Appendix C

Biodiversity development assessment report

Orange Grove
Sun Farm

Overland Sun Farming

Orange Grove Sun Farm

Biodiversity Development Assessment Report

Prepared for Orange Grove Sun Farm Pty Ltd | 11 May 2018

Orange Grove Sun Farm

Biodiversity Development Assessment Report

Prepared for Orange Grove Sun Farm Pty Ltd | 11 May 2018

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Orange Grove Sun Farm

Final

Report J17210RP1 | Prepared for Orange Grove Sun Farm Pty Ltd | 11 May 2018

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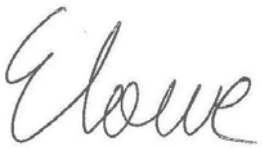
Signature		Signature	
Date	11 May 2018	Date	11 May 2018

Document Control

Version	Date	Prepared by	Reviewed by
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Executive Summary

EMM Consulting Pty Ltd was commissioned by **OVERLAND Sun Farming** Pty Ltd (OVERLAND), on behalf of Orange Grove Sun Farm Pty Ltd (the proponent), to prepare a Biodiversity Development Assessment Report (BDAR) for the Orange Grove Sun Farm, a proposed large-scale solar photovoltaic (PV) generation facility and associated building and electrical infrastructure including grid connection works near the township of Gunnedah, in the Brigalow Belt South Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion of northern NSW (Figure 1.1) (the project). The project will involve the installation of PV solar panels and associated infrastructure on the development site. The development site is divided by Orange Grove Road into two portions, northern and southern, and encompasses an area of approximately 253 hectares (ha) (Figure 1.2).

The development site has been highly modified by past disturbances associated with land clearing, irrigation development, cropping and livestock grazing. It is currently used for livestock grazing and cropping, and the quality of native vegetation within the development site boundary is reflective of the past and current land use. Land immediately to the north and south of Orange Grove Road (Figure 1.2) is used for livestock grazing and contains widely scattered paddock trees, no mid-storey and a heavily grazed groundcover dominated by introduced pasture grass species. Land in the far northern portion of the development site is used for cropping. This area contains very widely scattered paddock trees and a completely cleared mid-storey and ground layer to allow for crop production.

The development site is defined as the maximum area to be impacted by the proposal. The site boundary is defined as the development site plus the surrounding land investigated during the field surveys. Both the development site and the site boundary are shown in Figure 1.1.

Ecological values

Key ecological values identified within the development site include:

- 145.8 ha of PCT 101 *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* (low condition - grazed)*;*
- 2.4 ha of PCT 281 *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* (low condition - grazed). This PCT represents *White Box Yellow Box Blakely's Red Gum Woodland* endangered ecological community (EEC), an EEC listed under Biodiversity Conservation Act 2016 (BC Act); and
- hollow bearing trees across the development site (paddock trees).

No threatened species were identified within the development site, despite targeted surveys being undertaken.

Within the site boundary, Finger Panic Grass (*Digitaria porrecta*), Koala (*Phascolarctos cinerus*) and Squirrel Glider (*Petaurus norfolcensis*) were recorded; however, the development site was reduced to avoid these biodiversity values.

Impact avoidance, minimisation and mitigation

The principal means to reduce impacts to biodiversity values resulting from the project has been to avoid areas of high quality or supporting significant biodiversity values, and minimise the removal of identified native vegetation and fauna habitat. OVERLAND has made significant reductions to the development site and have avoided impacts upon the following significant biodiversity features:

- 0.58 ha of PCT 438 - *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion.*
- 19.13 ha of habitat for Koala and Squirrel Glider;
- riparian vegetation along the Namoi River;
- potential habitat for Murray Cod (*Maccullochella peelii*), Silver Perch (*Bidyanus bidyanus*) and Flat-headed Galaxias (*Galaxias rostratus*) in the Namoi River; and
- potential nest sites for the Black-breasted Buzzard (*Hamirostra melanosternon*) and Square-tailed Kite (*Lophoictinia isura*).

OVERLAND has made refinements to the proposed development site and have significantly reduced impacts upon the following vegetation communities:

- reduced impact upon PCT 101 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* from removal of approximately 342.9 ha down to 145.8 ha; and
- reduced impact upon PCT 281 - *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* from removal of approximately 14.9 ha down to 2.4 ha.

Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts. This mitigation is largely centred on the implementation of 'No Go Zones' or 'Environmental Protection Areas' to protect retained surrounding vegetation of a better quality, as well as appropriate pre-clearance procedures for the hollow bearing trees within the development site.

Biodiversity credits

The vegetation integrity score of both the vegetation zones within the development site is less than 15, and therefore offsets are not required for impacts on native vegetation. The project will not result in any impacts on threatened species that require offsetting. Therefore, the project does not require any offsets and no biodiversity offset strategy is required.

Conclusion

The PCTs within the development site are heavily grazed and were identified to be in very low condition. Measures to avoid and minimise impacts to vegetation were considered during the planning and detailed design stages of the project, resulting in avoidance of all significant biodiversity values, and minimisation of impacts on other areas of native vegetation. Through an iterative design process, which considered the above biodiversity values, the residual impact of the project will be limited to removal of 148.2 ha of low quality native vegetation.

The vegetation integrity score of both vegetation zones within the development site is such that that offsets are not required for impacts on native vegetation. Therefore, the project does not require any offsets and no biodiversity offset strategy is required.

Table of contents

Table of contents *(Cont'd)*

Appendices

Tables

Figures

PART A

Stage 1: Biodiversity Assessment

1 Introduction

1.1 Project background

OVERLAND Sun Farming Pty Ltd (OVERLAND) on behalf of Orange Grove Sun Farm Pty Ltd (the proponent) proposes to develop the Orange Grove Sun Farm, a large-scale solar photovoltaic (PV) generation facility and associated building and electrical infrastructure including grid connection works near the township of Gunnedah, in the Brigalow Belt South Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion of northern NSW (Figure 1.1) (the project).

The project has been deemed State significant development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). Therefore, a development application (DA) for the project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning, or the Minister's delegate, is the consent authority.

This Biodiversity Development Assessment Report (BDAR) forms part of the DA and associated Environmental Impact Statement (EIS) for the project. It documents the biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise biodiversity impacts, and the additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

1.2 Assessment requirements

On 20 December 2017, the Department of Planning and Environment (DPE) provided Secretary's Environmental Assessment Requirements (SEARs) for the Orange Grove Sun Farm. A copy of the SEARs is attached to the EIS as Appendix A. In relation to biodiversity, the SEARs required are listed in Table 1.1.

Table 1.1 SEARS requirements and how they have been addressed

Requirement	Section addressed
An assessment of the biodiversity values and the likely biodiversity impacts of the development.	Biodiversity values are assessed in Sections 3 to 5 of this report. Impacts to these values are assessed in Section 6 of this report.
A detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time.	Measures to avoid, minimise and mitigate impacts are detailed in Section 6 of this report.
A strategy to offset any residual impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW).	Residual impacts requiring offsets are detailed in Section 6.3 of this report.

To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. A copy of the NSW Office of Environment and Heritage (OEH) advice to DPE was attached to the SEARs and matters relevant to the BDAR are listed in Table 1.2.

Table 1.2 Government agency (OEH) requirements

Requirement	Section addressed
Biodiversity impacts are to be assessed in accordance with the Biodiversity Assessment Method (BAM, OEH 2017) and documented in a Biodiversity Development Assessment Report (BDAR)	Assessment has been undertaken in accordance with the BAM and outlined in this BDAR.
The BDAR must include information in the form detailed in Section 6.12 of the Biodiversity Conservation Act 2016 (BC Act) and Section 6.8 of the BAM, including details of the measures proposed to address the offset obligation as follows; • The total number and classes of biodiversity credits required to be retired for the development/project; • The number and classes of like-for-like biodiversity credits proposed to be retired; • The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; • Any proposal to fund a biodiversity conservation action; • Any proposal to conduct ecological rehabilitation (if a mining project); and • Any proposal to make a payment to the Biodiversity Conservation Fund (Fund).	The number and class of credits required to be retired for the project are outlined in Section 6.3 of this report.
The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the BAM Order 2017 under Section 6.10 of the BC Act	This report has been prepared by Nathan Garvey (Associate Ecologist and BAM Assessor Accreditation Number BAAS17037) with assistance from Erin Lowe (Senior Ecologist).

1.3 Development proposal

The project includes the development, construction and operation of a solar PV electricity generation facility, which comprises the installation of PV solar panels, electrical cabling, electrical switch yard / substation, electrical connection to the TransGrid network and other associated infrastructure within the development site.

The project will connect to the TransGrid 132 kV electricity distribution network that feeds TransGrid's Narrabri to Gunnedah and Gunnedah to Tamworth network system. The electricity generated from the project will be sold to one or more of a registered energy retailing organisation, large energy user (governmental or private) or to the National Electricity Market that is managed by the Australian Energy Market Operator.

As an indication of scale, based on current technologies, the estimated total installed capacity will be in the order of 110 megawatts (MW), which would be generated by approximately 330,000 PV solar panels.

The project comprises the following key components:

- a network of PV solar panel arrays including supporting structures and tracker system;
- an internal network of electrical collection and distribution systems including electrical inverters;

- an internal network of communications and control cabling and systems;
- switchyard including electrical switching, control and monitoring equipment, electrical transformation system and operational control room;
- electrical connection and communications cabling from the on-site switchyard and transformation area to the TransGrid 132 kV electrical network;
- a management hub, including material storage areas, demountable offices, amenities and equipment sheds;
- provision of land area within the development site for possible future energy storage and network support devices; and
- fencing, access roads from adjacent public roadways, on-site parking and internal access roads.

The project may include the installation of battery and energy storage devices within a secure compound within the development site. The rated capacity of future battery and energy storage devices has not been determined at this stage of project development. The inclusion of such energy storage devices will be determined during the detailed design stage of the project, and will be dependent on network integration and commercial considerations at such time. A modification to the consent would be sought to permit installation of this infrastructure within the development site if required.

The purpose of the battery and energy storage devices would be to store energy on-site, which will allow energy to be released at specific times. The battery and energy storage devices would also provide a number of network services, including frequency control integration and energy arbitrage, as well as improved reliability of electricity provision from the project. Energy arbitrage allows energy to be stored on-site during periods of low demand and then be discharged into the network during periods of greater demand.

The development site, defined as the maximum area to be impacted by the project, and the conceptual infrastructure layout have been refined on the basis of grid connection studies, environmental constraints identification, stakeholder engagement and design of project infrastructure with the objective of developing an efficient project that avoids or minimises environmental impacts.

1.4 Site description

The development site is located approximately 12 km east of the township of Gunnedah in the Gunnedah Shire Local Government Area (LGA), within the Namoi River catchment (refer to Figure 1.1). It is within the Brigalow Belt South IBRA region and the Liverpool Plains IBRA subregion. It consists of the following lots:

- Lot 1 in DP945590;
- part Lot 2 in DP945590;
- part Lot 1 in DP1068520;
- Lot 3 in DP1068518;
- Lot 30 DP754928;
- part Lot 2 in DP945590; and

- part Lot 1 in DP126183.

Land use within the Namoi River catchment is dominated by extensive agricultural operations with grazing occupying 61.2% of the total catchment area (NOW 2011). Other prevalent land uses across the catchment area include dry land cropping and horticulture (16.2%), forestry (10.3%), native landscapes (5.1%), conservation (3.2%) and irrigation (3.0%) (NOW 2011). The development site and the majority of land surrounding the development site is zoned RU1 primary production under the Gunnedah Local Environment Pan (LEP).

Biodiversity assessment has considered a broader area than the development site, referred to as the site boundary, to ensure a full understanding of the biodiversity and other constraints within the site, and allow for detailed design to avoid and minimise impacts where possible (refer Figure 1.1).

Land within the site boundary is of varying quality, dependent on land use and grazing pressure. To the east of the development site is grazing land that contains scattered trees with native grassland. To the south of the development site, towards the Namoi River, the grazing land becomes more timbered, with a sparse tree cover and a ground layer containing more native species. Roadside vegetation along Orange Grove Road contains scattered trees over grassy groundcover that contains a mixture of native and exotic species. These areas of better biodiversity within the site boundary have since been excluded from the development site in order to avoid potential impacts.

The development site is divided by Orange Grove Road into two portions, northern and southern, and encompasses an area of approximately 253 hectares (ha) (Figure 1.2). The development site has been highly modified by past disturbances associated with land clearing, irrigation development, cropping and livestock grazing. It is currently used for livestock grazing and cropping, and the quality of native vegetation within the development site boundary is reflective of the past and current land use. Land immediately to the north and south of Orange Grove Road (Figure 1.2) is used for livestock grazing and contains widely scattered paddock trees, no mid-storey and a heavily grazed groundcover dominated by introduced pasture grass species. Land in the far northern portion of the development site is used for cropping. This area contains very widely scattered paddock trees and a completely cleared mid-storey and ground layer to facilitate crop production.

1.5 Information sources

1.5.1 Publications and databases

In order to provide context for the development site, information about flora and fauna species, populations, communities and habitats from within 10 km (the locality) was obtained from the following databases:

- Office of Environment and Heritage (OEH) *BioNet Atlas of NSW Wildlife* (Bionet) for previous threatened species records (search undertaken 27/02/2018);
- Commonwealth Department of Environment and Energy (DoEE) *Protected Matters Search Tool* (PMST) for MNES, including threatened species likely to occur within the development site (search undertaken 27/02/2018); and
- The NSW Plant Community Types, as held within the Vegetation Information System (VIS) Classification 2.1 database.

The following report was also reviewed:

- *Gunnedah Solar Farm, NSW – Biodiversity Constraints Report* (Biosis 2017) commissioned by OVERLAND.

1.5.2 Spatial data

Spatial data encompassing the site boundary and development site was provided by OVERLAND. Base map data was obtained from DFSI NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI (2013).

The following spatial datasets were utilised during the development of this report:

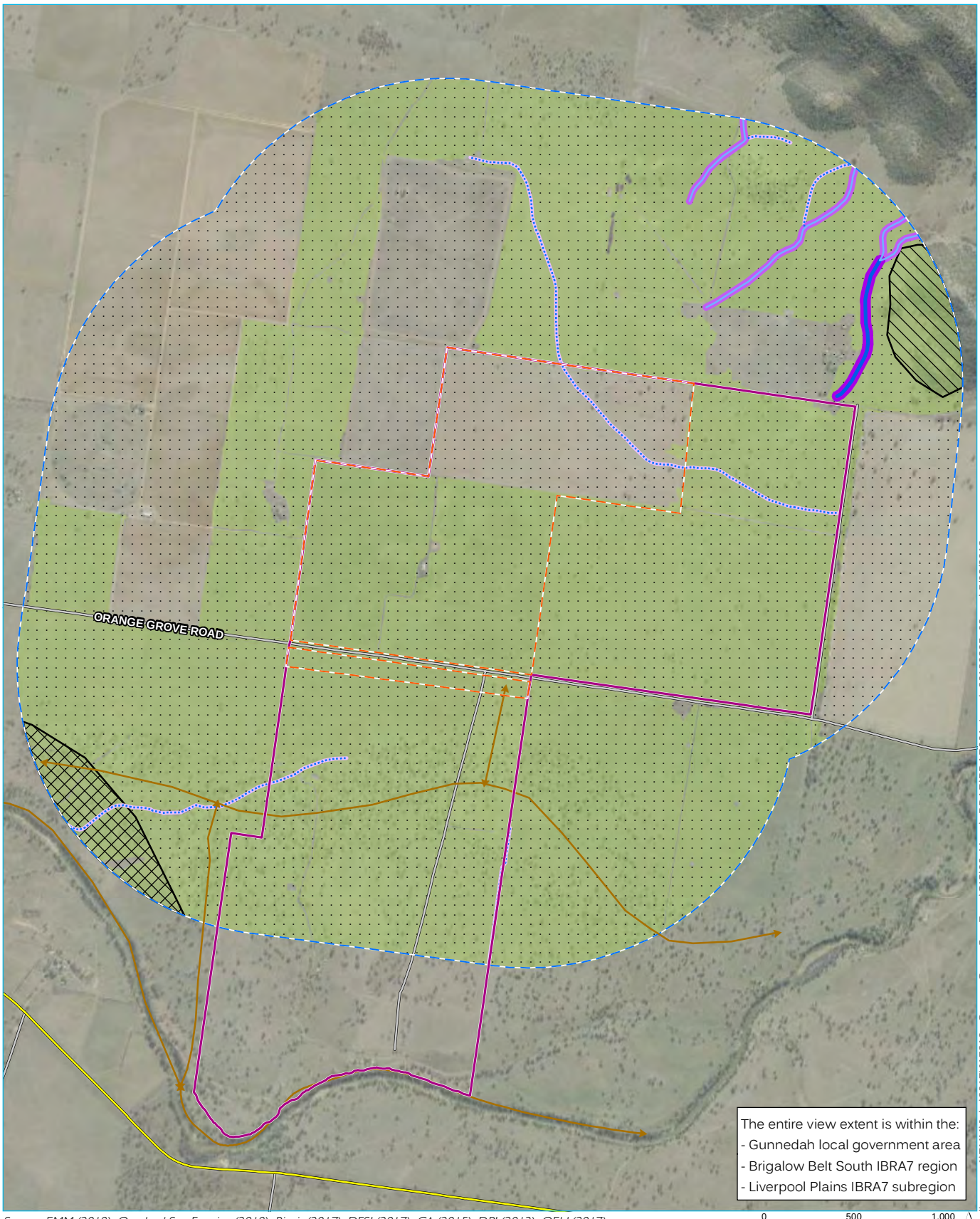
- State Vegetation Type Map: Border Rivers Gwydir / Namoi Region Version 2.0. VIS_ID 4467 (OEH 2015);
- Mitchell Landscapes Version V3.1 (OEH 2016a);
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2013);
- Directory of important wetlands (DoEE 2010);
- SEPP 14 Coastal Wetlands (DPE 2006); and
- NSW Wetlands (OEH 2010).

Mapping undertaken during the site assessment was conducted using a hand-held GPS unit (GDA94), mobile tablet computer and aerial photo interpretation. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

1.6 Legislative requirements

The project has been assessed against the key biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Environmental Planning and Assessment Act 1979* (EP&A Act);
- *Biodiversity Conservation Act 2017* (BC Act);
- *Fisheries Management Act 1994* (FM Act), and
- *Biosecurity Act 2015* (BS Act).



Source: EMM (2018); Overland Sun Farming (2018); Biosis (2017); DFSI (2017); GA (2015); DPI (2013); OEH (2017)

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KEY

- Orange Grove Sun Farm site boundary
- Development site
- 1500 m buffer
- Habitat connectivity
- Main road
- Local road
- Native vegetation cover

Strahler stream order
- 1
- 2
- 3

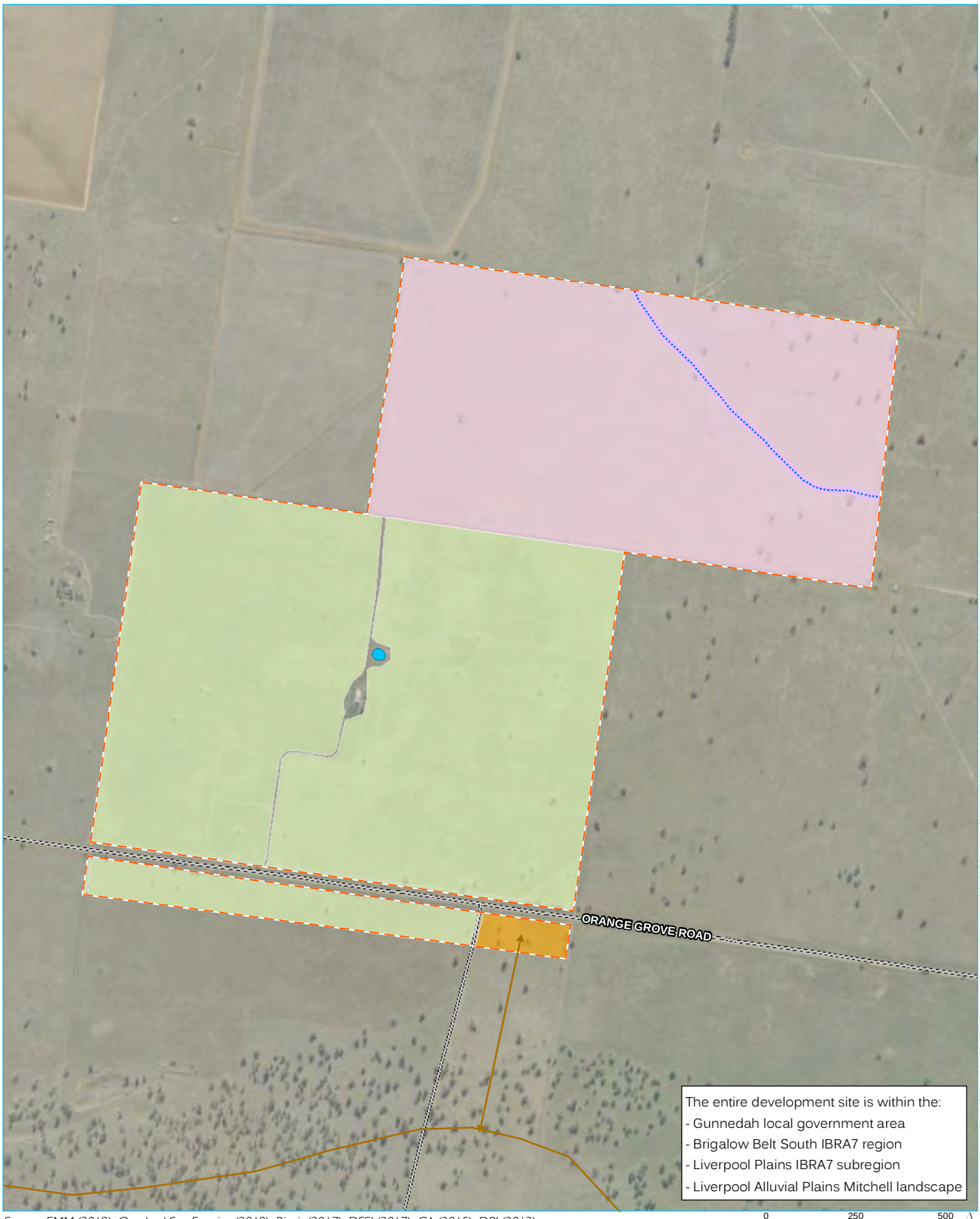
Riparian buffer
- 10 m
- 20 m
- 30 m

Mitchell landscape (OEH, 2017)
- Kelvin Range
- Liverpool Alluvial Plains
- Mooki - Namoi Channels and Floodplains

Location map

Orange Grove Sun Farm
Biodiversity development assessment report
Figure 1.1

EMM



Source: EMM (2018); Overland Sun Farming (2018); Biosis (2017); DFSI (2017); GA (2015); DPI (2013)

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KEY

- Development site
- Local road
- 1st order stream
- Dam
- 10 m riparian buffer
- Habitat connectivity
- Cropped/disturbed land

Plant community type

- PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion - Low (grazed)
- PCT281 - Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion - Low (grazed)

Site map

Orange Grove Sun Farm
Biodiversity development assessment report
Figure 1.2

EMM

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES (Matters of National Environmental Significance) under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a 'controlled action' and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DoEE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act for approval.

