name	Plot 1 PCT 76 Zone 7		Plot 2 PCT 80 Zone 1		Plot 3 PCT 80 Zone 4		Plot 4 PCT 80 Zone 4		Plot 5 PCT 80 Zone 3		Plot 6 Planted Zone 6		Plot 7 Exotic Zone 8	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	<i>Marrubium vulgare</i>	White Horehound			0.1	10										
*	<i>Medicago sativa</i>	Lucerne					0.5	30	0.1	30						
*	<i>Modiola caroliniana</i>	Red-flowered Mallow					0.1	20								
	<i>Oxalis perennans</i>				0.1	20										
*	<i>Polygonum aviculare</i>	Wireweed					0.1	10								
*	<i>Rumex crispus</i>	Curled Dock														
	<i>Sida corrugata</i>	Corrugated Sida			0.1	1			0.1	10						
	<i>Sida spp.</i>															
	<i>Solanum esuriale</i>	Quena	0.1	5												
*	<i>Sonchus asper</i>	Prickly Sowthistle			0.1	2										
*	<i>Sonchus oleraceus</i>	Common Sowthistle	0.1	1												
*	<i>Tribulus terrestris</i>	Cat-head					0.1	5					0.2	100		
*	<i>Trifolium angustifolium</i>	Narrow-leaved Clover														
*	<i>Trifolium spp.</i>	A Clover					0.1	30								
	<i>Vittadinia spp.</i>	Fuzzweed			0.1	1			0.1	1						
	<i>Wahlenbergia spp.</i>	Bluebell														
	<i>Wahlenbergia stricta</i>	Tall Bluebell														
* Δ	<i>Xanthium spinosum</i>	Bathurst Burr					0.1	1	0.1	3						
	<i>Zaleya galericulata</i>	Hogweed											0.1	10		
GRASSES AND GRASS LIKE																
	<i>Anthosachne scabra</i>	Common Wheatgrass														
	<i>Austrostipa aristiglumis</i>	Plains Grass														
	<i>Austrostipa scabra</i>	Speargrass			5	100			0.5	30						
	<i>Austrostipa spp.</i>	Speargrass														
*	<i>Avena fatua</i>	Wild Oats			1	300			0.3	30						



	Scientific Name	Common Name	Plot 1 PCT 76 Zone 7		Plot 2 PCT 80 Zone 1		Plot 3 PCT 80 Zone 4		Plot 4 PCT 80 Zone 4		Plot 5 PCT 80 Zone 3		Plot 6 Planted Zone 6		Plot 7 Exotic Zone 8	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#
	<i>Bothriochloa macra</i>	Red Grass														
*	<i>Bromus diandrus</i>	Great Brome			10	1000										
	<i>Carex spp.</i>	A Sedge	0.1	1												
	<i>Chloris truncata</i>	Windmill Grass					0.1	10	20	30			0.2	30		
	<i>Cynodon dactylon</i>	Common Couch														
	<i>Enteropogon acicularis</i>	Curly Windmill Grass							0.5	50			0.5	50		
*	<i>Eragrostis cilianensis</i>	Stinkgrass					0.1	1	0.1	30						
*	<i>Eragrostis minor</i>	Small Stink Grass											15	500		
	<i>Eragrostis parviflora</i>	Weeping Lovegrass														
	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass														
*	<i>Hordeum leporinum</i>	Barley Grass			15	1000										
	<i>Juncus spp.</i>	A Rush	0.1	15												
	<i>Lomandra filiformis</i>	Wattle Matt-rush														
*	<i>Lolium perenne</i>	Perennial Ryegrass	30	1000	5	500										
*	<i>Panicum capillare</i>	Witchgrass							3	100			30	500		
	<i>Panicum effusum</i>	Hairy Panic														
* Δ	<i>Paspalum dilatatum</i>	Paspalum														
	<i>Rytidosperma spp.</i>		30	500	10	300			0.1	30						
*	<i>Triticum aestivum</i>	Wheat													15	500

	Scientific Name	Common Name	Plot 8 Planted Zone 5		Plot 9 Planted Zone 5		Plot 10 PCT 80 Zone 2		Plot 11 PCT 80 Zone 2		Plot 12 PCT 80 Zone 4		Plot 13 PCT 80 Zone 1		Incidental
			%	#	%	#	%	#	%	#	%	#	%	#	
	<b>TREES</b>														
	<i>Allocasuarina luehmannii</i>	Bulloak													
	<i>Callitris glaucophylla</i>	White Cypress Pine			0.1	1			2	10			20	30	
	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum	5	1											
	<i>Eucalyptus melliodora</i>	Yellow Box	25	4											
	<i>Eucalyptus microcarpa</i>	Western Grey Box													
	<i>Eucalyptus oleosa</i>	Red Mallee	4	1	12	1									
	<i>Eucalyptus sideroxylon</i>	Mugga Ironbark	4	1	10	1									
	<i>Eucalyptus viridis</i>	Green Mallee			3	1									
	<b>SHRUBS</b>														
	<i>Acacia baileyana</i>	Cootamundra Wattle	0.1	1											
	<i>Acacia melanoxylon</i>	Blackwood													
	<i>Atriplex nummularia</i>	Old Man Saltbush													
	<i>Atriplex semibaccata</i>	Creeping Saltbush	0.3	10	0.1	5							0.5	5	
	<i>Hakea tephrosperma</i>	Hooked Needlewood													
	<i>Rhagodia spinescens</i>	Thorny Saltbush	0.1	1	2	10									
	<i>Senna artemisioides</i>	Desert Senna							5	10					
	<i>Sclerolaena muricata</i>	Black Rolpoly			0.1	1	0.1	1							
	<b>VINES AND CLIMBERS</b>														
	<i>Convolvulus angustissimus</i>	Desert Bindweed							0.1	5			1	10	
	<b>FERNS</b>														
	<i>Cheilanthes sieberi</i>	Rock Fern							0.1	1					
	<i>Marsilea drummondii</i>	Common Nardoo					0.2	100					0.1	20	
	<b>FORBS</b>														
	<i>Alternanthera denticulata</i>	Lesser Joyweed					0.1	10							

