Powering a Sustainable Future

Biodiversity Development Assessment Report

WALLA WALLA SOLAR FARM

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CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BAM	Biodiversity Assessment Methodology
AC	Alternating Current
BC Act	_Biodiversity Conservation Act 2016_ (NSW)
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	_Biosecurity Act 2015_
BOM	Australian Bureau of Meteorology
CEEC	Critically endangered ecological communities
CEMP	Construction environmental management plan
Cwth	Commonwealth
DBH	Diameter at Breast Height
EEC	Endangered ecological community
EPBC Act	_Environment Protection and Biodiversity Conservation Act 1999_ (Cwth)
EP&A Act	_Environmental Planning and Assessment Act 1979_ (NSW)
GHG	Greenhouse gases
ha	Hectares
HBT	Hollow-bearing trees
IBRA	Interim Biogeographic Regionalisation of Australia
ISEPP	_State Environmental Planning Policy (Infrastructure) 2007_ (NSW)
km	Kilometres
LEP	Local Environment Plan
LRET	Large-scale renewable energy target
m	Metres
MNES	Matters of National environmental significance under the EPBC Act (_c.f._)
MW	Megawatt
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PV	Photovoltaic
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy (NSW)
sp/spp	Species/multiple species
SSD	State Significant Development
TEC	Threatened Ecological Community
VIS	Vegetation Integrity Score

EXECUTIVE SUMMARY

Fotowatio Renewable Ventures (FRV) is proposing to construct a 300 megawatt (MW) alternating current (AC) photovoltaic solar farm northeast of Walla Walla, NSW. The proposal would develop around 493 hectares (ha) of the 605 ha development site. This Biodiversity Development Assessment Report (BDAR) has been prepared by NGH Environmental on behalf of the proponent, FRV.

The aim of this BDAR is to address the biodiversity matters raised in the Secretary's Environmental Assessment Requirements (SEARs) and to address the requirements of the *Biodiversity Conservation Act 2016* (NSW) (BC Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwth) (EPBC Act). This BDAR forms part of an Environmental Impact Statement (EIS) for the State Significant Development (SSD), prepared under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The Biodiversity Assessment Methodology (BAM) is the required assessment methodology for SSDs that trigger the NSW Biodiversity Offsets Scheme under the BC Act. This report follows the field work methodologies and assessment required by the BAM.

Comprehensive mapping and field surveys were completed in accordance with the requirements of the BAM. The majority of the development site has been cleared of native vegetation, and cultivated for agriculture, which is the dominant land use in the area. Approximately 505 ha of the development site is comprised of exotic vegetation in the form of exotic pastures and crops. Around 99 ha of native vegetation occurs in the development site, comprised of scattered isolated patches of remnant woodland, paddock trees and derived grassland. The native vegetation is comprised of four Plant Community Types (PCTS). These are;

- PCT 5 – River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.
- PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.
- PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.
- PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion.

PCT 76 is listed as Endangered under the BC Act as it forms part of the TEC - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion.

PCT 277 and PCT 278 forms part of the Endangered Ecological Community (EEC): White Box-Yellow Box-Blakely's Red Gum woodland under the BC Act. These communities within the development site do not meet the criteria for the federally listed EEC, due to having a very degraded understory dominated by exotic annual grasses.

Consideration has been given to avoiding and minimising impacts to native vegetation throughout each phase of the proposal. Site design options have been assessed against key environmental, social and economic criteria using feedback from community engagement and Holbrook Landcare Group Larger patches of remnant woodland and creek lines have been avoided by the development footprint to maintain connectivity for threatened species. Proposed revegetation areas will also enhance connectivity throughout the development site. Mitigation and management measures would be put in place to adequately address impacts associated with the proposal, both direct and indirect.

For biodiversity impacts that are unavoidable, the proposal would require the removal of:

- 0.2 ha of PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion
- 13.3 ha of PCT 76 – Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions
- 23.9 ha of PCT 76 – Derived Grassland of western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions
- 1.3 ha of PCT 5 – River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.

The removal of this native vegetation generated the following ecosystem credits;

- PCT 5 – River Red Gum herbaceous-grassy very tall open forest wetland – 9 credits.
- PCT 76 – Western Grey Box tall grassy woodland – 160 credits.

PCT 277 was not required to be offset as the vegetation condition was low and fell below the threshold of requiring an offset.

The removal of 52 paddock trees generated the following credits

- PCT 5 – River Red Gum herbaceous-grassy very tall open forest wetland – 2 credits.
- PCT 76 – Western Grey Box tall grassy woodland – 39 credits.
- PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland - 11 credits

Two ecosystem species, Flame Robin (*Petroica phoenica*) and Brown Treecreeper (*Climacteris picumnus*) listed as vulnerable under the BC Act, were detected during the site surveys. These species are accounted for in the ecosystem credit requirement.

Targeted surveys were undertaken for 18 candidate credit species. One credit species, the Squirrel Glider (*Petaurus norfolcensis*) was detected within the development site. Three other species were unable to be surveyed for during the appropriate survey period and were assumed to be present within suitable habitat.

The removal of suitable habitat relating to these threatened species credit species generated the following species credits.

- Squirrel Glider (*Petaurus norfolcensis*)- 89 credits
- Little Eagle (*Hieraaetus morphnoides*) – 87 credits.
- Southern Myotis (*Myotis Macropus*) – 19 credits.
- Pine Donkey Orchid (*Diuris tricolor*) – 14 credits.

The retirement of the credits generated will be carried out in accordance with the NSW Biodiversity Offsets Scheme under the BC Act. With the retirement of credits and effective implementation of the mitigation measures, the proposal would be consistent with the requirements of the BAM.

1 INTRODUCTION

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

The following terms are used in this document:

- **Development footprint** – The area of land that is directly impacted on by the proposal. Including, solar array design, perimeter fence, access roads, inverter areas and areas used to store construction materials. The development footprint is approximately 493 ha.
- **Development site** – The area of land that is subject to a proposed development. The development site is approximately 605 ha. The development site is the area surveyed for this assessment.
- **Subject land** – All land within the affected lot boundaries.
- **Buffer area** – All land within 1500 m of the outside edge of the boundary of the development footprint.

1.1 THE PROPOSAL

Walla Walla Solar Farm would occupy around 493 hectares (ha) of the 605 ha development site, retaining existing viable native vegetation remnants that occur on the array site. The proposal would comprise the installation of a solar plant that would generate a maximum 300 MW AC of renewable energy for the national grid.

The proposal would include the following elements:

- One primary access point of Benambra Road at northeast corner of the development site. Two minor access points on Schneiders Road, facilitating traffic movements east to west only and one minor access pont on northwest corner of Benambra Road for construction and operational access for the Transgrid substation.
- Single-axis tracker photovoltaic solar panels mounted on steel frames (approximately 900,000 PV solar panels).
- Onsite 330 kV substation.
- A site operations and maintenance building, switchroom and vehicle parking areas.
- Internal inverter stations to allow conversion of DC module output to AC electricity.
- Underground electrical conduits and cabling to connect the arrays on the array site.
- Internal access tracks to allow for site maintenance.
- Perimeter security fencing.
- Native vegetation screening to break up views of infrastructure and enhance biodiversity values onsite.

In total, the construction phase of the proposal is expected to take 16 to 20 months. The Walla Walla Solar Farm is expected to operate for around 30 years. Approximately 21 operations and maintenance personnel would operate the plant. The solar farm would be decommissioned at the end of its operational life; all above ground infrastructure and below ground infrastructure less than 2500 mm deep would be removed in consultation with the landowner, with the site to be returned to its existing land capability for agricultural land use.

1.2 THE DEVELOPMENT SITE

1.2.1 Site location

The proposed location of Walla Walla Solar Farm is in the Greater Hume Local Government Area (LGA), around 35 km north of Albury as shown in Figure 1-1. The subject land comprises Lots 16, 17, 20, 21, 87, 88, 89, 108, 109 118 of DP 753735, Lot 3 253113, Lot 1 DP 933189, Lot A DP 376389 and Lot 1 DP 1069452, approximately 807 ha, as shown in Figure 1-1**.**.

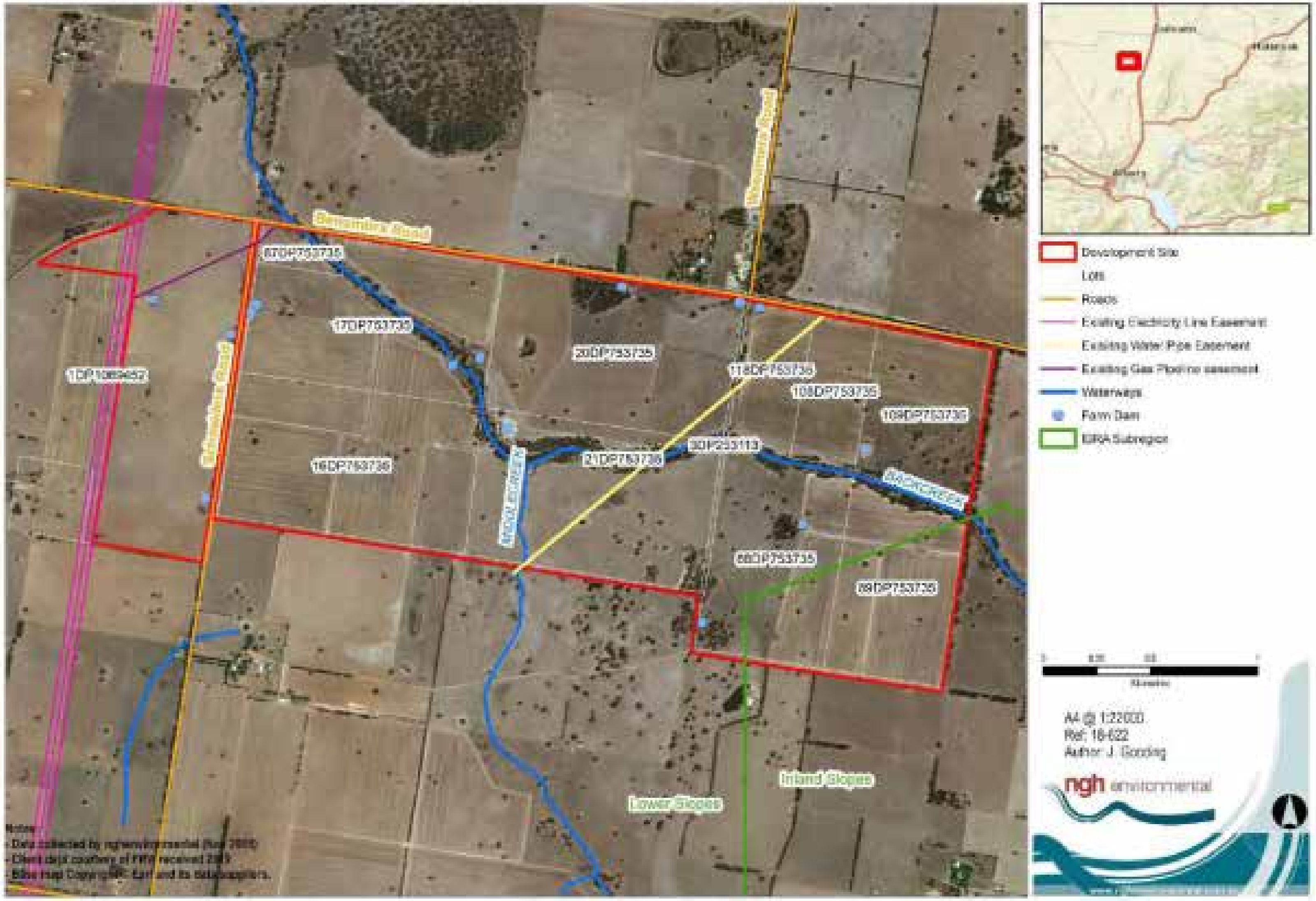

Figure 1-1 Site map

1.2.2 Site description

The development site is located within the Greater Hume Local Government Area (LGA). It is accessed primarily from Benambra Road, approximately 2.6 km north-west of the intersection with the Olympic Highway, with alternative access points off Schneiders Road. Benambra Road and Schneiders Road are both local roads managed and maintained by Greater Hume Shire Council. An existing quarry is located on Weeamera Road, off Benambra Road. The intersection of Benambra Road and the Olympic Highway has already been upgraded to facilitate the turning of heavy vehicles.

The Olympic Highway is a major regional highway, servicing the communities of the central western and south-eastern Riverina including the LGAs of Cowra, Hilltops, Cootamundra-Gundagai, Wagga Wagga, Greater Hume and Albury. The Olympic Highway is an important link between the towns in this productive region and connecting these areas with the national highway network. The region supports a diverse economy associated with agriculture, tourism, large commercial centres, residential facilities, health centres, railroad activities, energy generation (hydro, gas, solar), energy distribution, road freight and intermodal logistics.

Walla Walla is the closest town to the proposal, approximately 4.3 km south-west of the proposal. Its population in 2016 was recorded as 836 persons (ABS 2016) and hosts a number of historic buildings, churches, a grain storage facility and a community sports ground. The closest services are located in the regional centre of Albury, around 39 km south of the proposal. The population for Albury's urban locality in June 2018 was recorded as 53,289 persons (Population Australia 2018). It supports supermarkets, post offices, service stations, accommodation, restaurants, medical services and recreation facilities.

The Murray River and Lake Hume are located approximately 36 km south and 20 km south-east, respectively, of the proposed. Lake Hume is one of the major water storage areas for the Murray River system and water discharged from the Snowy Mountains Hydro-electric Scheme is also used as a recreational facility. The Benambra National Park and Tabletop Nature Reserve are located approximately 9.5 km east and 13.7 km south-east, respectively, of the proposed.

The proposal is located within the South Western Slopes Bioregion with the main vegetation types identified as Grey Box tall grassy woodland, Blakely's Red Gum – Yellow Box grassy tall woodland, River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains, and Riparian Blakely's Red Gum – box – sedge grass tall open forest.

1.3 STUDY AIMS

This BDAR has been prepared by NGH Environmental on behalf of FRV.

The aim of this BDAR is to address the requirements of the BAM, as required in the Secretary's Environmental Assessment Requirements (SEARs) and summarised in Table 1-1 below.

Table 1-1 Biodiversity SEARs for Walla Walla Solar Farm

Secretary's Environmental Assessment Requirement	Where addressed
The EIS must address the following specific issues: Biodiversity impacts related to the proposed development are to be assessed in accordance with section 7.9 of the *Biodiversity Conservation Act 2016* using the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the Biodiversity Conservation Act 2016 (s6.12), Biodiversity Conservation Regulation 2017 (s6.8) and the BAM, unless OEH and DPE determine that the proposed development is not likely to have any significant impact on biodiversity values.	**Sections 6 and 7**
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	**Sections 8, 9 and 10**
The BDAR must include details of the measures proposed to address the offset obligation as follows; a. The total number and classes of biodiversity credits required to be retired for the development/project; b. The number and classes of like-for-like biodiversity credits proposed to be retired; c. The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; d. Any proposal to fund a biodiversity conservation action; e. Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits	**Section 10**
The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the BC Act 2016.	**Document verification (front of document)**

No specific considerations for any threatened species, populations or communities were specified in the SEARs or by the NSW Office of Environment and Heritage (OEH).

1.4 SOURCE OF INFORMATION USED IN THE ASSESSMENT

The following information sources were used in this BDAR:

- Proposal layers, construction methodology and concept designs provided by EB Pro Pty Ltd.
- Australian Government's Species Profiles and Threats (SPRAT) database http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.
- DPI profiles of threatened species, population, and ecological communities.
- Commonwealth Department of Environment and Energy Protected Matters Search Tool Accessed online at http://environment.gov.au/epbc/protected-matters-search-tool.

- Australia's IBRA Bioregions and Sub-bioregions. Accessed online at http://environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps.
- Department of Environment and Climate Change NSW (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2.
- NSW OEH's Biodiversity Assessment Method (BAM) calculator (http://www.environment.nsw.gov.au/bbccapp/ui/mynews.aspx).
- NSW OEH's BioNet threatened biodiversity database Accessed online via login at http://www.bionet.nsw.gov.au/.
- NSW OEH Threatened Species Profiles http://www.environment.nsw.gov.au/threatenedSpeciesApp/ and www.environment.nsw.gov.au/AtlasApp/UI_Modules/.
- OEH BioNet Vegetation Classification Database (OEH 2017) Accessed online via login at http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx.
- OEH VIS Mapping Accessed online at http://www.environment.nsw.gov.au/research/VISmap.htm.
- Office of Environment and Heritage (OEH) (2017). Biodiversity Assessment Method.
- NSW Government SEED Mapping https://geo.seed.nsw.gov.au/Public_Viewer/index.html?viewer=Public_Viewer&locale=en-AU.
- NSW Biodiversity Values Map https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap.

2 LANDSCAPE FEATURES

2.1 IBRA BIOREGIONS AND SUBREGIONS

Interim Biogeographic regionalisation for Australia (IBRA) Bioregions are geographically distinct bioregions based on common climates, geology, landforms and native vegetation (Thackaway and Creswell, 1995) There are 89 IBRA bioregions within Australia. The development site falls within the NSW South Western Slopes IBRA Bioregion. The South Western Slopes is an extensive area of foothills and isolated ranges, comprising the lower inland slopes of the Great Dividing Range extending from north of Cowra through southern NSW into western Victoria.

The development site occurs within two IBRA subregions. Inland Slopes and Lower Slopes. The majority of the development site falls within the Lower Slopes subregion and this was entered into the BAM Calculator for the proposal.

The Lower Slopes Subregion is characterised by wide valleys of the Riverina alluvial fans containing isolated peaks and undulating hilly ranges. The geology of the Lower Slopes comprises Ordovican to Devonian faulted sedimentary rocks imbedded with large areas of intrusive granites.

The Lower Slopes also contains large areas of Tertiary and Quaternary alluvium deposits. Vegetation communities within the subregion occupy suitable landscapes, such as:

- White Cypress Pine on the ranges.
- Poplar Box, Kurrajong, Wilga and Red Box in the north.
- Grey Box woodlands with Yellow Box, White Cypress Pine and Belah on lower areas.
- Myall, Rosewood and Yarran on grey clays.
- Dwyer's Gum on granite.
- Red Ironbark on sedimentary rocks.
- River Red Gum on all streams with Black Box in the west.

2.1 NSW LANDSCAPE REGIONS AND AREA

The development site falls across three Mitchell Landscapes. These are:

- Brokong Plains.
- Burrumbuttock Hills and Footslopes.
- Table Top Range.

The dominant Mitchell Landscape within the development site is the Brokong Plains. This was entered into the BAM Calculator for the proposal.

2.2 NATIVE VEGETATION

An assessment of native vegetation in the 1500 m buffer area was undertaken using aerial imagery, State Vegetation Mapping (OEH, 2016b) and field assessments. Approximately 455 ha of native vegetation occurs in the surrounding 1500 m buffer area. This vegetation, in the landscape surrounding the development site is predominantly open woodland comprised of Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora*), Grey Box (*Eucalyptus microcarpa*), White Box (*Eucalyptus albens*) and River Red Gum (*Eucalyptus camaldulensis*).

2.3 CLEARED AREAS

An assessment of cleared areas in the 1500 m buffer area was undertaken using aerial imagery, State Vegetation Mapping (OEH, 2016b), NSW Landuse Mapping (OEH, 2017) and field assessments. Approximately 2569 ha occurs as cleared areas within the 1500 m buffer around the development site. These cleared areas are primarily agricultural lands used for cropping and modified pastures. Approximately 46 ha occurs as rural residential areas.

Figure 2-1 Example of cleared areas within the development site

2.4 RIVER AND STREAMS

The development site is located approximately 33 km north of the Murray River. Two water courses run through the development site; Back Creek and Middle Creek. Both these creeks are ephemeral and were dry at the time of the field inspections. Back Creek is vegetated with River Red Gum, Blakley's Red Gum, Grey Box and White Box. Middle Creek is a small drainage depression and runs through a cropped paddock. Middle creek lacks any woody vegetation. These two water courses flow into Billabong Creek, which in turn flows into the Murray River.

Seventeen man-made dams exist within the development site, four within Lot 22 DP 1069452 and thirteen across multiple Lots of DP 753735.

Figure 2-2 Back Creek within the development site

Figure 2-3 Middle Creek

Figure 2-4 Farm dam

2.5 WETLANDS

An EPBC Protected Matters search completed on 7 November 2018 identified seven wetlands of international importance. The closest of these to the development site is Barmah Forest and NSW Central Murray State Forests, located over 100 km from the development site, upstream within the Murray Catchment. The EPBC Protected Matters search also identified one nationally important wetland that could potentially be impacted by land use at the development site. Walla Walla Swamp (Gum Swamp), is located about 2.5 km west from the development site and is a seasonal swamp that is mostly dry during the warmer months.

Several smaller, unlisted swamps were identified near the development site. These are shown in Figure 2-5 from the Greater Hume LEP.

Figure 2-5 Wetlands identified in the Greater Hume LEP.

2.6 CONNECTIVITY FEATURES

The 1.5 km buffer area is largely cleared and heavily fragmented. The vegetated Back Creek provides connectivity for wildlife in an East to West direction.

2.7 AREAS OF GEOLOGICAL SIGNIFICANCE

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

2.8 AREAS OF OUTSTANDING BIODIVERSITY VALUE

No areas of Outstanding Biodiversity Value occur within the development site (NSW Biodiversity Values Map). Back Creek is listed as an area of high biodiversity value under the Biodiversity Conservation Regulation 2017 (Figure 2-6). The development site falls within an area of high biodiversity value. The potential impact to an area of high biodiversity value would trigger the requirement of a BDAR if not already required as a state significant development. Impacts on Back Creek have been considered in this report.

Figure 2-6 Areas listed as high biodiversity value (marked in purple).

2.9 SITE CONTEXT COMPONENTS

Method applied

The proposal conforms to the definition of a *site-based development* under the Biodiversity Assessment Methodology. The site-based development assessment methodology has been used in this BAM assessment. The Percent Native Vegetation was calculated by estimating the percent cover of native vegetation relevant to the benchmark for the PCT. PCTs were allocated based on existing vegetation mapping, field inspections and aerial imagery.

Percent native vegetation cover

The 1500m buffer area around the development site comprises as area of 3098 ha. As determined by GIS mapping from aerial imagery, approximately 472 ha of native vegetation occurs in the 1500 m buffer area (Figure 2-2-7).

Thus, the Percent Native Vegetation Cover within the 1500 m buffer area surrounding the development site was calculated to be 15.2%. This was entered into the BAM calculator for the assessment

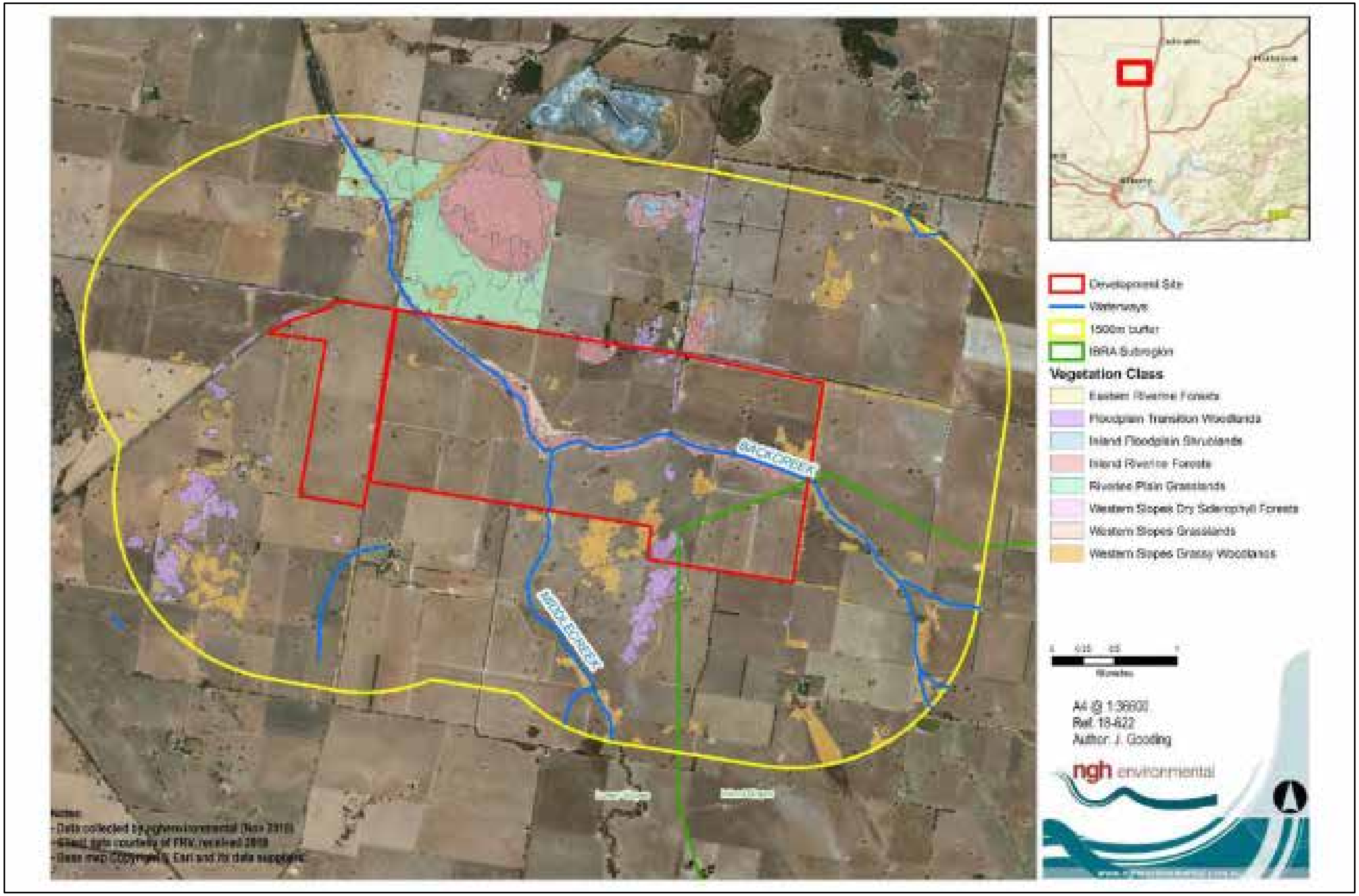

Figure 2-2-7 Location map

3 NATIVE VEGETATION WITHIN THE DEVELOPMENT SITE

3.1 NATIVE VEGETATION EXTENT

69.4 ha of native woodland vegetation occurs within the development site (Figure 3-1). This is comprised of:

- 44.5 ha of River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.
- 17.9 ha of Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.
- 0.2 ha of Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.
- 6.8 ha of Riparian Blakely's Red Gum – box – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion.