The project is unlikely to have a significant impact on MNES and is, therefore, not required to be referred to DoEE for approval. Further information is provided in Section 7.1 of this report.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DPE).

The EP&A Act provides the overarching structure for planning in NSW; however, is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

i State Environmental Planning Policies (Part 3 Division 3.3)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. The SEPP relevant to the current development is *SEPP No. 44 Koala Habitat Protection.*

SEPP 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 1 of SEPP 44. The development site is located in the Gunnedah Shire Council LGA, which is listed in Schedule 1, therefore Koala habitat has been considered within this assessment.

Further consideration of SEPP 44 is provided in Section 7.2.1 of this report.

2.2.2 Biodiversity Conservation Act 2016

In August 2017, the BC Act commenced operation and changed the way impacts to biodiversity are assessed and offset in NSW, with offsetting required for any projects exceeding certain clearing thresholds outlined in the *Biodiversity Conservation Regulation 2017* (BC Regulation).

Concurrent with the commencement of the BC Act, the NSW Government released the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (Savings and Transitional Regulation). This Regulation sets out a number of transitional arrangements, including for Major Projects (Part 7) for which development applications can be considered under the previous legislation if assessment requirements have been issued or substantial environmental assessment was undertaken before the 25 August 2017.

As identified within the SEARs, the project is not defined as a pending or interim planning application under Part 7 of the Savings and Transitional Regulation, therefore the BAM has been used to assess and offset impacts to biodiversity in accordance with the BC Act.

2.2.3 Fisheries Management Act

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the Assessment of Significance process under Section 220ZZ of the FM Act.

Two key objectives of the FM Act are to conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications, the Department of Primary Industries (DPI) will assess the likelihood of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS).

The Namoi River to the south of the development site is mapped as Key Fish Habitat by DPI. The entire project is located within the catchment of the Namoi River. However, no impacts to any drainage lines (see Section 3.1.2) that drain into this identified waterway will result from the project and no further consideration is required.

2.2.4 Biosecurity Act 2015

The NSW Biosecurity Act 2015 (BS Act) has superseded the Noxious Weeds Act 1993, which has now been repealed.

The primary object the BS Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

The BS Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The *North West Strategic Weed Management Plan* (NWLLS 2017) outlines how government, industry, and the community will share responsibility and work together to identify, minimise, respond to and manage weeds. The plan also supports regional implementation of the BS Act.

No state or regional level priority weeds, as identified within the plan, were recorded within the development site. No further consideration is given to the BS Act.

3 Landscape features

The identification of landscape features at the development site was determined using Section 4 of the BAM (OEH 2017), as summarised within this chapter.

3.1 Landscape features

3.1.1 Bioregions and landscapes

The development site occurs within the Brigalow Belt South IBRA Bioregion and the Liverpool Plains IBRA subregion, which covers the entire development site and is the sub-region used in this assessment (Figure 1.2).

The development site occurs within the Liverpool Alluvial Plains Mitchell Landscape, which covers the entire development site and is used in this assessment (Figure 1.2). The Kelvin Range Mitchell Landscape is located in the 1500 m buffer to the north-east, while the Mooki – Namoi Channels and Floodplains Mitchell Landscape is located in the 1500 m buffer to the south-west (Figure 1.1).

3.1.2 Waterways and wetlands

The development site is located within the Namoi River catchment in north-western NSW. The Namoi catchment is bound by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mount Kaputar to the north (NOW 2011).

The development site is within the floodplain of the Namoi River. The Namoi River is approximately 2.5 km south of the development site. There is a first-order stream mapped within the cropped land in the north of the development site, as shown in Figure 1.2. The cropped land has been highly modified by cropping activities and due to this heavy disturbance, the first-order stream occurs as a depression within the disturbed land with no native vegetation.

There are a number of wetlands downstream of the development site, however no wetlands were identified within the development site or buffer area. One farm dam is located within the centre of development site (refer Figure 1.2).

3.1.3 Connectivity

A connective link occurs within the south of the buffer area, as shown in Figure 1.1. This link may facilitate the movement of species such as the threatened Koala (*Phascolarctos cinereus*) or Squirrel Glider (*Petaurus norfolcensis*) with records of both species within this identified connective link. The connective link includes the south-eastern corner of the development site, but does not continue through the development site due to the more disturbed condition of the land within the development site that contains very widely spaced paddock trees and is intersected by Orange Grove Road thus prohibiting movement for the Squirrel Glider, and lacks primary feed trees for the Koala.

3.1.4 Areas of geological significance and soil hazard features

The development site and buffer area does not contain karst, caves, crevices, cliffs or other areas of geological significance. Similarly, there are no soil hazard features that occur within the development site or buffer area.

3.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value, as declared by the Minister, within the development site or buffer area.

3.1.6 Assessment of site context

Site context has been assessed in accordance with section 4.3 of BAM (OEH 2017) for site -based developments.

3.2 Native vegetation extent

Mapping of vegetation within a 1500 m buffer of the development site was undertaken using aerial mapping interpretation and *Border Rivers Gwydir / Namoi Regional Native Vegetation Mapping* (OEH 2015). This mapping was modified using the vegetation extent as mapped by Biosis (2017) and EMM (see Section 4).

Revised regional mapping of plant community types (PCTs) within the 1500 m buffer includes:

- Candidate Native Grasslands;
- PCT 101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion;
- PCT 102 - Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion;
- PCT 112 - Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion;
- PCT 147 - Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion;
- PCT 202 - Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregions, and
- PCT 592 - Narrow-leaved Ironbark - cypress pine - White Box shrubby open forest in the Brigalow Belt South Bioregion and Nandewar Bioregion.

Those areas mapped as 'Not Native' by OEH (2015) within the 1500 m buffer were checked against aerial mapping and/or in the field and are considered cleared and not included within the native vegetation extent.

A conservative approach was undertaken to include all areas of native vegetation, including the mapped candidate native grassland (as verified) that are likely to be derived from the mapped woodland communities. This approach allowed a greater list of threatened species to be filtered in for later assessment of habitat suitability of the development site.

Native vegetation cover within the buffer area was determined as the sum of the areas of native vegetation map units listed above, divided by the entire buffer area.

Approximately 1500 ha of native vegetation was mapped within the 2059 ha buffer area. Native vegetation cover within the buffer area is approximately 73%.

4 Native vegetation

The extent of native vegetation within the development site was determined using Section 5 of the BAM (OEH 2017), as summarised within this chapter.

4.1 Background review

A review of regional vegetation mapping (OEH 2015) was undertaken to inform the site investigation. OEH identifies one native vegetation community within the development site:

- Candidate native grasslands.

4.2 Methods

4.2.1 Constraints assessment vegetation survey

A constraints assessment of land within the site boundary (Figure 1.1) was undertaken by Biosis in March 2017 (Biosis 2017). The purpose of this assessment was to:

- undertake vegetation mapping;
- undertake a detailed assessment of vegetation condition in accordance with the requirements of the Framework for Biodiversity Assessment (FBA) (OEH 2014); and
- undertake targeted surveys (see Section 5).

Biosis completed detailed mapping of vegetation communities using hand-held (uncorrected) tablet units using the ArcGIS Collector application and aerial photo interpretation. Areas of native vegetation for which a PCT could accurately be assigned were identified and delineated in the field, and vegetation condition determined. Identification of PCTs within the site boundary was confirmed with reference to the community profile descriptions (and diagnostic species tests) held within the NSW Vegetation Information System (VIS): Classification Version 2.1.

Biosis stratified the PCTs into vegetation zones based on condition (low or moderate/good) and ancillary code, and assessed site value using data obtained via a series of plots and transects, as per the methodology outlined in Section 5 of the FBA (OEH 2014). A total of nine plots/transects were completed by Biosis within the site boundary. Four of these occur within the development site.

Further detail on the methodology of the constraints assessment undertaken by Biosis (2017) is included within Appendix A.

4.2.2 Site investigation

EMM has utilised the vegetation data from the previous constraints assessment (Biosis 2017) to inform the current biodiversity assessment.

Through an iterative design process, which considered biodiversity values, OVERLAND has reduced the area of the proposed development and restricted it to the development site, as shown in Figure 4.1.

Further, as the SEARs for the project specify that the project must be assessed in accordance with the BAM (OEH 2017), additional data was needed to supplement that gathered previously by Biosis (2017). Therefore, EMMs field effort was targeted to fill in gaps in the existing site information (Biosis 2017) given the change in method from FBA (OEH 2014) to BAM (OEH 2017), as well as the change to the development site area.

Following the stratification of vegetation zones within the development site, based upon Biosis (2017) vegetation mapping, native vegetation integrity was assessed using data obtained via a series of plots, as per the methodology outlined in Section 5 of the BAM (OEH 2017). Plot data was collected from the development site between 13 -14 February 2018 and included:

- One 20 x 20 m plot, for assessment of composition and structure; and
- One 20 x 50 m plots for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure, based on a 20 x 20 m plot, recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1-5%) or estimated to the nearest 5% (5- 100%). Abundance was counted (up to 20) and estimated above 20, and recorded using the following intervals: 1, 2, 3, 4, 5, 10, 20, 50, 100, 500, 1000, 1500, 2000 etc.

The assessment of function recorded the number of large trees, tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and 1 x 1 m subplots.

The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017). A total of eight plots and transects were completed within the development site, as shown in Figure 4.1. At four locations (Plots 10, 11, 12 and 13) a full survey was undertaken including the assessment of composition, structure and function. At four locations (Plots 2, 3, 4 and 9) data on composition and structure was collected by Biosis (2017). This data was verified in the field with additional data on functional attributes collected to fulfil the requirements of the BAM (OEH 2017).

Floristic data, including plot and transect data, is included within Appendix B.

The land in the north of the northern portion of the development site is used for cropping. Under the BAM (OEH 2017), land not containing native vegetation is not subject to assessment beyond Section 5.4 (determination of a vegetation integrity score). However, advice from OEH, North West Branch Regional Operations Division (M.Howarth pers. comm. 23 December 2017) confirmed that photos of the cropped land and a species list obtained via rapid assessment demonstrating little to no native cover would suffice for the cropped land. Therefore, this was the method used for the cropped land.

4.3 Results

4.3.1 Vegetation description

The development site is currently used for cattle grazing and cropping and has long history of past intensive irrigation and dryland cropping. Native vegetation and fauna habitats have been modified by past disturbances associated with land clearing, irrigation development, cropping, livestock grazing and weed invasion. Native vegetation occurs as isolated paddock trees with a heavily modified ground storey.

The development site supports 148 ha of native vegetation of low quality (Figure 4.1). The following PCTs were identified within the development site:

- PCT 101 *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*, in a heavily modified condition due to the land uses outlined above, with a total area of 145.8 ha; and

- PCT 281 *Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South*, in a heavily modified condition due to the land uses outlined above, with a total area of 2.4 ha.

Heavy cattle grazing and cropping and past intensive irrigation have impacted the groundcover, resulting in heavy weed infestations, soil disturbance and compaction. This has limited recruitment of native shrubs, grasses and eucalypts species. The vegetation is characterised by isolated mature native trees with an understorey dominated by exotic (pasture) grasses and herbs and disturbance tolerant native species. Existing irrigation channels, soil disturbance and lack of shrub species are evidence of past irrigation and cropping activities. The cropped land does not fit in any PCT.

The two PCTs and the cropped land are described in further detail within the following section.

4.3.2 Plant community types

Site investigations, including determination of vegetation communities using the methods described in Section 4.2.1 and 4.2.2, identified the presence of two PCTs within the development site (Figure 4.1). The PCT, vegetation formation and vegetation class (Keith 2004) are described within Table 4.1

Table 4.1 Plant community types of the development site and corresponding formation and class

Plant community type	Vegetation formation	Vegetation class	Area (ha)
PCT 101 – *Poplar Box - Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	Semi-arid Woodlands (Grassy sub-formation)	Brigalow Clay Plain Woodlands	145.8
PCT 281 – *Rough-Barked Apple – Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*	Grassy Woodlands	Western Slopes Grassy Woodlands	2.4

The two PCTs identified within the development site were assessed as being in low condition (grazed). One area of non-native vegetation, which is cropped land, was also identified (Figure 4.1).

4.3.3 Vegetation zones

As there are only two PCTs, with each one having no change in condition across the development site, no further stratification of the PCTs was required. This has resulted in two vegetation zones identified for the development site, as outlined in Table 4.2.

Table 4.2 Vegetation zones mapped within the development site

Vegetation zone	Plant community type	Condition	Area (ha)
1	PCT 101 – *Poplar Box - Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	Low (grazed)	145.8
2	PCT 281 – *Rough-Barked Apple – Red Gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*	Low (grazed)	2.4

Descriptions of each vegetation zone are provided in Tables 4.3 and 4.4 and a description of the cropped land is described within Table 4.5. The PCTs and cropped land are mapped within Figure 4.1.

Table 4.3 Vegetation zone 1 description

Vegetation Zone 1 – Poplar Box - Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion	
PCT ID	101
Common name	Poplar Box - Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion
Condition class	Low (grazed)
Extent within development site	145.8 ha (Figure 4.1)
Description	Bimble Box (*Eucalyptus populnea* subsp. *bimbil)* occurs as scattered paddock trees throughout this vegetation zone. There is a complete absence of the shrub layer due to past clearing and continual grazing pressures. The ground cover is dominated by introduced pasture species including Urochloa Grass (*Urochloa panicoides*), Barley Grass (*Hordeum leporinum)* and Perrenial Ryegrass (*Lolium perenne*) Some native grass species include Slender Bamboo Grass (*Austrostipa verticillata)*, *Rytidosperma racemosum* var. *obtusatum,* Threeawn Speargrass (*Aristida vagans*) and Curly Windmill Grass (*Enteropogon acicularis)*. Native forbs, including Tarvine (*Boerhavia dominii)* and Climbling Saltbush (*Einadia nutans*), are present within this vegetation zone. Other exotic ground cover species include Cat-head (*Tribulus terrestris)*, St Barnabys Thistle (*Centaurea solstitialis)*, Wireweed *(Polygonum aviculare)* and Wild Melon (*Citrullus lanatus* var. *lanatus)*. This community is found on heavy alluvial clay soils derived from volcanic or sedimentary substrates.
Survey effort	Six plots/transects within the development site (P2, P3, P4, P10, P12 and P13).
Condition description	The community is in poor condition with a high cover of introduced plant species due to past irrigation, cropping, soil modification and current cattle grazing activities. Surrounding land use (mostly cropping) and associated edge impacts contribute even further to the existing condition of this zone.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community that align with the dominant species listed as characteristic of this PCT include Bimble Box. Aligning ground layer species include Slender Bamboo Grass, Curly Windmill Grass, Tarvine and Climbing Saltbush.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA Subregion. The occurrence of the community on heavy alluvial clay soils derived from volcanic or sedimentary substrates as well as the landscape position on alluvial plains is consistent with this PCT. The characteristic species, as listed above, are consistent with the PCT, with Bimble Box being the characteristic over storey species. The mid-storey is absent as the vegetation zone is heavily grazed. The ground layer is dominated by exotic grasses but does contain native grasses and forbs characteristic of the PCT.
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed Justification: This PCT is associated with the EPBC Act and BC Act threatened ecological communities listed below: • Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (BC Act), and • Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar. Peneplain, Nandewar and Brigalow Belt South Bioregions (BC Act). Due to the low condition, scattered presence of Bimble Box, absence of shrub layer and exotic dominated ground cover (more than 80%), Vegetation Zone 1 is not considered to align with any of the threatened ecological communities above.
Estimate of percent cleared value of PCT	75%

Table 4.3 Vegetation zone 1 description

Vegetation Zone 1 – Poplar Box - Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion

Photograph 1: Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion – Plot 3.

Table 4.4 Vegetation zone 2 description

Vegetation zone 2 – Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
PCT ID	281
Common name	Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion
Condition class	Low (grazed)
Extent within development site	2.4 ha (Figure 4.1)
Description	Rough-barked Apple (*Angophora floribunda*) and Yellow Box (*Eucalyptus melliodora*) are the dominant canopy trees within this vegetation community. There is a complete absence of the shrub layer due to past clearing and continual grazing pressures. The ground cover is dominated by introduced pasture species including Urochloa Grass, Barley Grass, Prairie Grass (*Bromus cartharticus*) and Perennial Ryegrass. Introduced forb species include Wireweed (*Polygonum aviculare*), Cat-head, Wild Melon and Khaki Weed (*Alternanthera pungens*). Some native ground cover is present and includes Tarvine, Purslane (*Portulaca oleracea*), Wallaby Grass (*Rytidosperma fulva*), Wheatgrass (*Anthosachne scabra*), Cotton Panic Grass (*Digitaria brownii*) and *Rytidosperma racemosum* and *Oxalis perennans*. This community is found on black and brown alluvial clay loam soils within the development site.
Survey effort	Two plots/transects within the development site (P9 and P11).
Condition description	The community is in poor condition with a high cover of introduced plant species due to past irrigation, cropping, soil modification and current cattle grazing activities. Surrounding land use (mostly cropping) and associated edge impacts contribute even further to the existing condition of this zone.
Characteristic species used for identification of PCT	According to the NSW VIS Classification Version 2.1, the canopy layer species recorded within this community that align with the dominant species listed as characteristic of this PCT include Rough-barked Apple and Yellow Box. Aligning ground layer species include *Oxalis perennans*, Wheatgrass and *Rytidosperma racemosum*.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution is north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA Subregion. The occurrence of the community on heavy alluvial clay soils derived from volcanic or sedimentary substrates as well as the landscape position on alluvial plains is consistent with this PCT. The characteristic species, as listed above, are consistent with the PCT with the main diagnostic feature being a canopy dominated by Rough-barked Apple and Yellow Box. The mid-storey is absent as the vegetation zone is heavily grazed. The ground layer is dominated by exotic grasses but does contain two native grasses and one forb characteristic of the PCT.
Status	Commonwealth EPBC Act: not listed NSW BC Act: *White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community*. Justification: The vegetation zone aligns with *White Box Yellow Box Blakely's Red Gum Woodland* endangered ecological community under the BC Act. The vegetation zone is located in the western slopes of NSW, contains Yellow Box as a canopy species and the ground layer is dominated by grasses. The presence of Wheatgrass, Wallaby Grass and *Rytidosperma racemosum* also align with the White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community. However, this vegetation zone does not meet the minimum EBPC Act condition threshold as the percentage cover of non-native perennial plant species exceeds the percentage cover of native plant species in the ground layer (TSSC 2006).

Table 4.4 Vegetation zone 2 description

Vegetation zone 2 – Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
Estimate of percent cleared value of PCT	67%
Photograph 2: Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion – east of Plot 11.	

Table 4.5 Cropped land description

Cropped land	
PCT ID	N/A
Common name	Cropped land
Condition class	N/A
Extent within the development site	102 ha (Figure 4.1)
Description	This area has scattered Bimble Box with a completely cleared mid and ground-layer (Photograph 3). The area is utilised for cropping and contains no native mid-storey or ground layer. There are some exotic grass and forb species under the remaining Bimble Box trees, where the farm machinery has not turned up the soil (Photograph 4).
Survey effort	No plots/transects required as outlined within Section 4.2.2
Condition description	The community is in poor condition due to cropping.
Characteristic species used for identification of PCT	N/A
Justification of evidence used to identify the PCT	N/A
Status	Commonwealth EPBC Act: not listed NSW BC Act: not listed
Estimate of percent cleared value of PCT	N/A

Table 4.5 Cropped land description

Cropped land	
Photograph 3: Cropped land	

Table 4.5 Cropped land description

Cropped land	
Photograph 4: Cropped land, under Bimble Box tree.	

4.3.4 Assessment of patch size

For each vegetation zone within the development site, patch size was assessed using a select process in ArcGIS, using existing vegetation mapping (OEH 2015) and aerial imagery.

Instead of omitting the mapped candidate native grassland (as verified) from the patch size assessment, a conservative approach was undertaken to include the native grassland, which is likely to be derived from the two mapped woodland communities. This approach allowed a greater patch size for both PCTs and a greater list of threatened species to be assessed for habitat suitability of the development site.

All intact native vegetation separated by a distance of less than 100 m (woody vegetation ecosystems) or 30 m (non-woody vegetation ecosystems) was mapped sequentially. This process showed that the two vegetation zones within the development site both form part of large patches of connecting vegetation having patch sizes larger than 100 ha.

4.3.5 Vegetation integrity score

The vegetation integrity score for each vegetation zone is presented in Table 4.6.

Table 4.6 Current vegetation integrity score for the vegetation zones

Vegetation zone	Plant community type	Area (ha)	Vegetation integrity score
1	PCT 101 *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	145.8	6.1
2	PCT 281 *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*	2.4	6.1

As the vegetation integrity scores for all vegetation zones is below 15, then assessment of native vegetation is not required beyond Section 5.4 of the BAM (OEH 2017) and an assessment of threatened species habitat according to Section 6.2 of the BAM (OEH 2017) is not required.

5 Threatened species

5.1 Fauna habitat assessment

To inform the assessment of ecosystem credit species predicted to occur within the development site in accordance with Section 6.2 of the BAM (OEH 2017), and to assist in developing a list of candidate threatened species requiring further assessment in accordance with Section 6.4 of the BAM (OEH 2017), an initial habitat-based fauna assessment was undertaken by Biosis (2017), seeking to identify the following fauna habitat features within the site boundary. The following features were assessed:

- habitat trees including large hollow-bearing trees, availability of flowering shrubs and feed tree species;
- waterbody condition;
- quantity of ground litter and logs; and
- searches for indirect evidence.

The majority of the development site contains cleared paddocks which are heavily grazed, with only widely scattered remnant Bimble Box and Yellow Box present. Most of these trees are hollow bearing, but there is little fallen timber, sparse leaf litter, no understorey vegetation and a groundcover of heavily grazed and mainly introduced grasses and herbs. The northern part of the development site is largely devoid of native vegetation, with scattered paddock trees only.

The road reserve has similar features to the woodland areas; however, ground cover is taller with a greater diversity as this area is not being intensively grazed.

No rock outcrops are present on the development site.

Watercourses or wetlands within the development site are limited to one small farm dam, which is surrounded by heavily grazed and exotic ground cover, and one highly disturbed first-order stream within the cropped land in the north of the development site.