	Scientific Name	Common Name	Plot 8 Planted Zone 5		Plot 9 Planted Zone 5		Plot 10 PCT 80 Zone 2		Plot 11 PCT 80 Zone 2		Plot 12 PCT 80 Zone 4		Plot 13 PCT 80 Zone 1		Incidental
			%	#	%	#	%	#	%	#	%	#	%	#	
	<i>Atriplex spinibractea</i>	Spiny-fruit Saltbush	0.1	10			0.3	5	0.5	5					
*	<i>Brassica spp.</i>	Brassica													
	<i>Calotis cuneata</i>	Mountain Burr-Daisy													roadside
*Δ	<i>Carthamus lanatus</i>	Saffron Thistle													
*	<i>Chenopodium album</i>	Fat Hen													
*	<i>Chondrilla juncea</i>	Skeleton Weed							3	50					
*	<i>Cirsium vulgare</i>	Spear Thistle	0.1	1							0.1	5			
*	<i>Citrullus lanatus var. lanatus</i>	Camel Melon													
*	<i>Cucumis myriocarpus subsp. leptodermis</i>	Paddy Melon					0.1	1							
	<i>Dysphania pumilio</i>	Small Crumbweed	0.1	20									0.1	1	
*	<i>Echium plantagineum</i>	Patterson's Curse	0.1	2			0.5	200			0.5	50			
	<i>Eclipta platyglossa</i>						1	50			0.1	1			
	<i>Einadia nutans</i>	Climbing Saltbush	0.3	40	0.1	5			0.5	20					
	<i>Epilobium billardierianum</i>	Willowherb					0.1	30	0.1	10					roadside
	<i>Euphorbia drummondii</i>	Caustic Weed					0.1	10							
*	<i>Gomphrena celosioides</i>	Gomphrena Weed											0.1	1	
*	<i>Heliotropium europaeum</i>	Potato Weed	0.1	5			1	100	0.2	30	0.1	1			
*	<i>Hypochaeris glabra</i>	Smooth Catsear							0.1	30					
*	<i>Lactuca serriola</i>	Prickly Lettuce					0.1	5			2	100	0.5	100	
	<i>Lepidium pseudohyssopifolium</i>	Peppercress					0.1	10							
*	<i>Limonium sinuatum</i>	Perennial Sea Lavender					5	80	0.1	5					
	<i>Maireana enchylaenoides</i>	Wingless Fissure-weed	0.1	20					0.1	1			0.1	20	
*	<i>Malva parviflora</i>	Small-flowered Mallow													
*	<i>Marrubium vulgare</i>	White Horehound											0.1	1	
*	<i>Medicago sativa</i>	Lucerne													



	Scientific Name	Common Name	Plot 8 Planted Zone 5		Plot 9 Planted Zone 5		Plot 10 PCT 80 Zone 2		Plot 11 PCT 80 Zone 2		Plot 12 PCT 80 Zone 4		Plot 13 PCT 80 Zone 1		Incidental
			%	#	%	#	%	#	%	#	%	#	%	#	
*	<i>Modiola caroliniana</i>	Red-flowered Mallow													
	<i>Oxalis perennans</i>														
*	<i>Polygonum aviculare</i>	Wireweed													
*	<i>Rumex crispus</i>	Curled Dock									0.2	30			
	<i>Sida corrugata</i>	Corrugated Sida			0.1	10			2	30					
	<i>Sida spp.</i>										0.1	1	5	30	
	<i>Solanum esuriale</i>	Quena													
*	<i>Sonchus asper</i>	Prickly Sowthistle													
*	<i>Sonchus oleraceus</i>	Common Sowthistle													
*	<i>Tribulus terrestris</i>	Cat-head													
*	<i>Trifolium angustifolium</i>	Narrow-leaved Clover							0.4	100					
*	<i>Trifolium spp.</i>	A Clover													
	<i>Vittadinia spp.</i>	Fuzzweed							2	30			0.1	5	
	<i>Wahlenbergia spp.</i>	Bluebell													roadside
	<i>Wahlenbergia stricta</i>	Tall Bluebell							0.1	1					
* Δ	<i>Xanthium spinosum</i>	Bathurst Burr													
	<i>Zaleya galericulata</i>	Hogweed													
<b>GRASSES AND GRASS LIKE</b>															
	<i>Anthosachne scabra</i>	Common Wheatgrass							5	50			2	20	
	<i>Austrostipa aristiglumis</i>	Plains Grass					0.1	20			5	30			roadside
	<i>Austrostipa scabra</i>	Speargrass							10	50			5	50	
	<i>Austrostipa spp.</i>	Speargrass							40	500					
*	<i>Avena fatua</i>	Wild Oats					1	30	0.5	100					
	<i>Bothriochloa macra</i>	Red Grass											5	50	
*	<i>Bromus diandrus</i>	Great Brome													

	Scientific Name	Common Name	Plot 8 Planted Zone 5		Plot 9 Planted Zone 5		Plot 10 PCT 80 Zone 2		Plot 11 PCT 80 Zone 2		Plot 12 PCT 80 Zone 4		Plot 13 PCT 80 Zone 1		Incidental
			%	#	%	#	%	#	%	#	%	#	%	#	
	<i>Carex spp.</i>	A Sedge													
	<i>Chloris truncata</i>	Windmill Grass					0.2	30	5	80			5	100	
	<i>Cynodon dactylon</i>	Common Couch					5	10			5	20			
	<i>Enteropogon acicularis</i>	Curly Windmill Grass			5	50	5	50	5	50			35	1000	
*	<i>Eragrostis cilianensis</i>	Stinkgrass													
*	<i>Eragrostis minor</i>	Small Stink Grass					0.1	10							
	<i>Eragrostis parviflora</i>	Weeping Lovegrass					0.1	10					0.1	20	
	<i>Eriochloa pseudoacrotricha</i>	Early Spring Grass					25	200			25	100			
*	<i>Hordeum leporinum</i>	Barley Grass													
	<i>Juncus spp.</i>	A Rush					0.1	10			0.2	5			
	<i>Lomandra filiformis</i>	Wattle Matt-rush							0.1	5					
*	<i>Lolium perenne</i>	Perennial Ryegrass			5	500			10	1000	15	1000	20	1000	
*	<i>Panicum capillare</i>	Witchgrass	0.3	50			5	200							
	<i>Panicum effusum</i>	Hairy Panic					4	30			20	50			
* Δ	<i>Paspalum dilatatum</i>	Paspalum									5	20			roadside
	<i>Rytidosperma spp.</i>				10	300	5	100	5	80			5	100	
*	<i>Triticum aestivum</i>	Wheat													

## APPENDIX D FIELD DATA SHEETS



## APPENDIX E PADDOCK TREES

Paddock Trees within the development site

ID	Latitude	Longitude	Species	DBH (cm)	Height (m)	Hollows Present	DBH above Benchmark (50cm)	Paddock Tree Class	Impacted By proposal	Credits Required
1	-34.91863	146.60851	White Cypress	80	12	No	Yes	3	Yes	0.75
2	-34.91949	146.60873	White Cypress	74	12	No	Yes	3	Yes	0.75
3	-34.914177	146.59896	White Cypress	60	10	No	Yes	3	Yes	0.75
4	-34.914814	146.5949	White Cypress	52	7	No	Yes	3	YES	0.75
5	-34.925335	146.59449	White Cypress	49	5	No	No	2	YES	0.5
6	-34.920972	146.58787	White Cypress	58	8	No	Yes	3	YES	0.75
7	-34.920792	146.5897	Stag	63	10	No	Yes	3	YES	0
8	-34.920767	146.58827	White Cypress	60	12	No	Yes	3	YES	0.75
9	-34.920425	146.59021	White Cypress	51	0	No	Yes	3	YES	0.75
10	-34.919088	146.58824	White Cypress	45	8	No	No	2	YES	0.5
11	-34.919102	146.58885	White Cypress	57	11	No	Yes	3	YES	0.75
12	-34.918056	146.58731	White Cypress	69	11	No	Yes	3	YES	0.75
13	-34.917604	146.58703	White Cypress	70	11	No	Yes	3	YES	0.75
14	-34.915692	146.58699	White Cypress	82	8	No	Yes	3	YES	0.75
15	-34.915058	146.58562	White Cypress	57	8	No	Yes	3	YES	0.75
16	-34.91448	146.58419	White Cypress	54	10	No	Yes	3	YES	0.75
17	-34.912129	146.58458	White Cypress	59	11	No	Yes	3	YES	0.75
18	-34.910447	146.58493	White Cypress	66	12	No	Yes	3	YES	0.75
19	-34.907771	146.58652	White Cypress	63	8	No	Yes	3	YES	0.75
20	-34.907213	146.58596	Yellow Box	89	10	No	Yes	3	YES	0.75
21	-34.91699	146.59224	White Cypress	54	10	No	Yes	3	YES	0.75
22	-34.922667	146.59063	White Cypress	64	7	No	Yes	3	YES	0.75
23	-34.925269	146.59031	White Cypress	51	8	No	Yes	3	YES	0.75