29.6 ha of derived grassland from Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions also occurs within the development site.

63 isolated paddock trees and 2 dead stags occur within the development site (Figure 3-1). Paddock trees are defined as:

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

*The regulatory land mapping has not yet been published under the new *Local Land Service Act 2016* (LLS Act). During the transitional period, land categories are to be determined in accordance with the definitions of regulated land in the LLS Act. In this case, the paddock trees are surrounded by land that has been cleared of native vegetation since January 1990.

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

3.2 EXOTIC VEGETATION

Approximately 505 ha of the development site occurs as cleared agricultural land used for rotational cropping and sheep and cattle grazing (Figure 3-1). These areas are dominated by exotic vegetation such as Wheat (**Triticum aestivum*), Canola (**Brassica rapa*) and Barley (**Hordeum* sp.).

The BC Act determines that the Biodiversity Assessment Method (BAM) is to exclude the assessment of the impacts of clearing native vegetation on Category 1 - exempt land. As Category 1 Land regulatory maps are not yet publicly available, an assessment of whether the cleared areas meet the definition of the Category 1 - exempt land was undertaken (Appendix A). Based on 2017 Landuse Dataset (OEH, 2017), NSW Woody

Vegetation extent dataset (OEH, 2015), Native Vegetation Regulatory Mapping and historical aerial Imagery, 502 ha was considered to be classed as Category 1 Land (Appendix A). These areas are exempt from further assessment in the BAM with exception to prescribed impacts as stated in Section 6.3 of the BC Act.

A further 13 ha was assessed as exotic vegetation from the field assessment comprised or predominantly agricultural weeds such as Barley Grass (**Hordeum leporinum*), Rye Grass (**Lolium*), Phalaris (**Phalaris aquatica*) and Patterson's Curse (**Echium plantagineum*).

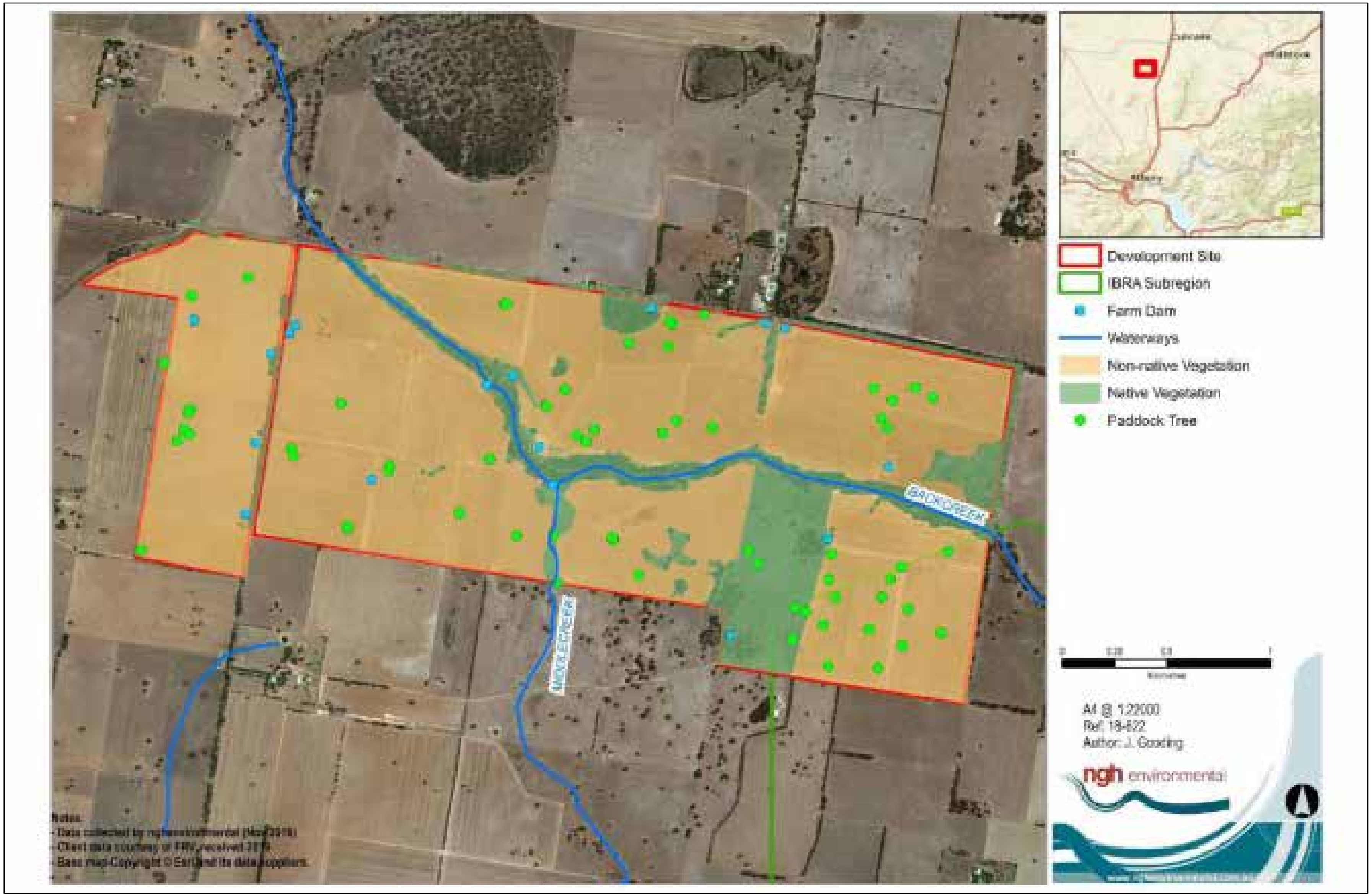

Figure 3-1 Native Vegetation extent within the development site

3.3 PLANT COMMUNITY TYPES (PCTS)

3.3.1 Methods to assess PCTs

Review of existing information

A search was undertaken of OEH Vegetation Information System (VIS) database and NSW SEED mapping to access existing vegetation mapping information within the development site. Two relevant existing vegetation maps were assessed:

- *SEED Mapping – Sharing and Enabling Environmental Data (2017)*.
- *Riverina State* and *Vegetation Mapping* – VIS 4469.

These two vegetation maps provided the same information. 10 PCTs were mapped to be present within a 100 m buffer from the development site. These mapped PCTs were;

- PCT 5 - River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.
- PCT 45 - Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and the NSW South Western Slopes Bioregion.
- PCT 74 - Yellow Box - River Red Gum tall grassy riverine woodland of NSW South Western Slopes Bioregion and Riverina Bioregion.
- PCT 76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.
- PCT 79 - River Red Gum shrub/grass riparian tall woodland or open forest wetland mainly in the upper slopes sub-region of the NSW South Western Slopes bioregion and western South East Highlands Bioregion.
- PCT 249 - River Red Gum swampy woodland wetland on Cowals (lakes) and associated flood channels in central NSW.
- PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion.
- PCT 277 - Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.
- PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion.
- PCT 633 - Speargrass - Red leg Grass derived grassland on hills in the Jindera to Holbrook region, southern NSW South Western Slopes Bioregion.

Floristic survey

An initial site survey was undertaken on the 8 and 9 November 2018. The entire subject land was surveyed by two ecologists by car and on foot. The aim of this survey was to confirm the PCTs present in the development site and their condition and extent. Random meander searches were conducted in areas of native vegetation to determine the plant species present. PCTs were identified from the native species present, landforms, physiography and location in the IBRA subregion using the BioNet Vegetation Classification Database. The subject land was then stratified into areas of similar condition class to determine vegetation zones for each PCT.

Detailed floristic surveys were undertaken on 9 November and the 13 to 15 November 2018. Vegetation integrity plots, of 20 m by 50 m (or 10 m by 100 m in the case of roadside verge), were established in each vegetation zone. Data were collected on the composition, structure and function of the vegetation. Data was collected utilising the methodology presented in the BAM 2017 by persons trained in the BAM and under the direction of persons accredited under the BAM.

3.3.2 PCTs identified on the development site

Based on the field surveys, four PCTs were identified to occur within the development site (Figure 3-5). These are:

- PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.
- PCT 76 – Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.
- PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.
- PCT 278 – Riparian Blakely's Red Gum – box – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion.

Once the development site had been ground truthed through the field surveys, it was revealed some of the existing vegetation mapping on SEED mapping and VIS Mapping was mapped incorrectly. This included;

- An area mapped as PCT 266 – White Box Woodland was identified as a patch of planted sugar gums (**Eucalyptus cladocalyx*).
- Patches mapped as PCT 277 – Blakely's Red Gum-Yellow Box grassy Woodland were either dominated by Grey Box (*E. microcarpa*) or River Red Gum (*E. camaldulensis*).
- Area mapped as PCT 633 – Speargrass-red leg grass derived grasslands on hills were identified as being highly modified from grazing and dominated by exotic annual grasses. No spear-grass or red-leg grass was present at the time of survey in November 2018.

A description of each of the PCTs identified in the development site follow in Table 3-1 to Table 3-4, which include justification of PCT selection.

Table 3-1 River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.

<table>
<tr><th colspan="3">River Red Gum Herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.</th></tr>
<tr><td>Vegetation formation</td><td colspan="2">Forested Wetlands</td></tr>
<tr><td>Vegetation class</td><td colspan="2">Inland Riverine Forests</td></tr>
<tr><td rowspan="2">Vegetation type</td><td>PCT ID</td><td>5</td></tr>
<tr><td>Common Community Name</td><td>River Red Gum herbaceous – grassy very tall open forest wetland.</td></tr>
<tr><td>Approximate extent within the development site</td><td colspan="2">44.5 ha of this PCT occurs in varying condition in the development site along Back Creek and isolated wetland depressions throughout the agricultural land.</td></tr>
<tr><td>Species relied upon for PCT identification</td><td>Species name</td><td>Relative cover</td></tr>
<tr><td></td><td>Eucalyptus camaldulensis</td><td>10 -20%</td></tr>
<tr><td></td><td>Alternanthera denticulata</td><td><1%</td></tr>
<tr><td></td><td>Euphorbia drummondii</td><td><1%</td></tr>
<tr><td></td><td>Rumex brownii</td><td><1%</td></tr>
<tr><td></td><td>Cynodon dactylon</td><td><1%</td></tr>
<tr><td></td><td>Juncus subsecundus</td><td>0 -15%</td></tr>
<tr><td></td><td>Carex sp.</td><td>0-1%</td></tr>
<tr><td></td><td>Eleocharis sp.</td><td>0-1%</td></tr>
<tr><td></td><td>Elymus scaber</td><td><1%</td></tr>
<tr><td>Justification of evidence used to identify the PCT</td><td colspan="2">This PCT was identified with a dominance of River Red Gum (E. camaldulensis). The shrub layer is absent and the ground cover is highly disturbed through frequent grazing by sheep and cattle.

Five PCTS were considered that have River Red Gum as the dominant species in the NSW South Western Slopes. These are:

PCT 2 - River Red Gum-sedge dominated very tall open forest in frequently flooded forest wetland along major rivers and floodplains in south-western NSW Based on the species.

PCT 5 - River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.

PCT 7 - River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion.

PCT 9 - River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion.

PCT 249 --River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW.

Very little understory vegetation remains and it was difficult to distinguish between the PCTS based on understory species. PCT 5 was considered the best match for the PCT based on existing vegetation mapping and location in the landscape.</td></tr>
</table>

River Red Gum Herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion.	
TEC Status	Not listed under either the BC Act or EPBC Act
Estimate of percent cleared	Current extent = 9000 ha (40% cleared)
Examples	 Figure 3-2 River Red Gum herbaceous-grassy very tall open forest in the development site.

Table 3-2 A description of PCT76 -Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion in the development site

<table>
<tr><th colspan="3">PCT 76: Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.</th></tr>
<tr><td>Vegetation formation</td><td colspan="2">Grassy Woodland</td></tr>
<tr><td>Vegetation class</td><td colspan="2">Floodplain Transition Woodlands</td></tr>
<tr><td rowspan="2">Vegetation type</td><td>PCT ID</td><td>76</td></tr>
<tr><td>Common Community Name</td><td>Western Grey Box tall grassy woodland</td></tr>
<tr><td>Approximate extent within the development site</td><td colspan="2">17.9 ha of woodland in varying condition within the development site
6.2 ha of woodland along adjacent roadsides
29.6 ha as a derived grassland</td></tr>
<tr><td rowspan="12">Species relied upon for PCT identification</td><td>Species name</td><td>Cover</td></tr>
<tr><td>Eucalyptus microcarpa</td><td>0 – 20%</td></tr>
<tr><td>Allocasuarina luehmannii</td><td>0 -1%</td></tr>
<tr><td>Callitris glaucophylla</td><td>0-1%</td></tr>
<tr><td>Enteropogon acicularis</td><td>0-1%</td></tr>
<tr><td>Chloris truncata</td><td>0-30%</td></tr>
<tr><td>Elymus scaber</td><td><1%</td></tr>
<tr><td>Cynodon dactylon</td><td><1%</td></tr>
<tr><td>Oxalis perennans</td><td><1%</td></tr>
<tr><td>Sida corrugata</td><td><1%</td></tr>
<tr><td>Austrostipa scabra</td><td><1%</td></tr>
<tr><td>Euphorbia drummondii</td><td><1%</td></tr>
<tr><td>Justification of evidence used to identify the PCT</td><td colspan="2">This PCT was identified by a dominance of Western Grey Box (E. microcarpa) in the understory. A few scattered Bulloak (Allocasuarina luehmannii) were also present within the paddock trees. The understory has been heavily disturbed through agricultural activities of cropping and continuous grazing by livestock. The shrub layer is absent, and the groundcover is mostly comprised of exotic annuals. Some native groundcovers persist on the road reserves.

Two PCTS were considered that have Western Grey Box as the dominant overstory species in the NSW South West Slopes. These are:
• PCT 76 – Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregion.
• PCT 80 – Western Grey Box – White Cypress Pine tall woodland on loam soil of alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion.

As White Cypress Pine was not dominant in the landscape, PCT 80 was not considered a suitable PCT for the remnant Grey Box Woodland. PCT 76 was considered to be most suitable PCT based on:
• Dominated by Grey Box in the overstory.</td></tr>
</table>

PCT 76: Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.	
	• Located in the Inland Slopes IBRA Subregion. • Occurs on flats and floodplains. • Species listed above characteristic of this community. • Existing Vegetation Mapping for this PCT present in the locality. For these reasons, PCT was selected as the most appropriate PCT.
TEC Status	Forms part of the TEC - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion listed as Endangered under the NSW BC Act.
Estimate of percent cleared in Bioregion	Current extent = 40 000 ha (92% cleared)
Examples	 Figure 3 4 Western Grey Box tall grassy woodland in the development site.

Table 3-3 Description of PCT 277 Blakely's Red Gum-Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion in the development site.

<table>
<tr><th colspan="3">PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.</th></tr>
<tr><td>Vegetation formation</td><td colspan="2">Grassy Woodlands</td></tr>
<tr><td>Vegetation class</td><td colspan="2">Western Slopes Grassy Woodlands</td></tr>
<tr><td rowspan="2">Vegetation type</td><td>PCT ID</td><td>277</td></tr>
<tr><td>Common Community Name</td><td>Blakely's Red Gum-Yellow Box grassy tall woodland</td></tr>
<tr><td>Approximate extent within the development site</td><td colspan="2">0.2 ha comprised of one patch within a cropped paddock</td></tr>
<tr><td rowspan="3">Species relied upon for PCT identification</td><td>Species name</td><td>Relative abundance</td></tr>
<tr><td>Eucalyptus blakelyi (Blakely's Red Gum)</td><td>50%</td></tr>
<tr><td>Eucalyptus melliodora (Yellow Box)</td><td>50%</td></tr>
<tr><td>Justification of evidence used to identify the PCT</td><td colspan="2">This woodland is comprised of a small patch of 4 trees within a cropped paddock that is used for heavy grazing. There is no native understory. The PCT was assigned based on the overstory species - Blakely's Red Gum and Yellow Box that are characteristic to this PCT in the IBRA subregion</td></tr>
<tr><td>TEC Status</td><td colspan="2">Forms part of the TEC - White Box - Yellow Box - Blakely's Red Gum Woodland listed as endangered under the BC Act.</td></tr>
<tr><td>Estimate of percent cleared in NSW</td><td colspan="2">Current extent = 30 000 ha (94% cleared)</td></tr>
<tr><td>Examples</td><td colspan="2">
Figure 3-3 Blakely's Red Gum-Yellow Box grassy tall woodland in the development site.</td></tr>
</table>

Table 3-4 Description of PCT 278 -Riparian Blakely's Red Gum - box - sedge grass tall open forest of the central NSW South Western Slopes Bioregion

PCT 278 – Riparian Blakely's Red Gum – box – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion.		
Vegetation formation	Grassy Woodlands	
Vegetation class	Western Slopes Grassy Woodland	
Vegetation type	**PCT ID**	278
	Common Community Name	Riparian Blakely's Red Gum – box – sedge – grass tall open forest
Approximate extent within the development site	6.8 ha of this PCT occurs within the development site along the Eastern side of Back Creek	
Species relied upon for PCT identification	**Species name**	**Relative abundance**
	Eucalyptus blakelyi (Blakely's Red Gum)	30%
	Eucalyptus melliodora (Yellow Box)	5%
	Eucalyptus microcarpa (Grey Box)	10%
	Eucalyptus albens (White Box)	5%
Justification of evidence used to identify the PCT	This PCT occurs along Back Creek on the Eastern end of the Development Site. Sections of the creek transition from a River Red Gum Woodland (PCT 9) into Blakely's Red Gum, with scattered White Box, Grey Box and Yellow Box. This zone was not assessed thoroughly with vegetation plots as it fell outside the development footprint. The PCT was identified based on existing mapping, location in the landscape and dominant overstory species. It is likely a transition zone between existing and past plant communities.	
TEC Status	Forms part of the White Box - Yellow Box - Blakely's Red Gum Woodland listed as endangered under the BC Act and Critically endangered under the EPBC Act.	
Estimate of percent cleared in NSW	Current extent – 6 000 ha (80% cleared)	

PCT 278 – Riparian Blakely's Red Gum – box – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion.	
Examples	 Figure 3-4 Riparian Blakely's Red Gum tall open forest

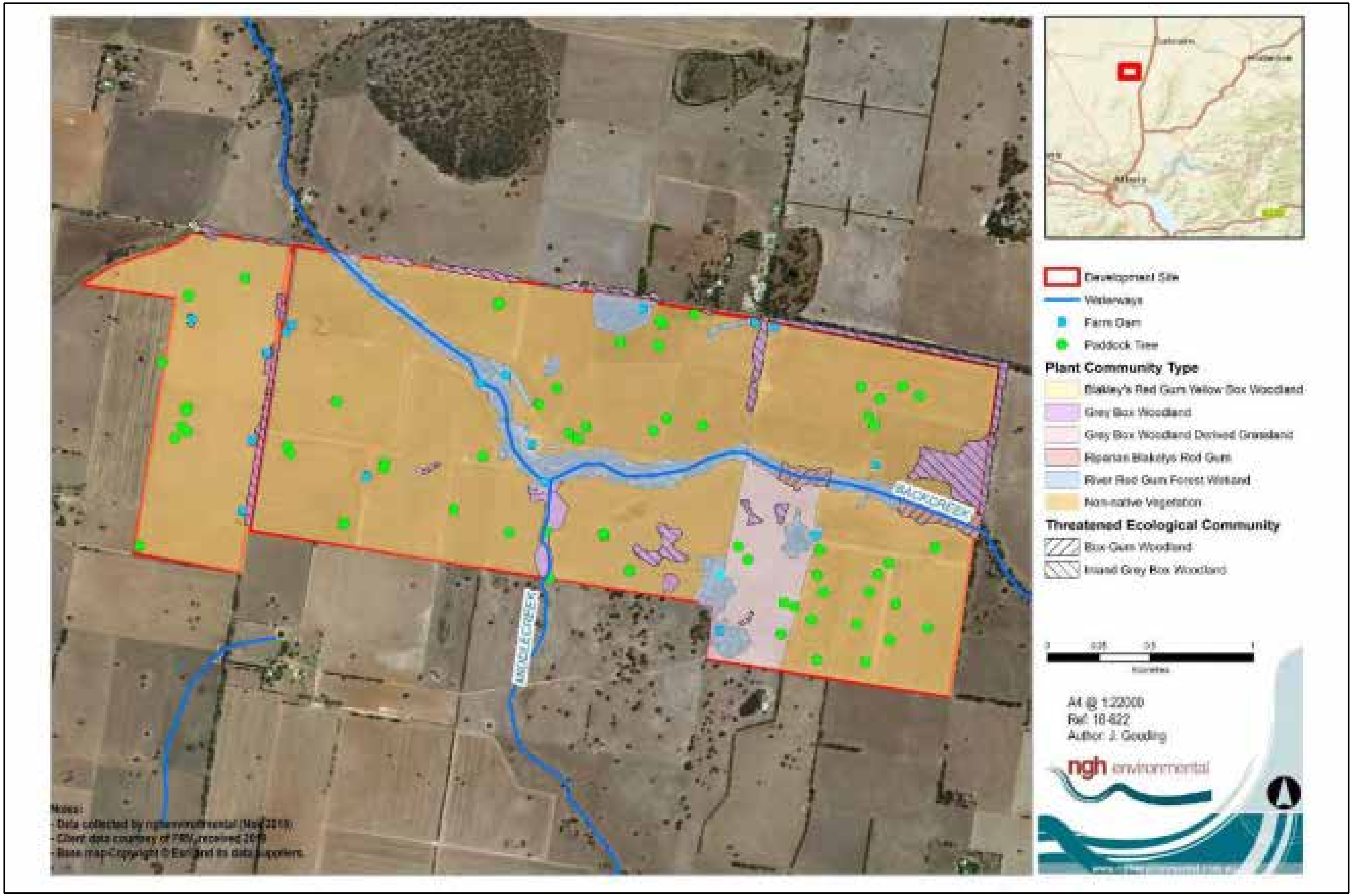

Figure 3-5 PCTS and TECS at the development site

3.4 VEGETATION INTEGRITY ASSESSMENT

3.4.1 Vegetation zones and survey effort

The random meander, overview inspection and detailed floristic plots have been used to assist the delineation of zones. Four PCTs were identified in the development site. Each of these PCTs was considered in terms of whether they should be further stratified into zones on the basis of current condition state/management or other environmental variables. PCT 76 was stratified into 4 zones dependent on the basis of tree cover, understory condition and land use. PCT 5 was stratified into 4 zones on the basis of tree cover, understory condition and land use. The other zones are considered homogenous and well represented by the plot data. Vegetation zones are shown in Table 3-5 and mapped in Figure 3-6.

33 vegetation integrity plots were undertaken during the field surveys. Some of these plots subsequently fell outside the development site once the proposal layout was redesigned or were undertaken within Category 1 Land. These plots were not used for the BAM Calculations. The number of floristic plots undertaken in each zone was in line with the minimum plot requirements per zone area as specified in the BAM (2017).

Table 3-5 Vegetation zones within the development site.