5.2 Ecosystem credit species assessment

As the vegetation integrity score for both vegetation zones is less than 15, an assessment of threatened species habitat according to 6.2 of the BAM (OEH 2017) is not required.

5.3 Species credit species assessment

5.3.1 Habitat constraints assessment (Step 2)

An assessment of habitat constraints for threatened species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017). For those threatened species predicted to occur, for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the development site along with the determination of whether impacts to these habitat features will result from the project.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 5.1.

Table 5.1 Assessment of habitat constraint features within the development site

Common name	Scientific name	Feature	Sensitivity to gain class	Habitat constraint present in development site	Justification
Pink-tailed Legless Lizard	*Aprasia parapulchella*	Rocky areas.; or Within 50 m of rocky areas.	High	No	The development site does not contain rocky areas and is not within 50 m of rocky areas.
Bush-stone Curlew	*Burhinus grallarius*	Fallen/standing dead timber including logs.	High	No	The development site does not contain standing or fallen dead timber, having been removed to facilitate grazing and cropping.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Cliffs; or Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	Very high	No	The development site does not contain cliffs. The development site is not within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.
Cyperus conicus	*Cyperus conicus*	Waterbodies; or Wetlands.	High	Yes	The development site contains one small farm dam. The development site does not contain wetlands.
Brush-tailed Phascogale	*Phascogale tapoatafa*	Hollow bearing trees.	High	Yes	The site contains widely scattered hollow bearing trees.

The development site supports suitable habitat features for two species, the Brush-tailed Phascogale and *Cyperus conicus*. Further consideration is given to these species in Section 5.3.2. For the remaining species listed within Table 5.1, habitat constraints are not present on the development site and the species are considered unlikely to occur and no further assessment is required as per section 6.4.1.13 of the BAM (OEH 2017).

5.3.2 Identifying candidate species credit species for further assessment (Step 3)

To develop a list of species credit species for further assessment, an assessment was undertaken in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017), as shown in Table 5.2.

Table 5.2 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Flora			
Cyperus conicus	*Cyperus conicus*	No	*Cyperus conicus* occurs rarely in the Pilliga area of NSW and is also found in Victoria, Qld, the NT and WA. The species grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. Recorded from *Callitris* forest in the Pilliga area, growing in sandy soil with *Cyperus gracilis, C. squarrosus* and *C. fulvus*. There are unlikely to be any areas of potential habitat within the development site. The vegetation surrounding the small farm dam is heavily grazed with a low native species cover and is considered substantially degraded. This species is considered unlikely to occur within the development site.
Bluegrass	*Dichanthium setosum*	Yes	Bluegrass occurs on heavy basaltic black soils and red-brown loams with clay subsoil. It is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Locally common or found as scattered clumps in broader populations. Although this species can tolerate moderately disturbed areas, habitat within the development site is considered substantially degraded due to grazing, with very little native cover. These areas are considered substantially degraded. Potential for this species to occur in roadside vegetation. This species is considered unlikely to occur within the development site.
Finger Panic Grass	*Digitaria porrecta*	Yes	Finger Panic Grass grows in native grassland, woodlands or open forest with a grassy understorey, on richer soils. This species is often found along roadsides and travelling stock routes where there is light grazing and occasional fire. Fire, livestock grazing and trampling, and physical disturbance of habitat by road and farm machinery are types of disturbances known to occur in Finger Panic Grass sites. Field observations indicate that this species does continue to persist in such habitats but the effect of the disturbances on the long term capability of the species to maintain a viable population is unknown. The species is unlikely to occur within the development site given the heavy disturbance resulting from grazing. These areas are considered substantially degraded. Potential for this species to occur in roadside vegetation. This species is considered unlikely to occur within the development site.
Belson's Panic	*Homopholis belsonii*	Yes	Belson's Panic occurs on the north-west slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. It grows in dry woodland (e.g. Belah) often on poor soils, although sometimes is found in basalt-enriched sites north of Warialda and in alluvial clay soils. Habitat and ecology appear to be poorly known. The soils in the development site are not considered poor, consisting of alluvial clays. Areas of potential habitat within the development site are heavily grazed with a low native species cover therefore these areas are considered substantially degraded. Potential for this species to occur in roadside vegetation. This species is considered unlikely to occur within the development site.

Table 5.2 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Slender Darling Pea	*Swainsona murrayana*	Yes	Slender Darling Pea is a sparsely-downy forb with greyish, thin or tapered, stiffly leathery pods which grows on clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species can be found in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Potential habitat within the development site is heavily grazed resulting in high levels of disturbance. These areas are considered substantially degraded. Potential for this species to occur in roadside vegetation. This species is considered unlikely to occur within the development site.
Austral Toadflax	*Thesium australe*	No	Austral Toadflax occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often in association with Kangaroo Grass (*Themeda australis)*. This species is a root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands region. Areas of potential habitat within the development site are heavily grazed with a low native species cover therefore these areas are considered substantially degraded. In addition, Kangaroo Grass (*Themeda australis*) was not recorded in any of the vegetation zones mapped in the development site. This species is considered unlikely to occur within the development site.
Fauna			
Regent Honeyeater (breeding)	*Anthochaera phrygia*	No	Mapped important areas are considered species credits under the BAM (OEH 2017). These areas do not require survey. The development site is not within a known breeding area. This species is considered unlikely to occur within the development site.
Eastern Pygmy-possum	*Cercartetus nanus*	No	The Pygmy Possum is found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes. Also feeds on insects throughout the year. This feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. No habitat is present within the development site, considering its heavily disturbed condition, distance between isolated paddock trees (>100 m), lack of suitable feed species and complete lack of mid-storey. This species is considered unlikely to occur within the development site.

Table 5.2 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
White-bellied Sea-eagle (breeding)	*Haliaeetus leucogaster*	No	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Paddock trees within 1km of rivers, lakes, large dams or creeks, wetlands and coastlines are of importance to the species. The timbered woodland to the south of the development site, closer to the Namoi River, may be suitable breeding habitat for the species. The habitat within the development site is unlikely to be important to the species considering the paddock trees within the site are over 1 km away from the river. This species is considered unlikely to occur within the development site.
Black-breasted Buzzard (breeding)	*Hamirostra melanosternon*	No	The Black-breasted Buzzard lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. The species nests in large, flat stick nests, usually lined with grasses. A large bird of prey nest was observed in areas of higher quality habitat in the south of the site boundary. This area was excluded from the development site. No suitable nests were identified in the development site. This species is considered unlikely to occur within the development site.
Little Eagle (breeding)	*Hieraaetus morphnoides*	No	The Little Eagle occupies open eucalypt forest, woodland or open woodland. Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW are also used. The species nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. No habitat was recorded within the development site, with no nests observed and a lack of remnant vegetation. This species is considered unlikely to occur within the development site.
Swift Parrot (breeding)	*Lathamus discolor*	No	Mapped important areas are considered species credits under the BAM (OEH 2017). These areas do not require survey. The development site is not within a mapped important area. This species is considered unlikely to occur within the development site.
Square-tailed Kite (breeding)	*Lophoictinia isura*	No	The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests. The species shows a particular preference for timbered watercourses, where nests are constructed in a fork or on large, horizontal limbs. A large bird of prey nest and a smaller stick next (possibly Corvid) were observed in areas of higher quality habitat in the south of the site boundary. This area was excluded from the development site. No suitable nests were identified in the development site. This species is considered unlikely to occur within the development site.
Powerful Owl (breeding)	*Ninox strenua*	No	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest, requiring large tracts of forest or woodland habitat. The species nests in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. The development site does not provide breeding habitat for the Powerful Owl, as there are no large hollows.

Table 5.2 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
			This species is considered unlikely to occur within the development site.
Squirrel Glider	*Petaurus norfolcensis*	Yes	The Squirrel Glider inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. The species prefers mixed species stands with a shrub or Acacia mid-storey. The species relies on large old trees with hollows for breeding and nesting; however, trees need to be less than 50 m apart. No habitat was recorded within the development site, and it is considered not suitable considering its heavily disturbed condition, distance between isolated paddock trees (>100 m) and complete lack of mid-storey. However, a precautionary approach has been taken and surveys of the site boundary included isolated trees in the development site. This species is considered a candidate species for further assessment.
Brush-tailed Phascogale	*Phascogale tapoatafa*	No	The Brush-tailed Phascogale prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. The species also inhabits heath, swamps, rainforest and wet sclerophyll forest. The habitat within the development site is considered substantially degraded from grazing, with a lack of tree canopy cover and widely spaced (100 m) canopy trees. This species is considered unlikely to occur within the development site.
Koala (breeding)	*Phascolarctos cinereus*	Yes	The trees on the development site provide foraging or sheltering resources for Koala. Yellow Box and Bimble Box are identified as secondary Koala feed trees in the Gunnedah Koala conservation plan (North West Ecological Services, 2016). Under the BAM (OEH 2017) 'important' habitat is defined by the density of Koalas and quality of habitat determined by on-site survey. As such, the species is considered a candidate species for further assessment.
Superb Parrot (breeding)	*Polytelis swainsonii*	No	The Superb Parrot breeds mostly in the NSW South Western Slopes and Riverina bioregions. The recovery plan (Baker-Gabb 2011) identifies three main breeding areas: • bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young (NSW); • along the Murrumbidgee River, between Wagga Wagga and Toganmain Station (near Bringagee), and farther north at Goolgowi (NSW); and • along the Murray and Edward Rivers, from east of Barmah and Millewa State Forest to south of Taylors Bridge (NSW & Victoria). The development site is well outside these areas. This species is considered unlikely to occur within the development site.

Table 5.2 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Masked Owl (breeding)	*Tyto novaehollandiae*	No	The Masked Owl lives in dry eucalypt forests and woodlands from sea level to 1100 m. The species requires old hollow-bearing eucalypts greater than 90 cm diameter at breast height, with hollows greater than 40 cm wide, greater than 100 cm deep and at least 3 m above the ground, for breeding. The development site is largely cleared, with only very widely scattered paddock trees, and does not support suitable hollow-bearing trees for this species. This species is considered unlikely to occur within the development site.

This assessment identified the following species as candidate species requiring further assessment:

- Flora species:
  - Bluegrass;
  - Finger Panic Grass;
  - Belson's Panic; and
  - Slender Darling Pea.
- Fauna species:
  - Koala; and
  - Squirrel Glider.

Targeted surveys were undertaken, and the presence or absence of these species in the development site determined, in accordance with Section 6.4 of the BAM (OEH 2017). Survey methods and outcomes are discussed further below.

5.3.3 Targeted surveys

i Targeted flora surveys

Biosis (2017) conducted targeted flora surveys within the site boundary, between 13-17 March 2017. Targeted surveys were undertaken in accordance with OEH (2016) and involved walking parallel transects approximately 10 m apart through all potential habitat within the site boundary and adjacent road reserves along Orange Grove Road.

Given the low quality of vegetation in the development site, with little native vegetation cover present, areas of cropped/disturbed land or PCT 101 *Poplar Box – Yellow Box – Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Bet South Bioregion* were not targeted, with only random meanders undertaken in some areas (See Figure 4.1 for those targeted surveys undertaken within the development site and road reserve). Transect surveys were undertaken in areas of *PCT 281 - Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion.*

Further detail on the methodology of the constraints assessment undertaken by Biosis (2017), including the areas surveyed that are no longer within the development site, is included within Appendix A.

ii Targeted fauna surveys

Biosis (2017) conducted targeted fauna surveys within the site boundary between 13-17 March 2017. Detailed targeted threatened fauna surveys were undertaken for a greater number of threatened species than the candidate threatened species requiring further assessment, as outlined in this report. Threatened species targeted included:

- Squirrel Glider (*Petaurus norfolcensis*);
- Koala (*Phascolarctos cinerus*);

- Regent Honeyeater (*Anthochaera phrygia*);
- Pale-headed Snake (*Hoplocephalus bitorquatus*);
- Pink-tailed Worm Lizard (*Aprasia parapulchella*);
- Grey Falcon (*Falco hypoleucos*); and
- Black-breasted Buzzard (*Hamirostra melanosternon*).

Surveys for these species were undertaken as a part of the constraints analysis to ensure the presence of these species was incorporated into measures to avoid and minimise impacts during detailed design.

Targeted survey methods, as undertaken by Biosis (2017), for the two candidate species requiring further assessment is provided in Table 5.3 with locations shown in Figure 5.1 (for those targeted surveys undertaken within the development site).

Table 5.3 Targeted fauna survey methods

Species	Habitat present	Targeted survey
Squirrel Glider	Suitable habitat is available throughout the woodland areas of the site boundary. Areas where trees are scattered further than 50 m apart, as within the development site, are less likely to form suitable habitat as these trees would be outside the gliding range for a Squirrel Glider.	Twenty Elliot B traps mounted on trees across four nights, resulting in 80 trap nights. Four of these were within or directly adjacent to the development site. Spotlighting was conducted on three evenings for 105–140 minutes by two observers. Spotlighting in the woodland areas was conducted on foot, while scattered paddock trees (development site) were spotlighted from a vehicle.
Koala	The primary feed tree River Red Gum, secondary feed trees Yellow Box, Bimble Box and Blakely's Red Gum (North West Ecological Services, 2016) are all present in the site boundary. Secondary feed trees Yellow Box and Bimble Box are located within the development site as widely scattered individuals.	All trees within the development site and along the roadside were searched for presence of Koala or their faecal pellets using the SAT Koala Survey Methodology (Phillips and Callaghan, 2011).

Source: Biosis (2017)

Further detail on the methodology of the constraints assessment undertaken by Biosis (2017), including additional species and areas surveyed that are no longer within the development site, is included within Appendix A.

Source: EMM (2018); Overland Sun Farming (2018); Biosis (2017); DFSI (2017); GA (2015); DPI (2013)

0 250 500 m
GDA 1994 MGA Zone 56
N

KEY

- Elliot trap
- EMM habitat tree assessment
- Biosis habitat tree assessment
- Spotlighting transect
- Development site
- Dam
- Local road
- 1st order stream
- Flora survey (Biosis, 2017)

Threatened species targeted survey effort

Orange Grove Sun Farm
Biodiversity development assessment report
Figure 5.1

EMM

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5.3.4 Targeted survey results

No threatened species were recorded within the development site during targeted surveys.

The Koala (probable identification) and Squirrel Glider (positive identification) were recorded by Biosis (2017) within the site boundary explored by OVERLAND. These results, located in the higher quality vegetation over 600 m south of the development site, were used to inform the detailed design phase and determine the development site, refer to Section 6.2.

One individual Finger Panic Grass was recorded within the Orange Grove Road reserve, as shown in Figure 4.1. This species will not be impacted by the project, which will use one of two existing access points through the Orange Grove Road reserve into the development site (ie one for the northern portion of the development site and one for the southern portion of the development site). Shoulder widening will occur at the proposed access point for the northern portion of the development site approximately 40 m to the east of the Finger Panic Grass record (refer Figure 4.1). Shoulder widening will result in clearance of a small area of disturbed grassland habitat, where targeted surveys did not detect the species.

5.3.5 Species credit species

A list of species credit species predicted to occur within the development site, based on the PCTs present and as predicted by the credit calculator, along with an assessment of whether the development site provides suitable habitat and whether the species will be impacted by the development is provided within Table 5.4. The potential for a species to occur within the development site was assessed in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017).

Table 5.4 Species credit species, habitat suitability and targeted survey results

Common name	Scientific name	Biodiversity risk weighting	Habitat present within the development site	Recorded during field surveys	Impacted by development	Justification
Flora						
Belson's Panic	*Homopholis belsonii*	1.0	Yes – roadside only	No	No	Not recorded during targeted surveys.
Bluegrass	*Dichanthium setosum*	2.00	Yes – roadside only	No	No	Not recorded during targeted surveys.
Finger Panic Grass	*Digitaria porrecta*	2.0	Yes – roadside only	No	No	Not recorded during targeted surveys.
Slender Darling Pea	*Swainsona murrayana*	1.5	Yes – roadside only	No	No	Not recorded during targeted surveys.
Fauna						
Koala	*Phascolarctos cinereus*	2.00	Yes	No	No	Not recorded during targeted surveys.
Squirrel Glider	*Petaurus norfolcensis*	2.0	Yes – marginal habitat only	No	No	Not recorded during targeted surveys.

PART B

Stage 2: Impact Assessment

6 Impact Assessment (biodiversity values)

This chapter identifies the potential impacts of the project on the biodiversity values of the development site. Measures taken to date to avoid and minimise impacts are summarised and recommendations to assist OVERLAND to design a development that further avoids, minimises and mitigates impacts are provided.

6.1 Impact summary

The project has potential for both direct and indirect impacts. The direct impacts arising from the project include:

- the removal of 145.8 ha of PCT 101 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* in low condition; and

- the removal of 2.4 ha of PCT 281 *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* in low condition.

Potential indirect impacts arising from the project include:

- temporarily increased noise levels from construction equipment, leading to disturbance of fauna, especially if this occurs during breeding seasons; and

- temporary increase of traffic volume (during construction) leading to higher chance of fauna strike and increased noise levels leading to disturbance of fauna.

The development site already occurs as low quality vegetation that is already heavily impacted by edge effects. The project will not significantly increase edge effects given the high level of existing clearance.

6.2 Avoid and minimise impacts

The principal means to reduce impacts to biodiversity values resulting from the project has been to avoid areas of high quality or supporting significant biodiversity values and minimise the removal of identified native vegetation and fauna habitat.

OVERLAND has considered all biodiversity values and sought advice from Biosis (2017) and EMM in the planning and detailed design stages of the project to avoid, where possible, direct impacts to identified biodiversity values.

Based upon the findings of the constraints assessment (Biosis 2017) (refer Biosis investigation area on Figure 6.1) and further work by EMM in areas to the east of the development site (refer EMM eastern investigation area on Figure 6.1), OVERLAND has made significant reductions to the extent of the development site, which was originally based upon a much larger area within the site boundary, as shown in Figure 6.1.

OVERLAND has made refinements to the proposed development site and has avoided impacts upon the following significant biodiversity features:

- 0.58 ha of PCT 438 - *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion,* by the Namoi River in a previously proposed transmission line route that crossed the river, over 2 km south of the development site;
- 19.13 ha of habitat for Koala and Squirrel Glider, south of the development site;
- riparian vegetation along the Namoi River, south of the development site;
- potential habitat for Murray Cod, Silver Perch and Flat-headed Galaxias in the Namoi River, south of the development site; and
- potential nest sites for the Black-breasted Buzzard and Square-tailed Kite, south of the development site.

OVERLAND has made refinements to the proposed development site and has significantly reduced impacts upon the following vegetation communities:

- reduced impact upon PCT 101 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* from removal of approximately 342.9 ha (based upon the EMM eastern investigation area and Biosis investigation area, as shown in Figure 6.1) down to 145.8 ha in the development site; and
- reduced impact upon PCT 281 - *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* from removal of approximately 14.9 ha (based upon the Biosis investigation area, as shown in Figure 6.1) down to 2.4 ha in the development site.

Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered and are explained in Table 6.1.

Table 6.1 Recommended mitigation measures for direct impacts and indirect impacts

Impact	Action and outcome	Responsibility	Timing
Direct impact			
Clearing of native vegetation - PCT 101 and PCT 281 - low condition (grazing)	Avoid and minimise clearing impacts to these PCTs where possible. Clearing limits will be clearly marked to prevent unnecessary clearing beyond the extent of the development site. Tree clearing and disturbance will be limited to the development site. Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. Identify the location of any 'No Go Zones' in site inductions.	Construction site manager	Prior to and during vegetation clearing

Table 6.1 Recommended mitigation measures for direct impacts and indirect impacts

Impact	Action and outcome	Responsibility	Timing
Direct impact			
Clearing of hollow bearing trees/habitat trees, resulting in fauna injury and mortality	Limit removal of trees to that required within the development site in support of the installation of project infrastructure. A clearing procedure will be implemented during the clearing of the development site, as follows: • preclearance surveys will be completed to determine if any nesting birds are present; and • a suitably trained fauna handler will be present during hollow-bearing tree clearing to rescue and relocate displaced fauna if found on-site. Installation of appropriate exclusion fencing around trees and vegetation to be retained in or directly adjacent to, the development site. The radius of tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 in accordance with the Standards Australia Committee (2009). Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. Identify the location of any 'No Go Zones' in site inductions.	Construction site manager and suitably trained fauna handler	Prior to and during tree clearing
Clearing of potential Koala habitat - PCT 101 and PCT 281 - low condition (grazing)	A clearing procedure will be implemented during the clearing of the development site, as follows: • preclearance surveys will be completed to determine if any Koalas are present; and • clearing not to proceed until Koala has moved on. Installation of appropriate exclusion fencing around trees and vegetation to be retained in or directly adjacent to, the development site. Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. Identify the location of any 'No Go Zones' in site inductions.	Construction site manager and suitably trained fauna handler	Prior to and during tree clearing
Indirect impact			
Indirect impacts on Finger Panic Grass in the road reserve.	Use existing farm gates and tracks to the development site. Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed at the proposed access point for the northern portion of the site that requires shoulder widening (refer Figure 4.1 - located approximately 40 m east of the Finger Panic Grass record). This will prevent any indirect impacts to sub-optimal potential habitat. Identify the location of any 'No Go Zones' in site inductions. Machinery to park in dedicated parking zones, and not within the road reserve. An erosion and sediment control plan is to be implemented on site.	Construction site manager	Prior to and during works

Table 6.1 Recommended mitigation measures for direct impacts and indirect impacts

Impact	Action and outcome	Responsibility	Timing
Direct impact			
Indirect impacts on retained better quality vegetation to the south.	Impacts to the south of Orange Grove Road (for grid connection) are limited to potential pole replacement or installation of a new pole within close proximity of TransGrid's existing 132 kV transmission line. The location of works will be well away from the better quality vegetation in the south of the site boundary, and hence, little (tree trimming) to no impacts are expected. Identify the location of any 'No Go Zones' in site inductions. An erosion and sediment control plan is to be implemented on site.	Construction site manager	Prior to and during works
Indirect impacts on retained Squirrel Glider and Koala habitat to the south.	Impacts to the south of Orange Grove Road (for grid connection) are limited to potential pole replacement or installation of a new pole within close proximity of TransGrid's existing 132 kV transmission line. The location of works will be well away from the better quality vegetation in the south of the site boundary, and hence, little (tree trimming) to no impacts are expected. Identify the location of any 'No Go Zones' in site inductions. An erosion and sediment control plan is to be implemented on site.	Construction site manager	Prior to and during works

6.3 Identification of impacts requiring offsets

6.3.1 Impacts on native vegetation

This section provides an assessment of the impacts on native vegetation requiring offsetting in accordance with Section 10 of the BAM (OEH 2017).