24	-34.925641	146.59141	Grey Box	131	10	Yes	Yes	3	YES	1
25	-34.926209	146.58658	Grey Box	80	12	Yes	Yes	3	NO	0
26	-34.915979	146.5854	Grey box	90	8	Yes	Yes	3	NO	0
27	-34.91163	146.58581	Grey box	150	8	Yes	Yes	3	YES	1
28	-34.908843	146.58116	Yellow box	83	11	Yes	Yes	3	YES	1
29	-34.908798	146.58031	Grey Box	62	7	Yes	Yes	3	YES	1
30	-34.908629	146.57824	Grey Box	65	8	Yes	Yes	3	YES	1
31	-34.906783	146.58912	Grey Box	90	7	Yes	Yes	3	NO	0
32	-34.912306	146.57639	Grey Box	66	9	Yes	Yes	3	YES	1
33	-34.914305	146.57943	Grey Box	90	8	Yes	Yes	3	NO	0
34	-34.917446	146.58854	Grey Box	89	8	Yes	Yes	3	YES	1
35	-34.925266	146.58821	Grey Box	76	12	Yes	Yes	3	YES	1
36	-34.925337	146.59064	Grey Box	92.5	12	Yes	Yes	3	YES	1
37	-34.917526	146.58177	Grey Box	59	7	Yes	Yes	3	NO	0
38	-34.913815	146.57986	Stag	110	10	Yes	Yes	3	YES	0
39	-34.907258	146.58154	Yellow box	91	11	Yes	Yes	3	YES	1
40	-34.916122	146.5945	White cypress	51	8	Yes	Yes	3	YES	1
41	-34.910708	146.59117	White cypress	57	9	Yes	Yes	3	YES	1
42	-34.905033	146.58922	Grey Box	104	6	Yes	Yes	3	YES	1
43	-34.914085	146.59407	White Cypress	75	9	No	Yes	3	YES	0.75
44	-34.912982	146.59468	White Cypress	42	8	No	No	2	YES	0.5
45	-34.916036	146.59294	White Cypress	67	10	No	Yes	2	NO	0
46	-34.926461	146.58777	Grey Box	41	11	No	No	2	NO	0
47	-34.922063	146.58784	White Cypress	48	7	No	No	2	YES	0.5
48	-34.907105	146.5788	Grey Box	81	6	Yes	Yes	3	YES	1
49	-34.905848	146.57936	Grey Box	98	8	Yes	Yes	3	YES	1
50	-34.905455	146.57965	Grey Box	85	8	Yes	Yes	3	YES	1
51	-34.904959	146.58897	Grey Box	68	7	Yes	Yes	3	YES	1
52	-34.905701	146.58856	Grey Box	96	6	Yes	Yes	3	YES	1

<b>53</b>	-34.909482	146.5872	Yellow box	111	9	Yes	Yes	3	YES	1
<b>54</b>	-34.910513	146.57686	Grey Box	78	6	Yes	Yes	3	YES	1
<b>55</b>	-34.910751	146.59041	White Cypress	64	12	Yes	Yes	3	YES	1
<b>56</b>	-34.913815	146.5943	White Cypress	53	8	No	Yes	3	YES	0.75

Notes: DBH – Diameter at Breast Height

The Large Tree Benchmark for PCT80 *Western Grey Box - White Cypress Pine tall woodland* is 50cm DBH



## APPENDIX F FAUNA SURVEY RESULTS

+ denotes threatened species

Scientific Name	Common Name	Opportunistic	Survey 1 E463268 N6137983 GDA94 Z55	Survey 2 E463693 N6135238 GDA94 Z55	Survey 3 E461378 N6137701 GDA94 Z55	Survey 4 E464991 6135299 GDA94 Z55	Nocturnal
<b>Birds</b>							
<i>Ardea pacifica</i>	White-necked Heron			X			
<i>Falco longipennis</i>	Australian Hobby	E461271 N6137004					
<i>Falco cenchroides</i>	Nankeen Kestrel	X (nest)					
<i>Vanellus tricolor</i>	Banded Lapwing	E465804 N6135213					
<i>Ocyphaps lophotes</i>	Crested Pigeon	X	X		X	X	
<i>Eolophus roseicapilla</i>	Galah	X			X		
<i>Platycercus eximius</i>	Eastern Rosella	X			X	X	
<i>Psephotus haematonotus</i>	Red-rumped Parrot	X	X			X	
<i>Tyto alba</i>	Barn Owl						E462129 N6135355
<i>Ninox novaeseelandiae</i>	Southern Boobook						E462216 N6135619
<i>Podargus strigoides</i>	Tawny Frogmouth						E464317 N6135237
<i>Hirundo neoxena</i>	Welcome Swallow					X	
<i>Anthus australis</i>	Australian Pipit	X					
<i>Cincloramphus cruralis</i>	Brown Songlark	X					
<i>Pachycephala rufiventris</i>	Rufous Whistler		X				
<i>Rhipidura leucophris</i>	Willy Wagtail	X	X				
+ <i>Pomatostomus temporalis</i>	+ Grey-crowned Babbler	E464718 N6135317					

<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			X	
<i>Manorina melanocephala</i>	Noisy Miner	X		X	X
<i>Lichenostomus virescens</i>	Singing Honeyeater	X			
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		X		
+ <i>Ephthianura albifrons</i>	+ White-fronted Chat	E463876 N6135542 (50) E464254 N6134965 (100+)			
<i>Sternus vulgaris</i>	Starling				X
<i>Grallina cyanoleuca</i>	Peewee	X		X	X
<i>Corcorax melanorhamphos</i>	White-winged Chough				X
<i>Struthidea cinerea</i>	Apostlebird	X			
<i>Cracticus nigrogularis</i>	Pied Butcherbird	X			
<i>Cracticus tibicen</i>	Australian Magpie	X		X	X
<i>Corvus mellori</i>	Little Raven	X			
<b>Mammals</b>					
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	X			
<i>Pteropus scapulatus</i>	Little Red Flying-fox	E462666 N6134986			

## APPENDIX G EPBC PROTECTED MATTERS SEARCH



## APPENDIX H EPBC HABITAT ASSESSMENT

Species highlighted in grey have suitable habitat present within the development site.