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
1	277	**Grazed** This zone consists of mature Blakley's Red Gum (*E. blakelyi*) and Yellow Box (*E. melliodora*) trees over a disturbed understorey. Any native understory has been eliminated through agricultural activities of cropping and grazing. This zone was considered to be of low condition. This zone forms part of the TEC listed under the BC Act as *White Box Yellow Box Blakely's Red Gum Woodland.*	0.2 ha	1	0.2 ha	
2	76	**Grazed** This zone consists of mature Grey Box (*E. microcarpa*) trees over a disturbed understorey. Any native understory has been eliminated through agricultural activities of cropping and grazing. This zone forms part of the TEC listed under the BC Act as *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion*s	12.1 ha	4	100+ ha	

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
3	76	**Wetland** This zone occurs along Middle Creek and some small depressions surrounding remnant Grey Box trees. These areas were dry at the time of survey but water-loving plants such as *Juncus usitatus, Cyperus* sp., and Lesser Joyweed (*Alternanthera denticulata*), were present indicating these areas hold moisture. These areas are heavily grazed and dominated by exotic species such as Phalaris (**Phalaris aquatica*) and Barley Grass (**Hordeum sp.*). Native grasses such as Windmill Grass (*Chloris truncata*), Couch (*Cynodon dactylon*) and Wallaby Grass (*Rytidosperma*) also persist in small numbers This zone form part of the TEC *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion*s as the understory is exotic dominated.	4.5 ha	2	3.3 ha	
4	76	**Derived grassland** This zone consists of a disturbed grassland. It has undergone regular grazing by livestock, but there has been no evidence of cropping in the past. The grassland is dominated by a mix of exotic Barley Grass (**Hordeum leporinum*) and native Windmill Grass (*Chloris truncata*). Some other natives such as Couch (*Cynodon dactylon*), Curly Windmill Grass (*Enteropogon acicularis*), Caustic Weed (*Euphorbia drummondii*) and Wallaby grass (*Rytidosperma spp.*) were also present in very small abundance (<1% cover). This zone is considered to form part of PCT 76 due to scattered and isolated Grey Box and Bulloak occurring in this paddock. It does not form part of the TEC *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion*s as the	29.6 ha	4	29.6 ha	

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
		understory is exotic dominated and very few native grasses or forbs remain.				
5	76	**Roadside** This zone consists of mature Grey Box trees along the road reserves surrounding the development site. These zones have not been subject to as much grazing pressure and native understory grasses and forbs are present in these zones. This zone forms part of the TEC listed under the BC Act as *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion*s	1.3 ha (11.4 ha in adjacent roadside reserve)	2	100+ ha	
6	5	**Grazed** This zone consists of mature River Red Gum (*E. camaldulensis*) trees over a disturbed understory. Native understory has been eliminated through intense agricultural activities of cropping and grazing. This zone is considered to be in low condition. This zone does not form part of a TEC under the BC or EPBC act.	1.4	1	0.6 ha	

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
7	5	**Wetland** This zone consists of a woodland of mature River Red Gum (*E. camaldulensis*) trees occurring in small drainage depressions in the landscape. These areas would hold water in times of substantial rainfall. Grazing occurs in these areas but native understory species such as Juncus sp, Swamp Dock (*Rumex brownii*) and Carex sp. persist. Fallen timber has been left in these areas, providing good fauna habitat. This zone does not form part of a TEC under the BC or EPBC act.	12.8 ha	3	6.0 ha	
8	5	**Low condition creek line** This zone occurs along Back Creek within the fenced areas protected from cropping and grazing. This low condition zone comprises a sparse regenerating River Red Gum trees (*E. camaldulensis*). Groundcover is mostly exotic annuals with some scattered native grasses. This zone does not form part of a TEC under the BC or EPBC act.	1.5 ha	1	100+ ha	

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
9	5	**Creekline** This zone occurs along Back Creek. It is fenced off from stock, although has occasional grazing. It is dominated by River Red Gum (*E. camaldulensis*). River Red Gums are a mix of mature trees and juvenile trees with large stands of juvenile trees, likely germinated through past flooding events. Understory has been degraded through grazing. This zone does not form part of a TEC under the BC or EPBC act.	28.5 ha	1 (not impacted by development footprint)	100+ ha	
10	278	**Creekline** This zone occurs along Back Creek. It is fenced off from stock although has occasional grazing.	6.8 ha	0 (not impacted by development footprint)	100+ ha	

Zone ID	PCT ID	Stratification unit / condition	Area in development site (ha)	Survey effort (# plots)	Patch size (ha)	Example
11	N/A	**Exotic Vegetation** Exotic vegetation within the development site is predominantly cropping land, comprised of Canola, Wheat and Barley. These lands are considered Category 1 land and are not assessed under the BAM. There are also some small stands of planted Sugar Gum (**Eucalyptus cladocalyx*) and Pepper Tree (**Schinus molle* var. *areira*) that are not native to NSW. Isolated Paddock Trees in this zone have been assessed under the Paddock Tree Assessment in Section 3.4.2 These areas are not considered to represent a PCT or TEC	502	3	502	

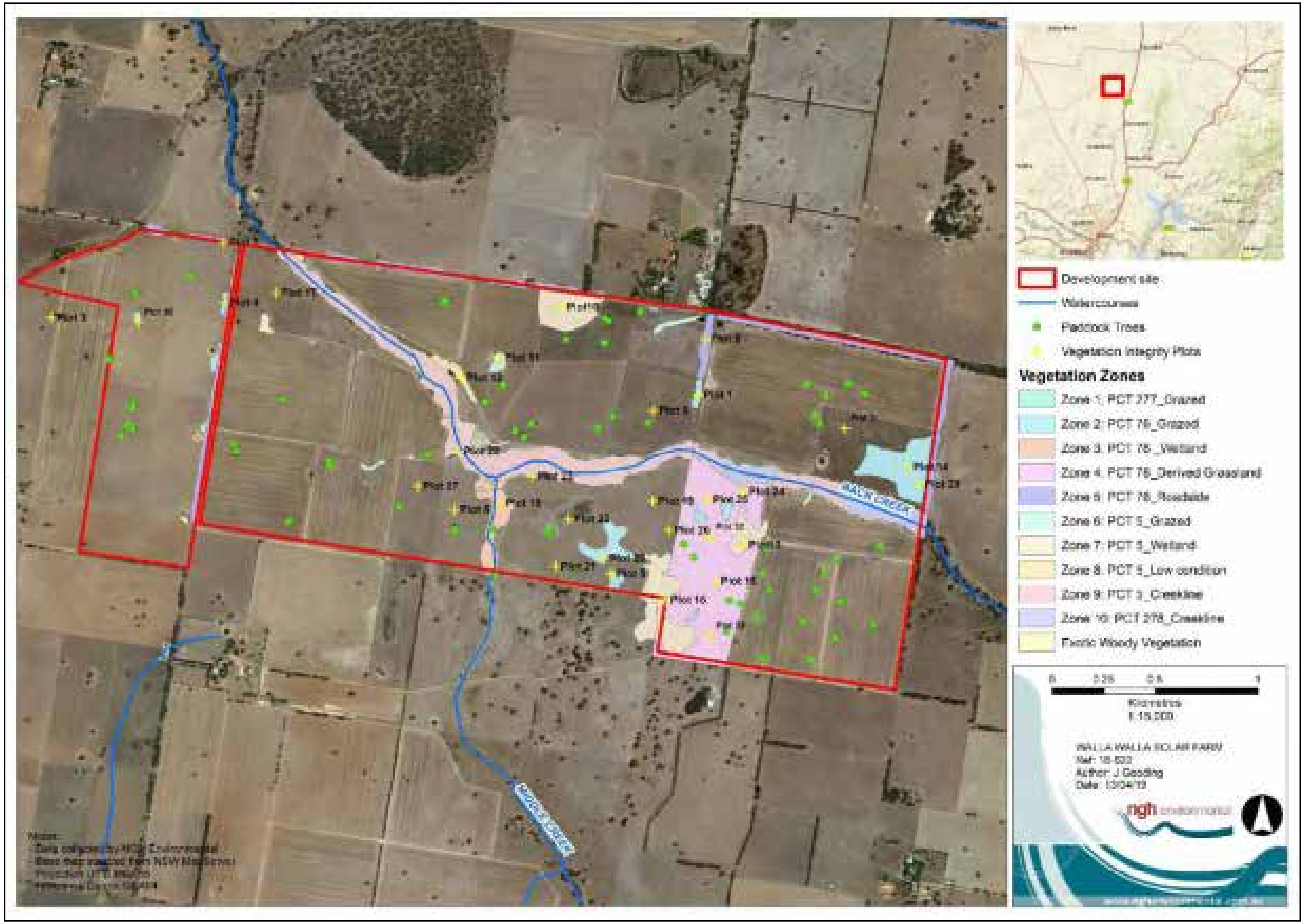

Figure 3-6 Vegetation zones at the development site and floristic plot locations

3.4.2 Paddock Trees

There are 63 living paddock trees and two dead stags in the development site within the exotic vegetation in Zone 11. The paddock trees are a mix of mainly Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi)* with an occasional White Cypress (*Callitris glaucophylla*) and River Red Gum (*E. camaldulensis*)

The Grey Box paddock trees and occasional White Cypress are most likely remnant of the surrounding Grey Box tall Grassy woodland identified in the development site. As such, PCT 76 was assigned to the paddock trees comprised of Grey Box and White Cypress.

The Blakely's Red Gum and Yellow Box paddock trees are most likely remnant of the Blakely's Red Gum - Yellow Box grassy tall woodland identified in the development zone. As such, PCT277 was assigned to the Paddock Trees comprised of Yellow Box and Blakely's Red Gum.

Threatened species that would use the paddock trees are assumed to be the same threatened species that are returned by the BAM Calculator for the vegetation zones. Where targeted fauna surveys were required for the BAM Calculations, paddock trees were also included in the surveys. Assessments of threatened species that would use the paddock trees as habitat has been incorporated into this BDAR under sections 4 and 5.

All paddock trees were mapped in the field using a handheld GIS Tablet. Trees were identified to genus and species. The Diameter at Breast Height (DBH) of the tree was assessed and assigned a paddock tree class relevant to the large tree benchmark. The large tree benchmark for PCT277 and PCT 76 is 50 cm DBH. The trees were visually assessed from the ground to determine whether any hollows were present. Examples of paddock trees occurring in the development site are shown in Figure 3-7 and listed in Appendix C.

Figure 3-7 Paddock trees within the development site

3.4.1 Vegetation integrity assessment results

90 plant species were identified within the 32 vegetation integrity survey plots comprising 26 native species and 64 exotic species. The results of the plot field data can be found in Appendix B.

The plot data from the vegetation integrity survey plots was entered into the BAM calculator by an accredited assessor. The results of the vegetation integrity assessment are provided in Table 3-6.

Table 3-6 Current vegetation integrity scores for each vegetation zone within the development site.

Zone ID	Zone Description	Patch Size	Composition score	Structure score	Function score	Vegetation Integrity Score
1	PCT 277_ Grazed	0.18	2.2	12.4	63.9	**12.1**
2	PCT 76_Grazed	101 ha	7.6	23.4	46.3	**20.2**
3	PCT 76_Wetland	2 ha	24.3	19.2	17.3	**20.0**
4	PCT 76_Derived Grassland	30 ha	11.8	34.1	10.6	**16.2**
5	PCT 76_Roadside	101 ha	22.7	69.8	42.1	**40.5**
6	PCT 5_ Grazed	101 ha	10.4	3	48.1	**11.4**
7	PCT 5_Wetland	35 ha	32.1	30.6	75.1	**41.9**
8	PCT 5_Low Condition	101 ha	14.6	5.5	2.2	**5.6**
9	PCT 5_Creekline	101 ha	17.4	48.3	80.2	**40.7**

4 THREATENED SPECIES

4.1 ECOSYSTEM CREDIT SPECIES

The following ecosystem credit species were returned by the calculator as being associated with the PCTs present on the development site. Two of these species were detected within the development site during field surveys. The Flame Robin was observed in the South of the site foraging in grassland and the Brown Tree Creeper was heard in the woodland vegetation along Back Creek. All other species are assumed to occur within the development site on occasion.

Table 4-1 Ecosystem credit species.

Common Name	Associated PCT	NSW Listing Status	National Listing Status
Fauna			
Australian Painted Snipe ***Rostratula australis***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Endangered	Endangered
Barking Owl (Foraging) ***Ninox connivens***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Black-Chinned Honeyeater ***(Eastern Subspecies)*** ***Melithreptus gularis gularis***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Brown Treecreeper **(eastern Subspecies)** ***Climacteris picumnus victoriae***	PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland. PCT 76 – Grey Box tall grassy woodland.	Vulnerable	Not Listed
Diamond Firetail ***Stagonopleura guttata***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Dusky Woodswallow ***Artamus cyanopterus cyanopterus***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not listed
Flame Robin	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Vulnerable	Not Listed

Petroica phoenicea	PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.		
Freckled Duck ***Stictonetta naevosa***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Vulnerable	Not Listed
Gang Gang Cockatoo (foraging) ***Callocephalum fimbriatum***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not listed
Gilbert's Whistler ***Pachycephala inornata***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Vulnerable	Not Listed
Glossy Black Cockatoo (Foraging) ***Calyptorhynchus lathami***	PCT 76 – Grey Box tall grassy woodland.	Vulnerable	Not listed
Grey Falcon ***Falco hypoleucos***	PCT 76 – Grey Box tall grassy woodland.	Endangered	Not Listed
Grey Headed Flying Fox (Foraging) ***Pteropus poliocephalus***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Vulnerable
Grey-crowned Babbler **(eastern subspecies)** ***Pomatostomus temporalis temporalis***	PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Hooded Robin (South-eastern form) ***Melanodryas cucullata cucullata***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Koala (Foraging) ***Phascolarctos cinereus***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Vulnerable
Little Eagle (Foraging) ***Hieraaetus morphnoides***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed

Little Lorrikeet ***Glossopsitta pusilla***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Little Pied Bat ***Chalinolobus picatus***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not listed
Major Mitchell's Cockatoo **(Foraging)** ***Lophochroa leadbeateri***	PCT 76 – Grey Box tall grassy woodland.	Vulnerable	Not Listed
Masked Owl (foraging) ***Tyto novaehollandiae***	PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland. PCT 76 – Grey Box tall grassy woodland.	Vulnerable	Not Listed
Painted Honeyeater ***Grantiella picta***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Vulnerable
Purple-crowned Lorikeet ***Glossopsitta porphyrocephala***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Vulnerable	Not Listed
Regent Honeyeater (foraging) ***Anthochaera phrygia***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Critically Endangered	Critically Endangered
Scarlet Robin ***Petroica boodang***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Speckled Warbler ***Chthonicola sagittata***	PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland. PCT 76 – Grey Box tall grassy woodland.	Vulnerable	Not listed
Spotted Harrier ***Circus assimilis***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not listed
Spotted-tailed quoll	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland.	Vulnerable	Endangered

Dasyurus maculatus	PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.		
Square-tailed Kite (Foraging) ***Lophoictinia isura***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Superb Parrot (Foraging) ***Polytelis swainsonii***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Vulnerable
Swift Parrot (Foraging) ***Lathamus discolor***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Endangered	Critically Endangered
Turquoise Parrot ***Neophema pulchella***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Varied Sittella ***Daphoenositta chrysoptera***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
White-bellied Sea-Eagle (foraging) ***Haliaeetus morphnoides***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed
Yellow-bellied Sheathtail Bat ***Saccolaimus flaviventris***	PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland. PCT 76 – Grey Box tall grassy woodland. PCT 277 – Blakely's Red Gum – Yellow Box grassy tall woodland.	Vulnerable	Not Listed

SPECIES CREDIT SPECIES

4.1.1 Candidate species to be assessed

The BAM Calculator predicted the following 31 species credit species to occur at the development site (Table 4-2). A desktop assessment was undertaken for habitat constraints and geographic restrictions to determine which species would be included or excluded for further targeted surveys in the development site. Eight species lacked suitable habitat or fell outside the known geographic range and were excluded from further assessment. These excluded species are highlighted in grey in the table below.

Table 4-2 Candidate species credit species requiring assessment

Credit species	Habitat and geographic restrictions1	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Fauna							
Barking Owl (Breeding) ***Ninox connivens***	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	High	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site
Bush Stone-curlew ***Burhinus grallarius***	Fallen/standing dead timber including logs.	High	Endangered	Not listed	Fallen timber in woodland areas in development site	Included	Habitat components on site
Eastern Pygmy-possum ***Cercartetus nanus***	Broad range of habitat from rainforest through sclerophyll forest and woodland to heath, but in most areas woodlands and heath preferred.	High	Vulnerable	Not listed	Suitable habitat in woodland areas.	Included	Habitat components on site
Gang-gang Cockatoo (Breeding) ***Callocephalon fimbriatum***	Eucalypt tree species with hollows greater than 9 cm diameter.	High (breeding) / Moderate (foraging)	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site
Glossy Black Cockatoo (Breeding) ***Calyptorhynchus lathami***	Living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground.	High	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site

Credit species	Habitat and geographic restrictions1	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Glossy Black Cockatoo, Riverina Population **(Breeding)** ***Calyptorhynchus lathami***	Only in Carrathool, Griffith, Leeton and Narrandera LGA.	High	Endangered	Not Listed	Development site falls outside geographic restrictions.	Excluded	Not within Geographic Range
Grey-headed Flying-fox (Breeding) ***Pteropus poliocephalus***	Range of vegetation communities including rainforest, open forest, and closed and open woodland. Roost sites usually near water, including lakes, rivers, and coastlines. Known to roost in locality. Breeding Camps	High	Vulnerable	Vulnerable	Woodland areas in development site	Included	Surveys required
Large-eared Pied Bat ***Chalinolobus dwyeri***	Cliffs or within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops or crevices. Or within two kilometres of old mines or tunnels.	Very High	Vulnerable	Vulnerable	No Cliff, Rocky areas or tunnels within 2km of development site.	Excluded	No habitat components on or near site
Koala (Breeding) ***Phascolarctos cinereus***	Temperate, subtropical and tropical eucalypt woodlands and forests where suitable food trees grow, of which there are more than 70 eucalypt species and 30 non-eucalypt species that are particularly abundant on fertile clay soils. Known in subregion.	High	Vulnerable	Not listed	Woodland areas in development site	Included	Surveys required

Credit species	Habitat and geographic restrictions[1]	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Little Eagle (Breeding) ***Hieraetus morphnoides***	Nest trees - live (occasionally dead) large old trees within vegetation. Paddock trees can provide important breeding habitat.	Moderate	Vulnerable	Not listed	Large old tree within development site	Included	Habitat components on site
Major Mitchell's Cockatoo (Breeding) ***Lophochroa leadbeateri***	Living or dead tree with hollows greater than 10 cm diameter.	High (breeding)/ Moderate (foraging)	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site
Masked Owl (Breeding) ***Tyto novaehollandiae***	Living or dead trees with hollows greater than 20 cm diameter.	High	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site
Pink-tailed Legless Lizard ***Aprasia parapulchella***	Rocky areas or within 50 m of rocky areas.	High	Vulnerable	Vulnerable	No Rocky Areas within development site	Excluded	No suitable habitat
Regent Honeyeater (Breeding) ***Anthochaera phrygia***	Temperate woodlands and open forests of the inland slopes of south-east Australia, in particular dry open forest, woodland, Box-Ironbark woodland, and riparian forests of River Sheoak.	High	Critically Endangered	Critically Endangered	Development site not within mapped important areas (OEH, pers. com)	Excluded	Not within Mapped Important Areas

Credit species	Habitat and geographic restrictions1	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Sloane's Froglet ***Crinia sloanei***	Semi-permanent/ephemeral wet areas containing relatively shallow sections with submergent and emergent vegetation. Within 500 m of wet areas, swamps or waterbodies.	Moderate	Vulnerable	Endangered	Farm Dams present in development site	Included	Habitat components on site.
Southern Myotis ***Myotis macropus***	Hollow Bearing Trees within 200 m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone.	High	Vulnerable	Not listed	Hollow Bearing Trees within 200m of Back Creek	Included	Habitat components on site.
Square-tailed Kite (Breeding) ***Lophoictinia isura***	Timbered habitats including dry woodlands and open forests, particularly timbered watercourses. Known in subregion. Nest Trees.	Moderate	Vulnerable	Not listed	Large old trees within development site	Included	Habitat components on site
Squirrel Glider ***Petaurus norfolcensis***	Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart).	High	Vulnerable	Not listed	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site
Superb Parrot (Breeding) ***Polytelis swainsonii***	Living or dead E. blakelyi, E. melliodora, E. albens, E. camaldulensis, E. microcarpa, E. polyanthemos, E. mannifera, E. intertexta with hollows greater than 5 cm diameter; greater than	High (breeding)/ Moderate (foraging	Vulnerable	Vulnerable	Suitable Hollow Bearing Trees within development site.	Included	Habitat components on site

Credit species	Habitat and geographic restrictions[1]	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
	4 m above ground or trees with a DBH of greater than 30 cm.						
Swift Parrot ***Lathamus discolor***	On the coast and southwest slopes in areas with abundant flowering eucalypts or lerp. Feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box. Known in subregion.	Moderate	Endangered	Critically Endangered	Development site not within mapped important areas (OEH, 2019)	Excluded	Not within mapped important areas
White-bellied Sea-Eagle (Breeding) ***Haliaeetus morphnoides***	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	High	Vulnerable	Not listed	Large dams within 1 km of development site. 1 known record within 10 km of development site.	Included	Suitable habitat within development site
Flora							
A spear-grass ***Austrostipa wakoolica***	Alluvial plains and plains.	Moderate	Endangered	Endangered	Suitable habitat within woodland areas	Included	Within Geographic Range
Ausfeld's Wattle ***Acacia ausfeldii***	Associated species include *Eucalyptus albens*, *E. blakelyi* and *Callitris* spp., with an understorey dominated by *Cassinia* spp. and grasses. Known in subregion.	High	Vulnerable	Not listed	Suitable habitat within woodland areas	Included	Within Geographic Range
Pine Donkey Orchid ***Diuris tricolor***	Will grow in disturbed areas.	Moderate	Vulnerable	Not listed	Suitable habitat within woodland areas	Included	Within Geographic Range

Credit species	Habitat and geographic restrictions1	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Mossgiel Daisy ***Brachyscome papillosa***	South and West of Coolamon-Ardlethan Road, West of Lockhart and north of Rand.	High	Vulnerable	Vulnerable	Development site not within geographic restrictions.	Excluded	Not within Geographic Range.
Sand-hill Spider Orchid ***Caladenia arenaria***	West of Lockhart and North of Rand.	High	Endangered	Endangered	Development site not within geographic restrictions.	Excluded	Not within Geographic Range
Silky Swainson-pea ***Swainsona sericea***	Box-gum woodland in southern tablelands and South West Slopes. Sometimes in association with cypress pines. Known in subregion.	High	Vulnerable	Not listed	Suitable habitat within woodland areas	Included	Within Geographic Range
Slender Darling Pea ***Swainsona murrayana***	Grows 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* spp.	Moderate	Vulnerable	Vulnerable	Suitable habitat within woodland areas	Included	Within Geographic Range
Spiny Peppercress ***Lepidium aschersonii***	On ridges of Gilgai Clays.	High	Vulnerable	Vulnerable	No Gilgai clays in development site	Excluded	No suitable habitat on site
Small Purple-pea ***Swainsona recta***	Predominantly grassy woodlands, but sometimes extends into grassy open forest, usually with tree cover including Blakely's Red Gum, Yellow Box, and White Box. Known in subregion.	Moderate	Not listed	Endangered	Suitable habitat within woodland areas	Included	Within Geographic Range

Credit species	Habitat and geographic restrictions1	Sensitivity to gain class	NSW listing status	National listing status	Habitat Components and abundance on site	Included or Excluded	Reason for Inclusion or exclusion
Small Scurf-pea ***Cullen parvum***	Grassland, River Red Gum woodland or Box-Gum woodland, sometimes on grazed land and usually on table drains or adjacent to drainage lines or watercourses, in areas with rainfall between 450 mm and 700 mm. Known in subregion.	High.	Endangered.	Not listed.	Suitable habitat within woodland areas.	Included.	Habitat components on site.
Spike-rush ***Eleocharis obicis***	Semi-permanent/ephemeral wet areas. Periodically waterlogged sites, including table drains and farm dams.	High.	Vulnerable.	Vulnerable.	Fam dams and ephemeral wet areas in development site.	Included.	Habitat components on site.

4.1.2 Inclusions based on habitat features

A Bionet search was undertaken on 7 November 2018 to determine if any further threatened species are considered likely to occur on the development site.

No records occurred within or adjacent to the development site. The following species have been recorded within 10km of the development site since the year 2000.

- Bush Stone Curlew (5 records)
- Squirrel Glider (3 records).
- Superb Parrot (3 records).
- Sloane's Froglet (1 record).
- Spotted Harrier (1 record).
- Little Lorikeet (1 record).
- Brown Treecreeper (30 records).
- Black-chinned Honeyeater (1 record).
- Grey-crowned Babbler (4 records).
- Varied Sittella (1 record).
- Dusky Woodswallow (6 records).
- Flame Robin (8 records).
- Diamond Firetail (12 records).
- Hooded Robin (1 record).