The project will result in the removal of the following:

- 145.8 ha of *PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*; and
- 2.4 ha of PCT 281 - *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*.

However, as outlined in Section 10.3.1.1 of the BAM (OEH 2017), since the vegetation integrity score of both vegetation zones within the development site is less than 15, offsets are not required for impacts on native vegetation (Table 6.1).

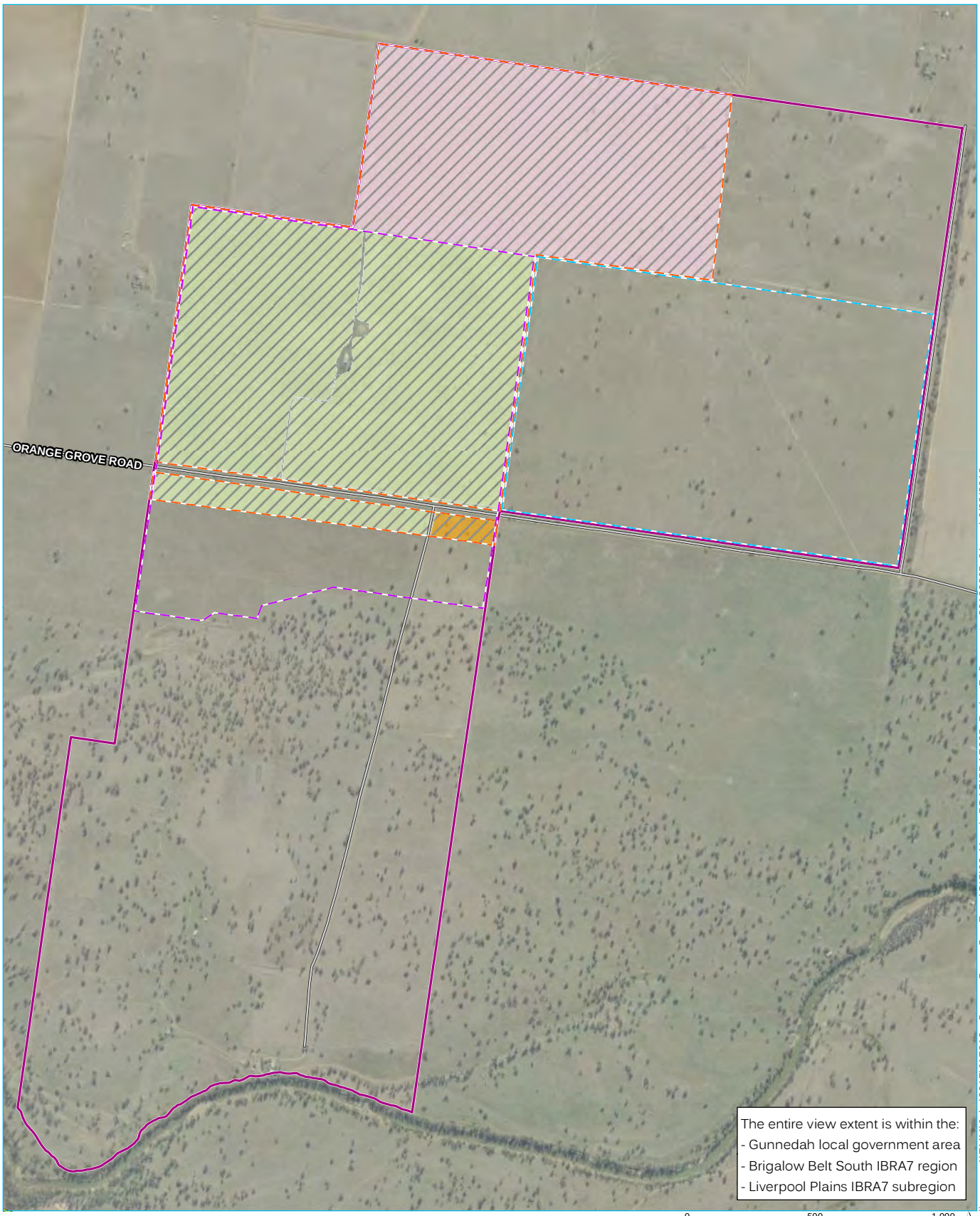
Table 6.2 Summary of ecosystem credits for all vegetation zones

Vegetation zone	PCT code	Vegetation integrity score	Area (ha)	Constant	Sensitivity to gain class	Biodiversity risk weighting	Candidate SAII	Ecosystem credits required
Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion								
1	101	6.1	145.8	0.25	High	2.00	-	0
Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion								
2	281	6.1	2.4	0.25	High	2.00	Yes	0
							Total	**0**

6.3.2 Impacts on threatened species

The project will not result in any impacts on threatened species that require offsetting.

Therefore, the project does not require any offsets and no biodiversity offset strategy is required. The full credit report is provided in Appendix C.



Source: EMM (2018); Overland Sun Farming (2018); Biosis (2017); DFSI (2017); GA (2015); DPI (2013); OEH (2017)

0 500 1,000 m

GDA 1994 MGA Zone 56

N

KEY

- Orange Grove Sun Farm site boundary
- Development site
- Biosis investigation area
- EMM eastern investigation area
- Main road
- Local road
- Areas not requiring offsets
- Cropped/disturbed land

Plant community type

- PCT101 - Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion - Low (grazed)
- PCT281 - Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion - Low (grazed)

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Project refinements and areas not requiring offsets

Orange Grove Sun Farm
Biodiversity development assessment report
Figure 6.1

EMM

7 Assessment of biodiversity legislation

7.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on MNES within the development site was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of MNES relevant to the development site are summarised in Table 7.1.

Table 7.1 Assessment of the project against the EPBC Act

MNES	Project specifics	Potential for significant impact
Threatened species	Nine flora species and 14 fauna species have been recorded or are predicted to occur within the locality. The majority of these species are considered unlikely to occur within the development site and the development site does not provide habitat for an ecologically significant proportion of any of these species.	Significant impact unlikely to result from the proposed development.
Threatened ecological communities	No threatened ecological communities, as listed under the EPBC Act, were recorded within the development site.	Significant impact unlikely to result from the proposed development.
Migratory species	Ten migratory species have been recorded or are predicted to occur within the locality. The development site does not provide important habitat for an ecologically significant proportion of any of these species.	Significant impact unlikely to result from the proposed development.
Wetlands of international importance	The development site does not flow directly into a Ramsar site and the development is not likely to result in a significant impact.	Significant impact unlikely to result from the proposed development.

No significant impacts are predicted to result from the project. Referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

7.2 Environmental Planning and Assessment Act 1979

7.2.1 SEPP No 44

One Koala feed tree species, as defined within Schedule 1 of the SEPP, was identified within the development site. Bimble Box makes up greater than 15 percent of the tree species within the development site. Therefore, the vegetation within the development site is considered potential Koala habitat as defined under SEPP 44.

Most of the trees on the development site are likely to provide foraging or sheltering resources for Koala. Although Koala scats were recorded on the southern banks of the Namoi River, in more timbered habitat to the south of the development site (Biosis 2017), no scats were found in the development site. The site is therefore not considered core Koala habitat under the SEPP.

8 Conclusion

This assessment has been completed in accordance with the BAM (OEH 2017) on behalf of Orange Grove Sun Farm Pty Ltd.

The site assessment identified areas of PCT 101 *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* and PCT 281 *Rough-Barked Apple - Red Gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* within the development site. PCT 281 represents White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community, an EEC listed under BC Act. Both PCTs identified within the development site are heavily grazed and were identified to be in very low condition.

Measures to avoid and minimise impacts to vegetation were considered during the planning and detailed design stages of the project, resulting in avoidance of all significant biodiversity values, and minimisation of impacts on other areas of native vegetation. This iterative process has resulted in the project impacting upon native vegetation of low quality only. Additional recommendations to mitigate any minor residual impacts are provided in Section 6.2. Through an iterative design process, which considered the above biodiversity values, the residual impact of the project will be limited to removal of 148.2 ha of low quality native vegetation.

The vegetation integrity score of both vegetation zones within the development site is such that that offsets are not required for impacts on native vegetation. Therefore, the project does not require any offsets and no biodiversity offset strategy is required.

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Appendix A

Biosis constraints report (2017)

Gunnedah Solar Farm, NSW
Biodiversity Constraints Report

Prepared for Overland Sun Farming

FINAL REPORT

13 June 2017

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File name: 24475.Gunnedah.Solar.Farm.Constraints.FIN.20170613

Citation: Biosis 2017. Gunnedah Solar Farm, NSW: Biodiversity Assessment Report. Report for Overland Sun Farming Company. Authors: A Barreto, A Rowles, S Allison & A Cable, Biosis Pty Ltd. Project no 24475.

Document control

Version	Internal reviewer	Date issued
Draft version 01	Nathan Garvey	23 May 2017
Final version 01	Nathan Garvey	13 June 2017

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Overland Sun Farming Company: Sten Fraser
- Department of the Environment and Energy for access to the Protected Matters Search Tool of the Australian Government
- NSW Office of Environment and Heritage for access to the Atlas of NSW Wildlife.
- BirdLife Australia for access to the New Atlas of Australian Birds 1998-2013.

Biosis staff involved in this project were:

- Lauren Harley & James Shepherd (mapping)
- Luke Stone and Sarah Allison (background research)
- Nathan Garvey (quality assurance)

Contents

Tables

Figures

Plates

Glossary

Assessment circles	Two circles (the inner and outer assessment circle) in which the percent native vegetation cover in the landscape is assessed, taking into account both cover and condition of vegetation (OEH 2014a).
BA	Birds Australia
DoEE	Commonwealth Department of the Environment and Energy
DCDB	Land and Property Information(LPI) digital cadastral database
Development site	The proposed location for the solar PV panels
DPE	NSW Department of Planning and Environment
DPI	Department of Primary Industries
DTDB	Digital topographic databases
Ecosystem credit species	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development.
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FBA	NSW Framework for Biodiversity Assessment
GSF	Gunnedah Solar Farm
HBT	Hollow Bearing Tree
LEP	Local Environment Plan
Locality	Area located within 10 kilometres radius from the study area
LPI	NSW Land and Property Information
Matters for further consideration	Impacts that are considered to be complicated or severe that will require further consideration by the consent authority (OEH 2014). The assessment is based on thresholds detailed in Section 9 of the FBA. These can also be included as part of the project SEARs.
Matters of NES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
NV Act	NSW *Native Vegetation Act 2003*
NW Act	NSW *Noxious Weed Act 1993*
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type

PV	Photovoltaic panels
RoTAP	Rare or Threatened Australian Plant
SEARs	Secretary's Environmental Assessment Requirements
SEPP 44	NSW State Environmental Planning Policy No. 44 – Koala Habitat Protection
SIS	Species Impact Statement
SSD	State Significant Development
Study area	The area of direct impact for the proposed works including the development site, road access and power easement
Tg value	The ability of a species to respond to improvement in site value or other habitat improvement at an offset site with management actions.
TSC Act	NSW *Threatened Species Conservation Act 1995*
VIS	NSW Vegetation Information System
WM Act	*Water Management Act 2000*

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Overland Sun Farming Company Pty Ltd to undertake a biodiversity assessment for the proposed Gunnedah Solar Farm, located near Gunnedah in north-western NSW (Figure 1).

The project will be assessed under Section 89C of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as State Significant Development (SSD). Impacts to biodiversity will be assessed in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014a) and *Framework for Biodiversity Assessment* (FBA) (OEH 2014b) by an appropriately accredited person.

All biodiversity assessment has been undertaken in accordance with the FBA. This report has therefore been prepared by Accredited BioBanking Assessor Nathan Garvey (No. 0103).

1.2 Development proposal

Overland Sun Farming Company is proposing to develop a solar photovoltaic (PV) farm near Gunnedah NSW. Hereafter this development is referred to as the Gunnedah Solar Farm (GSF). The proposed GSF will involve the installation of an array of PV panels (modules) within the site and associated infrastructure, including connection to the existing Gunnedah substation. The ultimate decision for the module type and racking system will be dependent upon availability and market conditions at the time of procurement.

The project will require the construction of connection to the Gunnedah substation to export electricity produced at the site to the electricity grid. The connection will be approximately 2.6 kilometres in length and will run along the south-western boundary of the study area, crossing the Namoi River and running along the Oxley Highway towards the substation (Figure 2).

Due to the site's relatively flat terrain and predominantly cleared landscape, limited site preparation and civil works will be required. Site establishment works and preparation for construction could potentially include the establishment of a temporary construction site compound in a fenced off area within study area including a site office, containers for storage, parking areas and construction of access tracks and boundary fencing. Access to the site will be from Orange Grove Road (Figure 2).

Construction will require the use of bulldozers, water trucks, graders, flatbed trucks, skid steers, front end loaders, roller compactors, trenchers, backhoes, gravel trucks, water tankers, cranes, and aerial lifts.

The final footprint of the solar farm infrastructure will be refined through consideration of findings of this report and identification of constraints and opportunities mapped through the environmental impact assessment process, including biodiversity. The intent, however, is to maximise the built footprint over the study area while minimising impacts on the ecological values present on the site. Areas of Aboriginal cultural heritage sensitivity were also considered in detail during the design phase of the PV array.

The study area is defined as the maximum area to be directly impacted by the proposal. This includes the area where solar panels will be constructed (referred to as the 'development site' in Figure 2) as well as the proposed power easement (referred to as the 'power easement' in Figure 2) and access points (as yet undefined). Impacts to biodiversity arising from the project are the subject of this assessment.

1.3 Site description

The proposed GSF includes part of Lot 2 DP945590, as well as Crown land located along the Namoi River. The 201 hectare study area is located approximately 15 kilometres east of Gunnedah and approximately 335 kilometres north-west of Sydney. The site is located east of the Kevin Road and Orange Grove Road intersection. The Gunnedah substation is located approximately 3.3 kilometres to the west of the study area along the Oxley Highway.

The study area consists of flat floodplain grazing land with isolated paddock trees and remnant native vegetation along the southern boundary and proposed easement. There is one mapped watercourse and two drainage lines located within the study area, as well as one farm dam. The Namoi River is located within the study area and is crossed by the proposed easement. Keepit Lake occurs approximately 12 kilometres to the northeast.

The study area is currently zoned RU1 Primary Production with a high conservation value under the *Gunnedah Local Environmental Plan* (LEP) *2012*.

The study area is within the:

- Brigalow Belt South Interim Biogeographic Regionalisation for Australia (IBRA) Region
- Liverpool Plains IBRA subregion
- Namoi Catchment Management Area
- Gunnedah Shire Council Local Government Area (LGA).

1.4 Information sources

1.4.1 Publications and databases

In order to provide a context for the study area, information about flora and fauna from within 10 kilometres (the 'locality') was obtained from relevant public databases. Records from the following databases were collated and reviewed:

- Department of the Environment and Energy (DoEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW BioNet - the database for the Atlas of NSW Wildlife, Office of Environment and Heritage (OEH).
- PlantNET (The Royal Botanic Gardens and Domain Trust) for Rare or Threatened Australian Plants (RoTAP).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015 (BA).
- Other sources of biodiversity information:
  - The NSW Plant Community Types, as held within the Vegetation Information System (VIS) Classification 2.1 database.
  - *State Vegetation Type Map: Border Rivers Gwydir / Namoi Regional Native Vegetation PCT Map Version 2.0. (VIS 4467)* (OEH 2015).
  - Refinement of vegetation mapping in the Namoi Catchment: Extant and pre-European (Eco Logical Australia 2013).

The following reports were also reviewed:

- Biosis 2016. Preliminary BioBanking Assessment: Gunnedah Solar Development Site, NSW.
- Australian Commonwealth listing advice, including (but not limited to):
  - *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (Threatened Species Scientific Committee 2006).
- NSW Scientific Committee final determinations for threatened biota, including (but not limited to):
  - *White Box Yellow Box Blakely's Red Gum Woodland* (NSW Scientific Committee 2002).

1.4.2 Spatial data

Aerial photography was supplied by NSW Land and Property Information (LPI) (dated 2011). The study area boundaries were provided by Overland Sun Farming.

Mapping was conducted using hand-held (uncorrected) GPS units (GDA94), mobile tablet computers running Collector for ArcGIS™ and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Base map data was obtained from LPI 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB). Mapping of stream order was undertaken manually, using the Hydroline layer within the DTDB.

The following spatial datasets were utilised during the development of this report:

- Catchment data was obtained from the Catchment Boundaries of New South Wales dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DIWA).
- State Environmental Planning Policy (SEPP) 14 Wetlands.
- NSW Soil and Land Information System (SALIS).

Mapping has been produced using a Geographic Information System (GIS).

1.5 Additional legislative requirements

The project has been assessed against key biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Threatened Species Conservation Act 1995* (TSC Act)
- *Fisheries Management Act 1994* (FM Act)
- *Noxious Weeds Act 1993* (NW Act)
- *Water Management Act 2000* (WM Act)
- Gunnedah Local Environmental Plan 2012.

Orange Grove

Orange Grove Road

Brigalow Belt South
Liverpool Plains

Lip

Mop

Namoi River

Carroll

Oxley Highway

Carroll Creek

Carroll Creek

Kibah Creek

Acknowledgements:Basemap © Land and Property Information 2015; Imagery © LPI 2011

Legend

- Study area
- Assessment circles
- IBRA Sub-region
- Native vegetation extent

MItchell landscape v3

- Lip, Liverpool Alluvial Plains
- Mop, Mooki - Namoi Channels and Floodplains

Figure 1: Location map - Gunnedah Solar Farm

0 160 320 480 640 800

Metres

Scale: 1:19,000 @ A3

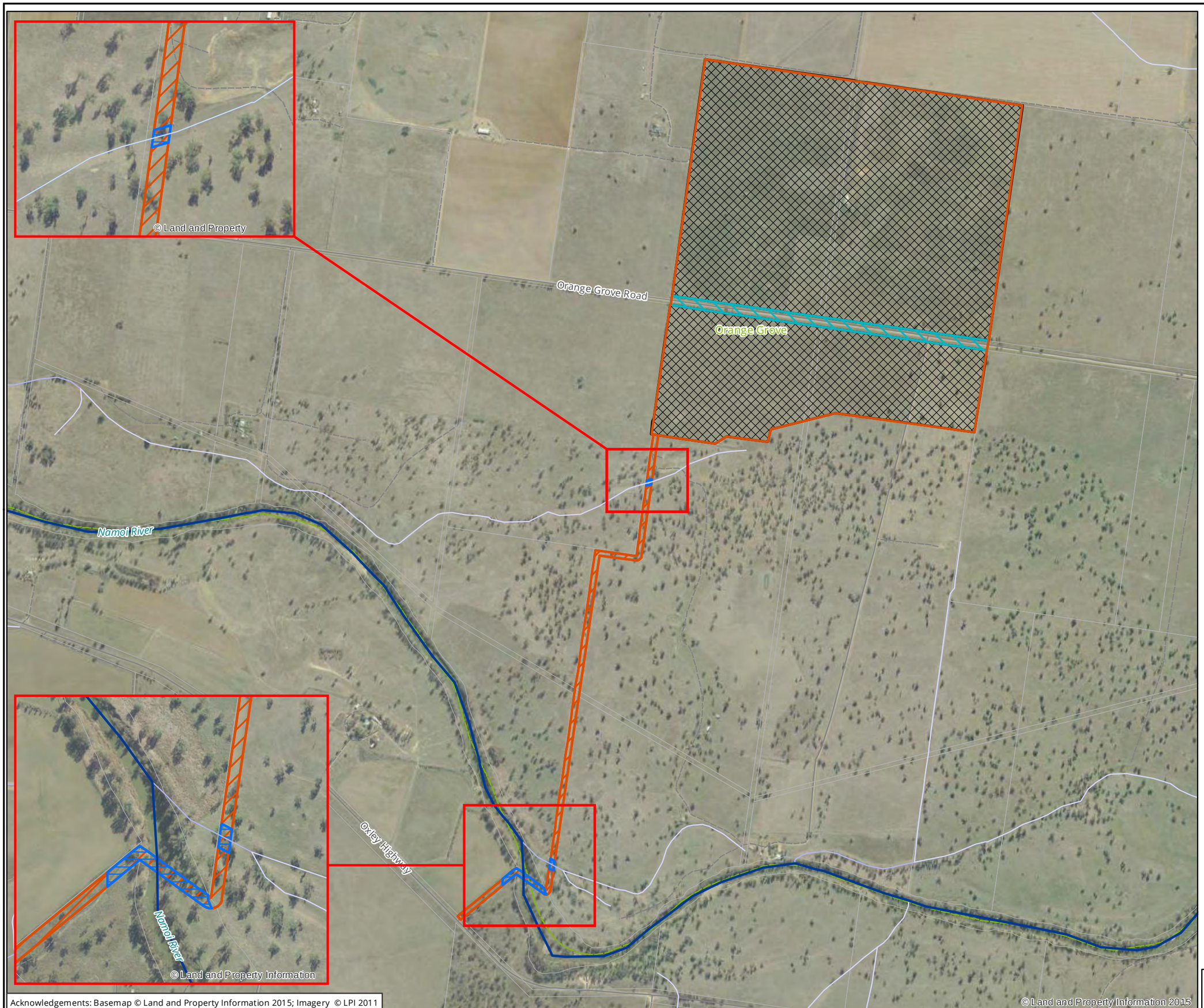
Coordinate System: GDA 1994 MGA Zone 56

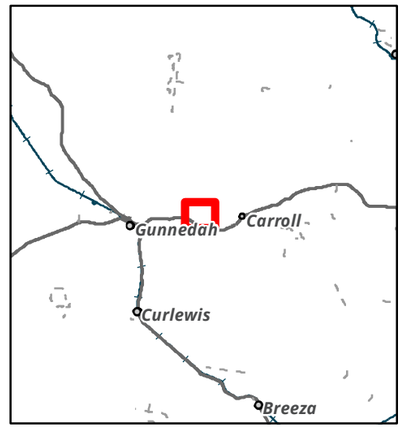
N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 24475
Date: 24 May 2017,
Checked by: ABM, Drawn by: LH, Last edited by: ngarvey
Location:P:\24400s\24475\Mapping
24475_F1_Location





Legend

- Study area
- Development site
- Power easement
- Road reserve

Strahler stream order

- 1st
- 2nd
- 9th
- Stream buffers

Figure 2: Site map - Gunnedah Solar Farm

0 160 320 480 640 800

Metres

Scale: 1:15,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 24475
Date: 09 May 2017,
Checked by: ABM, Drawn by: LH, Last edited by: ngarvey
Location:\\bio-data-01\matters$\24400s\24475\Mapping\24475_F2_SitePlan

Acknowledgements: Basemap © Land and Property Information 2015; Imagery © LPI 2011

2 Legislative context

This section provides an overview of key biodiversity legislation and government policy considered in this assessment. Where available, links to further information are provided. This section does not describe the legislation and policy in detail and guidance provided here does not constitute legal advice.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on Matters of National Environmental Significance (NES) protected under the Act.