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
<b>FAUNA</b>				
Australian Bittern <i>Botaurus poiciloptilus</i>	Permanent freshwater wetlands with tall, dense vegetation.	Absent – no freshwater wetlands with dense vegetation	Unlikely	No – Unlikely to occur on site
Curlew Sandpiper <i>Calidris ferruginea</i>	Intertidal mudflats in both fresh and brackish waters in sheltered coastal areas, such as estuaries, bays, inlets, and lagoons. Also recorded inland, including around ephemeral and permanent lakes, dams, and waterholes, usually with bare edges of mud or sand	Absent – no intertidal mudflats	Unlikely	No – Unlikely to occur on site
Painted Honeyeater <i>Grantiella picta</i>	Boree/Weeping Myall, Brigalow, and Box-Gum Woodlands and Box-Ironbark Forests. Specialist feeder on the fruits of mistletoes.	Scattered paddock trees of box-gum woodland. No mistletoes present.	Unlikely – not detected during site surveys. No suitable food sources. (mistletoes)	No – Unlikely to occur on site
Swift Parrot <i>Lathamus discolor</i>	On the coast and southwest slopes in areas with abundant flowering eucalypts or lerp. Feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box and Lerp infested trees such as Grey Box and Black Butt.	Present	Unlikely – outside mapped important areas (OEH). Not detected during surveys	Possible, Assessment of significance
Mallee Fowl <i>Leipoa ocellata</i>	Semi-arid to arid shrublands and low woodlands, especially those dominated by Mallee and/or Acacia which are tall, dense, and floristically rich. A sandy to sandy-loam substrate and abundance of leaf litter are required for breeding.	Absent	Unlikely	No – Unlikely to occur on site
Eastern Curlew <i>Numenius madagascariensis</i>	Large intertidal mudflats often with seagrass beds along sheltered coasts including in estuaries, bays, harbours, inlets,	Absent	Unlikely	No – Unlikely to occur on site

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
<b>FAUNA</b>				
	lagoons, and among saltmarshes and mangroves.			
Plains Wanderer <i>Pedionomus torquatus</i>	Semi-arid, lowland native grasslands that typically occur on hard red-brown soils. Habitat structure typically comprises 50% bare ground, 10% fallen litter and 40% herbs, forbs and grasses. Grassland habitat less than 5cm high.	Absent – no native grasslands with preferred habitat structure.	Unlikely	No – Unlikely to occur on site.
Superb Parrot <i>Polytelis swainsonii</i>	Box-Gum, Box-Cypress, and Boree Woodlands and River Red Gum Forests. They nest in hollows of large trees in tall open forest or woodland.	Present	Likely – Known to occur in the area	Yes – Assessment of Significance
Australian Painted Snipe <i>Rostratula australis</i>	Shallow terrestrial freshwater or occasionally brackish wetlands, including temporary and permanent lakes, swamps, and claypans, as well as inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms, and bore drains. Fringes of swamps, dams, and nearby marshy areas with cover of grasses, lignum, low scrub, or open timber. Shallow wetlands with areas of bare wet mud.	Absent	Unlikely	No – Unlikely to occur on site
Flathead Galaxias <i>Galaxias rostratus</i>	Still or slow-moving water bodies such as wetlands and lowland streams. Range of habitats including rock and sandy bottoms and aquatic vegetation.	Absent – No waterbodies	Unlikely	No – No suitable habitat
Murray Cod <i>Maccullochella peelii</i>	Wide range of warm water habitat including clear rocky streams, slow flowing turbid rivers, and billabongs, most frequently in main river channel and larger tributaries but occasionally in floodplain channels during floods. Near complex structural cover such as large rocks, woody debris, and overhanging vegetation.	Absent – No waterbodies	Unlikely	No – No suitable habitat

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
<b>FAUNA</b>				
Macquarie Perch <i>Macquaria australasica</i>	Both river and lake habitats; especially the upper reaches of rivers and their tributaries. Clear, deep, rocky holes with plenty of cover including aquatic vegetation, large boulders, large woody debris, and overhanging banks.	Absent – No waterbodies	Unlikely	No – No suitable habitat
Southern Bell Frog <i>Litoria raniformis</i>	Found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot Swamps, Lignum/Typha swamps and River Red Gum Swamps or Billabongs along floodplains and river valleys.	Absent	Unlikely	No – Unlikely to occur on site.
Corben's Long-eared Bat <i>Nyctophilus corbei</i>	Variety of vegetation types, most commonly Mallee, Bulloke, and Box-dominated communities, but most common in vegetation with distinct canopy and dense understorey. Roost in tree hollows, crevices, and under loose bark.	Present	Possible – Yes known to occur in locality.	Yes – Assessment of Significance undertaken
Koala <i>Phascolarctos cinereus</i>	Temperate, subtropical and tropical eucalypt woodlands and forests where suitable food trees grow, of which there are more than 70 eucalypt species and 30 non-eucalypt species that are particularly abundant on fertile clay soils.	Present	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	Range of vegetation communities including rainforest, open forest, and closed and open woodland. Roost sites usually near water, including lakes, rivers, and coastlines.	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Pink-tailed Worm-lizard <i>Aprasia parapulchella</i>	Inhabits sloping open woodland areas with predominantly native grassy ground layers. Commonly found beneath small, partially-embedded rock.	Absent – no rocky outcrops or partially buried rocks.	Unlikely – No suitable habitat	No – Unlikely to occur on site
<b>FLORA</b>				



Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
<b>FAUNA</b>				
A spear-grass <i>Austrostipa wakoolica</i>	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils.	Present - Grey Box-White Cypress Woodland an associated vegetation type	Possible – development site within known distribution	Yes – Assessment of Significance undertaken
Mueller Daisy <i>Brachyscome muelleroides</i>	Grows in damp areas on the margins of claypans in moist grassland with <i>Pycnosorus globosus</i> , <i>Agrostis avenacea</i> and <i>Austrodanthonia duttonianum</i> .	Absent - Grey Box woodland not an associated vegetation type.	Unlikely	No – Unlikely to occur on site
Sand-hill Spider-Orchid <i>Caladenia Arenaria</i>	Occurs in woodland with sandy soil, especially that dominated by White Cypress Pine	Present - Grey Box-White Cypress Woodland an associated vegetation type	Possible – development site within known distribution	Yes – Assessment of Significance undertaken
Turnip Copperburr <i>Sclerolaena napiformis</i>	Remnant grassland habitats on clay-loam soils. Found along roadside travelling stock reserves.	Marginal – Grey Box woodland not an associated vegetation type.	Unlikely – outside known distribution (OEH, 2017).	No – Unlikely to occur on site
Slender Darling Pea <i>Swainsona murrayana</i>	A variety of vegetation types including bladder saltbush, Black Box and grassland communities.	Present - Grey Box-White Cypress Woodland an associated vegetation type.	Unlikely – not detected during site surveys	No – unlikely to occur on site.

## APPENDIX I EPBC ASSESSMENTS OF SIGNIFICANCE

The *Environment Protection and Biodiversity Conservation Act 1999* specifies factors to be taken into account in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level. The *Matters of Environmental Significance – Significant Impact Guidelines* (DoE 2013) identify the factors the need to be considered.

The following assessment assesses the significance of the likely impacts associated with the proposed works on these species and ecological communities listed under the EPBC Act:

- Birds
  - Swift Parrot (*Lathamus discolor*)- CE
  - Superb Parrot (*Polytelis swainsonii*) – V
- Bats
  - Corben’s Long-eared Bat (*Nyctophilus corbei*) - V
- Flora
  - A Spear Grass (*Austrostipa wakoolica*) - E
  - Sand-hill Spider Orchid (*Caladenia arenaria*) – E
- Ecological Communities
  - Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia. - E

## CRITICALLY ENDANGERED AND ENDANGERED SPECIES

The following assessment assesses the significance of the likely impacts associated with the proposed works on these endangered and critically endangered species:

- Fauna
  - Swift Parrot – CE
- Flora
  - A Spear Grass (*Austrostipa wakoolica*) – E
  - Sand-hill Spider Orchid (*Caladenia arenaria*) – E

According to the guidelines (DoE 2013), the criteria for assessing endangered and critically endangered species are the same and as such, each group has been assessed accordingly below.