These species were all generated as candidate species in the BAM Calculator and have been surveyed or considered for as part of the BAM.

One additional threatened species, the Corben's Long eared Bat (*Nyctophilus corbeni*) was generated from the EPBC protected matters search. Corben's Long Eared Bat is an ecosystem species under the BAM and can inhabit box eucalypt woodlands. As suitable habitat is present in the development site this species was added to the BAM Calculator as an ecosystem species.

4.1.3 Exclusions based on habitat quality

Under Section 6.4.1.17 of the BAM, a species credit species can be considered unlikely to occur on a development site (or within specific vegetation zones) if following field assessment it is determined that the habitat is substantially degraded such that the species is unlikely to utilise the development site (or specific vegetation zones).

The following flora species (Table 4-3) were considered to have zones excluded on the basis of poor habitat quality. The habitats in these zones were no longer representative of the habitats in which these species could occur.

Table 4-3 Exclusions based on habitat quality.

Species Credit Species	Zones Excluded	Reason for exclusion
Spike-rush *Eleocharis obicis*	Zone 1, 2, 4, 6 and 8	Spike-rush grows in ephemeral wet areas and these zones lack wet areas that could provide suitable habitat.
A spear-grass *Austrostipa wakoolica*	Zone 1, 2, 4, 6 and 8	These zones have undergone significant understory disturbance either through regular cropping or heavy grazing. The understory is dominated by exotic species or bare ground from heavy stock trampling. Very few native understory species are present, and those that are present are disturbance tolerant such as Curly Windmill Grass (*Enteropogon acicularis*), Windmill Grass (*Chloris truncata*) and Couch (*Cynodon dactylon*). The habitat is sufficiently
Small Scurf-pea *Cullen parvum*	Zone 1, 2, 4, 6 and 8	
Pine Donkey Orchid *Diuris tricolor*	Zone 1, 2, 4, 6 and 8	

Species Credit Species	Zones Excluded	Reason for exclusion
Silky Swainson-Pea *Swainsona sericea*	Zone 1, 2, 4, 6 and 8	degraded for native understory species and these species are unlikely to occur in these zones.
Slender Darling Pea *Swainsona murrayana*	Zone 1, 2, 4, 6 and 8	
Small Purple Pea *Swainsona recta*	Zone 1, 2, 4, 6 and 8	

4.1.4 Candidate species requiring confirmation of presence or absence

The species listed in Table 4-2 Candidate species credit species requiring assessmentTable 4-2 are those considered to have habitats present at the development site. Surveys have been conducted for these species and the results are summarised in Table 4-4. Details of the survey methodologies and results are provided for each surveyed species in section 4.2.5. One threatened species, the Squirrel Glider (*Petaurus norfolcensis*) was detected within the development site. Three other threatened species were unable to be surveyed during the recommended survey time and are assumed to be present on the site.

Species polygons have been defined for the species present on the site as mapped on Figure 4-3 below.

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

Species credit species	Biodiversity risk rating	Survey period	Assumed to occur/survey/expert report	Present on site?	Species polygon area
FAUNA					
Bush Stone-curlew ***Burhinus grallarius***	2.00	Jan-Dec	Surveyed November 2018	No	Nil
Major Mitchell's Cockatoo ***Lophochroa leadbeateri***	2.00	Sep-Dec	Surveyed November 2018	No	Nil
Glossy Black-cockatoo ***Calyptorhynchus lathami***	2.00	Mar-Aug	Surveyed June 2019	No	Nil
Eastern Pygmy Possum ***Cercartetus nanus***	2.00	Oct-Mar	Surveyed November 2018	No	Nil
Square-tailed Kite ***Lophoictinia isura***	1.50	Sep-Jan	Surveyed November 2018	No	Nil
Southern Myotis ***Myotis macropus***	2.00	Oct-Mar	Surveyed November 2018	Assumed Present	1.5 ha (Impacted woodland areas within 200 m of water body)
Squirrel Glider ***Petaurus norfolcensis***	2.00	Any	Surveyed November 2018 and June 2019.	Yes	8.2 ha (Impacted woodland areas connected to Back Creek)
Barking Owl ***Ninox connivens***	2.00	May-Dec	Surveyed November 2018	No	Nil

Species credit species	Biodiversity risk rating	Survey period	Assumed to occur/survey/expert report	Present on site?	Species polygon area
Koala ***Phascolarctos cinereus***	2.00	Any	Surveyed November 2018	No	Nil
Superb Parrot ***Polytelis swainsonii***	2.00	Sep-Nov	Surveyed November 2018	No	Nil
Grey-headed Flying-fox ***Pteropus poliocephalus***	2.00	Oct - Dec	Surveyed November 2018	No	Nil
Masked Owl ***Tyto novaehollandiae***	2.00	May-Aug	Surveyed June 2019	No	Nil
Regent Honeyeater ***Anthochaera phrygia***	3.00	Sep-Dec	Surveyed November 2018	No	Nil
Gang-gang Cockatoo ***Callocephalon fimbriatum***	2.00	Oct-Jan	Surveyed November 2018	No	Nil
Sloane's Froglet ***Crinia sloanei***	1.50	Jul-Aug	Surveyed July 2019	No	Nil
Little Eagle ***Hieraaetus morphnoides***	1.50	Aug - Oct	Unable to be surveyed during recommended survey period	Assumed Present	10.8 ha (Impacted Woodland Areas)
White-bellied Sea-eagle ***Haliaeetus leucogaster***	2.00	Jul - Dec	Surveyed November 2018	No	Nil
FLORA					
Spike-rush ***Eleocharis obicis***	2.00	Any	Surveyed November 2018 in Zone 3, 5 & 7	No	Nil
A spear-grass ***Austrostipa wakoolica***	2.00	Sept-Dec	Surveyed November 2018 in Zone 3, 5 & 7.	No	Nil
Small Scurf-pea ***Cullen parvum***	2.00	Dec-Jan	Surveyed January 2019 in Zone 3, 5 & 7.	No	Nil
Pine Donkey Orchid ***Diuris tricolor***	1.50	Sept-Oct	Unable to be surveyed during recommended survey period	Assumed present	1.2 ha (Impacted areas with native ground cover)

Species credit species	Biodiversity risk rating	Survey period	Assumed to occur/survey/expert report	Present on site?	Species polygon area
Silky Swainson-Pea ***Swainsona sericea***	2.00	Sept-Feb	Surveyed November 2018 in Zone 3, 5 & 7	No	Nil
Slender Darling-Pea ***Swainsona murrayana***	1.50	Sept - Feb	Surveyed November 2018 in Zone 3, 5 & 7	No	Nil
Small Purple Pea ***Swainsona recta***	2.00	Sept - Nov	Surveyed November 2018 in Zone 3, 5 & 7	No	Nil
Ausfeld's Wattle ***Acacia ausfeldii***	2.00	Any	Surveyed November 2018	No	Nil

4.1.5 Survey methods

Weather conditions during the targeted surveys are summarised in Table 4-5 below.

Table 4-5 Weather conditions during targeted surveys

Date	Minimum (°C)	Maximum (°C)	Rainfall (mm)	Max Wind Gust (km/h Direction)
8 November 2018	6.8	19.6	0.2	35 WSW
9 November 2018	5.8	23.6	0	39 W
13 November 2018	14.2	26.9	0	24 SW
14 November 2018	16.9	27.7	12.2	30 W
15 November 2018	12.0	27.2	6.8	33 SSE
30 January 2019	23.2	31.7	0	37 SE
31 January 2019	19.3	34.1	0.4	50 NWW
11 June 2019	4.3	15.4	5.4	17 ENE
26 June 2019	-0.8	14.3	0	6 SE
3 July 2019	1.5	16.0	0	22 SE
4 July 2019	2.6	17.4	0	19 SE

Nocturnal Mammals: Eastern Pygmy Possum and Squirrel Glider.

SURVEY EFFORT

A targeted spotlight survey was completed on the evenings of 13 and 14 November 2018 for a total of approximately 8 person hours. Additional spotlighting surveys were taken on the 11 and 26 June 2019. A 100-watt spotlight was used from a slow-moving vehicle for visual searches of remnant vegetation, grassland and isolated paddock trees. Diurnal searches of Eucalyptus trees were undertaken on the 14 and 15 November for signs of scratches and scats.

<u>SURVEY RESULTS</u>

No Eastern Pygmy-possums were observed during the targeted surveys. Two Brushtail Possums were observed during the site surveys.

Two Squirrel Gliders were observed in the River Red Gum Woodland along Back Creek. The vegetation along Back Creek and any adjacent woodland within 100 m was considered to be suitable habitat for the Squirrel Glider. This area was calculated to be the threatened species polygon for the Squirrel Glider (Figure 4-3).

Figure 4-1 Squirrel Glider identified on site

Grey-headed Flying-fox (Breeding)

<u>SURVEY EFFORT</u>

Surveys for breeding camps were undertaken within the woodland areas on the 8 to 9 November and 13 to 15 November 2018. A search for known breeding camps was undertaken on the Department of Environment National Flying-fox Monitoring viewer.

<u>SURVEY RESULTS</u>

No Grey-headed flying fox breeding camps were observed within the development site. The nearest known Grey-headed Flying-fox camp is located at the Albury Botanic Gardens, approximately 35 km south of the development site (DoE, 2018).

Southern Myotis

<u>SURVEY EFFORT</u>

An ANABAT was located on a farm dam next to Back creek for a period of five nights from 8 to 12 November 2018. An assessment of suitable waterbodies was undertaken to determine if suitable habitat is present within the development site.

SURVEY RESULTS

The Southern Myotis is dependent on waterbodies greater than 3 m wide (TBDC, 2019). Back Creek and Middle Creek are ephemeral creeks which were dry at the time of survey. Their channel is less than 3 m wide and are not considered suitable habitat for the Southern Myotis. 17 farm dams wider than 3 m are present within the development site. All areas of woodland vegetation within 200 m from a dam is considered suitable habitat for the Southern Myotis (TBDC, 2019). A 200 m buffer was calculated around farm dams to determine the threatened species polygon (Figure 4-3).

Sloane's Froglet (Breeding)

SURVEY EFFORT

Targeted surveys for the Sloane's Froglet were undertaken over two mornings on the 3 and 4 July 2019. Sixteen farm dams were surveyed using call playback followed by a period of listening for ten minutes. Surveys were undertaken in line with the field Survey methods for Amphibians (DECC, 2009) with updated survey techniques listed on the Threatened Biodiversity Database Collection (Bionet, 2019).

SURVEY RESULTS

The Sloane's Froglet was not detected during the surveys. The farm dams lacked fringing vegetation and were heavily impacted by grazing stock. The poor condition of the vegetation is not considered optimal habitat for the Sloane's Froglet. One Beeping froglet (*Crinia parainsignifera*) was heard calling near Benambra Road.

Figure 4-2 Typical farm dam within development site

Little Eagle (Breeding)

<u>SURVEY EFFORT</u>

Surveys for the Little Eagle were unable to be undertaken during the specified time period (August to October) as per the BAM.

<u>SURVEY RESULTS</u>

As no targeted surveys were undertaken, this species is assumed to occur in the development site. Suitable breeding habitat for the Little Eagle occurs within nest trees within woodland vegetation. All areas of woodland vegetation were considered suitable breeding habitat for the Little Eagle. This woodland vegetation was calculated to be the threatened species polygon for this species.

Nocturnal Birds: Barking Owl and Bush-stone Curlew

<u>SURVEY EFFORT</u>

Targeted surveys were completed on the nights of 13 and 14 November 2018 for a total of 8 person hours. A 100 watt spotlight was used from a slow-moving vehicle for visual searches along remnant vegetation, grassland and isolated paddock trees. Call playback of the calls of each species was played from a megaphone at three locations (Figure 4-3), followed by a period of listening for responses.

<u>SURVEY RESULTS</u>

No threatened birds were seen or heard during the survey. Six Tawny Frogmouths (*Podargus strigoides*) were observed during the spotlighting surveys.

Masked Owl (Breeding)

SURVEY EFFORT

Targeted surveys for the Masked Owl were undertaken on the nights of 11 and 26 June 2019 for a period of approximately 8 person hours. Consecutive nights were unable to occur due to heavy rainfall on the 12 of June. A 100-watt spotlight was used from a slow-moving vehicle for visual searches along remnant vegetation and isolated paddock trees. Call playback of the calls of each species was played from a megaphone at three locations (Figure 4-3) followed by a period of listening for responses.

SURVEY RESULTS

The Masked Owl was not detected during the night surveys.

Koala

SURVEY EFFORT

Opportunistic surveys were undertaken on the 8 to 9 November 2018. A targeted search for signs of the Koala was completed on the 13 to 15 November 2018. Mature feed trees were searched for signs of Koalas (scats and scratches) taking a total of 2 person hours.

SURVEY RESULTS

No koalas or signs of koalas were seen over the five days of surveys. Scats underneath a River Red Gum were sent to a specialist consultant for identification; however, they were identified as a Brushtail Possum (*Trichosurus vulpecula*). (Pers. comm., G. Story, 2019). Five other scats found underneath River Red Gum trees were identified to be Brushtail Possum scats.

Woodland Birds: Regent Honeyeater, Gang-Gang Cockatoo, Major Mitchell Cockatoo, Superb Parrot and Swift Parrot

SURVEY EFFORT

A woodland bird census was completed at dusk on 13 and 14 November 2018 comprising three 20 minute surveys at multiple tree hollow locations within the development site, for a total of two hours over two days. Opportunistic surveys carried out over multiple site visits include traversing the site by car and on foot. Paddock trees and remnant trees were surveyed for evidence of nests.

SURVEY RESULTS

No threatened woodland birds were observed during the surveys. No evidence of nesting material was observed in remnant trees. A full list of bird species detected is shown in Appendix B.1.3

Raptors: White Bellied Sea Eagle and Square-tailed Kite

SURVEY EFFORT

Patches of remnant woodland vegetation and paddock trees were surveyed for the presence of stick nests over five days, for a total of eight person hours in November 2018. Cleared areas were also observed during daylight hours, opportunistically for hunting presence. Weather conditions recorded at the nearest weather station included minimum temperature 14.2°C, maximum temperature 27.7°C, and 12.2 mm of rainfall received on 14 November and 6.8 mm on 15 November.

SURVEY RESULTS

No threatened raptors were observed during the field surveys. No evidence of large stick nests was observed in remnant trees.

Glossy Black Cockatoo (Breeding)

SURVEY EFFORT

Targeted surveys for breeding Glossy Black Cockatoo were undertaken on the 11, 12 and 26 June 2019. Suitable hollow bearing trees were observed for signs of nesting. Woodland bird census was completed on 11 and 12 June 2019 comprising three 20 minute surveys at multiple tree hollow locations within the development site (Figure 4-1).

SURVEY RESULTS

The Glossy Black Cockatoo was not observed during the targeted surveys.

Threatened Forbs and Grasses: Silky Swainson-pea (*Swainsona sericea*), Slender Darling Pea (*Swainsona* murrayana), Small Purple-pea (*Swainsona recta*), A spear-grass (*Austrostipa wakoolica*) and Spike Rush (*Eleocharis obicis*)

SURVEY EFFORT

Targeted flora transects were undertaken of the woodland and grassland areas at 10 m intervals in accordance with the NSW Guide to Surveying Threatened Plants (OEH, 2016) from 8 to 15 November 2018 for *Swainsona sericea, Swainsona murrayana, Swainsona recta, Austrostipa wakoolica* and *Eleocharis obicis*. Survey effort for these species total 16 person hours.

SURVEY RESULTS

No threatened forbs or grasses were detected within the survey area. No other pea species were detected. Two other Austrostipa species - *Austrostipa scabra* and *Austrostipa blackii* were present in the development site in the grassland areas and River Red Gum Woodland areas.

Small Scurf Pea – *Cullen parvum*

SURVEY EFFORT

Surveys for the Small Scurf Pea were undertaken 30 -31 January 2019. Surveys were undertaken using the parallel field traverse survey technique in accordance with the NSW guide to Surveying Threatened Plants (OEH, 2016). Areas of woodland vegetation were surveyed for a total of approximately 20 person hours.

SURVEY RESULTS

The Small Scurf pea was not detected during the field surveys. Two other pea species were detected in the roadside vegetation. These were identified from their seed pods as *Desmodium varians* and *Glycine tabacina.*

Pine Donkey Orchid – *Diuris tricolor*

SURVEY EFFORT

Surveys for the Pine Donkey Orchid were unable to be undertaken during the specified time period (September) as per the BAM.

SURVEY RESULTS

As no targeted surveys were undertaken, this species is assumed to occur in the development site. Pine Donkey Orchid is associated with PCT 76 (Western Grey Box Grassy Woodland) (TBDC, 2019). Zones 3, 5 and 7 were considered suitable habitat for the Pine Donkey Orchid as they supported native vegetation in the understory. These zones were calculated to be the threatened species polygon for this species.

Threatened shrubs: Ausfeld's Wattle

SURVEY EFFORT

Suitable habitat for this species could occur in areas of remnant woodland vegetation. Surveys were undertaken for this species on 9, 12 and 13 November 2018. Very few mid-storey species were present, and any shrubs would have been easily detected.

SURVEY RESULTS

Ausfeld's Wattle was not detected during the site surveys. Very few understory shrubs occurred within the remnant woodlands in the development site. It is considered unlikely that the species would have been overlooked if present and they are not considered to occur within the development site.

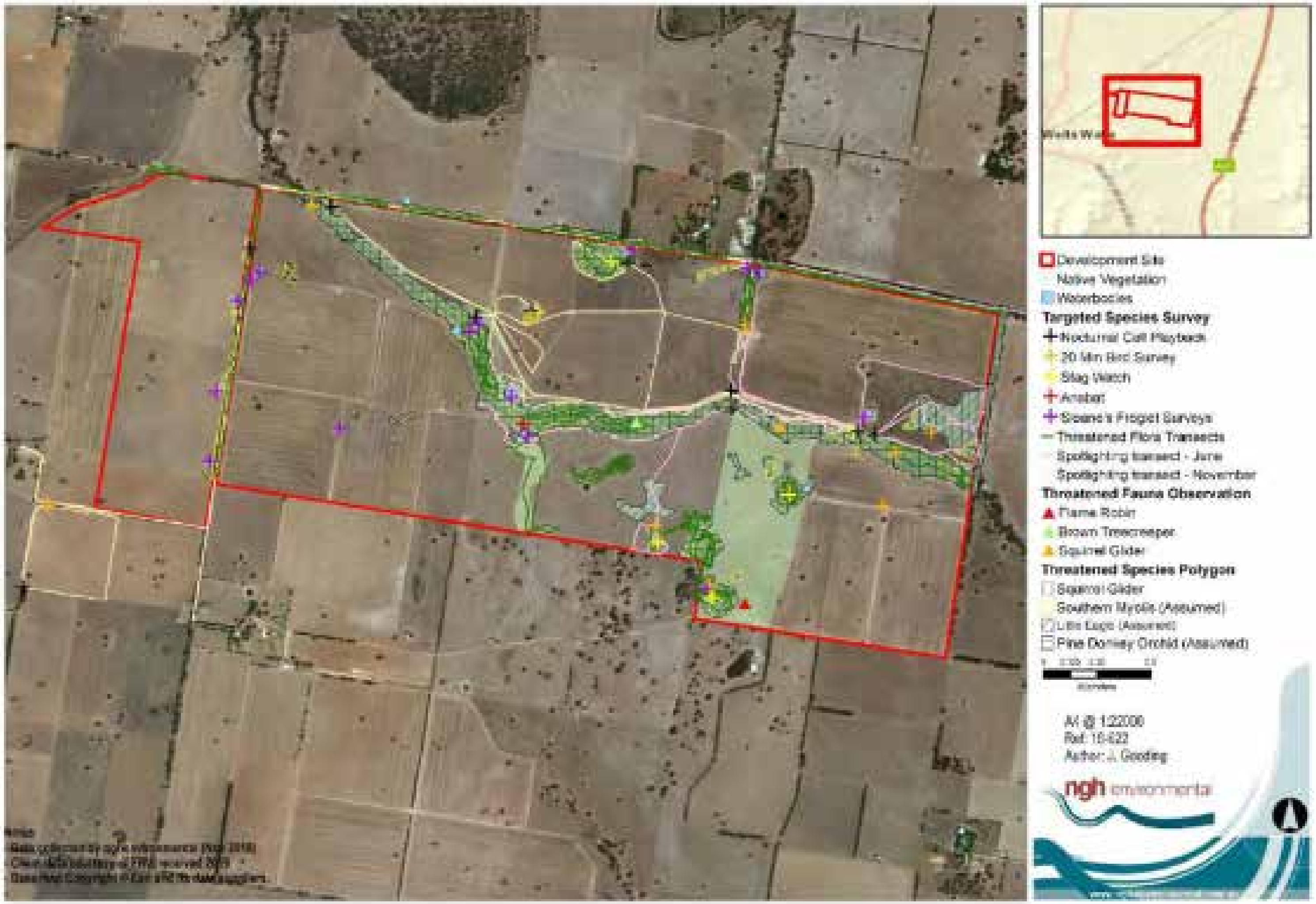

Figure 4-3 Threatened species polygons and targeted survey locations

Figure 4-4 Threatened species polygons and targeted survey locations (East)

Figure 4-5 Threatened species polygons and targeted survey locations (West)

4.2 ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS

4.2.1 Occurrences of karst, caves, crevices and cliffs

As verified by the field inspection, there are no occurrences of karst, caves, crevices, or cliffs in the development site.

4.2.2 Occurrences of rock

As verified by the field inspection, there are no occurrences of surface rock in the development site.

4.2.3 Occurrences of human made structures and non-native vegetation

As verified by the field inspection, there are no human made structures within the development site that could be utilised by threatened species. Exotic vegetation within the development site is currently used for cropping and pasture. The extent of productive agriculture land in the region is considerable and native animals benefiting cleared exotic vegetation environments have ample access to suitable habitat in the surrounding areas.

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

The Back Creek catchment extends into a hill range, 6 km east of the Olympic Highway. The upper catchment area drains westwards crossing the Olympic Highway and through the development site. The majority of Back Creek catchment has been predominantly cleared for agriculture, with the exception of the steeper hillside areas located in the upper catchment. The western boundary of the Back Creek/ Middle Creek catchment abuts the Petries Creek catchment, which drains into the Walla Walla township and ultimately Gum Swamp on the north side of Walla Walla.

The Back Creek corridor including the adjoining woodland on either side of the creek is not located within the development footprint and will not therefore be affected. Minimal infrastructure including solar arrays may intersect Middle Creek, but this is not expected to impede natural surface water flows.

5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

An EPBC protected matters report was undertaken on the 7 November 2018 (10 km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site (refer to 0). Relevant to Biodiversity these include:

- Wetlands of International Importance – 7.
- Threatened Ecological Communities – 3.
- Threatened species – 24
- Migratory species – 11.

Two additional species (Sloane's Froglet and White Throated Needletail) became newly listed as threatened species under the EPBC Act on the 4 July 2019.

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

5.1 WETLANDS OF INTERNATIONAL IMPORTANCE

Seven wetlands of international importance were returned from the protected matters report. The nearest of these (within 180 km of the development site) is Barmah Forest. NSW Central Murray State Forest occurs around 200 km south-east of the development site. All other wetlands returned from the search are over 300 km away.

5.2 THREATENED ECOLOGICAL COMMUNITIES

Three threatened ecological communities were returned from the protected matters report.

Characteristic tree species for two of these communities are present in the development site. These are;

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia.
- White Box-Yellow Box-Blakley's Red Gum Grassy Woodland and Derived Native Grassland.

An assessment was undertaken to determine whether the vegetation met the condition threshold for these two federally listed ecological communities.

Grey Box Grassy Woodlands and Derived Native Grasslands of South Eastern Australia

Remnant Grey Box (*E. microcarpa*) and Grey Box derived native grasslands are present in the development site. An assessment of the vegetation was made against the condition threshold for Grey Box Woodland listed in the EPBC Act (Table 5-1).

The remnant woodland patches are not considered to form part of the federally listed community due to being sufficiently degraded with too few trees. The derived grassland woodland patches are similarly not considered to form part of the federally listed community due to being sufficiently degraded with too few native species.