Nine Matters of NES are identified under the EPBC Act:

- world heritage properties
- national heritage places
- wetlands of international importance (also known as 'Ramsar' wetlands)
- nationally threatened species and ecological communities
- migratory species
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, activities that have potential to result in significant impacts on Matters of NES must be referred to the Commonwealth Minister for the Environment for assessment.

Matters of NES relevant to the current project include nationally threatened species and ecological communities, migratory species and Ramsar wetlands. Threatened ecological communities and species protected by the EPBC Act are outlined in Section 4 and Section 6, respectively. An assessment of potential impacts to all Matters of NES under the provisions of the EPBC Act will be provided upon receipt of the final detailed design.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the proper consideration and management of impacts of proposed development or land-use changes on the environment (both natural and built) and the community. The Act is administered by the NSW Department of Planning and Environment (DPE).

The GSF has been deemed SSD and will be assessed under Section 89C of the EP&A Act. Biodiversity impacts arising from SSD projects are assessed in accordance with the FBA.

The EP&A Act provides the overarching structure for planning in NSW; however is supported by other statutory environmental planning instruments. Sections of the EP&A Act of primary relevance to the natural environment are outlined further below.

Local Environment Plans (Part 3 Division 4)

Local Environment Plans (LEP) apply either to the whole, or part of, a local government area and make provision for the protection or utilisation of the environment through zoning of land.

The study area is subject to the Gunnedah Local Environmental Plan and is zoned RU1 Primary Production. This zoning provides for:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To provide for a range of ecologically sustainable agricultural and rural land uses and development on broad acre rural lands.
- To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Gunnedah's longer term economic sustainability.
- To conserve and enhance the quality of valuable environmental assets, including waterways, riparian land, wetlands and other surface and groundwater resources, remnant native vegetation and fauna movement corridors as part of all new development and land use.

Elements of the LEP objectives are relevant to this assessment will be discussed upon receipt of the final detailed design.

State Environmental Planning Policies (Part 3 Division 2)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. The SEPP relevant to the current development is:

SEPP No. 44 Koala Habitat Protection

SEPP 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 1 to the SEPP.

The study area is located in the Gunnedah LGA, which is a listed Council. Therefore, SEPP 44 is relevant to the current assessment and will be assessed upon receipt of the final detailed design.

2.2.2 Threatened Species Conservation Act 1995

The TSC Act is the key piece of legislation providing for the protection and conservation of biodiversity in NSW through the listing of threatened species, populations and ecological communities and the declaration and mapping of their critical habitats, as well as the identification of key threatening processes.

The TSC Act also establishes a system for biodiversity certification and establishes the Biodiversity Banking and Offsets Scheme. For all major projects, impacts to biodiversity are assessed in accordance with the FBA.

2.2.3 Fisheries Management Act

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the Assessment of Significance process under Section 220ZZ of the FM Act and Section 5A of the EP&A Act.

Two key objectives of the FM Act are to; conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications the Department of Primary Industries (DPI) will assess the likelihood of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS).

The Namoi River to the south of the study are is mapped as TYPE 1 Highly Sensitive, and Class 1 Major, Key Fish Habitat by DPI. The two drainage lines that run from or through the study area are not considered Key Fish Habitat.

If any impacts to the Namoi River are likely to result from the proposed works additional surveys for threatened fish species will be required. Setbacks and mitigation measures to avoid impacts will be critical.

2.2.4 Water Management Act 2000

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated management of the state's water for the benefit of both present and future generations based on the concept of ecologically sustainable development.

Under the WM Act an approval is required to undertake controlled activities on waterfront land, unless that activity is otherwise exempt (WM Act, section 91E). Waterfront land is the bed of any river, lake or estuary and any land within 40 metres of the highest bank of the river, the lake shore or the mean high water mark of the estuary. In the WM Act, controlled activity means:

- The erection of a building or the carrying out of works (within the meaning of the *Environmental Planning and Assessment Act 1979*).
- The removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise.
- The deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise.
- The carrying out of any other activity that affects the quantity or flow of water in a water source.

In relation to controlled activities, the WM Act states amongst other things that the carrying out of controlled activities must avoid or minimise land degradation, including soil erosion, compaction, decline of native vegetation and where possible land must be rehabilitated.

The WM Act is supported by a series of interpretation guidelines including *Controlled activities on waterfront land - guidelines for riparian corridors on waterfront land* (NSW Office of Water, 2012a). This guideline defines a riparian management envelope referred to as the vegetated riparian zone (VRZ). The width of the VRZ within a riparian corridor has been pre-determined and standardised for first, second, third and fourth order and greater watercourses according to the Strahler System of ordering watercourses. The width of the VRZ is measured from the top of the highest bank on both sides of the watercourse. This guideline also presents the riparian corridor matrix that assists applicants for controlled activity approvals to identify certain works and activities that can occur on waterfront land and in riparian corridors. The guideline also includes overarching management measures for works on waterfront land.

Any works within 40 metres of the top of the bank of the Namoi River will need to be consistent with the riparian corridor matrix of the NSW Office of Water (2012a) including establishment of a 40 metre VRZ from the edge of the bank. Other NSW Office of Water guidelines should be referenced during detailed design of structures proposed in the riparian zone and for the preparation of a vegetation management plan that is likely to be required for maintenance of a VRZ (NSW Office of Water 2012c).

2.2.5 Noxious Weeds Act 1993

The NW Act was enacted to provide for the identification, classification and control of noxious weeds. The NW Act aims to reduce the negative impact of weeds on the economy, community and environment of NSW by:

- Establishing control mechanisms to prevent the establishment of significant new weeds in NSW.
- Preventing, eliminating or restricting the spread of particular significant weeds in NSW.
- Effectively managing widespread significant weeds in NSW.

Plants declared as noxious weeds are currently listed under *Noxious Weeds (Weed Control) Order 2014* published in the NSW Government Gazette No. 23. The NW Act is supported by a number of regulations and is administered by the DPI.

Noxious weeds are discussed further in Section 7, and will be assessed upon receipt of the final detailed design.

3 Landscape

3.1 Bioregions and landscapes

The study area occurs within the Brigalow Belt South IBRA bioregion and the Liverpool Plains IBRA subregion. The Liverpool Plains IBRA subregion covers the entire study area and is the subregion used in this assessment.

Most of the study area occurs within the Liverpool Alluvial Plains Mitchell Landscape, with the Mooki-Namoi Channels and Floodplains located along the Namoi River in the south (Figure 1). The Liverpool Alluvial Plains Mitchell Landscape was used in this assessment as it covers most of the study area, including the development site.

3.2 Waterways and wetlands

The study area is located within the Namoi catchment, in western NSW and west of the Great Dividing Range. The Namoi catchment borders the Gwydir River catchment to the north, Macleay River catchment to the east, Castlereagh catchment to the west and Hunter catchment to the south.

No watercourses are located within the development site. One farm dam is located in this area. The power easement traverses two non-perennial drainage lines (one 1st-order stream and one 2nd-order stream) before crossing the Namoi River (Figure 2). The Namoi River is a perennial 9th-order river at the crossing point. Keepit Lake is located 12 kilometres north-east of the study area.

3.3 Native vegetation extent

The smallest inner and outer assessment circles (200 hectares and 2,000 hectares) were used, as the 2,000 hectare assessment circle was sufficient to fit the whole the study area (Figure 3). The inner assessment circle was centred on the area of native vegetation that is most impacted by the project.

Mapping of vegetation within the inner and outer assessment circles was undertaken using aerial mapping interpretation and *State Vegetation Type Map: Border Rivers Gwydir / Namoi Regional Native Vegetation PCT Map Version 2.0. (VIS 4467)* (OEH 2015). This mapping was modified using vegetation extent as assessed by Biosis (see Section 4). Vegetation in the inner and outer assessment circles is shown Figure 3.

Regional mapping within the outer assessment circle includes the following vegetation communities:

- PCT 53 *Shallow freshwater wetland sedgeland in depressions on floodplains on inland alluvial plains and floodplains* (NA201).
- PCT 78 *River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion* (NA193).
- PCT *101Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* (NA185).
- PCT 102 *Liverpool Plains grassland mainly on basaltic black earth soils, Brigalow Belt South Bioregion* (NA181).
- PCT 112 *Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion* (NA253).

- PCT 281 *Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* (NA339).
- PCT 438 *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion* (NA336).

3.4 Assessment of landscape value

Landscape value has been calculated using the method for site-based developments, outlined in Appendix 4 of the FBA (OEH 2014b).

3.4.1 Assessment of the current extent of native vegetation cover

The extent of native vegetation cover before development for both outer and inner assessment circles was determined as the sum of areas of each of the native vegetation map units listed above.

To determine the extent of native vegetation cover after development, the extent of vegetation required for removal is subtracted from the extent of native vegetation cover before development. Table 1 provides a summary of the extent of native vegetation cover within the inner and outer assessments circles, before and after development.

Table 1 Extent of native vegetation cover before and after development

Assessment circle	Before development		After development	
	Area (ha)	%	Area (ha)	%
Outer assessment circle	846.18	42	830.65	41
Inner assessment circle	101.68	51	90.81	45

No major change in the extent of native vegetation in either the outer assessment circle will result from the development. A reduction of one class in native vegetation cover within the inner assessment circle will result from the development, with a reduction from 51-55% to 41-45%.

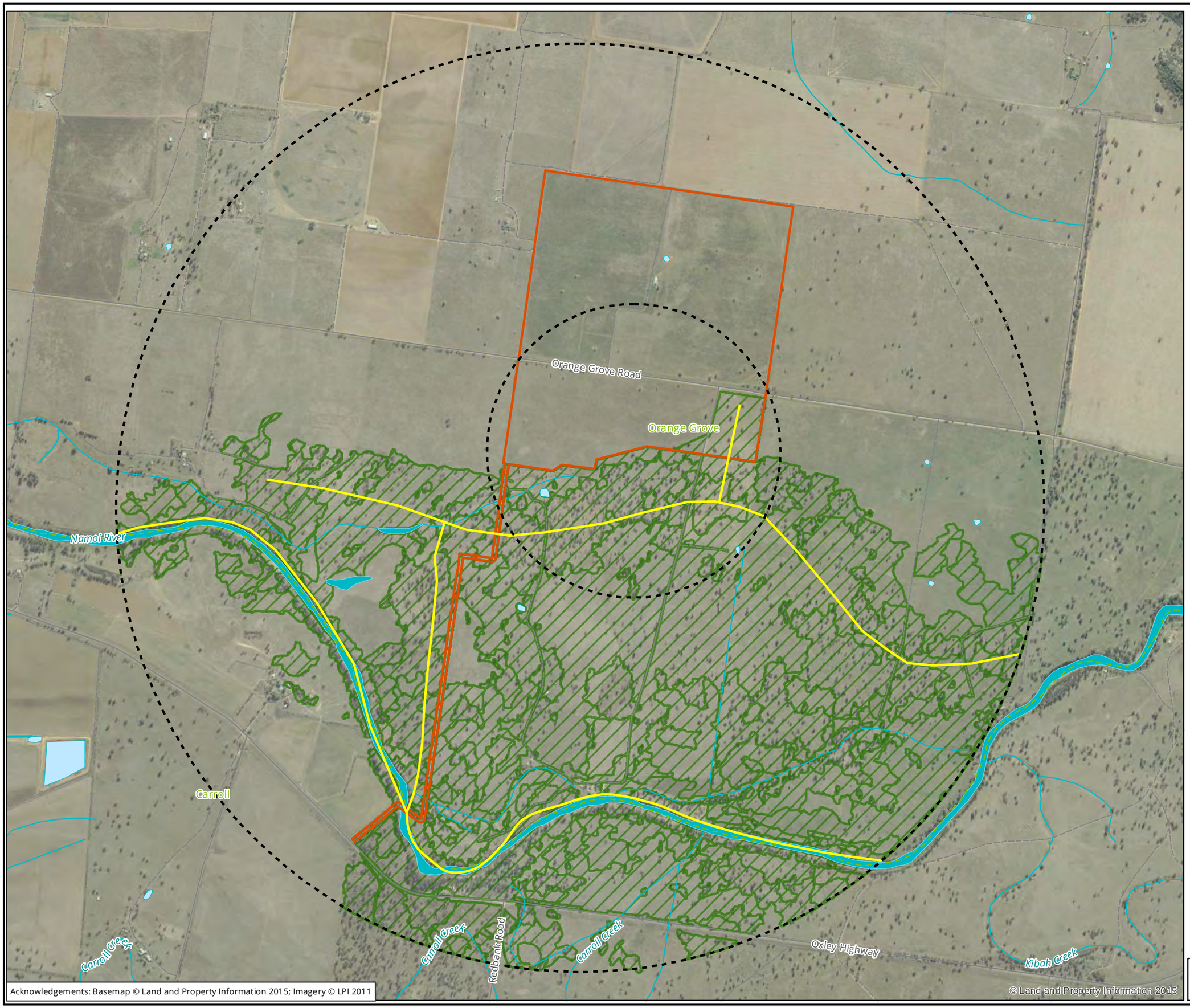
3.4.2 Assessment of connectivity value

The Namoi River that intercepts the proposed easement southwest of the study area is a 9th-order stream at this location. Therefore, the proposed development was assessed as being within the buffer of a 6th-order stream or greater. The proposed development is assessed as being part of a state significant biodiversity link.

3.4.3 Assessment of patch size

Patch size was assessed using a select process in ArcGIS. All vegetation not defined as low condition and separated by a distance of less than 100 metres (woody vegetation types) and 30 metres (non-woody vegetation types) was mapped sequentially. Using this method, the vegetation within the development site forms part of a relatively large patch of connecting vegetation with a patch size larger than 1000 hectares.

The Liverpool Alluvial Plains Mitchell Landscape is estimated to be 84% cleared. A patch size of greater than 100 hectares fits into the 'Extra Large' patch size class. The patch size is Extra Large.



Legend

- Study area
- Assessment circles
- Connective links
- Native vegetation extent

Figure 3: Vegetation in the inner and outer assessment circles including connective links

0 160 320 480 640 800

Metres

Scale: 1:19,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 24031
Date: 09 May 2017,
Checked by: ABM, Drawn by: LH, Last edited by: ngarvey
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4 Native vegetation

The extent of native vegetation within the development site was determined using Section 5 of the FBA.

4.1 Background review

A review of the *Refinement of vegetation mapping in the Namoi Catchment: Extant and pre-European* (Eco Logical Australia 2013) and *State Vegetation Type Map: Border Rivers Gwydir / Namoi Regional Native Vegetation PCT Map Version 2.0. (VIS 4467)* (OEH 2015) was undertaken to inform the site investigation. Eco Logical Australia (2013) identifies three vegetation communities within the study area, including:

- White Box grassy woodland, Brigalow Belt South and Nandewar.
- Box - gum grassy woodlands, Brigalow Belt South and Nandewar.
- Derived grasslands, Brigalow Belt South and Nandewar.

OEH (2015) was reviewed to determine the native vegetation extent as outlined in Section 3.3.

4.2 Methods

4.2.1 Site investigation

A detailed assessment of the study area was undertaken by Biosis in March 2017. The purpose of this assessment was:

- To undertake vegetation mapping.
- To undertake a detailed assessment of vegetation condition in accordance with the requirements of the FBA.
- To undertake targeted surveys (see Section 5).

Detailed mapping of vegetation communities was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using the ArcGIS Collector application and aerial photo interpretation. Areas of native vegetation for which a Plant Community Type (PCT) could accurately be assigned were identified and delineated in the field, and vegetation condition determined. Identification of PCTs within the study area was confirmed with reference to the community profile descriptions (and diagnostic species tests) held within the NSW Vegetation Information System (VIS): Classification Version 2.1.

General classification of native vegetation in NSW used in this report is based on the classification system in Keith (2004) which uses three groupings of vegetation: vegetation formation, vegetation class and vegetation type (or PCT), with vegetation type the finest grouping. The grouping referred to in this report is PCT. PCTs were stratified into Vegetation Zones based on condition (low or moderate/good) and ancillary code.

Following stratification of Vegetation Zones, site value was assessed using data obtained via a series of plots and transects, as per the methodology outlined in Section 5 of the FBA. Plot and transect data was collected from the study area in March 2017 and included:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes.
- A 20 metre x 20 metre quadrat, nested within the quadrat outlined above, for full floristic survey to determine native plant species richness.

The minimum number of plots/transects per Vegetation Zone was determined using Table 3 of the FBA. A total of nine plots/transects were completed within the study area (Figure 4).

Floristic data, including plot and transect data, is provided in Appendix 1. A list of flora species was compiled for each PCT. Records of all flora species will be submitted to OEH for incorporation into the Atlas of NSW Wildlife.

4.3 Results

4.3.1 Vegetation description

The study area is currently used for cattle grazing and has long history of intensive irrigation and cropping. Native vegetation and fauna habitats have been modified by past disturbances associated with land clearing, cropping, livestock grazing and weed invasion. Native vegetation occurs as isolated paddock trees and remnant native vegetation along the southern boundary and proposed easement in the south.

The study area supports 202 hectares of native vegetation with varying levels of disturbance (Figure 4). The following PCTs were identified within the study area:

- PCT 101 *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion* (NA185) was identified within the development site and road reserve, with total area of 186.6 hectares. This PCT is heavily modified due to land uses outlined above.
- PCT 281 *Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* (NA339) was identified in the south-eastern corner of the study area and along the proposed easement, with a total area of 14.87 hectares.
- PCT 438 *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion* (NA 336) was identified along the Namoi River, intersecting the proposed easement within the study area and extents 0.58 hectares.

The remnant vegetation in the south of the study area is well connected with native vegetation along the west and east boundaries and by an agricultural matrix in the north of the study area. Heavy cattle grazing and past cropping and intensive irrigation have impacted the ground cover resulting in in heavy weed infestations, soil disturbance and compaction. This has limited recruitment of native shrubs, grasses and eucalypts species. The vegetation is characterised by a canopy of mature and semi-mature native trees with an understorey of disturbance tolerant native species and exotic herbs and grasses. Existing irrigation channels, soil disturbance and lack of shrub species are evidence of past irrigation and cropping activities.

Ecological features of the study area and photographs of each community are provided below in Table 4 to Table 6. The extent of these communities is mapped in Figure 4.

4.3.2 Plant community types

Site investigations, including determination of vegetation communities using the methods outlined in Section 4.2.1, identified the presence of three PCTs within the study area. The PCT, vegetation formation and vegetation class (Keith 2004) are described in Table 2.

Table 2 Plant community types of the development site and corresponding formation and class (Keith 2004)

Plant community type	Vegetation formation	Vegetation class	Area (ha)
PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	Semi-arid Woodland (Grassy sub-formation)	Brigalow Clay Plain Woodland	186.6
PCT 281 Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (NA339)	Grassy Woodland	Western Slopes Grassy Woodland	14.87
PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion (NA 336)	Semi-arid Woodland (Grassy sub-formation)	Inland Floodplain Woodland	0.58

The three PCTs were stratified in accordance with the FBA. PCT 101 in the development site was found to be in low condition, being dominated by exotic grasses and a low cover of native grasses. Other PCTs were found to be in moderate/good condition. No further stratification was undertaken. This has resulted in four vegetation zones being identified within the study area (Table 3 and Figure 4).

Table 3 Vegetation zones mapped within the study area

Vegetation zone (VZ)	Plant community type	Condition	Ancillary code	Area (ha)
1	PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	Low	-	183.05
2	PCT 281 Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (NA339)	Moderate/Good	-	14.95
3	PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion (NA 336)	Moderate/Good	-	0.58
4	PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	Moderate/Good	-	3.69

Descriptions of each vegetation zone are provided in Table 4 to Table 6.

Table 4 Vegetation zone 1 description

Vegetation zone 1 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	
PCT ID	101
Biometric vegetation type ID	NA185
Common name	*Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*
Condition	Low
Extent within study area	182.92 ha of this PCT was recorded and mapped within the development site (Figure 4).
Description	Bimble Box *Eucalyptus populnea* subsp. *bimbil* occurs as scattered paddock trees throughout this vegetation zone. There was a complete absence of the shrub layer due to past clearing and continual grazing pressures. The ground cover is dominated by introduced pasture species including Liverseed Grass *Urochloa panicoides,* Barley Grass *Hordeum leporinum*. Some native grass species included Slender Bamboo Grass *Austrostipa verticillata*, *Rytidosperma racemosa* var. *obtusatum* and Curly Windmill Grass *Enteropogon acicularis.* Other exotic ground cover species included Caltrop *Tribulus terrestris,* St Barnabys Thistle *Centaurea solstitialis,* Wireweed *Polygonum aviculare and* Wild Melon *Citrullus lanatus var. lanatus* This community is found on heavy alluvial clay soils derived from volcanic or sedimentary substrates. Mostly cleared for grazing and cropping.
Survey effort	Four plot/transects within study area (Q1, 2, 3 and 4).
Condition	The community is in poor condition with a high cover of introduced plant species due to past irrigation, cropping, soil modification and current cattle grazing activities. Surrounding land use (mostly cropping) and associated edge impacts contribute even further to the existing condition of this zone.
Characteristic species used for identification of PCT	According with the NSW VIS: Classification Version 2.1, the overstorey species recorded within the study area that align with the dominant species listed as characterising this PCT include Bimble Box generally with an open understorey dominated by forbs, grasses and low growing chenopods.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution in north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA Subregion, and the occurrence on heavy alluvial clay soils derived from volcanic or sedimentary substrates as well as the landscape position on alluvial plains. These features are consistent with the PCT structure and growth forms and dominant species.

Vegetation zone 1 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	
Status	Commonwealth EPBC Act: Not listed. NSW TSC Act: Not listed. Justification: This PCT is associated with EPBC Act and TSC Act threatened ecological communities listed below: • White Box-Yellow Box Blakely's Red Gum Woodland. • Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions. • Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar. Peneplain, Nandewar and Brigalow Belt South Bioregions. Due to the low condition, scattered presence of Bimble Box, absence of shrub layer and exotic dominated ground cover (more than 80%), vegetation zone 1 is not considered to align with any of the threatened ecological communities above.
Estimate of percent cleared value of PCT in the major catchment area	75%
Plate 1 Poplar Box - Yellow Box - Western Grey Box grassy woodland	

Vegetation zone 1 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	
Plate 2 Poplar Box - Yellow Box - Western Grey Box grassy woodland Q2	

Table 5 Vegetation zone 2 description

Vegetation zone 2 - *Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*	
PCT ID	281
Biometric vegetation type ID	NA339
Common name	*Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*
Condition	Moderate/good
Extent within study area	A total of 14.87 ha of this PCT was recorded and mapped in the study area, including 10.28 ha in the south-eastern corner of the development site and 4.59 ha along the power easement along the south-western boundary (Figure 4).