### a) Will the action lead to a long-term decrease in the size of a population of a species?

#### *Austrostipa wakoolica*

*Austrostipa wakoolica* was not detected within the development site however survey timing was not considered suitable for proper identification of this species. *Austrostipa* species were present along Muntz Rd and Sandigo-Boree Creek Rd, however were unable to be identified due to the lack of seeds. One record of this species occurs within 10km of the development site.

Suitable habitat for *A. wakoolica* occurs along Muntz Rd and Sandigo-Boree Creek Rd. 1.6 ha of this 12ha patch of vegetation would be impacted by the proposal. 1.2 ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and unlikely to host a population of *A. wakoolica*. No impacts would occur to the nearest known population.

The small area of habitat impacted would be unlikely to lead to a long-term decrease to the size of a population of the species.

#### *Caladenia arenaria*

*Caladenia arenaria* was not detected within the development site however survey time was not considered suitable for this species. Sand-hill spider orchid is only visible above ground during Winter and Spring, with the plant persisting as an underground tuber during the rest of the year (DEC, 2004).

Six records of the Sand-hill Spider Orchid occur in Buckinbong State Forest about 6km West of the development site. Sand-hill Spider Orchid is associated with White Cypress Pine and suitable habitat for the Sand-hill Spider Orchid exists along Muntz Rd and Sandigo-Boree Creek Rd. 1.6 ha of this patch of vegetation would be impacted by the proposal. 1.2 ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and unlikely to host a population of Sandhill Spider Orchid. 6.3 ha of potential habitat would remain in the roadside reserve that would not be impacted. No impacts would occur to the nearest known population in Buckinbong State Forest.

The small area of habitat impacted would be unlikely to lead to a long-term decrease to the size of a population of the species.

#### Swift Parrot

The swift parrot breeds in Tasmania during the Summer and the entire population migrates north to the Mainland in Winter (TSSC, 2016). In NSW, swift parrots forage on winter flowering Eucalyptus species and lerp infested Eucalypts. Potential foraging habitat for Swift Parrot occurs within the development site and would be removed by the proposal. Surveys did not detect these species and so the development site is not considered known habitat but provides potential foraging habitat.

The proposal would involve the removal of around 1.6 ha of Box-gum woodland vegetation suitable as a foraging source and 47 scattered paddock trees of Grey Box and White Cypress. There would also be some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens.

The quality of potential habitat for these species is low, being largely cleared, and highly disturbed by agriculture. Given the relatively small amount of habitat to be removed, and with the recommended



mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of these species is minimal.

**b) Will the action reduce the area of occupancy of the species?**

***Austrostipa wakoolica* and *Caladenia arenaria***

1.6 ha of potential habitat in the form of White Cypress – Grey Box Woodland would be permanently removed for the widening of Muntz and Sandigo-Boree Creek road. 1.2 ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and unlikely to host a population of Sandhill Spider Orchid. 6.3 ha of potential habitat would remain in the roadside reserve that would not be impacted.

No impacts would occur to the nearest known populations. The small area of habitat to be impacted would have a minimal impact of the area of occupancy for these species.

**Swift Parrot**

The proposal would involve the removal of around 0.6ha of Box-gum woodland vegetation and 49 scattered paddock trees over a crop. There would also be some disturbance associated with construction. The development site is not considered known important habitat.

The quality of potential habitat for these species is low, and the area of habitat to be removed is relatively small. The removal of the vegetation would not impact on the ability of the species to move across the landscape and as such would have a minimal impact on the area of occupancy of the species.

**c) Will the action fragment an existing population into two or more populations?**

***Austrostipa wakoolica* and *Caladenia arenaria***

1.6 ha of vegetation would be removed along roadside. It is not known whether a population occurs within the roadside reserve. However, if the species did occur 6.6ha of suitable native vegetation would remain in the roadside reserve. Connectivity would be maintained along the roadside and would be unlikely to fragment a population. No impacts would occur to any known population.

**Swift Parrot**

The proposal would involve the removal of around 1.6 ha of Box-gum Woodland and 47 scattered paddock trees. There would also be some disturbance associated with construction. The development site is not considered known habitat and the likelihood of occurrence of these species is low.

The quality of potential habitat is low, and the area of habitat to be removed is relatively small and would not disrupt habitat connectivity for canopy species. The proposal would not fragment an existing population of these species into two or more populations.

**d) Will the action adversely affect habitat critical to the survival of a species?**

***Austrostipa wakoolica* and *Caladenia arenaria***

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these species.

**Swift Parrot**

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for this species.

**e) Will the action disrupt the breeding cycle of a population?**

***Austrostipa wakoolica* and *Caladenia arenaria***

*Caladenia arenaria* is both self-fertile and pollinated by a male thynnid wasps (DEC, 2014). Seeds are small and short lived. If these species occur within the development footprint, the proposal could disrupt the breeding cycle of the population through the removal of some plants. However, the small area to be impacted (1.6 ha) is in an area that has been disturbed through grazing by rabbits and stock, invasion by

weeds, past construction activities and edge effects is unlikely to provide ideal habitat. 6.6ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the nearest known population in Buckingbong State Forest.

*Austrostipa wakoolica* seeds are dispersed by wind and rain and seeds are viable for three to five years in the soil bank. However, the small area to be impacted (1.6 ha) is in an area that has been disturbed through grazing by rabbits and stock, invasion by weeds, past construction activities and edge effects is unlikely to provide ideal habitat. 6.6ha of vegetation would remain that could provide a recruitment source if the species did occur in the development site. No impacts would occur to the nearest known population.

Based on these factors, it is unlikely the action would disrupt the breeding cycle of these species.

#### Swift Parrot

Swift Parrots breed only in Tasmania, migrating to the mainland in autumn and winter. There would be no notable impacts on connectivity for this highly mobile species. The proposal would not disrupt the breeding cycle of the Swift Parrot.

#### f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

##### *Austrostipa wakoolica* and *Caladenia arenaria*

1.6 ha of potential habitat in the form of White Cypress – Grey Box Woodland would be permanently removed for the widening of Muntz and Sandigo-Boree Creek road. 0.9ha of this vegetation has previously been disturbed through past construction and maintenance of the road and table drain and unlikely to host a population of Sandhill Spider Orchid. 6.3 ha of potential habitat would remain in the roadside reserve that would not be impacted. No impacts would occur to the nearest known population

#### Swift Parrot

The proposal would involve the removal of around 1.6 ha of Box-gum Woodland and 47 scattered paddock trees. There would also be some disturbance associated with construction, which could decrease the quality of some habitat. The development site is not considered known habitat and is considered potential habitat only.

The quality of potential habitat is low, and the area of habitat to be removed is relatively small and would not disrupt habitat connectivity for canopy species. With the implementation of the recommended mitigation measures, the likelihood of the action modifying, destroying, removing, isolating, or decreasing the availability or quality of habitat to the extent that these species would be likely to decline is minimal.