Table 5-1 Condition threshold assessment for federally listed Grey Box Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia

EPBC Requirement	Woodland remnant	Derived Grassland
Is (or was previously) the most common tree species Grey Box	Yes, Grey Box dominant in 6 isolated patches.	Yes, Grey Box as scattered paddock trees.
Is the patch at least 0.5 ha in size	Yes – remnant patches range from 2.3 ha to 7.1 ha.	Yes, the extent of derived grassland is approximately 30 ha.
Do non-grass weeds make up more than 30% of the plant cover in the ground layer	No. Non grass weeds less than 5% cover.	No - Non grass weeds less than 5% cover.
Do trees cover at least 10% of the patch	Yes, approx. 15% overstory cover.	No. Derived Grassland with scattered paddock trees.
Is the patch bigger than 2 ha	Yes, two patches are greater than 5 ha.	n/a.
Are there at least 8 trees/ha that contain hollows or have a DBH > 60 cm	No, approx. 6 mature trees/ha.	n/a.
Are there at least 20 live trees/ha with a DBH>12cm.	No, approx. 6 mature trees per hectare. **Not the listed community: degraded with too few trees.**	n/a.
Is there evidence that Grey Box trees were once common in the patch	n/a.	Yes, scattered remnant Grey Box paddock Trees.
Are there at least 12 perennial native species in the mid and ground layer	n/a.	No, 4 perennial native species in the mid and ground layer. **Not the listed community: degraded with too few native species.**

White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands.

A small patch of Yellow Box and Blakely's Red Gum is present on the Western edge of the development site. An assessment was undertaken to determine if this community met the condition threshold for the federally listed community (Table 5-2).

The remnant woodland patch is not considered to meet the condition threshold for the federally listed community due to the predominantly exotic understory.

Table 5-2 Condition threshold assessment for the federally listed White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and derived native grasslands

EPBC Requirement	Woodland remnant
Is, or was previously, at least one of the most common overstory species White Box, Yellow Bo or Blakely's Red Gum.	Yes, Yellow Box and Blakley's Red Gum common in the overstory.

Does the patch have a predominantly native understory	No – no native understory species present. The understory is dominated by exotic crop species. **Not the listed ecological community**

No federally listed ecological communities are considered to occur within the development site.

5.3 THREATENED SPECIES

Twenty-four threatened species were returned from the protected matters report, comprising six flora species, and eighteen fauna species.

Site surveys did not detect any threatened flora species. Based on the highly disturbed understory from intensive grazing and cropping, no federally listed flora species are considered to occur on the development site.

Based on the fauna habitats in the development site, eight federally listed fauna species are considered to have the potential to utilise the habitats at the development site. These are:

Birds

- Regent Honeyeater (*Anthochaera phrygia*) – CE.
- Swift Parrot (*Lathamus discolor*) – CE.
- Superb Parrot (*Polytelis swainsonii*) – V.
- Painted Honeyeater (*Grantiella picta*) – V.
- White Throated Needletail (*Hirundapus caudacutus*) – V.

Mammals

- Koala (*Phascolarctos cinereus*) – V.
- Corben's Long Eared Bat (*Nyctophilus corbeni*) – V.

Amphibians

- Sloane's Froglet (*Crinia sloanei*) – E.

Surveys were undertaken for the five bird species and koala during the field visits and were not detected on site. However, these species are highly mobile and may forage in the site on occasion. Potential impacts to these species are addressed in section 7.5

Anabats were used on site at two locations for across four nights from November 2018 to detect microbat species present. Analysis of the Anabat data was undertaken and a *Nyctophilus sp*. was identified. However, the species present is not distinguishable and therefore, *Nyctophilus corbeni* is assumed to be present on site.

Targeted surveys for Sloane's Froglet were undertaken by NGH ecologists in July 2019 (see section 4.1.5). 16 farm dams were surveyed using call playback followed by a period of listening for calls. Sloane's froglet was not detected during the surveys. Farm dams lacked any fringing vegetation and were not considered optimal habitat for the Sloane's froglet. It is not considered to occur in the development site.

5.4 MIGRATORY SPECIES

Eleven migratory species were returned form the protected matters report. Of these, three species are considered to have the potential to occur in the development site. These are the:

- Fork-tailed Swift.
- White Throated Needletail.

Potential impacts to these species are addressed in section 7.5

6 AVOID AND MINIMISE IMPACTS

6.1 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT

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

During the development of the proposal, a number of alternatives were considered. These include the 'do nothing option' (not developing the solar farm), alternative proposal area locations, and developing different renewable technologies.

During the site selection process for the proposal, the proponent reviewed the solar generation potential of many areas in NSW using a combination of grid capacity, high level constraints analysis and experience of the proponent. The proposed site was selected because it provides the optimal combination of:

- Low environmental constraints (predominantly cleared cropping and grazing land).
- Level terrain for cost effective construction.
- Suitable quality solar resource.
- Compatible land use zoning (on the development site and considering adjacent land holdings).
- Manageable flood risk.
- Existing road access.
- Onsite connection to the transmission network.
- High levels of available capacity on the grid transmission system.
- Land availability and support from the landowners.

The development site is of a scale that allows for flexibility in the design, allowing site constraints identified during the EIS process to be avoided or effectively mitigated. The remnant vegetation along Back Creek within the development site provides a wildlife corridor to Billabong Creek. Back Creek also connects with remnant vegetation along the eastern boundary of the subject land that extends along Benambra Road. The development footprint of the proposal was selected to avoid impacts to the remnant woodland along Back Creek. This would allow for existing connectivity across the landscape to be maintained.

The proposed layout achieves the objective of efficient electricity production while minimising environmental impacts overall.

Available grid capacity at a suitable voltage on the existing Jindera to Walla Walla transmission line was also instrumental in making Walla Walla an ideal choice for a renewable energy development.

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

The Australian Government's Large-scale Renewable Energy Target (LRET) and NSW Government's Renewable Energy Action Plan (REAP) outline the commitment by both Australia and NSW more specifically to reducing greenhouse gas (GHG) emissions and have set targets for increasing the supply of renewable energy. Other forms of largescale renewable energy accounted for in the LRET include wind, hydro, biomass, and tidal energy. The feasibility of wind, solar, biomass, hydro and tidal projects depend on the availability of energy resources and grid capacity.

PV solar technology was chosen because it is cost-effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology readily available for broadscale deployment at the site. Unlike wind farms, which are installed on elevated topography, solar energy farms can be effectively screened by vegetation to reduce the impact of visual disturbance, which would also provide additional habitat for local fauna. Solar energy farms also have few moving parts and are less likely to interfere with bird flight patterns.

Suitable solar resources have been identified in NSW, providing excellent opportunities for solar projects.

6.1.3 Proposal planning phase – detailed design

A preliminary constraints analysis was conducted by NGH Environmental, which informed the proposed site layout design. Impacts to vegetation constituting the highest ecological constraints was minimised as far as practical by;

- reducing the clearing footprint of the project to avoid impacts to larger patches of remnant woodland where possible.
- Avoiding impacts to vegetation with the highest vegetation integrity score.
- locating ancillary facilities in areas where there are no biodiversity values.
- Avoiding impacts to Back Creek to allow for connectivity to be maintained across the landscape.
- maintaining the landscape to allow surface water to follow existing drainage routes.
- Avoiding impacts to ten farm dams and restoring and rehabilitating these as habitat for wildlife.
- Developing a biodiversity enhancement plan in consultation with local Landcare to make provision for the ecological restoration, rehabilitation and ongoing maintenance of retained native vegetation habitat on the development site.
- Establish plantings of native species to enhance connectivity between the riparian zone and roadside vegetation.

The final site layout and location has not been able to completely avoid all areas of biodiversity value because the length and size of the solar panel infrastructure means it is difficult to avoid small patches of vegetation and isolated paddock trees.

The substation and ancillary infrastructure would be located on a 4 ha compound located on the north eastern corner of the development site, on previously cropped exotic vegetation with no impact on native vegetation.

No grading or permanent road infrastructure will be installed and sensitive areas of PCT 5, PCT 76 and PCT 278 and Back Creek would be avoided. Additional damage would be avoided by accessing the site via Benambra Road, which does not require any impact on native vegetation for widening.

The preferred option for the connection of the transmission line was directly into the existing 330 kV transmission line, running along the western boundary of the development site on previously cropped exotic vegetation. This option would completely avoid the need to remove native vegetation.

The proposed design footprint is detailed in Figure 6-1.

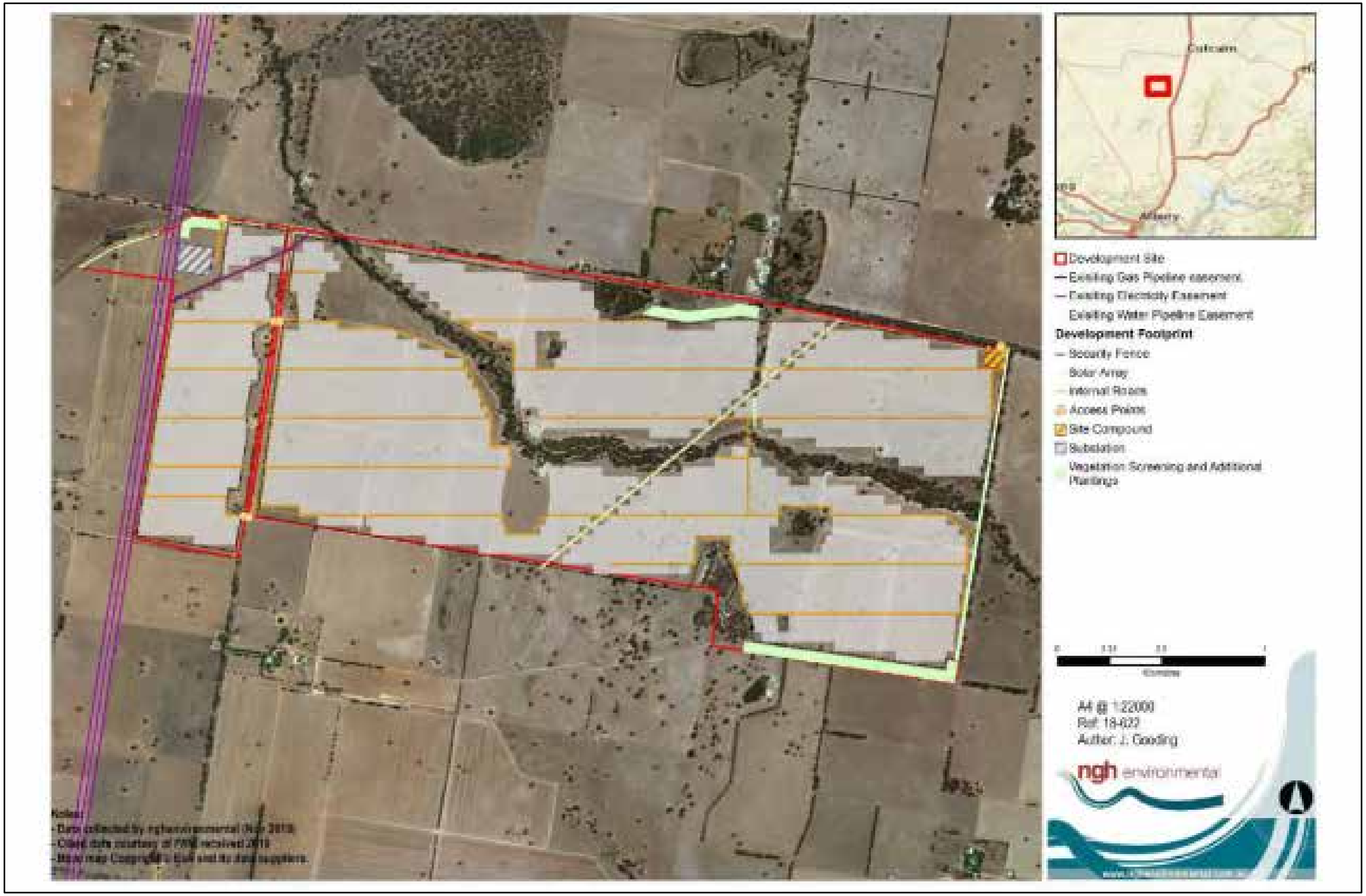

Figure 6-1 Final project footprint

6.2 AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS

The BC Regulation (clause 6.1) identifies actions prescribed as impacts to be assessed under the biodiversity offsets scheme:

a) *Impacts of development on the habitat of threatened species or ecological communities associated with:*
   i. *karst, caves, crevices, cliffs and other geological features of significance, or*
   ii. *rocks, or*
   iii. *human made structures, or*
   iv. *non-native vegetation.*
b) *Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.*
c) *Impacts of development on movement of threatened species that maintains their life cycle.*
d) *Impacts of development on water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining).*
e) *Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.*

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

6.2.1 Impacts of development on the habitat of threatened species or ecological communities associated with human made structures or non-native vegetation.

There are no karsts, caves, crevices, cliffs or rocky outcrops within the development site.

With the exception of 17 farm dams, there are no human-made structures that provide fauna habitat within the development site. Farm dams can provide habitat for threatened Sloane's Froglet (*Crinia sloanei*) however they were not detected during field surveys. Two of these dams would be filled in as they fall within the development footprint. Fifteen dams would be retained within the development site, with ten of these dams within woodland areas proposed to be rehabilitated with native riparian vegetation and transformed into small wetlands maintaining habitat for threatened species that may occur in the development site on occasion.

Non-native vegetation in the form of exotic grasses and crops is dominant in the development site. The Flame Robin (*Petroica phoenicea*) was detected in the development site in the South-East corner foraging in grassland areas adjacent to a River Red Gum woodland and fallen timber. Flame Robins often forage in open pastures and use fence posts or timber to pounce on invertebrate prey (OEH, 2017). As the priority within the development site was to reduce impacts to native vegetation and woodland areas, all open pastures and cleared land in the development site were utilised to form part of the development footprint and have not been avoided by the proposal. However, abundant open pastures are common in the adjacent paddocks outside the development site and surrounding environment and provide similar habitat for the Flame Robin.

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

For threatened species that may move across the landscape, retaining the vegetation along Back Creek will maintain connectivity across the landscape to facilitate movement in an East West Direction for mobile aerial species. A biodiversity enhancement plan (will be implemented to improve the biodiversity values of the retained habitat such as strategic tree plantings and direct seeding to enhance connectivity and food sources, installation of 120 nest boxes, relocation of fallen timber and rehabilitation of farm dams for fauna habitat. Larger woodland patches would also be retained providing 'steppingstone' refuges for mobile species in an existing highly cleared environment.

6.2.3 Impacts of development on movement of threatened species that maintains their life cycle.

The development site is not a known migratory path for threatened species. For threatened species that may move across the landscape, retaining the vegetation along Back Creek will maintain connectivity across the landscape to facilitate movement in an East West Direction for mobile aerial species. Larger woodland patches would also be retained providing 'steppingstone' refuges for mobile species in an existing highly cleared environment. A biodiversity enhancement plan will be implemented to improve the biodiversity values of the retained habitat such as strategic tree plantings to enhance connectivity and food sources, installation of nest boxes, relocation of fallen timber and rehabilitation of farm dams for fauna habitat.

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

Back Creek and Middle Creek run through the development site. The development footprint was selected to avoid developing the vegetated sections of Back Creek. Solar infrastructure may impact groundcover associated with Middle Creek (PCT 76 derived grassland) with direct impacts largely limited to piling installation. The current site layout does not modify the topography of vegetation of ephemeral drainage lines, though this section of Middle Creek was already cleared of native vegetation.

Seventeen farm dams are present across the development site. Fifteen of these dams would be retained, with ten of these dams within woodland vegetation to be rehabilitated with native riparian vegetation. The remaining two would be filled by the proposal due to the size constraints of the solar trackers. These farm dams would be filled in during construction.

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

The proposal would not directly increase impacts of vehicle strikes on animals that are part of a TEC. No additional roads would be created and threatened species would not be funnelled into transport corridors. However, an increase in vehicle traffic may increase vehicle strikes on threatened species such as the Superb Parrot and Squirrel Glider outside of the study area. Site design would be unrelated to impacts of vehicle strikes as birds like the Superb Parrot generally fly above the canopy. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes within the development site.

7 IMPACTS UNABLE TO BE AVOIDED

7.1 DIRECT IMPACTS

The construction and operational phases of the proposal have the potential to impact biodiversity values at the site that cannot be avoided. This would occur through direct impacts such as habitat clearance and installation and existence of infrastructure.

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

Nature of impact	Extent	Frequency	Duration and timing	Consequence
Direct impacts				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, transmission lines, compound sites, stockpile sites, access tracks)	38.6 ha	Once	Construction Phase: Short Term	• Direct loss of native flora and fauna habitat • Potential over-clearing of habitat outside proposed development footprint • Injury and mortality of fauna during clearing of fauna habitat and habitat trees • Disturbance to stags, fallen timber, and bush rock
Removal of paddock trees	53 Trees	Once	Construction Phase: Short Term	• Injury and mortality of fauna during clearing of fauna habitat and habitat trees • Direct Loss of native flora and fauna habitat
Displacement of resident fauna	Unknown	Regular	Construction & Operation Phase: Long Term	• Direct loss of native fauna • Decline in local fauna populations
Injury or death of fauna	Unknown	Regular	Construction Phase: Short Term	• Direct loss of native fauna • Decline in local fauna populations
Removal of habitat features e.g. HBTs	72 HBTs 2 Farm Dams	Regular	Construction Phase: Long Term	• Direct loss of native fauna habitat • Injury and mortality of fauna during clearing of habitat features
Existence of permanent solar infrastructure (Fencing, array infrastructure).	Total 90 ha (14.93% over 605 ha development site)	Regular	Operational Phase: long-term	• Modification of habitat beneath array • Reduced fauna movements across landscape due to fencing • Collision risks to birds and microbats (fencing).

7.1.1 Loss of native vegetation

38.6 ha of native vegetation would be removed by the development. Complete clearing is assumed of the woodland vegetation zones (Zone 1- 3 and Zones 5 -10). All overstory trees would be removed and any native groundcover composition is not expected to recover. The final vegetation integrity scores for these zones would be zero.

Zone 4 is a derived grassland that has been heavily disturbed through agricultural activities. The native species present are disturbance tolerant grasses and forbs such as;

- Windmill Grass – *Chloris truncata.*
- Curly Windmill Grass – *Enteropogon acicularis.*
- Couch – *Cynodon dactylon.*
- Wallaby Grass – *Rytidosperma auriculatum.*
- Caustic Weed – *Erodium drummondii.*
- Sida – *Sida Corrugata.*

These species have recolonised after past agricultural practices of tilling and are expected to recolonise again after the construction of the solar panels. They are also shade tolerant and would survive under partial shade covering of the solar panels. Only partial clearing has been calculated for this zone. For species composition, it is expected the three grass species (Windmill Grass, Curly Windmill Grass and Couch) and one Forb (Caustic Weed) currently in the grassland would persist under the solar panels after construction. Permanent land impacts arising from installation of tracker posts, inverter blocks and access roads has been calculated to cover an area of 8.9% over the grassland (Appendix J). As a precautionary approach, this figure has been rounded up to a 10% impact area and used as the reduction in vegetation structure and function. Litter cover was comprised mainly from Barley Grass and Rye Grass lodgings and these are expected to remain in the groundcover. The calculations for the changes in vegetation integrity score for this zone are shown in Table 7-2.

Table 7-2 Zone 4 change in vegetation Integrity Score

Composition	**Tree (#)**	**Shrub (#)**	**Grass (#)**	**Forb (#)**	**Fern (#)**	**Other (#)**	**Final Score**
Current composition	0	0	3.3	1	0	0	**11.8**
Future composition	0	0	3	1	0	0	**10.2**
Structure	Tree (%)	Shrub (%)	Grass (%))	Forb (%))	Fern (%)	Other (%)	Final Score
Current structure	0	0	18.1	0.1	0	0	**34.1**
Future structure	0	0	16	0.1	0	0	**30.1**
Function	**Regen**	**Large Trees (#)**	**Litter cover (%)**	**Coarse Woody Debris (m)**	**Stem size classes (#)**	**High threat Weed Cover (%)**	**Final Score**
Current function	Absent	0	36.8	0	0	0.1	**10.6**
Future function	Absent	0	33	0	0	0	**9.1**

A summary of the changes in vegetation integrity scores as a result of vegetation clearing are documented for each vegetation zone in Table 7-3 below.

Table 7-3 Current and future vegetation integrity scores for each vegetation zone within the development site.

Zone ID	PCT	TEC and/or threatened species habitat?	Impact Area (ha)	Current vegetation integrity score	Future vegetation integrity score
1	PCT 277 _Grazed	Box-Gum Woodland EEC	0.2	**12.1**	**0**
2	PCT 76_Grazed	Inland Grey Box Woodland EEC	10.0	**20.2**	**0**
3	PCT 76_Wetland	Inland Grey Box Woodland EEC	3.2	**14.1**	**0**
4	PCT 76_Derived Grassland	Inland Grey Box Woodland EEC	23.9	**16.2**	**14.1**
5	PCT 76_Roadside	Inland Grey Box Woodland EEC	0.04	**40.5**	**0**
6	PCT 5_Grazed	-	0.1	**11.4**	**0**
7	PCT 5_Wetland	-	0.2	**41.9**	**0**
8	PCT 5_Low	-	0.6	**5.6**	**0**
9	PCT 5_Creekline	-	0.4	**40.7**	**0**
		TOTAL:	**38.6 ha**		

7.1.2 Loss of paddock trees

63 living paddock trees were recorded within the development sites. 53 paddock trees are unable to be avoided by the development due to the size restrictions of the solar panels (Table 7-4). These trees would be removed by the proposal.

Table 7-4 Summary of Loss of Paddock Trees

PCT	Paddock Trees in development site (#)	Paddock Trees Impacted (#)
PCT 76 – Western Grey Box Tall Grassy Woodland	45	40
PCT 277 – Blakely's Red Gum – Yellow Box grassy tall Woodland	13	11
PCT 5 – River Red Gum herbaceous very tall open forest wetland on inner floodplains.	5	2
TOTAL:	**63**	**53**

7.1.3 Loss of species credit species habitat

Two Squirrel Gliders were detected in the River Red Gum Woodland along Back Creek. This creek line would provide core habitat for the Squirrel Glider and it has been avoided by the proposal. Grey Box woodland areas within 100 m of the creek line are considered to provide some secondary habitat and have been considered as loss of species credit habitat in the offset calculations. Three other species were unable to be surveyed for and are assumed to occur in suitable habitat in the development site. The loss of species credit species habitat or individuals as a result of clearing is documented in Table 7-5 below.

Table 7-5 Summary of species credit species loss at the development site.

Species Credit Species	Biodiversity risk weighting	Area of habitat lost
Squirrel Glider ***Petaurus norfolcensis***	2.00	8.2 ha (observed
Southern Myotis ***Myotis Macropus***	2.00	10.8 ha (assumed)
Little Eagle ***Hieraaetus morphnoides***	1.50	10.8 ha (assumed)
Pine Donkey Orchid ***Diuris tricolor***	1.50	1.2 ha (assumed)

7.1.4 Loss of hollow bearing trees

Hollow-bearing Trees provide nesting and breeding habitat for arboreal mammals, birds and microbats. It is estimated 76 hollow-bearing trees would be removed by the proposal (Table 7 -6).

Table 7-6 Hollow-bearing trees impacted by the proposal.

Zone ID	PCT	Impact Area (ha)	Average HBTs / plot (0.1ha)	Estimated HBTs removed/zone
1	PCT 277 _Grazed	0.2	**6**	**6**
2	PCT 76_Grazed	10.8	**1**	**10**
3	PCT 76_Wetland	3.3	**1**	**4**
4	PCT 76_Derived Grassland	23.9	**0**	**0**
5	PCT 76_Roadside	1.0	**2**	**6**
6	PCT 5_Grazed	0.6	**2**	**2**
7	PCT 5_Wetland	0.7	**2**	**2**
8	PCT 5_Low	0.6	**0**	**0**
9	PCT 5_Creekline	0.4	**0**	**0**
	Paddock Trees	53 trees	**n/a**	**42**
			TOTAL:	**72**

7.2 INDIRECT IMPACTS

Indirect impacts can occur when the proposal or activities relating to the construction or operation of the proposal affect native vegetation, threatened ecological communities or threatened species habitat beyond the development site. Table 7-1 below details the indirect impacts required to be assessed by the BAM.

Table 7-7 Potential impacts on biodiversity during the construction and operational phases.

Nature of impact	Impact	Duration and timing	Vegetation communities, threatened species and habitats likely to be affected	Consequence for bioregional persistence
Indirect impacts (those listed below are included in the BAM)				
Inadvertent impacts on adjacent habitat or vegetation.	Possible – Clearing may inadvertently extend into retained vegetation patches.	Construction Phase: Short-term.	• PCT 76 – Western Grey Box tall grassy woodland. • PCT 5 - River Red Gum herbaceous-grassy very tall open forest. • PCT 277 – Blakely's Red Gum-Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion. • Squirrel Glider.	• Direct loss of native flora and fauna habitat. • Injury and mortality of fauna during clearing of fauna habitat and habitat trees. • Disturbance to stags, fallen timber. • Increased edge effects.
Reduced viability of adjacent habitat due to edge effects.	Unlikely – retained vegetation is currently isolated and surrounded by exotic vegetation.	n/a.	n/a.	n/a
Reduced viability of adjacent habitat due to noise, dust, heat or light spill.	Possible – construction works may impact on habitat quality in retained vegetation.	Operational Phase: Short-term.	• Squirrel Glider. • Southern Myotis. • Little Eagle. • Flame Robin. • Brown Tree Creeper.	• May alter fauna activities and/or movements. • Loss of foraging or breeding habitat. • Inhibit the function of plant species, soils and dams.
Transport of weeds and pathogens from the site to adjacent vegetation.	Possible – may be brought in soils or unclean machinery.	Construction & Operational Phase: Long-term.	• PCT 76 – Western Grey Box tall grassy woodland. • PCT 5 - River Red Gum herbaceous-grassy very tall open forest. • PCT 277 – Blakely's Red Gum-Yellow Box grassy tall woodland of	• Degradation of community biodiversity and integrity. • Weed encroachment (remnant veg). • Movement of weeds by water to downstream habitats.