Vegetation zone 2 - *Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*	
Description	Rough-barked Apple *Angophora floribunda* and Yellow Box *Eucalyptus melliodora* are the dominant canopy trees. The shrub and mid layer are absent due to heavy grazing and past clearing. The ground cover is dominated by introduced pasture species including Liverseed Grass, Rye Grass, Caltrop, St Barnabys and Prairie Grass *Bromus cartharticus*. Some native ground cover is present and includes Climbing Saltbush *Einadia nutans,* Curly Windmill Grass and Wallaby Grass *Rytidosperma fulvum,* Wheatgrass *Elymus scaber* and *Rytidosperma racemosum.* This community is found on black and brown alluvial clay loam soils within the study area.
Survey effort	Four plot/transects within the study area (Q6, 7, 8 and 9).
Condition	The community is generally in medium condition with a native overstorey and a high cover of introduced plant species in the ground layer due to grazing, surrounding land use and associated edge impacts.
Characteristic species used for identification of PCT	According with the NSW VIS: Classification Version 2.1, the overstorey species recorded within the study area that align with the dominant species listed as characterising this PCT include Rough-barked Apple and Yellow Box with grassy understorey. Aligning ground cover species include Wheatgrass, Wallaby Grass and *Rytidosperma racemosum.*
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution in north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA Subregion, and the occurrence on heavy alluvial clay soils derived from volcanic or sedimentary substrates as well as the landscape position on alluvial plains. These features are consistent with the PCT structure and growth forms and dominant species. The main diagnostic feature is a canopy dominated by Rough-barked Apple and Yellow Box. The mid-storey is absent in heavily grazed areas. The ground layer is sparse and contains native grasses like Wheatgrass, Wallaby Grass and *Rytidosperma racemosum.* These features are consistent with the PCT structure and growth forms and dominant species particularly within the less disturbed and modified parts of the community adjacent to the study area.
Status	Commonwealth EPBC Act: Not listed. NSW TSC Act: *White Box Yellow Box Blakely's Red Gum Woodland* endangered ecological community. Justification: The vegetation zone aligns with *White Box Yellow Box Blakely's Red Gum Woodland* endangered ecological community under the TSC Act. The vegetation zone is located in the western slopes of NSW, contains Yellow Box as a canopy species and the ground layer is dominated by grasses. The presence of Wheatgrass, Wallaby Grass and *Rytidosperma racemosum* also align with the White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community. However, this vegetation zone does not meet the minimum EBPC Act condition threshold as the percentage cover of non-native perennial plant species exceeds the percentage cover of native plant species in the ground layer (TSSC 2006).
Estimate of percent cleared value of PCT in the major catchment area	75%

Vegetation zone 2 - *Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion*

Plate 3 Rough-Barked Apple red gum - Yellow Box woodland Q7

Plate 4 Rough-Barked Apple red gum - Yellow Box woodland Q9

Table 6 Vegetation zone 3 description

Vegetation zone 3 - *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion*	
PCT ID	438
Biometric vegetation type ID	NA336
Common name	*River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion*
Condition	Moderate/Good
Extent within study area	0.58 ha of this PCT was recorded along the Namoi River at the intersection of the proposed easement (Figure 4).
Description	Tall open woodland to woodland dominated by River Red Gum *Eucalyptus camaldulensis* subsp. *camaldulensis*. Shrubs are absent and ground cover is very dense. Ground cover is dominated by Slender Bamboo Grass, Couch Grass *Cynodon dactylon* and exotic pasture species like Liverseed Grass and Prairie Grass. Forb species include Stinging Nettle *Urtica incisa* and Paddy's Lucerne *Sida rhombifolia*. This community occurs on black earth or humic alluvial soils.
Survey effort	One plot/transect within study area (Q5).
Condition	The community is generally in moderate condition with a good canopy cover but a moderate weed infestation in the ground layer due to proximity to the Namoi River and flooding events. Livestock grazing has also altered the floristics and habitat quality of these areas.
Characteristic species used for identification of PCT	According with the NSW VIS: Classification Version 2.1, the species recorded within the study area that align with the species listed as characterising this PCT include River Red Gum, Common Couch and Slender Bamboo Grass.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution in north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA subregion, and the occurrence on floodplains and river banks on alluvial loam soils is consistent with PCT identified. The diagnostic feature is the presence of include River Red Gum, Common Couch and Slender Bamboo Grass. These features are consistent with the PCT.
Status	Commonwealth EPBC Act: Not listed NSW TSC Act: Not listed
Estimate of percent cleared value of PCT in the major catchment area	75%

Vegetation zone 3 - *River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion*

Plate 5 River Red Gum riparian tall woodland wetland Q5

Plate 6 River Red Gum riparian tall woodland wetland Q5 facing the Namoi River

Table 7 Vegetation zone 4 description

Vegetation zone 4 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	
PCT ID	101
Biometric vegetation type ID	NA185
Common name	*Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*
Condition	Moderate/good
Extent within study area	3.68 ha of this PCT was recorded and mapped within the road reserve (Figure 4).
Description	Bimble Box occurs as scattered paddock trees throughout this vegetation zone. There was a complete absence of the shrub layer due to past clearing and continual grazing pressures. The ground cover is dominated by introduced pasture species including Liverseed Grass, Barley Grass. Some native grass species included Slender Bamboo Grass, *Rytidosperma racemosa* var. *obtusatum* and Curly Windmill Grass. Other exotic ground cover species included Caltrop, St Barnabys Thistle, Wireweed *and* Wild Melon. This community is found on heavy alluvial clay soils derived from volcanic or sedimentary substrates.
Survey effort	No plot/transects were completed in this area.
Condition	The community is in moderate condition with a high cover of introduced plant species due to regular mowing and edge effect. Surrounding land use (mostly cropping) and associated edge impacts contribute even further to the existing condition of this zone.
Characteristic species used for identification of PCT	According with the NSW VIS: Classification Version 2.1, the overstorey species recorded within the study area that align with the dominant species listed as characterising this PCT include Bimble Box generally with an open understorey dominated by forbs, grasses and low growing chenopods.
Justification of evidence used to identify the PCT	Apart from species composition, the stated distribution in north-western NSW, mostly in the eastern section of the Brigalow Belt South Bioregion and Liverpool Plains IBRA Subregion, and the occurrence on heavy alluvial clay soils derived from volcanic or sedimentary substrates as well as the landscape position on alluvial plains. These features are consistent with the PCT structure and growth forms and dominant species.

Vegetation zone 4 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*	
Status	Commonwealth EPBC Act: Endangered. NSW TSC Act: Endangered. Justification: This PCT is associated with EPBC Act and TSC Act threatened ecological communities listed below: • White Box-Yellow Box Blakely's Red Gum Woodland. • Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions. • Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar. Peneplain, Nandewar and Brigalow Belt South Bioregions. Due to the moderate condition, landscape location, presence of Bimble Box, exotic ground cover (less than 80%) on heavy clay soils, vegetation zone 4 is considered to align with Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar. Peneplain, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community.
Estimate of percent cleared value of PCT in the major catchment area	75%
Plate 7 Poplar Box - Yellow Box - Western Grey Box grassy woodland along the Orange Grove Road reserve	

Vegetation zone 4 - *Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion*

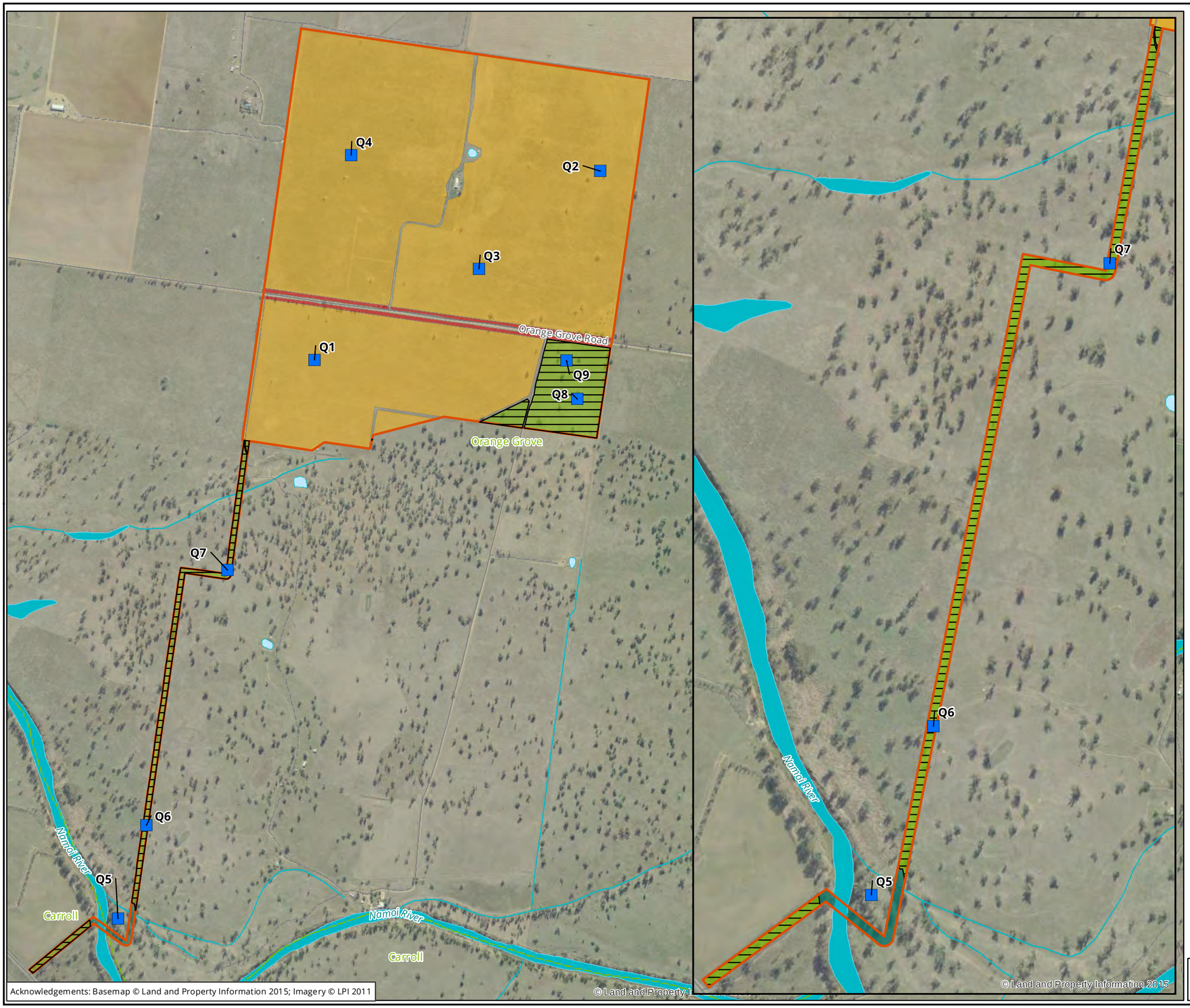
Plate 8 Poplar Box - Yellow Box - Western Grey Box grassy woodland along the Orange Grove Road reserve

4.3.3 Site value scores

Site value scores for each vegetation zone are presented in Table 8.

Table 8 Site value score for each vegetation zone

Vegetation zone	Plant community type	Area (ha)	Site value score
1	PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	183.05	15.85
2	PCT 281 Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (NA339)	14.95	44.81
3	PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion (NA 336)	0.58	56.77
4	PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	3.69	Not determined



Legend

Study area

Plot/transect

Plant community type

PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion, Low (NA 185)

PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion, Moderate/good (NA 185)

PCT 281 Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion, Moderate/good (NA 339)

PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion, Moderate/good (NA 336)

Endangered ecological community

White Box Yellow Box Blakely's Red Gum Woodland EEC

Figure 4: Native vegetation within the study area, including flora and fauna survey effort

0 120 240 360 480 600

Metres

Scale: 1:13,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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Matter: 24475
Date: 24 May 2017,
Checked by: ABM, Drawn by: LH, Last edited by: ngarvey
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5 Aquatic environment

Aquatic environments within and adjacent to the study area are typical of lowland rivers within the Murray-Darling Basin, characterised by broad channels, complex floodplain features and highly variable seasonal flows. The Namoi River flows through the southern section of the study area, and is bordered by some remnant River Red Gums and introduced Weeping Willows *Salix babylonica*. Large woody debris is abundant within the river (**Error! Reference source not found.**), and provides complex structural instream habitats for native fish species. Root mats from Weeping Willow are prevalent along the verge, subsequently preventing the establishment of other vegetation. While this provides a high degree of bank stability in these sections, the simplification of the riparian vegetation structure reduces the ecological value of the waterway for aquatic ecological communities. Stock access to the banks of the waterway within the study area has resulted in compaction of bare soils, increasing the risk of erosion in these bare sections.

Plate 9 Namoi River looking west from proposed easement witihn the study area

The Namoi River, while subject to disturbance as a result of previous and current land use, provides suitable habitat for Murray Cod *Maccullochella* (EPBC Act listed - Vulnerable), Silver Perch *Bidyanus bidyanus* (EPBC Act

listed – Critically Endangered and FM Act Listed – Endangered) and Flat-headed Galaxias *Galaxias rostratus* (EPBC Act and FM Act listed– Critically Endangered).

6 Threatened species

6.1 Methods

Flora and fauna assessments and targeted surveys of the study area were undertaken from 13 March 2017 to 17 March 2017. Weather observations for each survey date are shown in Table 9.

Table 9 Weather observations during flora and fauna surveys (Gunnedah, NSW)

Survey date	Temperature (°C)		Rainfall to 0900 hrs (mm)
	Minimum (recorded at 0900 hrs)	Maximum (recorded at 1500 hrs)	
13 March 2017	18.7	23.6	0
14 March 2017	14.8	24.5	10
15 March 2017	18.2	32.9	0
16 March 2017	17.4	33.1	0.6
17 March 2017	16.2	30.3	0

Flora Survey Methods

Flora survey methods are outlined above, included mapping of vegetation and condition assessment and targeted surveys. Targeted threatened flora surveys were undertaken for the following threatened species:

- Austral Toadflax *Thesium australe*
- Bluegrass *Dichanthium setosum*
- Finger Panic Grass *Digitaria porrecta*
- Slender Darling Pea *Swainsona murrayana*

Targeted surveys were undertaken in accordance with OEH (2016) and involved walking parallel transects approximately 10 metres apart through all potential habitat vegetation within the study area and adjacent road reserves along Orange Grove Road (see Figure 5). Areas of PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185) were not targeted due to their poor condition and level of disturbance

Fauna Survey Methods

Fauna assessment was habitat-based, seeking to identify the following fauna habitat features of the study area:

- Habitat trees including large hollow-bearing trees, availability of flowering shrubs and feed tree species.
- Waterbody condition.
- Quantity of ground litter and logs.
- Searches for indirect evidence.

Detailed and targeted fauna surveys were undertaken for the following threatened fauna species which were predicted to occur based on the habitat assessment (Section 6.2), geographic habitat features assessment (Section 6.3) and PCTs mapped within the study area (Section 4.3.2):

- Squirrel Glider *Petaurus norfolcensis*
- Koala *Phascolarctos cinereus*
- Regent Honeyeater *Anthochaera phrygia*
- Pale-headed Snake *Hoplocephalus bitorquatus*
- Pink-tailed Worm Lizard *Aprasia parapulchella*
- Grey Falcon *Falco hypoleucos*
- Black-breasted Buzzard *Hamirostra melanosternon*

Targeted survey methods are shown in Table 9 and Figure 5.

Table 10 Targeted fauna survey requirements.

Species	Habitat Present	Targeted Survey
Squirrel Glider	Suitable habitat for the Squirrel Glider is available throughout the woodland areas of the site. Areas where trees are scattered further than 50m apart are less likely to form suitable habitat as these trees would be outside the gliding range for a Squirrel Glider.	Twenty Elliot B traps were mounted on trees using timber platforms fixed to tree trunks at a height of 3-4m. These traps were baited with peanut butter and oat balls, honey on paper towel and the tree trunks sprayed with honey water. The traps were closed each day and reopened for the evening. Trapping was undertaken across four nights, resulting in 80 trap nights. Spotlighting was conducted on three evenings for a 105–140 minutes by two observers. Spotlighting in the woodland areas was conducted by foot, while scattered paddock trees were spotlighted from a vehicle.
Koala	Primary feed tree River Red Gum, secondary feed trees Yellow Box, Bimble Box and Blakely's Red Gum (North West Ecological Services, 2016) were all present in the study area.	All trees within the development site and along the roadside were searched for presence of Koala or their faecal pellets using the SAT Koala Survey Methodology (Phillips and Callaghan, 2011).
Regent Honeyeater	The Regent Honeyeater inhabits dry open forest and woodland, favouring Box-Ironbark assemblages. There were no Ironbarks in the study area. However, the Regent Honeyeater has been recorded foraging in planted Yellow Box in urban areas. The Yellow Box is a listed major feed tree for the Regent Honeyeater and is present in the study area and on the site. As a result the Regent Honeyeater may visit the	No targeted surveys conducted as no eucalypts, including the Yellow Box were flowering at the time of the survey resulting in the species being unlikely to be recorded on the site during the surveys. If the species was to visit the site it would be sporadic and a suitable survey time would be unpredictable.

Species	Habitat Present	Targeted Survey
	study area during peak flowering time for the Yellow Box.	
Pale-headed Snake	The Pale-headed Snake shelters in tree hollows or behind loose bark in dry eucalypt forests and woodlands as well as cypress forest and occasionally in rainforest or moist eucalypt forest. In drier environments, it appears to favour habitats close to riparian areas. Habitat for the species may be present in the woodland areas of the study site.	Spotlighting is considered a suitable method to detect this species. Spotlighting was conducted on three evenings for a 105–140 minutes by two observers. Spotlighting in the woodland areas was conducted by foot, while scattered paddock trees were spotlighted from a vehicle.
Pink-tailed Worm Lizard	Rocky habitat and natural grass ground cover as preferred by this species, does not occur in the study area.	As a precaution, a small patch of rocks used to line a drainage channel and fallen timber across the study area were inspected for the presence of the species.
Grey Falcon and Black-breasted Buzzard	Both of these bird of prey have potential to use the site. They are more likely to nest along the Namoi River and forage over the study area. The Grey Falcon is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. It utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse. The Black-breasted Buzzard utilise a range of inland habitats, particularly along timbered watercourses where they prefer to breed. They also hunt over grassland and sparsely timbered woodlands.	Two large stick nests were observed within the power easement along the Namoi River. One is smaller and more likely a Corvid nest; however, the larger nest is a bird of prey nest. The Grey Falcon may use both of these nests, with the Black-breasted Buzzard more likely to use the larger nest. Both species have a preference for nesting near watercourses and may forage over the entire site. It is not possible to know which bird species are using the nests outside of the breeding period. Both of these species lay from late winter to early or mid-spring. To determine whether these nests are currently being used, targeted surveys would need to be carried out during the breeding season.

6.2 Fauna habitat assessment results

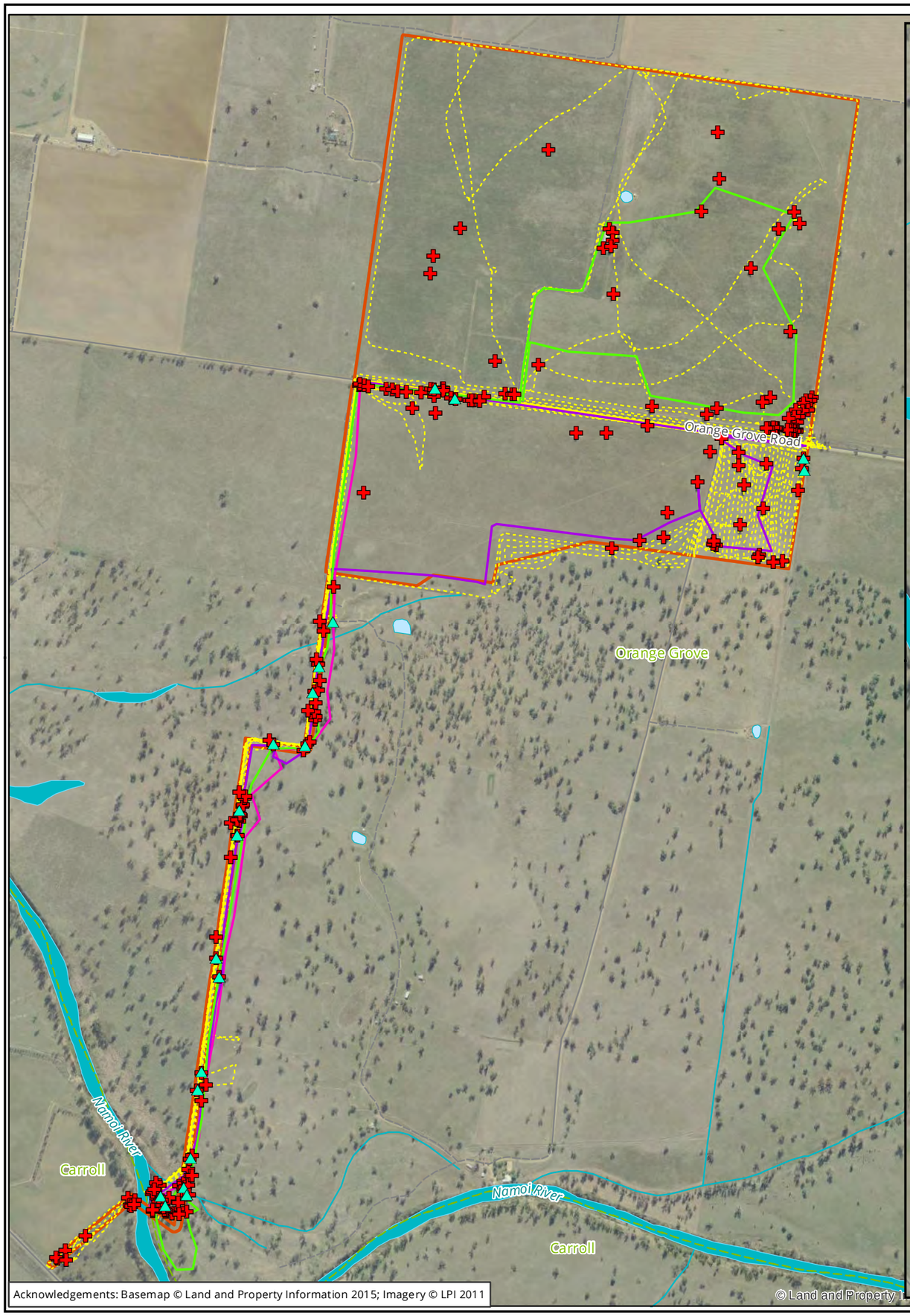
The majority of the development site contains cleared paddocks which are heavily grazed with only scattered remnant Bimble Box and Yellow Box. Most of these trees are hollow bearing, but there is little fallen timber, sparse leaf litter, no understorey vegetation and a ground cover of heavily grazed and mainly introduced grasses and herbs.