#### g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered / critically endangered /vulnerable species habitat?

##### Swift Parrot, *Austrostipa wakoolica* and *Caladenia arenaria*

The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these threatened species becoming established in potential habitat.

#### h) Will the action introduce disease that may cause the species to decline?

##### Swift Parrot, *Austrostipa wakoolica* and *Caladenia arenaria*

There is a risk that diseases could be introduced to the development site via machinery, vehicles, and materials during construction and operation. With the implementation of the recommended mitigation measures, the proposal is unlikely to result in the introduction of any disease that may cause these species to decline.

#### i) Will the action interfere with the recovery of the species?

##### *Austrostipa wakoolica* and *Caladenia arenaria*

No recovery plans have been implemented for *A. wakoolica* or *C. arenaria*. No impacts would occur to any known population of these species.

#### Swift Parrot

The National Recovery Plan for the Swift Parrot lists the following objectives:

1. To identify and prioritise habitats and sites used by the species across its range, on all land tenures.
2. To implement management strategies to protect and improve habitats and sites on all land tenures.
3. To monitor and manage the incidence of collisions, competition and Beak and Feather Disease (BFD).
4. To monitor population trends and distribution throughout the range.

The proposal would not interfere with any of these objectives.

#### Conclusion

##### *Austrostipa wakoolica* and *Caladenia Arenaria*

Suitable habitat for these species exists along Muntz Rd and Sandigo-Boree Creek Rd. Seasonal conditions were considered unsuitable for these species and it is not known if they occur within the development site. Based on the small area of potential habitat impacted, suitable remaining habitat and that no impacts to the known populations would occur, it is considered unlikely the proposal would have a significant impact on *Austrostipa wakoolica* or *Caladenia arenaria*.

#### Swift Parrot

A significant impact to this species is considered unlikely, on the basis that the proposal would not;

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of these species
- Affect habitat or introduce disease such that these species would decline
- Introduce invasive species harmful to the species
- Interfere with the recovery of these species.

No referral is considered necessary to the Federal Department of Environment for this species.



## VULNERABLE SPECIES

The following assessment assesses the significance of the likely impacts associated with the proposed works on these vulnerable species:

- Birds
  - Superb Parrot – V
- Bats
  - Corben's Long-eared Bat– V

An 'important population' is defined as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

### a) Will the action lead to a long-term decrease in the size of an important population of a species?

#### Superb Parrot

The Superb Parrot was not detected within the development site during the field surveys, however surveys were not undertaken during the optimal timing in Spring. Suitable habitat exists in the development footprint in the form of scattered Grey Box paddock trees. Five records of the Superb Parrot have been detected within 10km of the development, mainly along the Sturt Highway (Bionet, 2018). The population of superb parrot within Southern NSW is considered one population of about 6500 individuals (Baker-Gabb, 2011)

The national recovery plan (Baker- Gabb, 2011) indicates core breeding areas as:

1. Area bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young,
2. Along the Murrumbidgee River between Wagga Wagga and Bringagee,
3. Along the Murray and Edward Rivers

The development site is not located within any of these core breeding areas. The Murrumbidgee River is located 20km from the development site. However Sandy Creek, a tributary of the Murrumbidgee is located 5km north of the development site. Sandy Creek is fringed with Riverine Woodland and may provide suitable breeding habitat for the Superb Parrot. Nesting occurs in hollows near water usually within 10km of Box-Gum Woodland (Baker – Gabb, 2011). The development site is located 5km from suitable breeding habitat paddock and the superb parrot may forage within the development site on occasion.

An important population is not considered to occur within the development site, as no known population occurs within the development site, the species has a large home range and the development site is not near the limit of the species range. The action is unlikely to lead to a long term decrease in the size of an important population.

#### Corben's Long-eared Bat

Surveys were not undertaken for the Corben's Long-eared Bat and it is not known whether it occurs on site. Suitable habitat for the Corben's Long-eared Bat exists in the development site in the form of scattered Grey Box and White Cypress Paddock Trees. The nearest known record occurs about 80km to the north of the site, near Griffith. Studies shown that Corben's long eared bat is more commonly found in habitats that have a distinct tree canopy and dense understory and extensive stands of vegetation rather than smaller woodland patches (TSSC, 2015). These preferred habitat features are not present within the development footprint.

The Corben's distribution occurs from Queensland and into northern Victoria. It is considered 50% of the species known distribution occurs in inland NSW (TSSC, 2015). It is considered to have large home range.

An important population is not considered to occur within the development site, as no known population occurs within the development site, the species has a large home range and the development site is not near the limit of the species range. The action is unlikely to lead to a long term decrease in the size of an important population.

**b) Will the action reduce the area of occupancy of an important population of a species?**

**Superb Parrot**

As an important population is not considered to occur within the development site, the proposal is not considered to reduce the area of occupancy of an important population. The broader development site and surrounding area will continue to contain suitable areas of breeding and foraging habitat to maintain individuals of the species with the proposal area and wider locality.

**Corben's Long-eared Bat**

As an important population is not considered to occur within the development site, the proposal is not considered to reduce the area of occupancy of an important population. The broader development site and surrounding area will continue to contain suitable areas of breeding and foraging habitat to maintain individuals of the species with the proposal area and wider locality.

**c) Will the action fragment an existing important population into two or more populations?**

**Superb Parrot**

An important population is not considered to occur within the development site. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

**Corben's Long-eared Bat**

An important population is not considered to occur within the development site. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

**d) Will the action adversely affect habitat critical to the survival of a species?**

**Superb Parrot**

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these species.

**Corben's Long-eared Bat**

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these species.

**e) Will the action disrupt the breeding cycle of an important population?**

**Superb Parrot**

An important population is not considered to occur within the development site. However, Superb parrots usually breed in hollows in riverine woodlands along watercourses but occasionally in Box-gum Woodland (Baker-Gabb, 2011). 112 Hollow Bearing Trees (HBT) occur within the development site. 25 of these would be impacted by the proposal. Only 8 of the 25 HBTs to be removed were considered to have suitable hollows of the right size and height for the Superb Parrot. 49 trees with suitable hollows would remain within the development site.

Mitigation measures will be put in place for hollow bearing tree removal to avoid impacts to the breeding cycle of the species if they are present within the development site.

#### Corben's Long-eared Bat

No known important population occurs within the proposal area. However, specific mitigation measures will be put in place for hollow-bearing tree removal to avoid impacts to the breeding cycle of the species if they are present within the development site. Higher quality areas of suitable habitat will be retained in the development site, ensuring that individuals could continue to utilise the development site, and the breeding cycle of the broader population is not disrupted.

**f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?**

#### Superb Parrot

The proposal would involve the removal of around 1.6 ha of Box-Gum woodland habitat, and 47 paddock trees. The quality of potential habitat is low, and the area of habitat to be removed is relatively small and would not disrupt habitat connectivity for this mobile canopy species. With the implementation of the recommended mitigation measures, the proposal would not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species would be likely to decline.

#### Corben's Long-eared Bat

The proposal will remove approximately 1.6 ha of woodland vegetation containing native canopy and 47 paddock trees, 25 containing hollows. The vegetation to be removed as a result of the proposal is considered to constitute low quality foraging habitat and small amounts of potential roosting and breeding habitat. Higher quality areas of suitable habitat have been avoided and will be retained within the development site, ensuring that areas of suitable habitat remain. As such, the impacts to habitat are not considered likely to be such that the species is likely to decline, were it present within the development site.