Nature of impact	Impact	Duration and timing	Vegetation communities, threatened species and habitats likely to be affected	Consequence for bioregional persistence
			the NSW South Western Slopes Bioregion. • Pine Donkey Orchid.	
Increased risk of starvation, exposure and loss of shade or shelter.	Unlikely – Food sources still abundant.	n/a.	n/a.	n/a.
Loss of breeding habitats.	Possible.	Construction Phase: Long-Term.	• Squirrel Glider. • Southern Myotis. • Little Eagle. • Flame Robin. • Brown Treecreeper.	• Loss of potential breeding habitat.
Trampling of threatened flora species.	Unlikely – no known threatened flora species in adjacent vegetation.	n/a.	n/a.	n/a.
Inhibition of nitrogen fixation and increased soil salinity.	Unlikely – Ground water table unlikely to change. Majority of site is currently under cropping rotation.	n/a.	n/a.	n/a.
Fertiliser drift.	Unlikely – Fertilisers unlikely to be applied.	n/a.	n/a.	n/a.
Rubbish dumping.	Unlikely – Development site will be fenced.	n/a.	n/a.	n/a.
Wood collection.	Unlikely – Development site will be fenced.	n/a.	n/a.	n/a.

Nature of impact	Impact	Duration and timing	Vegetation communities, threatened species and habitats likely to be affected	Consequence for bioregional persistence
Bush rock removal and disturbance.	Unlikely – No bush Rock in development site.	n/a.	n/a.	n/a.
Increase in predatory species populations.	Possible – additional shelter habitat for predatory invasive species.	Construction & Operational Phase: long-term.	• Squirrel Glider. • Little Eagle. • Flame Robin. • Brown Treecreeper.	• Injury and mortality of fauna from predatory species.
Increase in pest animal populations.	Possible - additional shelter habitat for invasive species.	Construction & Operational Phase: long-term.	• Squirrel Glider. • Little Eagle. • Flame Robin. • Brown Treecreeper.	• Injury and mortality of fauna from predatory species. • Disturbance to native flora and fauna. • Loss of foraging or breeding habitat.
Increased risk of fire.	Unlikely – No battery storage in proposal.	n/a.	n/a.	n/a.
Disturbance to specialist breeding and foraging habitat.	Unlikely – No specialist breeding or foraging habitat.	n/a.	n/a.	n/a.
Earthworks and mobilisation of sediments.	Possible - loss of groundcover during construction may increase mobilisation of sediments.	Construction; Short term.	• PCT 5 - River Red Gum herbaceous-grassy very tall open forest • PCT 76 – Western Grey Box tall grassy woodland • PCT 277 – Blakely's Red Gum-Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion. • Pine Donkey Orchid.	• Erosion and sediment deposition pollution on downstream habitats. • Alternation of surface watercourses (isolating high biodiversity value communities).

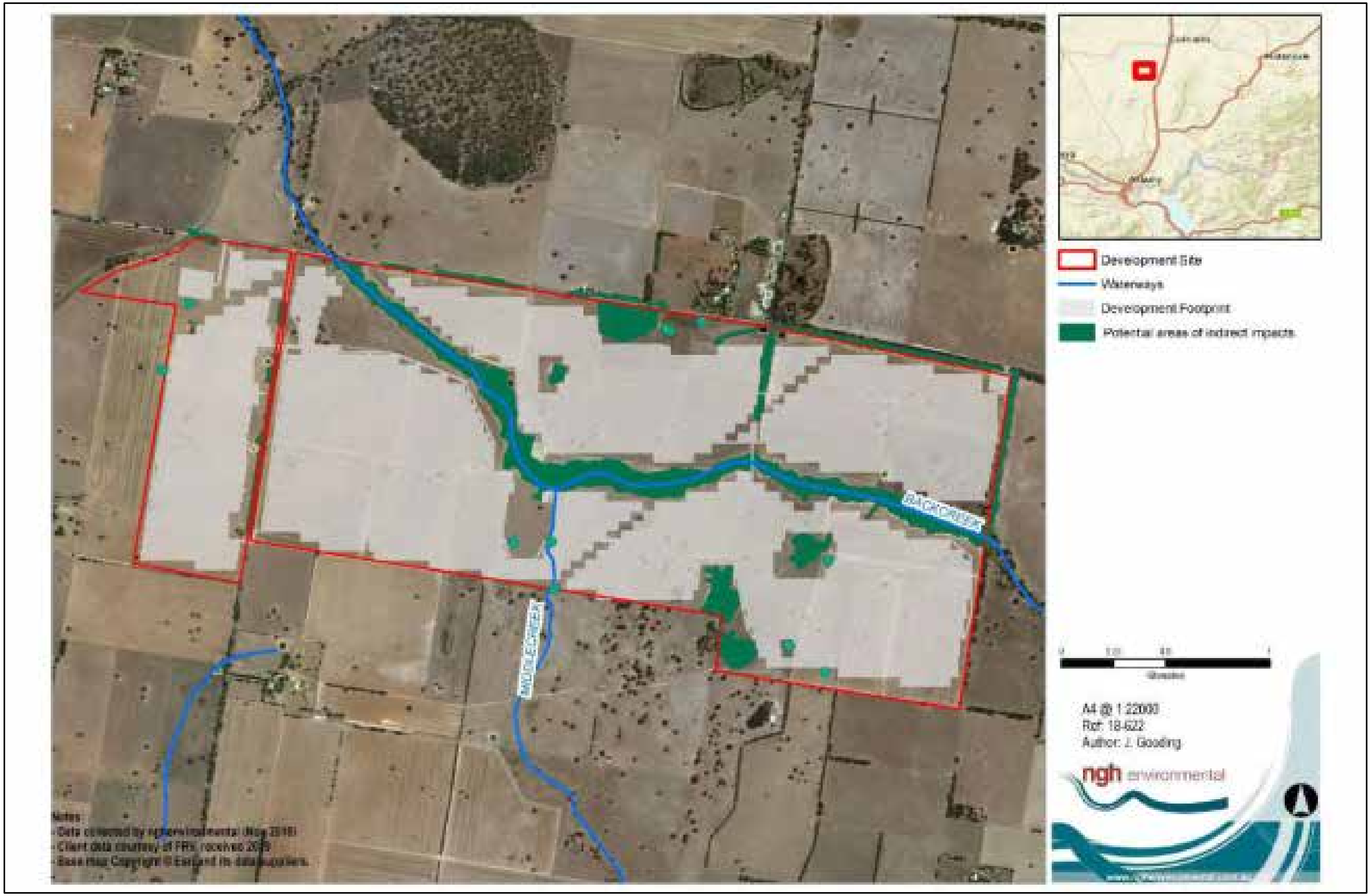

Figure 7-1 Estimated zones of indirect impact for the proposal

7.3 PRESCRIBED IMPACTS

The following prescribed biodiversity impacts are relevant to the proposal:

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

These are discussed in detail below:

7.3.1 Impacts of development on the habitat of threatened species or ecological communities associated with human made structures

Two human made dams would be filled in within the development site. Farm dams may provide habitat for the Sloane's Froglet. Surveys were undertaken for the species during breeding season and they were not detected within the development site.

Fifteen farm dams would be retained for any threatened species that may use farm dams for refuge sites on occasion. Ten of these farm dams would be enhanced with native plantings and partial fencing from stock. No other human made structures would be impacted within the development site.

7.3.2 Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation

Non-native groundcover species occupying much of the development site would be disturbed and shaded by solar infrastructure. Flame Robins detected in the development site forage in exotic and native pastures. The breeding habitat of the Flame Robin is tall moist eucalypt forests and woodlands, with nests built in sheltered sites dominated by native grasses (OEH, 2017). The non-native vegetation does not support breeding habitat for the Flame Robin and provides foraging habitat only. Possible breeding habitat would be retained in the remnant River Red Gum woodland patches that have been avoided by the development footprint. The Flame Robin is highly mobile, being migratory, and abundant open pastures and cleared lands occurs in the surrounding and adjacent paddocks outside the development site. Woodland vegetation would be retained and enhanced within the development site. It is not anticipated any impacts would occur to the Flame Robin for the clearing of non-native vegetation.

7.3.3 Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

Retaining the vegetation along Back Creek in the development site will maintain connectivity across the landscape to facilitate movement in an east-west direction. This creek lines also connect to the remnant roadside vegetation that would be retained. Larger woodland patches would also be retained providing 'steppingstone' refuges for mobile species in an existing highly cleared environment and strategic plantings of native tree and shrub species will be used to enhance connectivity. Due to the highly cleared and fragmented landscape within the development site the proposal is not likely to disrupt the movement of any threatened species.

7.3.4 Impacts of the development on movement of threatened species that maintains their life cycle

For migratory threatened species that may move across the landscape, retaining the revegetation along Back Creek will maintain connectivity across the landscape to facilitate movement in an east-west direction. This creek line also connects to the remnant roadside vegetation that would be retained. Larger woodland patches would also be retained providing 'steppingstone' refuges for mobile species in an existing highly cleared environment. A biodiversity enhancement plan (Appendix I) will be implemented to improve the biodiversity values of the retained habitat such as strategic tree plantings to enhance connectivity and food source, installation of nest boxes, relocation of fallen timber and rehabilitation of farm dams for fauna habitat. Due to the highly cleared and fragmented landscape within the development site the proposal is not likely to disrupt the movement of any other threatened species that maintains their lifecycle.

7.3.5 Impacts of development on water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

The construction of the proposal would involve a range of activities that would disturb soils and potentially lead to sediment laden runoff affecting local waterways during rainfall events. These potential impacts are unlikely to significantly impact water quality with the implementation of recommended mitigation measures including erosion and sedimentation controls. The use of fuels and other chemicals on site during construction poses a risk of surface water contamination in the event of a spill. Mitigation measures to implement spill management procedures would minimise impacts to waterways and hydrological processes.

7.3.6 Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC

The proposal would not directly increase impacts of vehicle strikes on threatened species. The development site is surrounded by country roads that threatened species such would currently be crossing. However, an increase in vehicle traffic may increase vehicle strikes on these threatened species outside of the study area. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes within the subject land.

7.4 IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

7.4.1 Wetlands of international importance

No wetlands of international importance would be impacted by the development.

7.4.2 Threatened ecological communities

No federally listed communities would be impacted by the development site.

7.4.3 Threatened species

Based on a habitat assessment and site surveys seven federally listed species could occur in the development site. These are:

- Superb Parrot (*Polytelis swainsonii*) – V.
- Painted Honeyeater (*Grantiella picta*) – V.
- Swift Parrot (*Lathamus discolor*) – CE.
- Regent Honeyeater (*Anthochaera phrygia*) – CE.
- Koala (*Phascolarctos cinereus*) – V.
- Corben's Long-eared Bat (*Nyctophilus corbeni*) – V.
- White-throated Needletail (*Hirundapus caudacutus*) – V.

Superb Parrot, Painted Honeyeater, Corben's Long-eared Bat and White-throated Needletail

These species are listed as vulnerable under the EPBC Act. Suitable Woodland habitat is present for the Swift Parrot, Painted Honeyeater, Corben's Long-eared Bat and White-throated Needletail in the development site. Surveys were undertaken for this species and they were not detected. However, it is considered these species may forage in the development site on occasion.

EPBC assessments of significance (AoS) were completed for these four fauna species (Appendix G**.**). These concluded that a significant impact was unlikely, on the basis that the proposal would not:

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

A referral to the Federal Department of Environment is not considered necessary for these species.

Specific mitigation and management measures have been recommended in Section 8 to avoid impacts to these species. With the implementation of these measures, impacts to these species are unlikely and no further assessment is required.

Regent Honeyeater and Swift Parrot

These species are listed as Critically Endangered under the EPBC Act. Suitable Woodland habitat is present for the Swift Parrot and Regent Honeyeater in the development site. It is considered these species may forage in the development site on occasion.

EPBC assessments of significance (AoS) were completed for these two fauna species (Appendix G). These concluded that a significant impact was unlikely, on the basis that the proposal would not:

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

- Introduce invasive species harmful to the species.
- Interfere with the recovery of these species.

A referral to the Federal Department of Environment is not considered necessary for these species.

Specific mitigation and management measures have been recommended in Section 8 to avoid impacts to these species. With the implementation of these measures, impacts to these species are unlikely and no further assessment is required.

Koala

Habitat for Koalas within the development site is isolated and highly degraded and it is considered unlikely that the Koala would utilise the habitats available.

The EPBC Referral Guidelines for the Koala (DoE 2014) documents the 'Koala habitat assessment tool' to assist proponents in determining if a proposal may impact on habitat critical to the survival of the Koala. The tool is provided as Table 7-8 below as it applies to the proposal. Impact areas that score five or more using the habitat assessment tool contain habitat critical to the survival of the Koala. The assessment in Table 7-8 resulted in a score of 4 and so habitat within the study area is not considered to be critical to the survival of the Koala, and an assessment of significant impact according to the EPBC Act significant impact criteria is not required.

Table 7-8: Koala habitat assessment tool for inland areas (DoE 2014)

Attribute	Score	Inland	Applicable to the proposal?
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.	
	0 (low)	None of the above.	✓ No records of Koala within 10km of the development site. Koala not detected during site surveys.
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	✓ Red River Gum, Blakely's Red Gum, Grey Box and Yellow Box are food tree species in the South Western Slopes Bioregion
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.	
	0 (low)	None of the above.	

Attribute	Score	Inland	Applicable to the proposal?
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha.	
	+1 (medium)	Area is part of a **contiguous landscape** < 1000 ha, but ≥ 500 ha.	✓ Development site part of linear riparian corridor along Back Creek connecting to Billabong Creek
	0 (low)	None of the above.	
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, **OR** Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.	
	0 (low)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, **OR** Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	✓ High vehicle threat present; - Remnant Vegetation mostly occurs along roadside corridors. Linear Riparian corridor crosses roads frequently High Dog threat present; - Highly fragmented landscape with periurban rural landholder
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1 of EPBC Koala Referral	
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	

Attribute	Score	Inland	Applicable to the proposal?
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	✓ Study area is not considered a habitat refuge nor does it provide important connectivity to large areas surrounding a habitat refuge
Total	**4**	**Decision: Habitat not critical to the survival of the Koala—assessment of significance not required**	

7.4.4 Migratory species

Based on a habitat assessment, the development site contains habitat that could be potentially used by two federally listed migratory species could occur in the development site. These are:

- Fork-tailed Swift (*Apus pacificus*).
- White-throated Needletail (*Hirundapus caudacutus*).

An Assessment of Significance was undertaken for these species (Appendix G) and determined that the project is unlikely to cause a significant impact to any criteria. The proposal is therefore considered unlikely to significantly impact the Fork-tailed Swift or the White-throated Needletail and no referral to the Federal Department of Environment is considered necessary.

7.5 LIMITATIONS TO DATA, ASSUMPTIONS AND PREDICTIONS

The floristic plots are based on a single visit survey. Floristic surveys were undertaken during the optimal flowering time for species in spring 2018, however it is possible that not all plant species were detected that may be present at the site due to seasonal and climatic constraints. In particular, inconspicuous or geophytic species which flower outside the surveyed period may not have been recorded.

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

8 MITIGATING AND MANAGING IMPACTS

8.1 MITIGATION MEASURES

A general summary of the key measures required to mitigate the impacts of the proposal is provided below. FRV is committed to maximising opportunities to enhance the biodiversity value of retained habitat features and has commissioned a Biodiversity Enhancement Plan for the development site, developed by Holbrook Landcare. This Biodiversity Enhancement Plan is provided in Appendix I. Mitigation measures proposed to manage impacts, including proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure and an analysis of the consequences of any residual impacts are provided in Table 8-1.

8.1.1 *Impacts from the clearing of vegetation and habitats*

1. Timing of works to avoid critical lifecycle events.
2. Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler.
3. Relocate habitat features (fallen timber, hollow logs) into retained vegetation patches within the development site.

8.1.2 *Indirect impacts*

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

8.1.3 *Prescribed impacts*

1. Screening and landscaping plantings to be comprised of local indigenous species representative of the vegetation in the development site. The food potential for fruit, pollen and nectar feeders will be considered in selecting component species.
2. Install approximately 120 nesting boxes for birds and mammals across the development site.
3. 10 retained dams would be planted with native riparian vegetation and transformed into small artificial wetlands to benefit native amphibians, birds, reptiles and invertebrates.

4. Sediment barriers and spill management protocols to control the quality of water runoff from the site into the receiving environment.
5. Enforce site speed limits to reduce impacts of vehicle strikes on threatened fauna.
6. Involve a local landcare group or educational institution in ongoing biodiversity monitoring and enhancement.
7. No barbed wire to be used on external security fencing or internal stock fencing.

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

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Displacement of resident fauna through vegetation clearing and habitat removal						
Time works to avoid critical life cycle events.	• Hollow-bearing trees would not be removed during breeding season (spring to summer). • If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur.	Construction.	Regular.	Contractor.	Moderate.	Species not detected during pre-clearing surveys may be impacted.
Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler.	• Pre-clearing checklist. • Tree clearing procedure.	Construction.	Regular.	Contractor.	Moderate.	Species not detected during pre-clearing surveys may be impacted.
Relocate habitat features (fallen timber, hollow logs) from within the development site.	• Tree-clearing procedure including relocation of habitat features to adjacent area for habitat enhancement.	Construction.	Regular.	Contractor.	Low.	None.
Indirect impacts on native vegetation and habitat						
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance: for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed.	• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees. • In areas to clear adjacent to areas to be retained, chainsaws would be	Construction.	Regular.	Contractor.	Low.	None.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	used rather than heavy machinery to minimise risk of unauthorised disturbance. • Access to the Box-Gum Woodland EEC would not be permitted via vehicles to reduce understorey impacts and clearing. • Strict weed protocol must be observed at all times.					
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise.	• Construction Environmental Management Plan will include measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as possible.	Construction.	Regular.	Contractor.	Low.	None.
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill.	• Avoid night works. • Direct lights away from vegetation.	Construction/ Operation.	Regular.	Contractor.	Low.	None.
Adaptive dust monitoring programs to control air quality.	• Daily monitoring of dust generated by construction activities. • Construction would cease if dust observed being blown from site until control measures were implemented. • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site.	Construction.	Regularly.	Contractor.	Moderate.	Sedimentation in ephemeral waterways and dams.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Temporary fencing to protect significant environmental features such as riparian zones.	• Prior to construction commencing, exclusion fencing, and signage would be installed around habitat to be retained.	Construction.	Regularly.	Contractor.	Low.	None.
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas.	• A Weed Management procedure would be developed for the proposal to prevent and minimise the spread of weeds. This would include: ○ Management protocol for declared priority weeds under the *Biosecurity Act 2015* during and after construction. ○ Weed hygiene protocol in relation to plant, machinery, and fill. • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported. • The weed management procedure would be incorporated into the Biodiversity Management Plan.	Construction/ Operation.	Regular.	Contractor.	Moderate.	Weed encroachment.
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented.	• Site induction. • Toolbox talks.	Construction.	Regular.	Contractor.	Moderate.	Impacts to native vegetation or threatened species for Staff training not being followed.
Preparation of a biodiversity management plan to regulate activity in vegetation and habitat	• Preparation of a Biodiversity management plan that would include protocols for:	Construction.	One-off.	Contractor.	Moderate.	Impacts to native vegetation or threatened species for Biodiversity Management Plan not being followed.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
adjacent to the proposed development.	○ Protection of native vegetation to be retained. ○ Best practice removal and disposal of vegetation. ○ Staged removal of hollow-bearing trees and other habitat features such as fallen logs with attendance by an ecologist. ○ Weed management. ○ Pest animal management ○ Unexpected threatened species finds. ○ Exclusion of vehicles through sensitive areas. ○ Rehabilitation of disturbed areas.					
Prescribed biodiversity impacts						
Screening and landscaping plantings to be comprised of local indigenous species representative of the vegetation in the development site.	• Landscape plantings will be comprised of local indigenous species and food plants.	Operation.	Regular.	Client.	Moderate.	Plants not surviving.
Install approximately 120 nesting boxes for birds and mammals across the development site.	• Nesting boxes will be designed to meet the requirements of target species including Squirrel Gliders, bats, parrots and owls. • Nesting boxes will be monitored periodically for use and/or replacement.	Construction.	Regular.	Client.	Low.	Use of nesting boxes by exotic pest animals.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
10 retained dams will be planted with native riparian vegetation and transformed into small created wetlands for wildlife.	• Riparian plantings will comprise local native sedges, rushes, grasses and small shrubs.	Construction.	Regular.	Client.	Moderate.	Plants not surviving or being overtaken by weeds.
Sediment barriers and spill management procedures to control the quality of water runoff released from the site into the receiving environment.	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented. • Spill management procedures would be implemented.	Construction.	Regular.	Contractor.	Moderate.	Impacts may occur to waterway if erosion and sedimentation control plan not implemented.
Staff training and site briefing to communicate impacts of traffic strikes on native fauna.	• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Construction/ Operation.	Regular.	Contractor.	Moderate.	Fauna strikes from vehicles.
Involve a local landcare group or educational institution in ongoing biodiversity monitoring and enhancement.	• Involve a third party organisation to monitoring and maintain biodiversity enhancement activities. • Communicate outcomes with third parties to contribute knowledge of how biodiversity can be preserved on solar farms.	Operation.	Regular.	Contractor.	Moderate.	Lack of interest from third parties.
Barbed Wire would not be used on external security fences or internal stock fences.	• Security fencing would be comprised of 2 m high cyclone fencing. • Use plain wire perimeter fencing where this intersects woodland to avoid potential entrapment of fauna on fence.	Construction.	Regular.	Client.	Low.	None.

9 SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

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

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

9.1 POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT ENTITIES

9.1.1 Threatened ecological communities

One threatened ecological community will be impacted by the proposal that is listed as a potential SAII entity in the *Guidance to assist a decision-maker to determine a serious and irreversible impact*. This is the:

- White Box-Yellow Box- Blakely's Red Gum Woodland (Box-Gum Woodland).

9.1.2 Threatened species

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

9.1.3 Additional potential entities

No further species were considered to be potential SAII entities.

9.2 ASSESSMENT OF SERIOUS AND IRREVERSIBLE IMPACTS

9.2.1 White Box - Yellow Box – Blakely's Red Gum Woodland (Box-gum Woodland)

An assessment of the impacts to Box-gum Woodland was undertaken. Figure 9-1 shows the location of the Box-gum Woodland within the development site.

a) **the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII**
The Box-Gum Woodland within the development site is comprised of a small (0.2 ha) isolated patch within the middle of a cleared agricultural paddock that undergoes regular cropping and grazing. This 0.2 ha patch is of low quality comprised of four remnant trees over an almost completely exotic groundcover. Small isolated patches of woodland vegetation are unable to be avoided because the size constraints of the solar panels and trackers are unable to adapt around small patches of vegetation. Additionally, retained vegetation in the development site create potential shadowing effects reducing the capacity

of the solar panels. Avoiding the small 0.2 ha patch would have required moving solar panels into larger more intact patches of remnant vegetation.

b) **the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone**

0.2 ha of Box-Gum Woodland would be impacted by the proposal. This vegetation is comprised of a small isolated patch of mature Yellow Box and Blakely's Red gum within a cropped paddock. There is no native understory remaining. The vegetation integrity score for this patch is 12.1. This vegetation integrity score is below the threshold for requiring assessment in the BDAR.