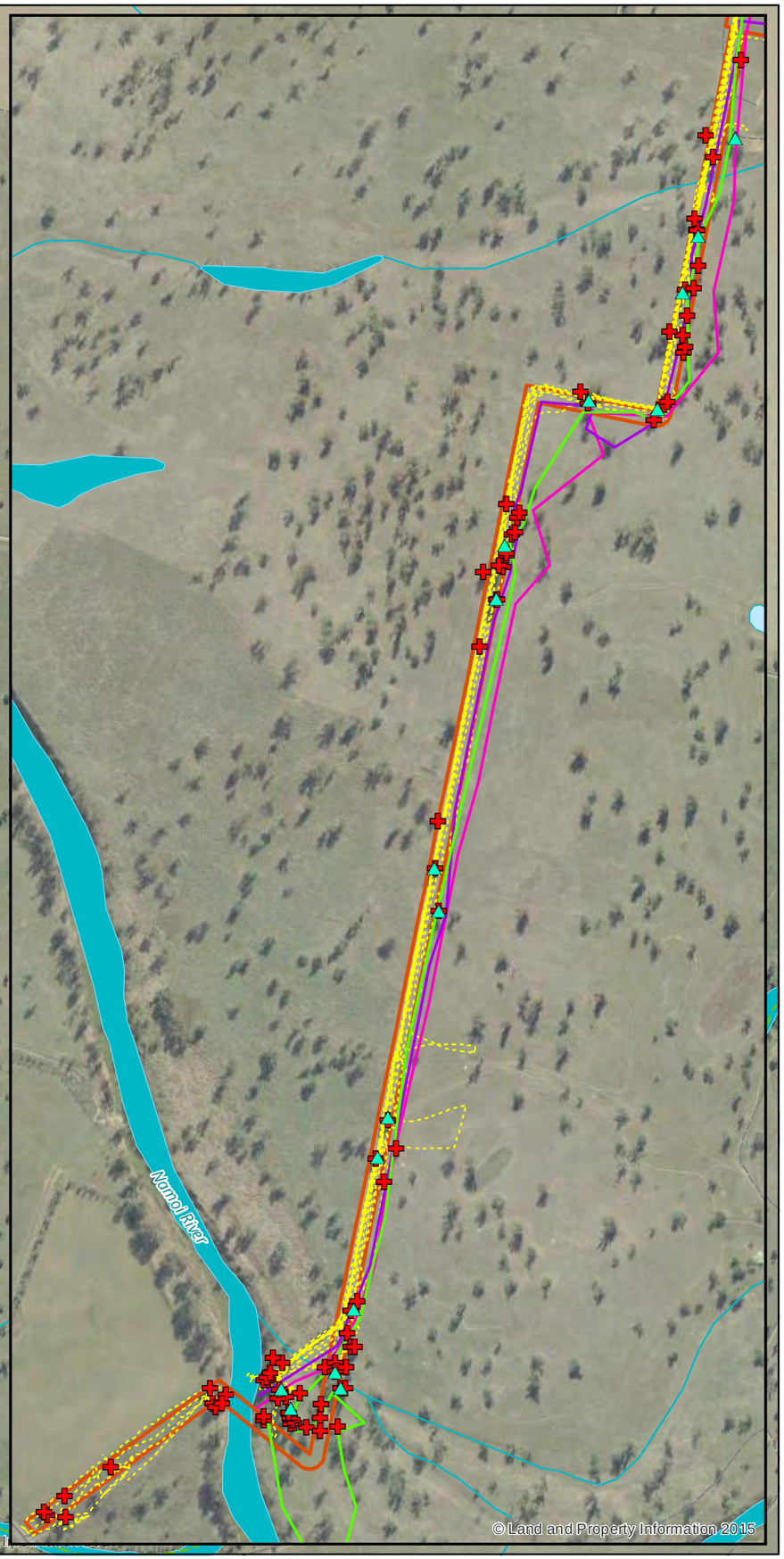
The power easement contains a higher density of eucalypts, most of which are hollow bearing, with no understorey vegetation. Ground cover contains slightly more variety than the cleared paddocks but is still heavily grazed. Fallen timber is common throughout this area including some large hollow logs.

The road reserve has similar features to the woodland areas; however, ground cover is taller with a greater diversity as this area is not being grazed.

The banks of the Namoi River are vegetated with River Red Gum, River She-oak, Willows and a ground cover of weed species. The river is described in detail in Section 5.

No rock outcrops are present on the site.





Legend

- Study area
- Flora survey

Fauna survey

- Spotlighting 1
- Spotlighting 2
- Spotlighting 3
- Habitat tree assessment
- Elliot Trap

Figure 5: Targeted survey effort

0 120 240 360 480 600

Metres

Scale: 1:13,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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6.3 Geographic habitat features

An assessment of the occurrence of geographic habitat features, in accordance with Section 6.3 of the FBA was undertaken. The results of this assessment, along with the species generated by the calculator associated with the FBA are outlined in Table 11.

Table 11 Assessment of geographic habitat features within the development site

Common name	Scientific name	Feature	Present in development site	Justification
Large-eared Pied Bat	*Chalinolobus dwyeri*	Land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels.	No	The study area does not contain escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels.
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Land within 1 km of rock outcrops or cliff lines.	No	The study area is not within 1 km of rock outcrops or cliff lines.
Pink-tailed Legless Lizard	*Aprasia parapulchella*	Land containing surface rocks (embedded or loose).	No	The study area does not contain surface rocks (embedded or loose).
Belson's Panic	*Homopholis belsonii*	Dry woodland on poor soils or areas of basalt capping over sandstone.	No	The study area consist of heavily modified, relatively fertile soils with no basalt capping over sandstone.
Austral Toadflax	*Thesium australe*	Coastal headlands, grassland, grassy open forest or woodland on fertile or moderately fertile soils.	Yes	The study area is a grassy open woodland on moderately fertile soil.
Black-breasted Buzzard	*Hamirostra melanosternon*	Land within 40 m of riparian woodland on inland watercourses/waterholes containing dead or dying eucalypts	Yes	The study area is within 40 m of riparian woodland along the Namoi River containing dead or dying eucalypts.
Grey Falcon	*Falco hypoleucos*	Land containing within 100 m of riparian woodland on inland rivers containing mature living eucalypts or isolated paddock trees overhanging water or dry watercourses	Yes	The study area is within 100 m of riparian woodland along the Namoi River.
Pale-	*Hoplocephalus*	Land within 40 m of	Yes	Study area is within 40 m of the Namoi River,

Common name	Scientific name	Feature	Present in development site	Justification
headed Snake	*bitorquatus*	watercourses, containing hollow-bearing trees, loose bark and/or fallen timber		containing hollow-bearing trees, loose bark and/or fallen timber.

Further consideration is given to these species in Section 6.6.

6.4 Targeted survey results

Two threatened species were identified across the study area (Figure 6):

- Finger Panic Grass *Digitaria porrecta*
- Squirrel Glider *Petaurus norfolcensis*
- Koala *Phascolarctos cinereus* (probable).

One Finger Panic Grass *Digitaria porrecta* individual was observed in PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland (NA185) road reserve along Orange Grove Road (eastern end). The Finger Panic Grass individual found was in good condition and flowering.

Four Squirrel Gliders were captured in the power easement, including two males and two females. Three were captured near the northern end of the power easement and the fourth in a Red Gum near the Namoi River. At least one den site was located within the power easement. Squirrel Gliders are known to glide a maximum of 50 meters in flat terrain. It can therefore be assumed that the entire woodland habitat within the study area is being used by the species. It is also possible that the species may move further out into the paddocks where trees are spaced less than 50 meters from one another. Interestingly, no Squirrel Gliders were observed during spotlighting transects which were considered to be quite thorough. There is a high abundance of hollows throughout the study area, with 78 of the trees mapped in the study area containing hollows.

A small number of probable Koala faecal pellets were located on the southern side of the Namoi River. These pellets were sent to scat identification specialist Georgeanna Story of Scats About who confirmed the probable identification. The pellets were small, resulting in the lack of certainty and indicate that they are likely to be from a juvenile. The cattle activity in the paddocks and woodland areas made detecting faecal pellets very difficult as all matter around tree trunks was heavily trampled.

Spotlighting did not detect the Pale-headed Snake or any other threatened fauna. Active searches amongst fallen timber and one patch of rocks used in a drainage line did not uncover any threatened fauna. Opportunistic diurnal bird surveys did not record Regent Honeyeater, Grey Falcon or Black-breasted Buzzard.

6.5 Ecosystem credit species

A list of ecosystem credit species predicted to occur within the study area, based on the PCTs present and generated by the calculator associated with the FBA is provided in Table 12. The potential for these species to occur within the development site was assessed in accordance with Section 6.3 of the FBA.

Table 12 Assessment of ecosystem credit species within the development site

Scientific name	Common name	TS offset multiplier
Australian Bustard	*Ardeotis australis*	2.6
Barking Owl	*Ninox connivens*	3
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	1.3
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	2
Bush Stone-curlew	*Burhinus grallarius*	2.6
Diamond Firetail	*Stagonopleura guttata*	1.3
Flame Robin	*Petroica phoenicea*	1.3
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1.8
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis* subsp. *temporalis*	1.3
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7
Little Eagle	*Hieraaetus morphnoides*	1.4
Little Lorikeet	*Glossopsitta pusilla*	1.8
Little Pied Bat	*Chalinolobus picatus*	2.1
Masked Owl	*Tyto novaehollandiae*	3
Painted Honeyeater	*Grantiella picta*	1.3
Powerful Owl	*Ninox strenua*	3
Scarlet Robin	*Petroica boodang*	1.3
Speckled Warbler	*Chthonicola sagittata*	2.6
Spotted Harrier	*Circus assimilis*	1.4
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6
Square-tailed Kite	*Lophoictinia isura*	1.4
Swift Parrot	*Lathamus discolor*	1.3
Turquoise Parrot	*Neophema pulchella*	1.8
Varied Sittella	*Daphoenositta chrysoptera*	1.3
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	2.2

The presence of these species could not be discounted using the methodology outlined in Section 6.3 of the FBA (OEH 2014b). It was therefore assumed that these species may occur within the development site.

The Barking Owl, Masked Owl and Powerful Owl have the lowest Tg values and therefore the highest threatened species offset multipliers. No adjustment of the TS offset multiplier value has been undertaken.

6.6 Species credit species

A list of species credit species predicted to occur within the study area, based on the PCTs present, along with an assessment of whether the development site provides suitable habitat is provided in Table 13. The potential for a species to occur within the development site was assessed in accordance with Section 6.5 of the FBA.

Table 13 Species credit species and status within the development site

Scientific name	Common name	Habitat present in the development site	Recorded during field surveys	Justification
Flora				
Thesium australe	Austral Toadflax	Yes	No	There are two 30 year old records of the species in the IBRA Subregion located approximately 40 km south of the study area. Austral Toadflax is a small, straggling herb to 40 cm tall. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast, often in association with Kangaroo Grass *Themeda australis*. This species is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass. This species is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. Region. Limited habitat was identified within the study area. Not recorded during targeted surveys.
Dichanthium setosum	Bluegrass	Yes	No	There are several records of the species in the IBRA Subregion, all of them located approximately 30 km south the study area, west of Breeza NSW. The species is an upright grass less than 1 m tall that occurs on heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. Locally common or found as scattered clumps in broader populations. The extensive distribution and wide environmental tolerances make predictions about suitable habitat difficult. Potential habitat present within the study area. Not recorded during targeted surveys.
Digitaria porrecta	Finger Panic Grass	Yes	Yes	There are several records of the species in the IBRA Subregion, some of them located approximately less than 5 km south the study area, along the Kamilaroi Highway. The species is a loosely tufted grass growing to 60 cm tall which grows on native grassland, woodlands or open forest with a grassy understorey, on richer soils. This species is often found along roadsides and travelling stock routes where there is light grazing and occasional fire. Fire, livestock grazing and trampling, and physical

Scientific name	Common name	Habitat present in the development site	Recorded during field surveys	Justification
				disturbance of habitat by road and farm machinery are types of disturbances known to occur in Finger Panic Grass sites. Field observations indicate that this species does continue to persist in such habitats but the effect of the disturbances on the long term capability of the species to maintain a viable population is unknown. Suitable habitat is present in the moderate condition vegetation within the study area. The species was recorded during targeted surveys, with one individual along the Orange Grove Road (Figure 6). Careful consideration of the proposed access to the development site should be able to avoid impact6s.
Swainsona murrayana	Slender Darling Pea	Yes	No	There are two records of the species in the IBRA sub-region, both of them more than 25 years old. The closest record is located 25 km south of the study area, south of Goran Lake. The species is a sparsely-downy forb with greyish, thin or tapered, stiffly leathery pods which grows on clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. The species can be found in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated. Limited habitat is present in the moderate condition vegetation within the study area. Not recorded during targeted surveys within study area.
Fauna				
Hamirostra melanosternon	Black-breasted Buzzard	Yes	No	A large bird of prey nest was observed on the site near the river. The Black-breasted Buzzard lays from late winter to early or mid-spring. To determine whether these nests are currently being used, targeted surveys would need to be carried out during the breeding season. The easement alignment zigzags as it approaches the river and therefore the nest should not be directly impacted by the proposal. Provided that there is no construction disturbance during the breeding season, the Black-breasted Buzzard should not be impacted by the proposed development.

Scientific name	Common name	Habitat present in the development site	Recorded during field surveys	Justification
				Not recorded during targeted surveys within study area.
Phascogale tapoatafa	Brush-tailed Phascogale	No	No	Brush-tailed Phascogale prefer forest, rainforest, swamp or heath. Habitat is likely to be too open. Not recorded during targeted surveys within study area.
Cercartetus nanus	Eastern Pygmy-possum	No	No	Although woodland is a preferred habitat type for the Eastern Pygmy -possum, it is likely that the understorey is too greatly disturbed for this species to occur. Not recorded during targeted surveys within study area.
Falco hypoleucos	Grey Falcon	Yes	No	Two large stick nests were observed within the study area. One is smaller and more likely a Corvid nest; however, the larger nest is a bird of prey nest. The Grey Falcon may use both of these nests, The Grey Falcon has a preference for nesting near watercourses and may forage over the entire site. It is not possible to know which bird species are using the nests outside of the breeding period. Grey Falcon lay from late winter to early or mid-spring. To determine whether these nests are currently being used, targeted surveys would need to be carried out during the breeding season. The easement alignment zigzags as it approaches the river and therefore the bird of prey nest should be able to be avoided during detailed design. The corvid nest is also just outside the easement. Provided that there is not construction disturbance during the breeding season, the Grey Falcon should not be impacted by the proposed development.
Phascolarctos cinereus	Koala	Yes	Yes (probable)	Koala scats were recorded on the southern banks of the Namoi River (Figure 6). Most of the trees on the site are likely to provide foraging or sheltering resources for Koala. As the site would only make up a small portion of local Koala home-range, it is unlikely that the local population will be impacted by the development.
Hoplocephalus bitorquatus	Pale-headed Snake	Yes	No	Not recorded during targeted surveys within study area.

Scientific name	Common name	Habitat present in the development site	Recorded during field surveys	Justification
Anthochaera phrygia	Regent Honeyeater	Yes	No	The Regent Honeyeater has potential to visit the study area during times of peak eucalypt flowering. The study area is not within a known breeding area.
Petaurus norfolcensis	Squirrel Glider	Yes	Yes	Four individuals were captured along the easement during the 4 nights of survey (Figure 6) indicating that this area is extensively used by Squirrel Gliders. At least one den site was located within the easement. Hollows are abundant throughout the woodland and it is therefore expected that there are den sites outside of the development site. Measures to avoid and minimise impacts are outlined in Section 7

Acknowledgements: Basemap © Land and Property Information 2015; Imagery © LPI 2011

Legend

Study area

Threatened Flora

Finger Panic Grass

Threatened fauna

Squirrel Glider

Koala

Nests

Endangered ecological community

White Box Yellow Box Blakely's Red Gum Woodland EEC

Figure 6: Threatened species records

0 120 240 360 480 600

Metres

Scale: 1:13,500 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

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7 Constraints assessment

This section identifies the biodiversity constraints of the study area, and provides recommendations on how these can be addressed during detailed design.

7.1 Biodiversity values and constraints of the study area

7.1.1 Biodiversity values of the study area

The biodiversity values within the study area include:

- 202 hectares of native vegetation, as outlined in Table 14.
- An individual of Finger Panic Grass in the road reserve.
- 19.13 hectares of habitat for Squirrel Glider and Koala.
- 78 hollow bearing trees.
- Two bird nests providing potential breeding habitat for the Grey Falcon and Black-breasted Buzzard.
- Riparian vegetation along the Namoi River.
- Potential habitat for Murray Cod, Silver Perch and Flat-headed Galaxias in the Namoi River.

Table 14 Plant community types within the study area

Plant community type	Development site (ha)	Power easement (ha)	Road Reserve (ha)	Total (ha)
PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185)	182.92		3.68	186.60
PCT 281 Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (NA339)	10.28	4.59		14.87
PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion (NA 336)		0.58		0.58
Total				**202**

7.1.2 Constraints of the study area

To assist Overland in developing a detailed design for the study area, the biodiversity values of the study area have been broken down into high, medium and low constraints based on their biodiversity values and impacts on the planning approvals for the GSF (Table 15).

The principal means to reduce impacts on biodiversity values within the study area will be to avoid and minimise removal of native vegetation and fauna habitat, particularly areas of high constraint identified above. Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered below.

Table 15 Biodiversity constraints within the study area and recommendations

Ecological feature	Constraint class	Notes and justification	Recommendations
PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185), Low condition	Low	This PCT is in a highly degraded condition due to past land use and current grazing pressure. This has resulted in a site value score of less than 17, meaning offsets are not required for impacts to this PCT.	• Maximise the development footprint in this area. • Site all key construction infrastructure, including site offices, temporary construction site compound, containers for storage and parking areas in this area.
PCT 101 Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion (NA185), Moderate/good condition	High	This PCT is in medium condition. The PCT aligns with Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, and Cobar. Peneplain, Nandewar and Brigalow Belt South Bioregions endangered ecological community listed under the EPBC and TSC Act. If this community is nominated in the Secretary's Environmental Assessment Requirements (SEARs) further consideration will be required, including justification as to why impacts cannot be avoided. EPBC referral will also be required.	• Avoid and minimise impacts to this PCT by using existing farm gates and tracks to access the site. • Consider excluding the extent of this community from the development site. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.

Ecological feature	Constraint class	Notes and justification	Recommendations
PCT 281 Rough-Barked Apple red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (NA339)	High	This PCT is in moderate condition. The PCT aligns with White Box Yellow Box Blakely's Red Gum Woodland endangered ecological community listed under the TSC Act. If this community is nominated in the Secretary's Environmental Assessment Requirements (SEARs) further consideration will be required, including justification as to why impacts cannot be avoided. In addition, approximately 40 credits per hectare will be required to offset impacts to this PCT. Based on the removal of all vegetation mapped within the study area a total of 596 credits will be required to offset these impacts.	• Avoid and minimise impacts to this PCT where possible. • Consider excluding the south-eastern extent of this community from the development site. • Site power poles in areas of poorer condition vegetation. • Site power poles to avoid removal of trees. • Limit construction pads to the minimum area required. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.

Ecological feature	Constraint class	Notes and justification	Recommendations
PCT 438 River Red Gum riparian tall woodland wetland on basaltic alluvial soils mainly in the Liverpool Plains sub-region, Brigalow Belt South Bioregion (NA 336)	Medium	This PCT is in medium condition, but does not align with any threatened ecological community listed under the EPBC Act or TSC Act. Approximately 48 credits per hectare will be required to offset impacts to this PCT. Based on the removal of all vegetation mapped within the study area a total of 28 credits will be required to offset these impacts.	• Minimise impacts to this PCT where possible. • Site power poles in areas of poorer condition vegetation. • Site power poles to avoid removal of trees. • Limit construction pads to the minimum area required. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.
Finger Panic Grass in the road reserve	Medium	A single individual was recorded in the Orange Grove Road Reserve. If impacts to this species cannot be avoided additional offsets will be required.	• Use existing farm gates and tracks to access the site. • Site access away from the record of this species. • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.

Ecological feature	Constraint class	Notes and justification	Recommendations
Squirrel Glider habitat	Medium	The power easement provides known habitat for the Squirrel Glider, including potential den sites. Any impacts to this area will require offsets, with approximately 22 credits per hectare required to offset impacts to this habitat. Based on the removal of habitat within the study area a total of 342 credits will be required to offset these impacts.	• Site power poles to avoid removal of trees, particularly hollow-bearing (denning) trees, where possible. • Where this is not possible, ensure removal of trees does not create gaps of greater than 50 metres. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions. • Ensure appropriate clearing controls are put in place.

Ecological feature	Constraint class	Notes and justification	Recommendations
Koala habitat	High	Woodland vegetation provides known habitat for the Squirrel Glider, including potential den sites. Any impacts to this area will require offsets Approximately 26 credits per hectare will be required to offset impacts to Koala habitat. Based on the removal of habitat within the study area a total of 404 credits will be required to offset these impacts. In addition, referral to the Commonwealth Department of the Environment and Energy (DEE) may be required for assessment under the EPBC Act.	• Site power poles to avoid removal of trees where possible. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.
Hollow bearing trees (outside of PCTs 281 and 438)	Medium	As these hollows are accounted for in the relevant PCTs no additional offsets would be required. However, hollows provide a key habitat resource for a number of threatened species, including the Squirrel Glider. Removal of hollow-bearing trees, particularly in the power easement, may elevate your offset requirements.	• Limit removal of trees to that required for the GSF. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.

Ecological feature	Constraint class	Notes and justification	Recommendations
Two bird nests	Medium	The two bird nests identified near the Namoi River provide potential breeding habitat for the Grey Falcon and Black-breasted Buzzard. If impacts cannot be avoided additional surveys and offsets may be required.	• Avoid removal of these nests. • Limit impacts to outside the breeding season where feasible. • If this is not possible, ensure the project ecologist inspects trees to determine nesting and monitors the nest (if occupied) to minimise disturbance. • If the project ecologist determines the project is resulting in disturbance, and the birds are at risk of deserting the nest, immediately cease works. • Installation of appropriate exclusion fencing around trees and vegetation to be retained in, or directly adjacent to, the development site: • The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Standards Australia Committee (2009). • A TPZ should not be less than 2 metres or greater than 15 metres, except where crown protection is required (Standards Australia Committee 2009). • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.