**g) Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?**

#### Superb Parrot & Corben's Long-eared Bat

The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread or introduction of invasive species on site. The proposal is therefore unlikely to result in invasive species that are harmful to these vulnerable species becoming established in potential habitat.

**h) Will the action introduce disease that may cause the species to decline?**

#### Superb Parrot & Corben's Long-eared Bat

There is a risk that diseases could be introduced to the development site via machinery, vehicles, and materials during construction and operation. With the implementation of the recommended mitigation measures, the proposal is unlikely to result in the introduction of any disease that may cause these species to decline.

**i) Will the action interfere substantially with the recovery of the species?**

#### Superb Parrot

The National Recovery Plan for Superb Parrot lists the following specific objectives:

1. Determine population trends in the Superb Parrot.



2. Increase the level of knowledge of the Superb Parrot's ecological requirements.
3. Develop and implement threat abatement strategies.
4. Increase community involvement in and awareness of the Superb Parrot recovery program.

The proposal would not interfere with any of these objectives.

#### **Corben's Long-eared bat**

No national recovery plan has been made for the Corben's Long-eared Bat.

Considering the small areas of potential foraging and roosting habitat to be removed, the mitigation measures in place to avoid impacts to individuals and that substantial habitat will remain within the broader proposal area and locality, the proposal is unlikely to interfere with the recovery of Corben's Long-eared Bat.

#### **Conclusion**

A significant impact to these species is considered unlikely, on the basis that the proposal would not;

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of these species
- Affect habitat or introduce disease such that these species would decline
- Introduce invasive species harmful to the species
- Interfere with the recovery of these species.

No referral is considered necessary to the Federal Department of Environment for these species.

## ENDANGERED ECOLOGICAL COMMUNITY

The following assesses the significance of the likely impacts associated with the proposed works on the Endangered Ecological Community (EEC); Grey Box (*Eucalyptus microcarpa*) Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

### a) Will the action lead to a reduction in the extent of an ecological community?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

Up to 1.6 ha of Grey Box Grassy Woodland along Muntz Rd and Sandigo-Boree Creek Road would be impacted by the proposal. The majority of this (1.2 ha), is comprised of vegetation that has previously been disturbed through prior construction and maintenance of the road and table drain and is predominantly comprised of coloniser species. The remaining 0.4ha of Grey Box Grassy Woodland to be removed comprises two mature Grey Box (*Eucalyptus microcarpa*). No other mature Grey Box trees would be removed. 6.3 ha of Grey Box Grassy Woodland and 30 mature Eucalypt trees would remain in the road reserve within the development site.

There will be a small reduction in the extent of the ecological community, however the extent of undisturbed Grey Box Grassy Woodland to be removed is a small proportion (6%) and would unlikely place the patch of Grey Box Grassy Woodland at risk of extinction.

### b) Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

The patch of EPBC listed community along Muntz Rd and Sandigo-Boree Creek Rd is already highly fragmented from past clearing in the agricultural landscape. The removal of 1.6 ha of native vegetation would slightly increase fragmentation of the patch, however the narrow patch of roadside vegetation is already exposed to disturbance from edge effects and the removal would not result in any further loss of ecological function. Connectivity would still be maintained along the roadside and the proposal would not isolate any patches of the community.

### c) Will the action adversely affect habitat critical to the survival of an ecological community?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for this community.

### d) Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

Soils and nutrient balance in parts of the subject site are already highly disturbed through past construction and maintenance of Muntz Rd and Sandigo-Boree Creek Rd. The proposal would have a short-term impact upon soils and possibly surface water flow during construction. These impacts are manageable with the implementation of erosion and sediment controls and would be unlikely to further degrade the community in the long-term. The actions associated with the proposal are not considered likely to substantially alter hydrological patterns necessary for the community's survival.

### e) Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

The proposal would be unlikely to cause a change in the species composition of the remaining patch. Understory species are similar throughout the range of the patch. No characteristic or functionally important species would be lost through the impact to the 1.6 ha of Grey Box Grassy woodland. Two mature Grey Box trees would be removed; however 30 mature Eucalyptus trees would remain in the patch. No further impacts are anticipated to the remaining Grey Box Grassy woodland. No introduced fire or flooding regimes would occur and no increase of natural occurrences of these events is anticipated from the development. No harvesting of plants would occur in the remaining Grey Box Grassy woodland.

- f) Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:
- a. Assisting invasive species, that are harmful to the listed ecological community, to become established; or
  - b. Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

Perennial grasses such as Paspalum occur in small sections along Muntz Rd and Sandigo-Boree Creek Rd. Exotic annual grasses such as Wild Oats, Rye Grass and Barley Grass are also dominant within the woodland vegetation. There is a risk that new invasive weeds could be established in the proposal area via seeds or plant parts on machinery during construction. These impacts can be readily managed and minimised with the implementation of a weed management procedure.

The proposal does not involve the introduction of any fertilisers, herbicides or other chemicals or pollutants.

With the recommended hygiene measures implemented, the likelihood of the proposal resulting in invasive species or introduction of pollutants that are harmful to the EEC is minimal.

- g) Will the action interfere with the recovery of an ecological community?

#### Grey Box Grassy Woodland and Derived Native Grasslands of South-Eastern Australia

There is no adopted or made recovery plan for this ecological community.

#### Conclusion

The proposal would result in the permanent removal of up to 1.6 ha of Grey Box Grassy Woodland along Muntz Rd and Sandigo-Boree Creek Rd. The majority of this vegetation to be removed is disturbed from prior construction and maintenance of the road. 6.3 ha of Grey Box Grassy Woodland would remain within the road reserve in the development site.

Minimal fragmentation or isolation of habitat would occur and the proposal would not modify or destroy abiotic factors. The proposal would not cause a substantial change in the species composition or substantial reduction in the quality of the ecological community. For these reasons, a significant impact is not considered to occur to the EPBC listed community and a referral is not considered necessary to the federal department of Environment.



## APPENDIX J BAM CALCULATOR RESULTS



### BAM Credit Summary Report

#### Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00010929/BAAS18074/19/00014176	Avonlie Solar Farm Paddock Trees	04/01/2019
Assessor Name	Report Created	BAM Data version *
Julie Gooding	07/02/2019	6
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18074		

#### Paddock Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
<b>80- Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion</b>			
2	False	4.0	2
3	False	21.0	16
3	True	3.0	3
3	False	1.0	1
3	True	3.0	3
3	True	15.0	15
			<b>40</b>
			<b>40</b>



## BAM Credit Summary Report

### Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00010724/BAAS18074/19/00010725	Avonlie Solar Farm	03/06/2019
Assessor Name	Report Created	BAM Data version *
Dave Maynard	05/06/2019	9
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS17026		

### Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAI	Ecosystem credits
<b>Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)</b>								
6	158_Planted	34.1	0.9	0.25	High Sensitivity to Potential Gain	2.00		15
<b>Subtotal</b>								<b>15</b>
<b>Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion</b>								
1	80_Good	51.8	1.1	0.25	High Sensitivity to Potential Gain	2.00		29