Table 9-1 Box-Gum Woodland impacted

Zone ID	Zone Description	Patch size	Composition score	Structure score	Function score	Vegetation Integrity Score
1	PCT 277_ Grazed	0.18	2.2	12.4	63.9	**12.1**

c) **a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact**
No threshold has yet been defined by OEH for the extent of Box-gum Woodland to be removed that constitutes a serious and irreversible impact.

d) **the extent and overall condition of the potential TEC within an area of 1000 ha, and then 10,000 ha, surrounding the proposed development footprint**
Using GIS and State Vegetation Mapping (VIS_4468 & 4469), it is estimated that 17 ha of Box-gum Woodland occurs within an area of 1000 ha surrounding the proposed development footprint, and 312 ha of Box-gum Woodland occurs within an area of 10 000 ha surrounding the proposed development footprint (Figure 9-1).

e) **an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration**
Using GIS and State Vegetation Mapping (VIS_4468 & 4469), it is estimated that 32,801 ha of Box-gum Woodland occurs within the Lower Slopes IBRA Subregion. Vegetation mapped from aerial imagery is assumed to be in moderate to good condition. Up to 0.2 ha is proposed to be removed by the development, which is less than 0.001% of the estimated extent remaining.

f) **an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion**
In NSW, Box-gum Woodland is known to occur within at least 42 reserve systems. Around 8 000 ha of Box-gum Woodland is estimated to occur in national parks and nature reserves within the NSW South Western Slopes IBRA Region (Benson 2008). Using GIS Vegetation Mapping, it is estimated that 481 ha of Box-gum Woodland occurs in four reserves in the Lower Slopes Subregion.

g) **the development, clearing or biodiversity certification proposal's impact on:**
    i. **abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns**

Groundwater supplies and levels are unlikely to be affected by the proposal and no groundwater is anticipated to be intercepted or extracted. During construction, the proposal would have a short-term gross impact upon soils and possibly surface water flow, within discreet areas. These impacts are manageable with the implementation of erosion and sediment controls and would be unlikely to impact on abiotic factors critical to the long-term survival of Box-Gum Woodland.

ii. **characteristic and functionally important species through impacts such as but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants**

The proposal would remove 0.2 ha of Box-Gum Woodland which would permanently remove the characteristic overstory species of Yellow Box (*Eucalyptus melliodora*) and Blakley's Red Gum (*Eucalyptus blakelyi*) in these areas. These areas have an exotic understory and no native understory species would be likely to remain.

iii. **the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts**

Up to 0.2 ha of Box-Gum Woodland would be removed reducing the vegetation quality and integrity of this patch. No further impacts would occur to remaining Box-gum Woodland in the locality.

h) **direct or indirect fragmentation and isolation of an important area of the potential TEC**

The small fragmented patches of Box-gum Woodland in the development site are already isolated within the agricultural landscapes. The small isolated patch to be removed would not cause further fragmentation to areas of Box-Gum Woodland in the locality.

i) **the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.**

Due to the low vegetation quality of the Box-Gum Woodland to be removed, no offsets are required for the removal of this vegetation.

The proposal would remove 0.2 ha of Box-Gum Woodland. This vegetation is of very low quality and does not meet the condition threshold as requiring further assessment under the BAM. Extensive areas of Box-Gum Woodland occur within 1000 ha and 10,000 ha of the development site. Based on these factors, the removal of a very small area of low-quality vegetation is considered unlikely to have a serious and irreversible impact on the Box-Gum Woodland EEC in the locality.

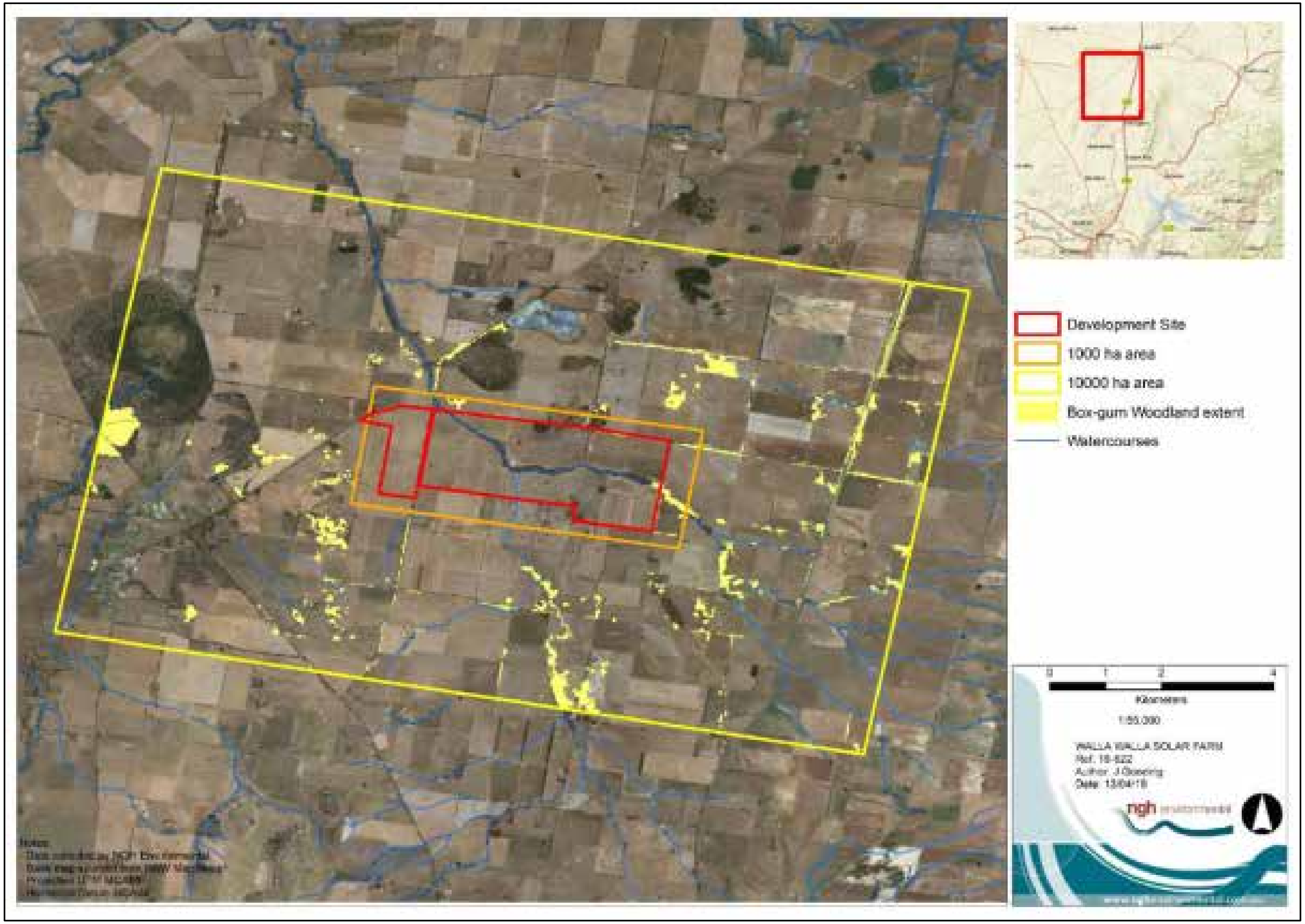

Figure 9-1 Location of serious and irreversible impacts

10 REQUIREMENT TO OFFSET

10.1 IMPACTS REQUIRING AN OFFSET

10.1.1 Ecosystem credits

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

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

The PCTs and vegetation zones requiring offset and the ecosystem credits required are documented in Table 10-1 and mapped on Figure 10-1 . The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix D.

Table 10-1 PCTs and vegetation zones that require offsets.

Zone ID	PCT ID	Zone Name	Impact area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Ecosystem credits required
PCT 76: Western Grey Box tall grassy woodland						
2	76	Grazed	10.0	20.2	0	101
3	76	Wetland	3.2	20	0	32
4	76	Derived Grassland	23.9	16.2	3.6	26
5	76	Roadside	0.03	40.5	0	1
					SUBTOTAL:	**160**
PCT 5: River Red Gum herbaceous grassy very tall open forest wetland						
7	5	Wetland	0.2	41.9	0	3
9	5	Creek line	0.4	40.7	0	6
					SUBTOTAL:	**9**
					TOTAL:	**169**

10.1.1 Paddock tree credits

Offsets are required for the clearing of Class 2 and Class 3 paddock trees. 53 Class 2 and Class 3 paddock trees would be removed by the proposal. The paddock trees form part of three different PCTS. PCT 76: Western Grey Box tall grassy Woodland, PCT 277: Blakely's Red Gum – Yellow Box grassy tall woodland and PCT 5: River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains. Ecosystem credits are calculated as per the streamlined assessment defined in the BAM – Appendix 1 and Table 12. These ecosystem credits required are documented in Figure 10-2. The credit profile for the paddock trees is shown in Figure 10-3.

Fifty-two ecosystem credits are required for the clearing of the paddock trees.

Table 10-2 Paddock trees that require offsets.

Class of Paddock Tree being cleared	Hollows Present	Number of Paddock Trees to be cleared	Number of Credits Required	Ecosystem credits required
PCT 76 – Western Grey Box tall grassy woodland				
Class 2 **(>20cm DBH and < 50cm DBH)**	No	0	0.5	0
Class 2 **(>20cm DBH and < 50cm DBH)**	Yes	1	0.75	1
Class 3 **>50cm DBH**	No	7	0.75	6
Class 3 **>50cm DBH**	Yes	32	1	32
			SUBTOTAL:	**39**
PCT 277 – Blakley's Red Gum – Yellow Box grassy tall woodland				
Class 2 **(>20cm DBH and < 50cm DBH)**	No	0	0.5	0
Class 2 **(>20cm DBH and < 50cm DBH)**	Yes	0	0.75	0
Class 3 **>50cm DBH**	No	3	0.75	3
Class 3 **>50cm DBH**	Yes	8	1	8
			SUBTOTAL:	**11**
PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains				
Class 2 **(>20cm DBH and < 50cm DBH)**	No	1	0.5	1
Class 2 **(>20cm DBH and < 50cm DBH)**	Yes	0	0.75	0
Class 3 **>50cm DBH**	No	0	0.75	0
Class 3 **>50cm DBH**	Yes	1	1	1
			SUBTOTAL:	**2**
			TOTAL:	**52**

10.1.2 Species credits

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

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

Table 10-3 Species credit species that require offsets.

Species Credit Species	Biodiversity risk weighting	Area of habitat lost (ha)	Species credits required
Squirrel Glider *Petaurus norfolcensis*	2.00	8.2 ha	89
Little Eagle *Hieraaetus morphnoides*	1.50	10.8 ha (assumed)	87
Southern Myotis *Myotis Macropus*	2.00	1.5 ha (assumed)	19
Pine Donkey Orchid *Diuris tricolor*	1.50	1.2 ha (assumed)	14

10.1.3 Offsets required under the EPBC Act

No species listed on the EPBC Act have been identified as having the potential to be significantly impacted by the development. As such, the proposal is not considered to require offsets in accordance with the EPBC Offsets Policy.

10.2 IMPACTS NOT REQUIRING AN OFFSET

Impacts to PCTs that do not meet the thresholds identified in section 10.1.1 do not require offsets.

Three zones in the development site did not meet the Vegetation Integrity Score threshold (Shown in Table 10.5). These zones are highly disturbed from intense agricultural activities of cropping and grazing. Zones 1 and Zones 5 are small isolated patches comprised of remnant overstory trees but have no other native components remaining. The groundcover is comprised of exotic grasses and no regeneration of overstory tree species has occurred. Zone 7 occurs within the fenced creek line area in the centre of the development site. These areas have been cleared in the past through agricultural activities and no mature overstory canopy remains. Some scattered River Red Gums have regenerated; however, the understory is dominated by exotic annual grasses. This zone lacks structure and diversity to meet the vegetation integrity score threshold.

These three zones identified are considered to be sufficiently degraded and not required to be offset.

Table 10-4 Impacts not requiring an offset

Zone ID	PCT ID	Zone name	Impact area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Ecosystem credits required
PCT 277: Blakley's Red Gum – Yellow Box grassy tall woodland						
1	277	Grazed	0.2	6.1	0	0
PCT 5: River Red Gum herbaceous grassy very tall open forest wetland						

6	5	Grazed	0.1	11.4	0	0
8	5	Low	0.6	5.6	0	0

10.3 AREAS NOT REQUIRING ASSESSMENT

Approximately 447 ha of exotic vegetation comprised of agricultural crops and pastures and considered to be Category 1 Land would be impacted by the proposal. These areas are not considered native vegetation and do not require offsetting or further assessment.

These areas are mapped on Figure 10-1 .

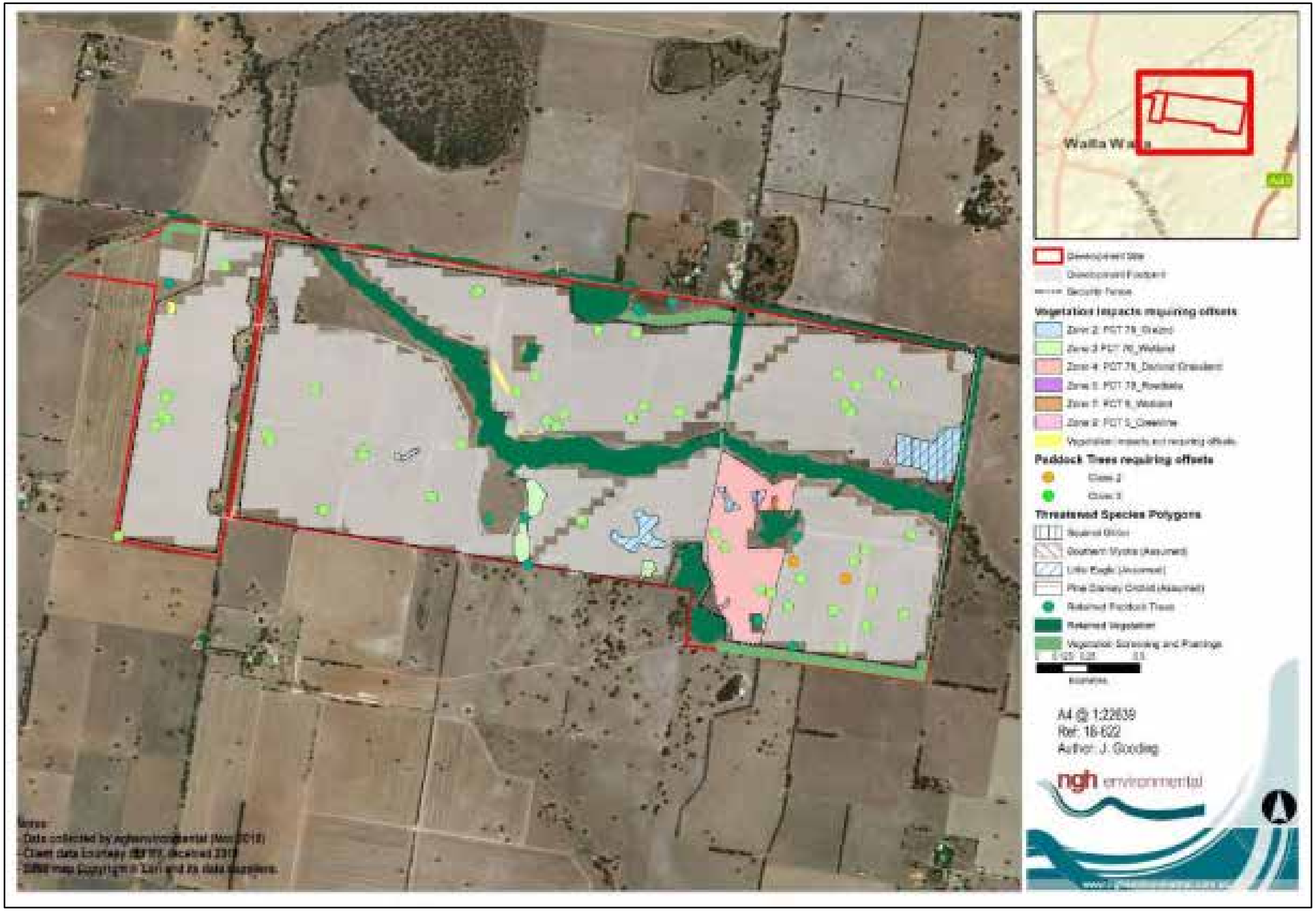

Figure 10-1 Impacts requiring offset, not requiring offset and not requiring assessment

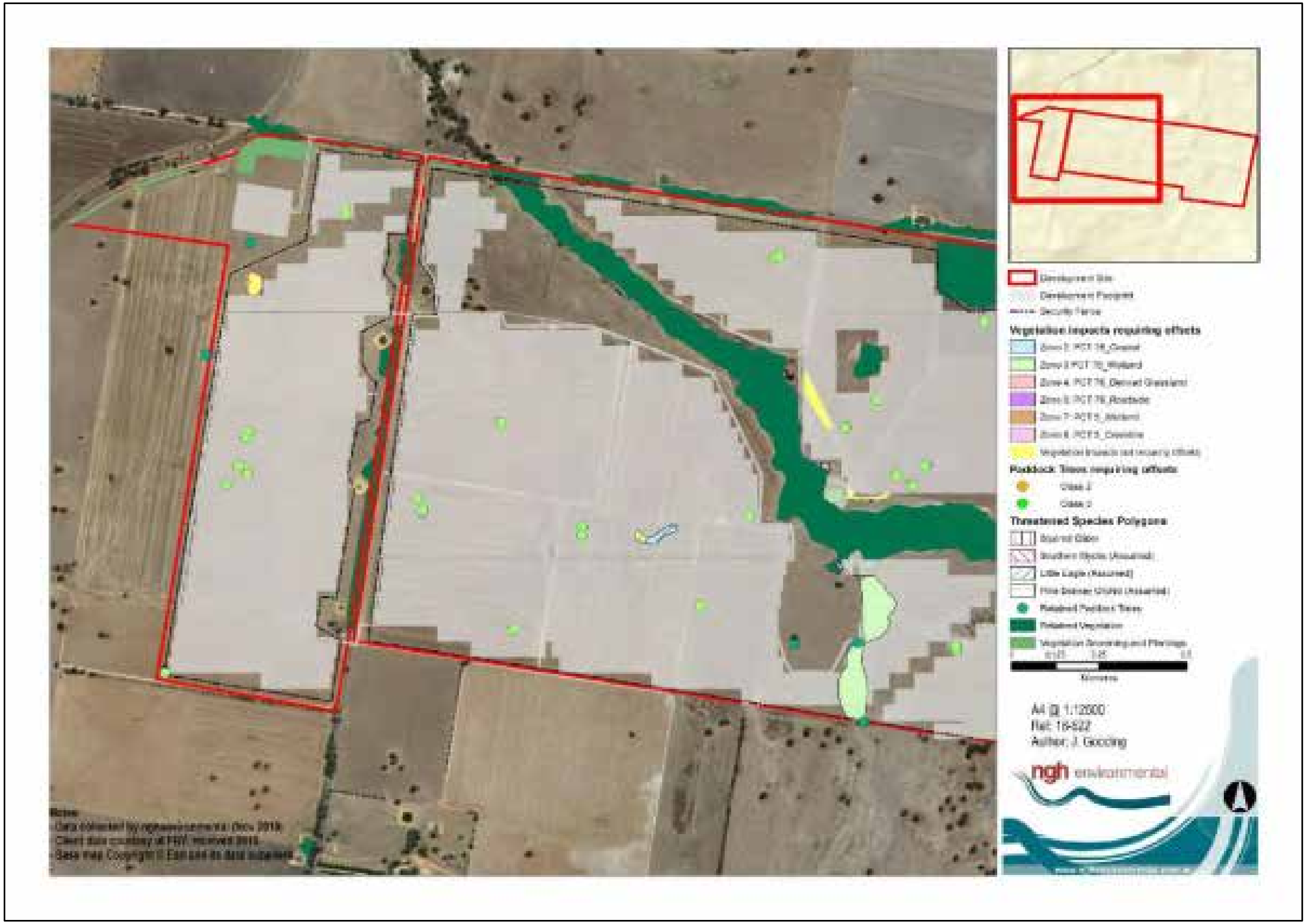

Figure 10-2 Impacts requiring offsets and not requiring offsets (Development Site East)

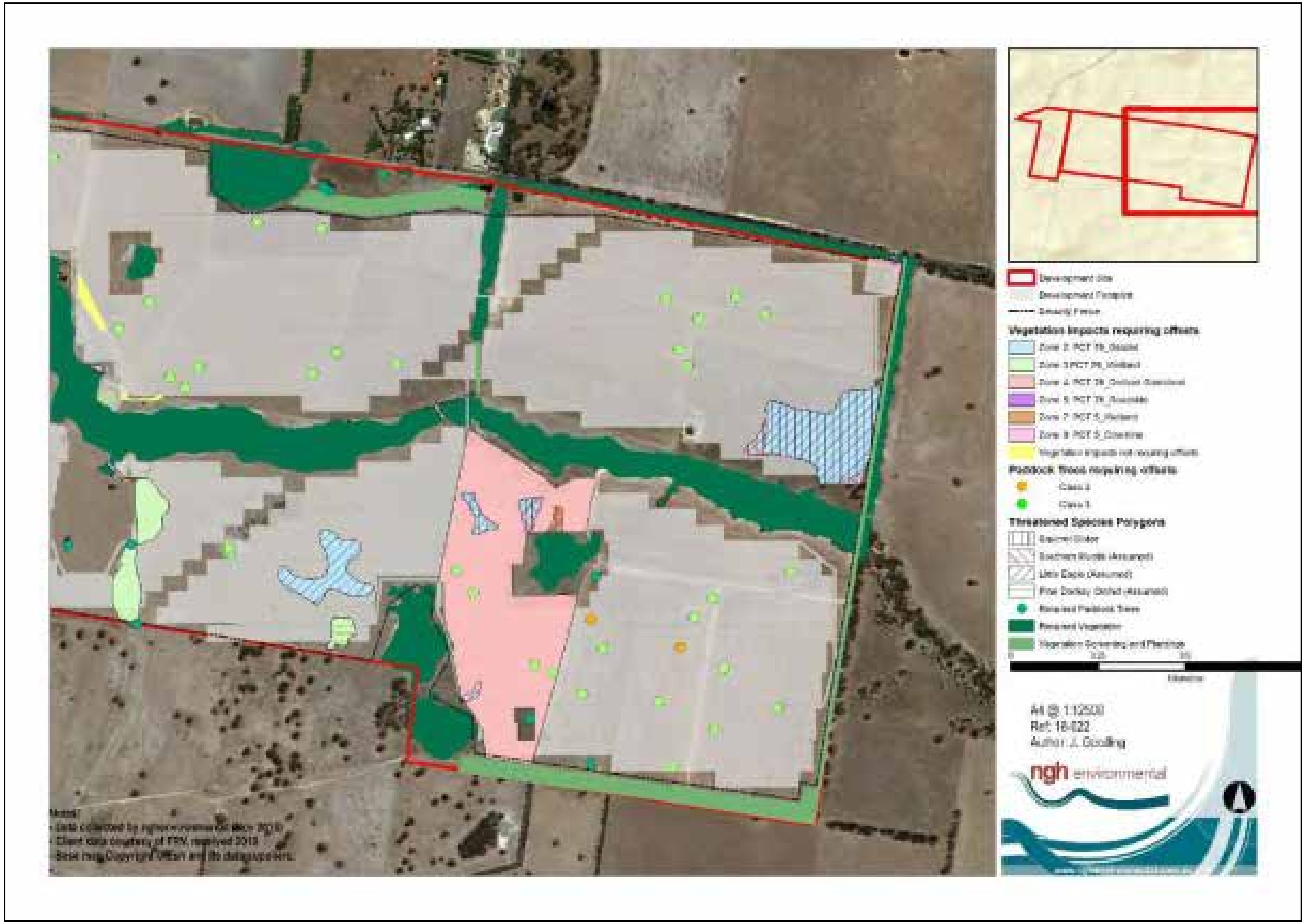

Figure 10-3 Impacts requiring offsets and not requiring offsets (Development Site West)

10.4 SUMMARY OF OFFSET CREDITS REQUIRED

Table 10-5 Summary of offset credits required.

Ecosystem Credits	Offset credits required
PCT 76: Western Grey Box tall grassy woodland	160
PCT 76: Western Grey Box tall grassy woodland – Paddock Trees	39
SUBTOTAL:	**199**
PCT 277: Blakley's Red Gum – Yellow Box grassy tall woodland -Paddock Trees	11
SUBTOTAL:	**11**
PCT 5: River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains	9
PCT 5: River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains – Paddock Trees	2
SUBTOTAL:	**11**
TOTAL:	**221**
Species Credits	**Offset Credits required**
Squirrel Glider *Petaurus norfolecnsi*	89
Little Eagle *Hieraaetus morphnoides*	87
Southern Myotis *Myotis Macropus*	19
Pine Donkey Orchid *Diuris tricolor*	14
TOTAL:	**209**

11 CONCLUSIONS

NGH Environmental has prepared this BDAR on behalf of FRV for the Walla Walla Solar Farm, 4.3 km northeast of Walla Walla, NSW. The purpose of this BDAR is to satisfy the assessment requirements of the BOS and BAM as set out under the BC Act for the proposal and to address the biodiversity matters raised in the SEARs. In this BDAR, biodiversity impacts have been assessed through:

- Comprehensive mapping and assessment completed in accordance with the BAM.
- Identification of four plant community types and one threatened species within the development site, the impacts to which have been adequately assessed.
- Site design to avoid areas of high biodiversity values and enhance retained vegetation
- Mitigation measures which have been outlined to reduce the impacts to biodiversity
- The generation of 221 ecosystem credits within the development site, and 209 species credits.