Ecological feature	Constraint class	Notes and justification	Recommendations
Riparian vegetation along the Namoi River	Medium	Riparian vegetation along the Namoi River is likely to provide bank stability, preventing erosion and reducing impacts to the Namoi River and associated threatened species. As the Namoi River is a 6th-order stream or higher, and is considered a State biodiversity link, any impacts to will require further consideration, including justification as to why impacts cannot be avoided	• Avoid and minimise impacts to riparian vegetation where possible. • Site power poles outside of riparian vegetation. • Where impacts cannot be avoided, try and limit impacts to trimming of vegetation to ensure appropriate clearances from power lines. • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions.
Potential habitat for Murray Cod, Silver Perch and Flat-headed Galaxias in the Namoi River	High	The Namoi River provides potential habitat for three threatened fish species. If impacts to the Namoi River, including indirect impacts, cannot be avoided targeted fish surveys will be required. If any of these species are recorded additional offsets may be required. In addition, referral to the Commonwealth Department of the Environment and Energy (DEE) may be required for assessment under the EPBC Act.	• Avoid riparian vegetation, including a buffer of 50 m where possible. • Avoid disturbing riparian vegetation or the bed and banks of the River. • Appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' should be installed. • Identify the location of any 'No Go Zones' in site inductions. • Implementation of temporary stormwater controls during construction is necessary to ensure that discharges to the drainage channels are consistent with existing conditions. • Sediment and erosion control measures should be implemented prior to construction works commencing (e.g. silt fences, sediment traps), to protect drainage channels to the west and to the south. These should conform to relevant guidelines, should be maintained throughout the construction period and should be carefully removed following the completion of works.

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Appendices

Appendix 1 Native vegetation data (BioBanking)

A.1 Plot and transect field data

Notes to table:

*	Indicates an exotic species, including non-indigenous to NSW
Cover	Recorded according to FBA (2014)
Stratum	O = Overstorey; G = Ground layer
Growth form	T = Tree; S = Shrub; H = Herb; G = Grass; V = Vine
Numerous species native to NSW, including those that are locally native in the above list, have been artificially planted on site.	

Table 16 Flora species recorded from the development site and BioBanking plot

Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Cover	Abundance	Stratum	Growth Habit
Aizoaceae	*Zaleya galericulata*	Hogweed	x									1	2	GC	HB
Amaranthaceae	*Alternanthera pungens**	Khaki Weed					x					2	4	GC	HB
										x		1	1		
											x	2	4		
Asteraceae	*Centaurea solstitialis**		x									15	50	GC	HB
					x							5	10		
						x						5	20		
							x					1	1		
	*Xanthium spinosum**	Bathurst Burr					x					1	1	GC	HB
Brassicaceae	*Lepidium africanum**	Common Peppercress	x									5	10	GC	HB
				x								1	3		
						x						1	3		
									x			2	5		
	*Rapistrum rugosum**	Turnip Weed					x					1	1	GC	HB
	*Sinapis arvensis**	Charlock					x					1	1	GC	HB
Chenopodiaceae	*Chenopodium album**	Fat Hen					x					1	1	GC	C
	Chenopodium glaucum							x				1	1	GC	C
	*Chenopodium murale**	Nettle-leaf Goosefoot					x					1	1	GC	C
	Einadia hastata	Berry Saltbush						x				1	1	GC	C

Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Cover	Abundance	Stratum	Growth Habit
	Einadia nutans	Climbing Saltbush				x						1	1	GC	C
							x					1	1		
									x			1	2		
	Einadia nutans subsp. nutans	Climbing Saltbush	x									-	-	GC	C
	Enchylaena tomentosa	Ruby Saltbush					x					10	6	GC	C
Cucurbitaceae	*Citrullus lanatus var. lanatus**	Wild Melon, Camel Melon, Bitter		x								5	4	GC	HB
											x	1	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine						x				1	1	GC	V
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne					x					5	20	GC	HB
Myrtaceae	*Angophora floribunda*	Rough-barked Apple						x				25	1	O	T
									x			55	2		
	Eucalyptus camaldulensis	River Red Gum					x					50	30	O	T
	Eucalyptus melliodora	Yellow Box							x			10	1	O	T
										x		25	1		
	Eucalyptus populnea subsp. bimbil	Bimble Box		x								25	1	O	T
Nyctaginaceae	*Boerhavia dominii*	Tarvine	x									1	1	GC	HB
				x								1	2		
					x							1	2		
							x					1	1		
								x				1	5		
										x		2	10		
											x	1	5		
Oxalidaceae	*Oxalis perennans*		x									1	4	GC	HB
											x	1	1		
Poaceae	*Aristida vagans*	Threeawn Speargrass						x				1	2	GC	G
	Austrostipa aristiglumis	Plains Grass									x	1	1	GC	G
	Austrostipa verticillata	Slender Bamboo Grass			X							10	20	GC	G
						X						2	3		G
							X					20	50		G
									X			1	1		G
										X		2	8		G
	*Avena barbata**	Bearded Oats		X								1	1	GC	G

Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Cover	Abundance	Stratum	Growth Habit
	*Avena ludoviciana**	Ludo Wild Oats	X									1	4	GC	G
	*Bromus catharticus**	Prairie Grass					X					3	10	GC	G
		Prairie Grass								X		1	1		
		Prairie Grass									x	10	50		
	Cynodon dactylon	Common Couch					X					5	50	GC	G
								x				5	50		
									x			3	10		
	Digitaria brownii	Cotton Panic Grass									X	1	2	GC	G
	Elymus scaber	Common Wheatgrass									x	1	1	GC	G
	Enteropogon acicularis	Curly Windmill Grass		x								1	2	GC	G
								X				1	4		
	*Hordeum leporinum**	Barley Grass	X									2	10	GC	G
				X								1	6		
						X						10	50		
									x			5	20		
										x		5	20		
											X	15	100		
	*Lolium perenne**	Perennial Ryegrass								x		1	1	GC	G
	Paspalidium jubiflorum	Warrego Grass					x					1	1	GC	G
	Rytidosperma fulva	Wallaby Grass									x	2	20	GC	G
	Rytidosperma racemosa var. obtusata	A Wallaby Grass				X						1	3	GC	G
	Rytidosperma racemosum	Wallaby Grass						X				1	2	GC	G
										x		1	1		
											x	1	1		
	*Urochloa panicoides**	Urochloa Grass	x									50	500	GC	G
				x								40	500		
					x							75	1000		
						x						50	500		
							x					15	100		
								x				25	100		
									x			25	100		
										x		35	100		
											x	20	500		
Polygonac	*Polygonum*	Wireweed	x									1	3	GC	HB

Family	Scientific Name	Common Name	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Cover	Abundance	Stratum	Growth Habit
eae	*aviculare**			x								1	1		
					x							1	3		
						x						5	9		
											x	1	4		
Urticaceae	*Urtica incisa*	Stinging Nettle					X					10	100	GC	HB
Zygophyllaceae	*Tribulus terrestris**	Cat-head		x								10	50	GC	HB
					x							5	50		
						x						3	6		
							x					3	20		
								x				5	20		
										x		10	100		
											x	4	50		

A.2 Plot and transect summary

Table 17 Plot scores for each vegetation zone within the development site

Plot name	Native plant species	Native over-storey cover	Native mid-storey cover	Native ground cover (grass)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over-storey regen	Total length of fallen logs
Q1	4	0	0	8	0	0	50	0	0	0
Q2	3	0	0	2	0	0	54	0	0	0
Q3	2	0	0	2	0	0	56	0	0	0
Q4	3	0	0	8	0	0	60	0	0	0
Q5	8	35	0	22	8	0	42	4	1.0	61
Q6	9	7	0	16	0	0	44	1	0	0
Q7	5	17	0	16	0	0	8	2	0	3
Q8	4	12	0	10	0	4	30	1	0	30
Q9	7	4	0	10	0	6	48	1	0	0

Appendix B

Flora data

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Orange Grove	Q2 (BIOSIS)	EL

Date	13-2-18	Zone	Datum	IBRA region	Liverpool plains	Photo #		Zone ID	1
		Easting	Northing	Dimensions	20 x 50	Orientation of midline from the 0 m point.			

Vegetation Class		Confidence: H M L
Plant Community Type	101 - Poplar box...	EEC: N — Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	25
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)	# Tree Stems Count		
dbh	Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc 80 + cm	—	—	—
50 – 79 cm	1	—	1
30 – 49 cm	—	—	—
20 – 29 cm	—	—	—
10 – 19 cm	—	—	—
5 – 9 cm	—	—	n/a
< 5 cm	—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	2		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	70	70	2	75	75	20	15	90	10	10	—	—	—	—	—	—	—	—	—	—
Average of the 5 subplots	58.4					29					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (incl. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (native/pasture)			
Fire damage			
Storm damage			
Weediness			
Other			

Q2 first end
~~Subplot 1~~
Subplot 2
~~Subplot 3~~
Subplot 4
~~Subplot 5~~
Second end

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: March 2017	Orange Grove	2	BioSis

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	* Lepidium africanum	E	5	10		
	* Citrullus lanatus var. lanatus	E	5	4		
	Euphorbia peplus	N	25	1		
	* Avena hybriciana	E	1	1		
	* Hordeum leporinum	E	1	6		
	* Urochloa panicoides	E	40	500		
	Enteropogon acicularis	N	1	2		
	* Polygonum aviculare	E	1	1		
	* Tribulus terrestris	E	10	50		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Date	13-2-18	Survey Name	Orange Grove	Plot Identifier	Q3 (Bio515)	Recorders	EL
Zone	Datum	IBRA region	Liverpool Plains	Photo #		Zone ID	
Easting	Northing	Dimensions	20 x 50	Orientation of midline from the 0 m point.			
Vegetation Class						Confidence: H M L	
Plant Community Type	101 - Poplar box....			EEC: N		Confidence: H M L	

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m^2 plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	10
	Forbs	1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)		# Tree Stems Count	
dbh	Euc*	Non Euc	Hollows†
Large trees for Euc* & Non Euc 80 + cm	–	–	–
50 – 79 cm	–	–	–
30 – 49 cm	–	–	–
20 – 29 cm	–	–	–
10 – 19 cm	–	–	–
5 – 9 cm	–	–	n/a
< 5 cm	–	–	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	–		total .

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	85	85	80	85	85	10	10	15	10	10	–	–	–	–	–	–	–	–	–	–
Average of the 5 subplots	84					11					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance

	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Conversion (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (inc. native)			
Fire damage			
Storm damage			
Weediness			
Other			

Q3 first end Subplot 4
Subplot 1 Subplot 5
Subplot 2 Q3 second end
Subplot 3

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: March 2017	Orange Grove	3	Biosis

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	*Centaurea solstitialis	E	5	10		
	Boerhavia dominii	N	1	2		
	Austrostipa verticillata	N	10	20		
	* Urochloa panicoides	E	75	1000		
	* Polygonum aviculare	E	1	3		
	* Tribulus terrestris	E	5	50		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code if 'top 3'.**

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Date	13-2-18	Survey Name	Orange Grove	Plot Identifier	Q4 (Bios 5)	Recorders	EL
Zone	Datum	IBRA region		Photo #		Zone ID	
Easting	Northing	Dimensions	20 x 50	Orientation of midline from the 0 m point.			
Vegetation Class						Confidence:	H M L
Plant Community Type	101				EEC: N	Confidence:	H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	2
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	3
	Forbs	1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		
dbh		Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc	80 + cm	—	—	—
	50 – 79 cm	—	—	—
30 – 49 cm		—	—	—
20 – 29 cm		—	—	—
10 – 19 cm		—	—	—
5 – 9 cm		—	—	n/a
< 5 cm		—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)		—		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot scores (% in each)	70	55	50	75	75	25	25	40	5	20	-	-	-	-	-	-	-	-	-	-
Average of the 5 subplots	65					22					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (native vegetation)			
Fire damage			
Storm damage			
Weediness			
Other			

Q4 first end
45 ~~Subplot 1~~
30 ~~Subplot 2~~
25 ~~Subplot 3~~
15 ~~Subplot 4~~
5 ~~Subplot 5~~
Plot end

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: March 2017	Orange Cove	4	BIOSIS

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	* Lantana solstitialis	E	5	20		
	* Lepedissa africanum	E	1	3		
	Einadia nutans	N	1	1		
	Austrostipa verticillata	N	2	3		
	* Hordeum leporinum	E	10	50		
	Rytidosperma valensa var. obtusa	N	1	3		
	* Urochloa panicoides	E	50	500		
	* Polygonum aviculare	E	5	9		
	* Tribulus terrestris	E	3	6		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Orange Grove	Q9 (Biosis)	EL

Date	13-2-18	Zone		Datum		Easting		Northing	

IBRA region		Photo #		Zone ID	
Dimensions	20 x 50	Orientation of midline from the 0 m point.			

Vegetation Class		Confidence: H M L
Plant Community Type	281	EEC: 4 Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	5
	Forbs	2
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	6
	Forbs	2
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)		# Tree Stems Count	
dbh	Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc 80 + cm	0	—	—
50 – 79 cm	—	—	—
30 – 49 cm	—	—	—
20 – 29 cm	—	—	—
10 – 19 cm	—	—	—
5 – 9 cm	—	—	n/a
< 5 cm	—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		total —

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30.... 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot scores (% in each)	60	60	60	60	20	20	10	20	15	80	-	-	-	-	-	-	-	-	-	-
Average of the 5 subplots	52					29					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance

	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (native or exotic)			
Fire damage			
Storm damage			
Weediness			
Other			

Form version 5 – released March 2017

Printed 31 August 2017

Q9 Transect
Subplot 1
Subplot 2
Subplot 3
Subplot 4
Subplot 5
Ground truth

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: March 2017	Orange Grove	Q9	BioSIS

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	* Alternanthera pungens	E	2	4		
	* Citrullus lanatus var. lanatus	E	1	1		
	Boerhavia dominii	E	1	5		
	Oxalis perennans	N	1	1		
	Austrostipa ~~stuck~~ aristiglumis	N	1	1		
	Austrostipa verticillata	N	2	6		
	* Bromus catharticus	E	10	50		
	Digitaria brownii	N	1	2		
	Elymus scaber	N	1	1		
	* Hordeum leporinum	E	15	100		
	Rhynchospermum fulva	N	2	20		
	Rhynchospermum racemosa var. obtusata	N	1	3		
	* Urochloa panicoides	E	20	500		
	* Polygonum aviculare	E	1	4		
	* Tribulus terrestris	E	9	50		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Orange Grove	Q10 (NEW)	EL

Date	Zone	Datum	Easting	Northing	IBRA region	Photo #	Zone ID
13-2-18							

Dimensions	Orientation of midline from the 0 m point.
20 x 50	

Vegetation Class		Confidence: H M L
Plant Community Type	101 - Poplar Box, Yellow Box, Western Grey Box	EEC: N Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	0.1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot) dbh	Euc*	Non Euc	# Tree Stems Count Hollows†
large trees for Euc* & Non Euc 80 + cm	—	—	—
50 – 79 cm	—	—	—
30 – 49 cm	—	—	—
20 – 29 cm	—	—	—
10 – 19 cm	—	—	—
5 – 9 cm	—	—	n/a
< 5 cm	—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	0		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	70	68	70	70	70	25	30	25	25	25	–	–	–	–	–	–	–	–	–	–
Average of the 5 subplots	69.6					26					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance

	Severity code	Age (yrs)	Comments on evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil erosion			
Firewood / CWD removal	—		
Grazing (stock/feral/native)			
Fire damage			
Storm damage	—		
Weed/s			
Other			

First end Subplot 4
Subplot 1 Subplot 5
Subplot 2 Second end
Subplot 3

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date: 13-2-18	Orange Grove	Q10	EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	~~Arbutus~~ leporinum	E	10	>1000		
	Austrostipa verticillata	N	1	5		
	Urochloa panicoides	E	80	>1000		
	Polygonum aviculare	E	0.5	~20		
	Alternanthera pungens	E	0.1	~5		
	Lentaurea Solstitialis	E	0.1	1		
	~~Khaki weed~~	~~E~~	~~0.1~~	~~10~~		
	Eimarda nutans subsp. nutans	N	0.1	1		
	Eida rhomboifolia	E	0.7	1		

GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code if 'top 3'.**

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Orana Grove	Q11 (NEW)	EL

Date	23-2-18	Zone	Datum	Easting	Northing

IBRA region		Photo #		Zone ID	
Dimensions	20 x 50	Orientation of midline from the 0 m point.			

Vegetation Class		Confidence: H M L
Plant Community Type	281	EEC: 4 Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	2
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	2
	Forbs	1.1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)	# Tree Stems Count		
dbh	Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc 80 + cm	—	—	—
50 – 79 cm	—	—	—
30 – 49 cm	—	—	—
20 – 29 cm	—	—	—
10 – 19 cm	—	—	—
5 – 9 cm	—	—	n/a
< 5 cm	—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	—		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30,.... 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	25	50	60	50	60	70	40	20	40	40	–	–	–	–	–	–	–	–	–	–
Average of the 5 subplots	49					42					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance

	Severity code	Age code	Observation evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (inc. evidence)			
Fire damage			
Storm damage			
Weediness			
Other			

Q11 Front end Subplot 4
Subplot 1
Subplot 2
Subplot 3
~~Subplot 5~~ Rear end

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 13-2-18	Orange Grove	Q11	EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	~~Annual grass~~ Urochloa pan.	E	50	>1000		
	~~Barley grass~~ Hordeum sp.	E	2	500		
	Portulaca oleracea	N	1	50		
	~~Spinach sp~~ Tribulus terrestris	E	5	500		
	~~Mid storm weed~~ khaki weed	E	2	250		
	~~Couch~~ Cynodon dactylon	E	2	50		
	Lolium sp perenne	E	2	200		
	Eragrostis ciliamensis	E	0.1	1		
	Boerhavia dominii	N	0.1	2		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

		Survey Name	Plot Identifier	Recorders
Date	14-2-18	Orange Grove	Q12 (NEW)	EL
Zone	Datum	IBRA region	Photo #	Zone ID
Easting	Northing	Dimensions: 20 x 50	Orientation of midline from the 0 m point.	

Vegetation Class			Confidence: H M L
Plant Community Type	101	EEC: N	Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m^2 plot)		Sum values
Count of Native Richness	Trees	0
	Shrubs	0
	Grasses etc.	1
	Forbs	2
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	0
	Shrubs	0
	Grasses etc.	0.1
	Forbs	1
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot) dbh	# Tree Stems Count: Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc: 80 + cm	–	–	–
50 – 79 cm	–	–	–
30 – 49 cm	–	–	–
20 – 29 cm	–	–	–
10 – 19 cm	–	–	–
5 – 9 cm	–	–	n/a
< 5 cm	–	–	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)	–		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30…, 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	80	85	85	75	75	10	5	5	15	15	–	–	–	–	–	–	–	–	–	–
Average of the 5 subplots	80					10					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age code	Observational evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing			
Fire damage			
Storm damage			
Weediness			
Other			

~~Q12 First end~~ ~~Subplot 2~~ ~~Subplot 5~~
~~Q12 Second end~~ Subplot 3
~~Subplot 1~~ ~~Subplot 4~~

'extra 5'
Q R10SIJ out of Site

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 14-2-18	Orange Grove	Q12	EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Urochloa panicoides	E	50	>1000		
	Hordeum leporinum	E	5	100		
	Zaleya galericulata	N	5	100		
	Lolium perenne	E	5	100		
	Centaurium solstitialis	E	1	10		
	Boerhavia dommii	N	1	50		
	Aristida vagans	N	0.1	2		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form

Site Sheet no:

Survey Name	Plot Identifier	Recorders
Orange Grove	Q13 (NEW)	EL

Date	14-2-18	Zone	Datum	Easting	Northing

IBRA region		Photo #		Zone ID	
Dimensions	20 × 50	Orientation of midline from the 0 m point.			

Vegetation Class		Confidence: H M L
Plant Community Type	101	EEC: N Confidence: H M L

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	1
	Shrubs	0
	Grasses etc.	2
	Forbs	1
	Ferns	0
	Other	0
Sum of Cover of native vascular plants by growth form group	Trees	10
	Shrubs	0
	Grasses etc.	2.2
	Forbs	0.5
	Ferns	0
	Other	0
High Threat Weed cover		0

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		
dbh		Euc*	Non Euc	Hollows†
large trees for Euc* & Non Euc	80 + cm	—	—	—
	50 – 79 cm	1	—	1
	30 – 49 cm	-	—	—
	20 – 29 cm	-	—	—
	10 – 19 cm	-	—	—
	5 – 9 cm	-	—	n/a
	< 5 cm	—	—	n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)		—		total

Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately

* Includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*

† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30.... 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	50	40	60	60	55	20	25	15	15	15	-	-	-	-	-	-	-	-	-	-
Average of the 5 subplots	53					18					0					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity code	Age class	Observable evidence
Clearing (inc. logging)			
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (pasture)			
Fire damage			
Storm damage			
Weediness			
Other			

Q13 first end ~~Subplot 3~~ second end
~~Subplot 4~~ ~~Subplot 2~~
~~Subplot 8~~ ~~Subplot 5~~

Noel Swain

400 m² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 14/2/18	Orangeville	013	EL

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	Urochloa panicoides	E	80	>1000		
	Hordeum leporinum	E	2	200		
	E. populnea	N	10	1		
	Lepidium africanum	~~E~~	~~0.3~~	~~50~~		
	Centaurium solstitialis	E	1	10		
	Boerhavia dominii	N	0.5	25		
	Aristida vagans	N	2	5.		
	Lolium perenne	E	1	50		
	~~Spinach weed~~ A. verticillata	N	0.2	2		
	~~Spinach weed~~ Tribulis terrestris	E	0.1	1		

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); *Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Appendix C

Credit report

BAM Credit Summary Report

Assessment Id	Proposal Name	Report Created
00009976/BAAS17013/18/00009977	Orange Grove Sun Farm	01/03/2018
Assessor Name	**Assessor Number**	
Katie Diver	0	

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 SAII	Ecosystem credits
Poplar Box - Yellow Box - Western Grey Box grassy woodland on cracking clay soils mainly in the Liverpool Plains, Brigalow Belt South Bioregion								
1	101_Low	6.1	145.8	0.25	High Sensitivity to Potential Gain	2.00		0
							Subtotal	**0**
Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion								
2	281_Low	6.1	2.4	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							Subtotal	**0**
							Total	**0**

BAM Credit Summary Report

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits

SYDNEY
Ground floor, Suite 01, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 1, Suite 6, 146 Hunter Street
Newcastle, New South Wales, 2300
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BRISBANE
Level 4, Suite 01, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866