## BAM Credit Summary Report

2	80_Good_understory	39.6	0.5	0.25	High Sensitivity to Potential Gain	2.00		9
3	80_Moderate_Grazed	36.0	0.1	0.25	High Sensitivity to Potential Gain	2.00		2
4	80_Low	20.9	0.1	0.25	High Sensitivity to Potential Gain	2.00		1
5	80_Planted	37.2	0.1	0.25	High Sensitivity to Potential Gain	2.00		2
							<b>Subtotal</b>	<b>43</b>
							<b>Total</b>	<b>58</b>

### Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAI	Species credits
<b><i>Austrastipa wakaolica</i> / A spear-grass (Flora)</b>						
80_Good	51.8	1.13	0.25	2	False	29
80_Good_understory	39.6	0.47	0.25	2	False	9
<b>Subtotal</b>						<b>38</b>
<b><i>Caladenia arenaria</i> / Sand-hill Spider Orchid (Flora)</b>						
80_Good	51.8	1.13	0.25	3	True	44
80_Good_understory	39.6	0.47	0.25	3	True	14
<b>Subtotal</b>						<b>58</b>





## BAM Credit Summary Report

<b><i>Diuris</i> sp. (Oaklands, D.L. Jones 5380) / Oaklands Diuris (Flora)</b>							
80_Good	51.8	1.13	0.25	3	True		44
80_Good_understory	39.6	0.47	0.25	3	True		14
						<b>Subtotal</b>	<b>58</b>
<b><i>Diuris tricolor</i> / Pine Donkey Orchid (Flora)</b>							
80_Good	51.8	1.13	0.25	1.5	False		22
80_Good_understory	39.6	0.47	0.25	1.5	False		7
						<b>Subtotal</b>	<b>29</b>
<b><i>Lophochroa leadbeateri</i> / Major Mitchell's Cockatoo (Fauna)</b>							
80_Good	51.8	0.15	0.25	2	N/A		4
80_Moderate_Grazed	36.0	0.1	0.25	2	N/A		2
						<b>Subtotal</b>	<b>6</b>
<b><i>Polytelis swainsonii</i> / Superb Parrot (Fauna)</b>							
80_Good	51.8	0.15	0.25	2	N/A		4
80_Moderate_Grazed	36.0	0.1	0.25	2	N/A		2
						<b>Subtotal</b>	<b>6</b>



## BAM Biodiversity Credit Report (Like for like)

### Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00010724/BAAS18074/19/00010725	Avonlie Solar Farm	03/06/2019
Assessor Name	Assessor Number	BAM Data version *
Dave Maynard	BAAS17026	9
Proponent Names	Report Created	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.
	05/06/2019	

### Candidate Serious and Irreversible Impacts

Nil

Species
<b>Caladenia arenaria</b> / Sand-hill Spider Orchid
<b>Caladenia arenaria</b> / Sand-hill Spider Orchid
<b>Diuris sp. (Oaklands, D.L. Jones 5380)</b> / Oaklands Diuris
<b>Diuris sp. (Oaklands, D.L. Jones 5380)</b> / Oaklands Diuris

### Additional Information for Approval

PCTs With Customized Benchmarks



## BAM Biodiversity Credit Report (Like for like)

No Changes

Predicted Threatened Species Not On Site

No Changes

### Ecosystem Credit Summary

PCT	TEC	Area	Credits
80-Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Mandewar and Brigalow Belt South Bioregions	1.9	43.00
158-Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW)	Not a TEC	0.9	15.00

Credit classes for 80	Like-for-like options		
	Any PCT with the below TEC	Containing HBT	In the below IBRA subregions
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Mandewar and Brigalow Belt South Bioregions (including PCT's 76, 80, 81, 82, 101, 110, 237, 248 )	Yes	Lower Slopes,Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.





## BAM Biodiversity Credit Report (Like for like)

Credit classes for 80				
Credit classes for 158	Like-for-like options			
	Any PCT in the below Class	And in any of below trading groups	Containing HBT	In the below IBRA subregions
	Riverine Chenopod Shrublands (including PCT's 158, 159, 195 )	Riverine Chenopod Shrublands - $\geq 70\%$ - $< 90\%$ cleared group (including Tier 4 or higher).	No	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

### Species Credit Summary

Species	Area	Credits
<b>Austrostipa wakoolica</b> / A spear-grass	1.6	38.00
<b>Caladenia arenaria</b> / Sand-hill Spider Orchid	1.6	58.00
<b>Diuris sp. (Oaklands, D.L. Jones 5380)</b> / Oaklands Diuris	1.6	58.00
<b>Diuris tricolor</b> / Pine Donkey Orchid	1.6	29.00



## BAM Biodiversity Credit Report (Like for like)

<b>Lophochroa leadbeateri</b> / Major Mitchell's Cockatoo		0.3	6.00
<b>Polytelis swainsonii</b> / Superb Parrot		0.3	6.00
<b>Austrostipa wakoolica</b> / A spear-grass	80_Good	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Austrostipa wakoolica</b> /A spear-grass	Any in NSW
	80_Good_understory	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Austrostipa wakoolica</b> /A spear-grass	Any in NSW
<b>Caladenia arenaria</b> / Sand-hill Spider Orchid	80_Good	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Caladenia arenaria</b> /Sand-hill Spider Orchid	Any in NSW



## BAM Biodiversity Credit Report (Like for like)

Caladenia arenaria/ Sand-hill Spider Orchid	80_Good		
	80_Good_understory	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		Caladenia arenaria/Sand-hill Spider Orchid	Any in NSW
Diuris sp. (Oaklands, D.L. Jones 5380)/ Oaklands Diuris	80_Good	<b>Like-for-like options</b>	
	80_Good_understory	Only the below Spp	In the below IBRA subregions
		Diuris sp. (Oaklands, D.L. Jones 5380)/Oaklands Diuris	Any in NSW
	80_Good_understory	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		Diuris sp. (Oaklands, D.L. Jones 5380)/Oaklands Diuris	Any in NSW





## BAM Biodiversity Credit Report (Like for like)

<b>Diuris sp. (Oaklands, D.L. Jones 5380)/</b> Oaklands Diuris	80_Good_understory	
<b>Diuris tricolor/</b> Pine Donkey Orchid	80_Good	<b>Like-for-like options</b>
		Only the below Spp
		In the below IBRA subregions
		<b>Diuris tricolor/</b> Pine Donkey Orchid
		Any in NSW
	80_Good_understory	<b>Like-for-like options</b>
		Only the below Spp
		In the below IBRA subregions
		<b>Diuris tricolor/</b> Pine Donkey Orchid
		Any in NSW
<b>Lophochroa leadbeateri/</b> Major Mitchell's Cockatoo	80_Good	<b>Like-for-like options</b>
		Only the below Spp
		In the below IBRA subregions
		<b>Lophochroa leadbeateri/</b> Major Mitchell's Cockatoo
		Any in NSW



## BAM Biodiversity Credit Report (Like for like)

<b>Lophochroa leadbeateri</b> / Major Mitchell's Cockatoo	80_Moderate_Grazed	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Lophochroa leadbeateri</b> /Major Mitchell's Cockatoo	Any in NSW
<b>Polytelis swainsonii</b> / Superb Parrot	80_Good	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Polytelis swainsonii</b> /Superb Parrot	Any in NSW
	80_Moderate_Grazed	<b>Like-for-like options</b>	
		Only the below Spp	In the below IBRA subregions
		<b>Polytelis swainsonii</b> /Superb Parrot	Any in NSW