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

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

12 REFERENCES

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APPENDIX A CATEGORY 1 LAND ASSESSMENT

6th May 2019

Miranda Kerr

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Conservation and Regional Delivery, South West

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Dear Miranda,

RE – Identification of Category 1 -exempt land – Walla Walla Solar Farm BDAR

1.1 INTRODUCTION

A BDAR is being prepared for the proposed Walla Walla Solar Farm. The development site is located on Lots 16, 17, 20, 21, 87, 88, 89, 108, 109 & 118 of DP 753735 and Lot 1 DP 1069452. (Figure 1).

Section 6.8(3) of the Biodiversity Conservation Act determines that the Biodiversity Assessment Method (BAM) is to exclude the assessment of the impacts of clearing of native vegetation on Category 1-exempt land (within the meaning of Part 5A of the *Local Land Services Act 2013*). Boundaries mapping Category 1-exempt land on the Native Vegetation Regulatory Mapping are not yet publicly available. During the transitional period, accredited assessors may establish the categorisation of land for the consent authority to consider following the method utilised to develop the Native Vegetation Regulatory Map.

Category 1 -exempt land is defined under the LLS act as;

- Land cleared of native vegetation as at 1 January or lawfully cleared after 1 January 2019.
- Low Conservation Grasslands
- Land containing only low conservation groundcover (Not being grasslands)
- Native Vegetation identified as regrowth in a Property Vegetation Plan under the repealed Native Vegetation Act 2003
- Land Bio-certified under the Biodiversity Conservation Act 2016

This letter report establishes the methodology, results and conclusions to evaluate the land categorisation for the development site. It is anticipated that OEH would support this approach and provide endorsement for the land categorisation of the development site for Walla Walla Solar Farm.

Reviewer:
Date:

1.2 METHODOLOGY

An initial field assessment was undertaken over the development site to determine the ecological constraints and native vegetation communities on site. A vegetation map was produced from the results of the initial field surveys and shown in Figure 2.

Areas of woody vegetation have been assessed using the BAM methodology. Areas of cropped land have been identified as exotic vegetation. Aerial imagery supports that these areas are frequently cropped.

However, three paddocks (Lots 21, 88 and 16 of DP 753735) shown in Figure 2 consisted of a low condition grassland (VIS score 21) at the time of field assessment. These areas are dominated with Barley Grass (**Hordeum leporinum*) but have recolonised with around a 5 -30% cover of Windmill Grass (*Chloris truncata*). Some other natives such as Couch (*Cynodon dactylon*), Curly Windmill Grass (*Enteropogon acicularis*), Caustic Weed (*Euphorbia drummondii*) and Wallaby grass (*Rytidosperma spp.*) were also present in very small abundance (<1% cover). In communication with the landholder, it was revealed that these paddocks had been cultivated cropped to Clover (*Trifolium spp.)* and Phalaris 8 years ago.

Assessment of whether this grassland area is Category 1-exempt or Category 2 -regulated land was undertaken using the following data sources;

- Aerial imagery of historical land use (Sourced from Google Earth and Department of Finance, Services and Innovation Spatial Services)
- 2017 Land Use Dataset (Australian Land Use and Management (ALUM) Classification Version 7 (OEH, 2017).
- NSW Woody vegetation extent and FPC 2011 (OEH, 2015)
- Sensitive regulated and vulnerable regulated lands on the Native Vegetation Regulatory Map portal
- Riverina State Vegetation Mapping (VIS_ID_4469, OEH)

1.3 RESULTS

Analysis of the above data sources showed the following information;

- Aerial imagery shows the grassland areas in Lot 16 and 21 of DP 753735 have been cultivated in years 2007 & 2010 (Figure 3 and Figure 4). There is no evidence of cropping from the aerial images in Lot 88 //753735.
- Aerial imagery shows the grassland areas in Lot 21//753735 being cultivated in 2003 (Figure 5). There are slight cultivation lines in the western portion of Lot 16//DP 753735, however are not 100 % conclusive.
- It is not 100% conclusive whether the grassland areas have been cropped from aerial images in 1990 and 1996, however there are slight cultivation lines in the western end of Lot 21//753735. The paddock trees from 1990 are still present now. Had the site not been continually used for agriculture over the past 29 years, regrowth would have occurred more substantially in these areas like that as has occurred along the creek and some woodland areas which have been fenced from agricultural practices. The grassland area has not improved in woody vegetation extent indicating it has been continually managed for agricultural purposes.
- The 2017 Land Use Dataset reveals Lot 16 and 21 are mapped as 'Cropping' and Lot 88 mapped as 'Grazing Modified Pastures'. (Figure 8)
- 2011 Woody Vegetation extent shows scattered paddock trees in these areas. These areas have been mapped as paddock trees within the BAM assessment. (Figure 2 and Figure 8)
- Native Vegetation Regulatory Map identifies the ephemeral waterways; Back creek and Middle Creek, as Category 2 - sensitive regulated land. Middle Creek is a tributary running through the grassland area. (Figure 9)
- Riverina State Vegetation mapping identifies grassland areas as non-native vegetation. (Figure 10).
- Field surveys identified areas of exotic vegetation. In particular, in the North East Corner of the development site, a small patch of woodland was identified to be planted Sugar Gum (**Eucalyptus cladocalyx*) which is not native to NSW.

1.4 CONCLUSION

Based on the above data sources, there is evidence to suggest that Lot 16 & Lot 21 of DP//753735 have been under regular rotational cropping or pasture improvement since 1990. The 2017 Land Use Mapping data also supports that the primary landuse for these lots as Cropping. These two lots are considered to meet the definition of Category 1 – exempt Land. The grassland area of Middle Creek is categorised as Category 2 -sensitive land.

It is not so conclusive that Lot 88//753735 has been regularly cropped in the past, and so as a precautionary approach, the grassland vegetation in this lot has been assigned to Category 2 – regulated land. A draft map of areas considered to be Category 1 Land and Category 2 Land has been produced and shown in Figure 11.

If you have any questions, please contact me on the number below. I would be pleased to discuss this report with you further.

Yours sincerely,

Julie Gooding
Environmental Consultant - Ecologist

Accredited Assessor BAAS 18074

Ph: 6923 1534
NGH Environmental Pty Ltd

FIGURES

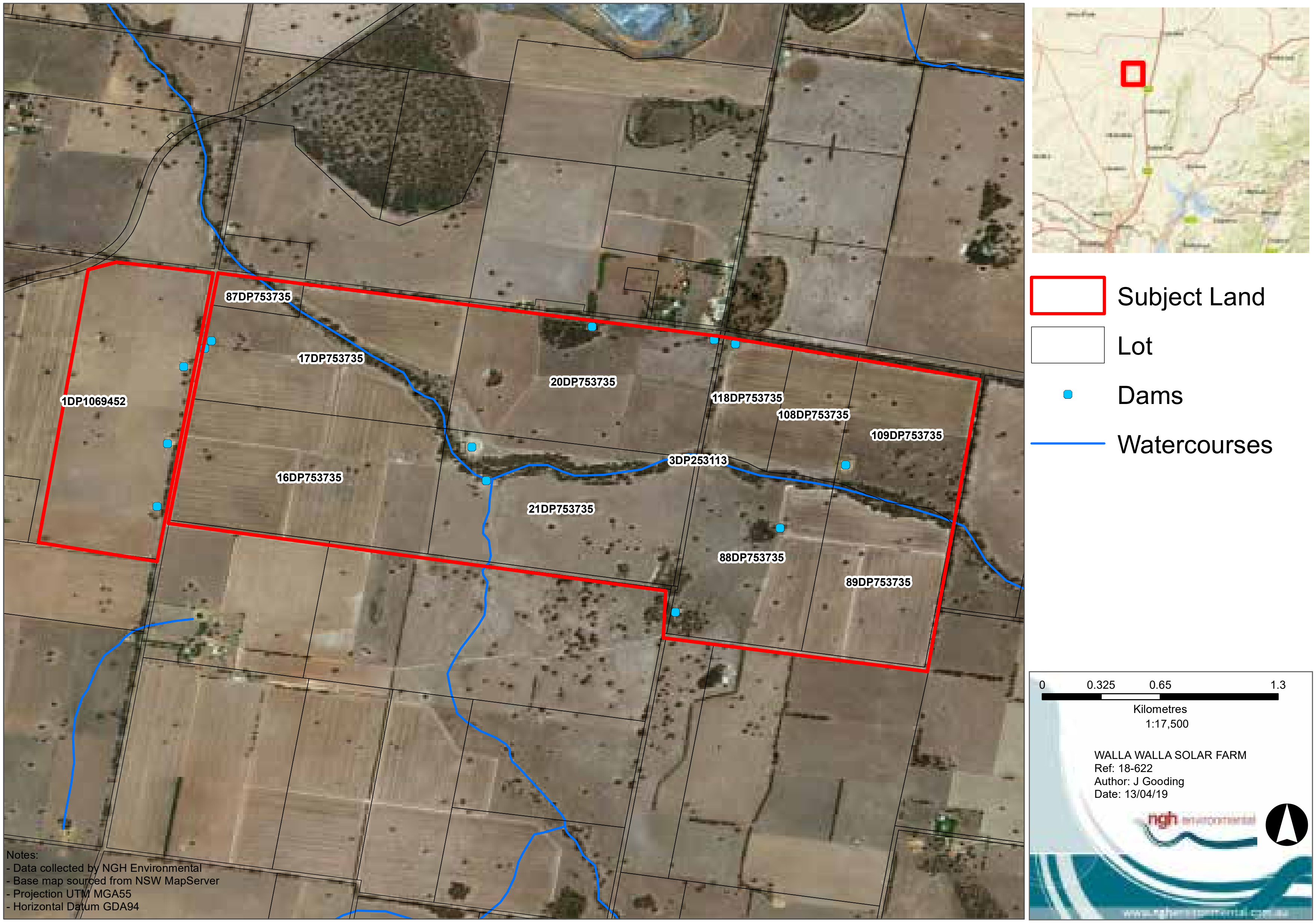

Figure 1 Location Map

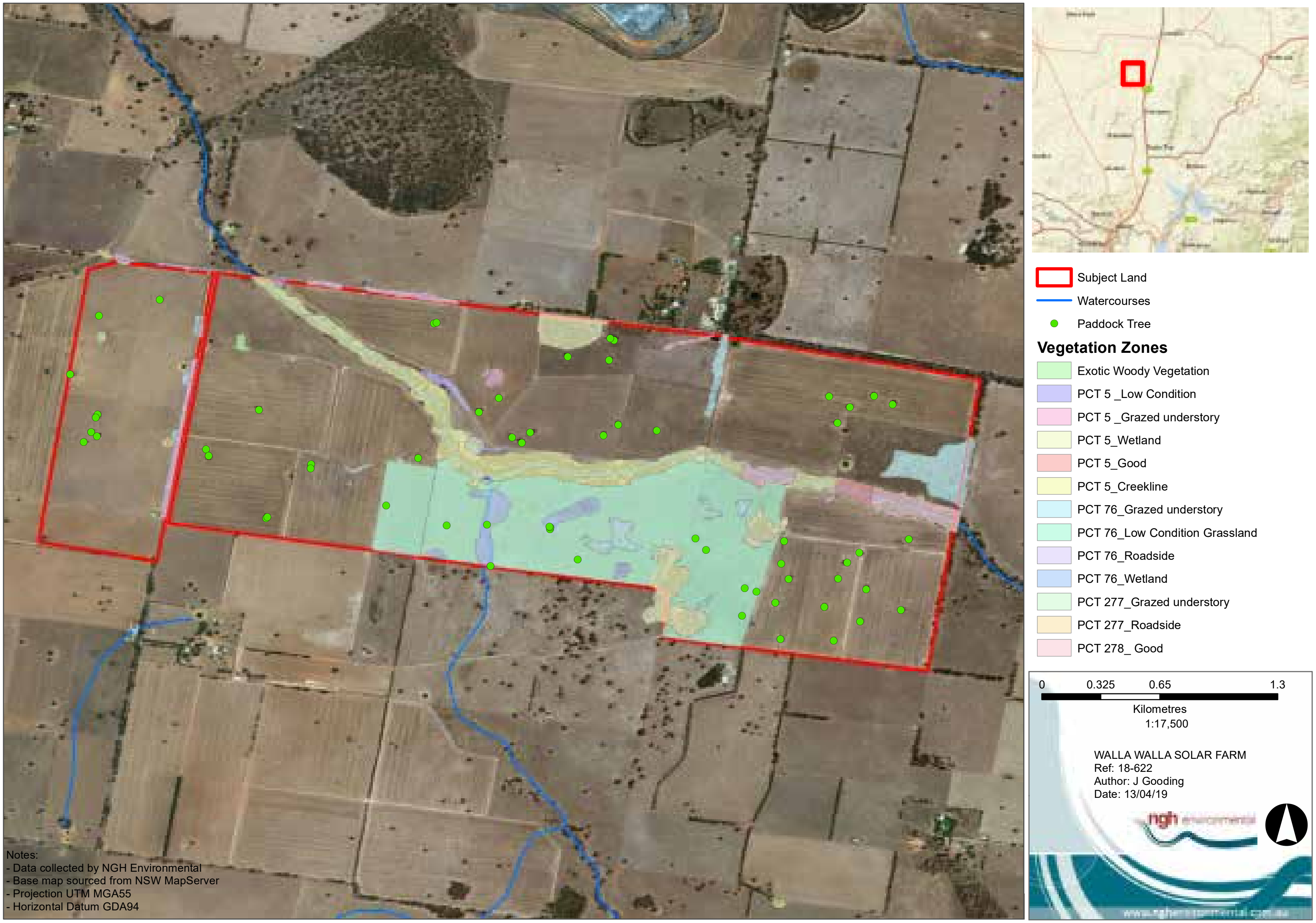

Figure 2 Native Vegetation mapping from field Inspection Nov 2018

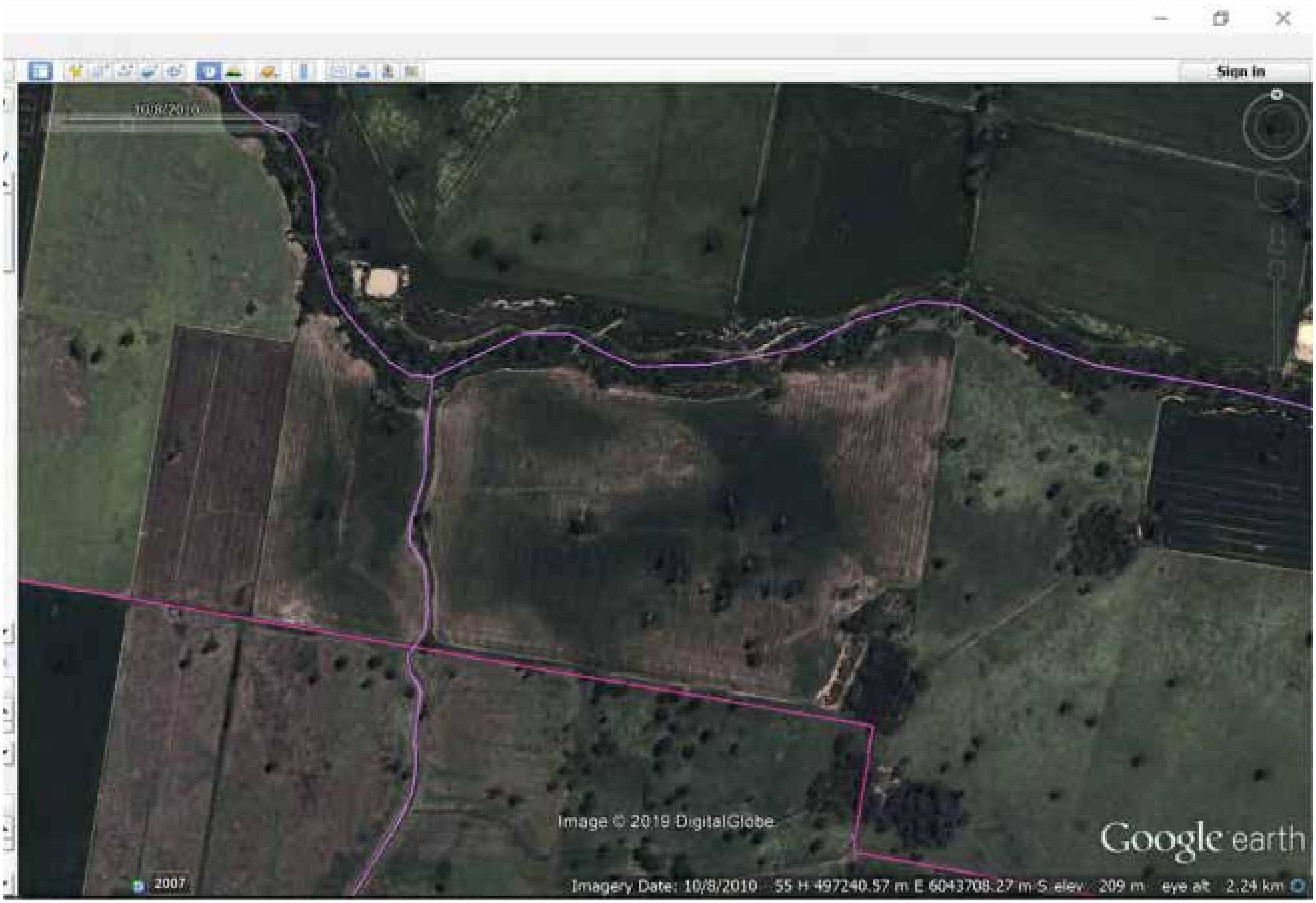

Figure 3 Aerial Imagery 2010

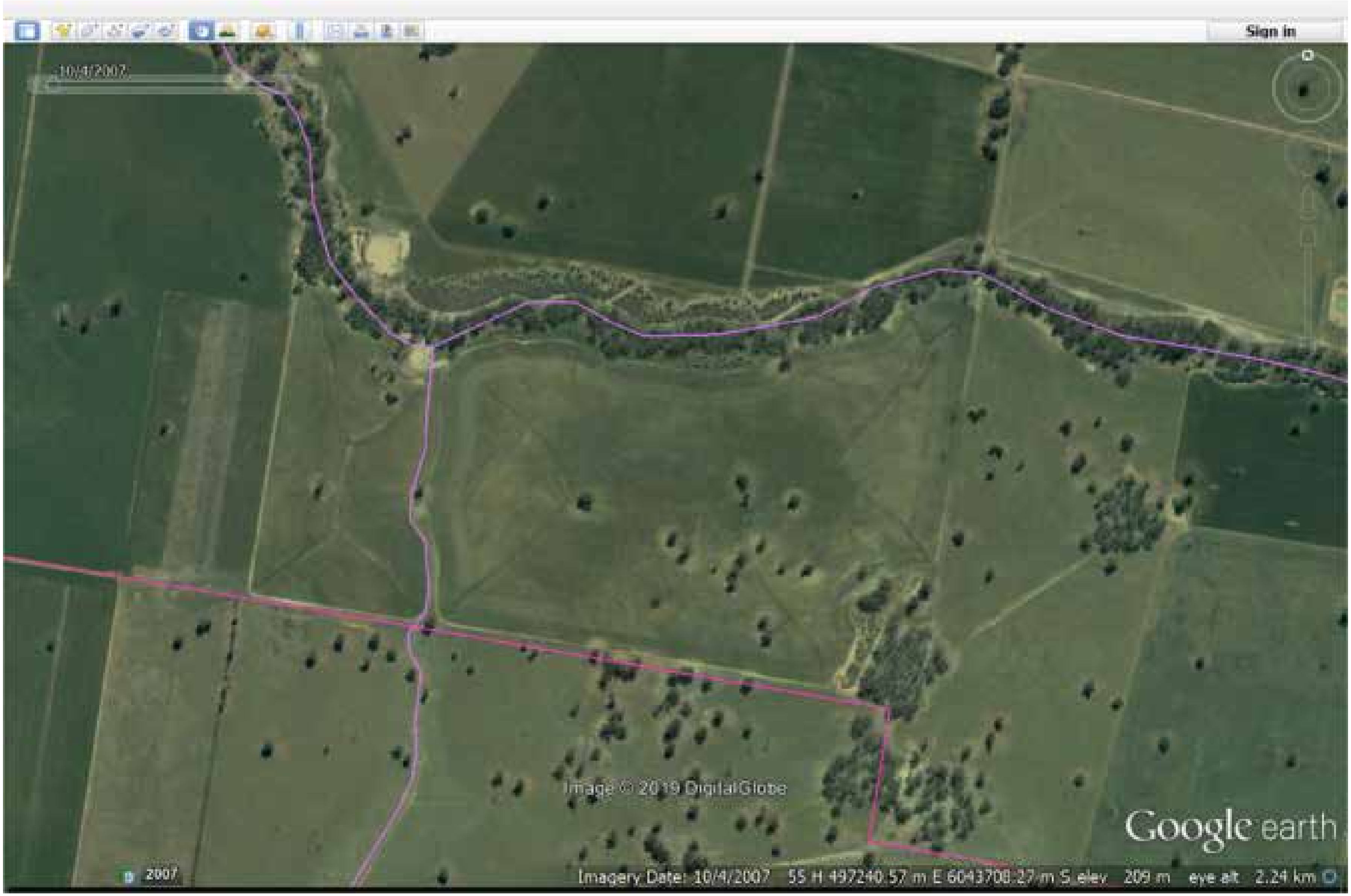

Figure 4 Aerial Imagery 2007

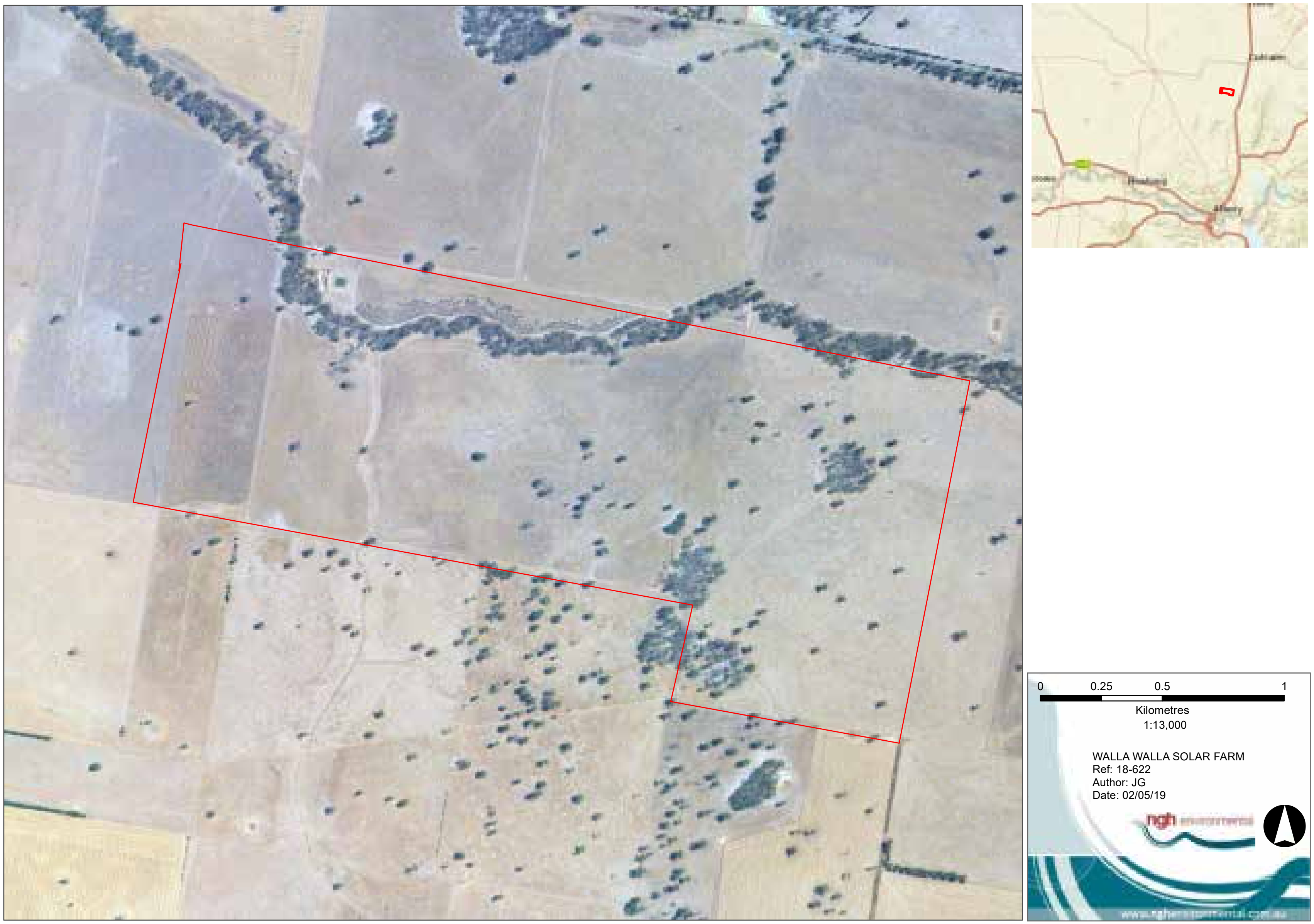

Figure 5 Aerial Imagery 2003

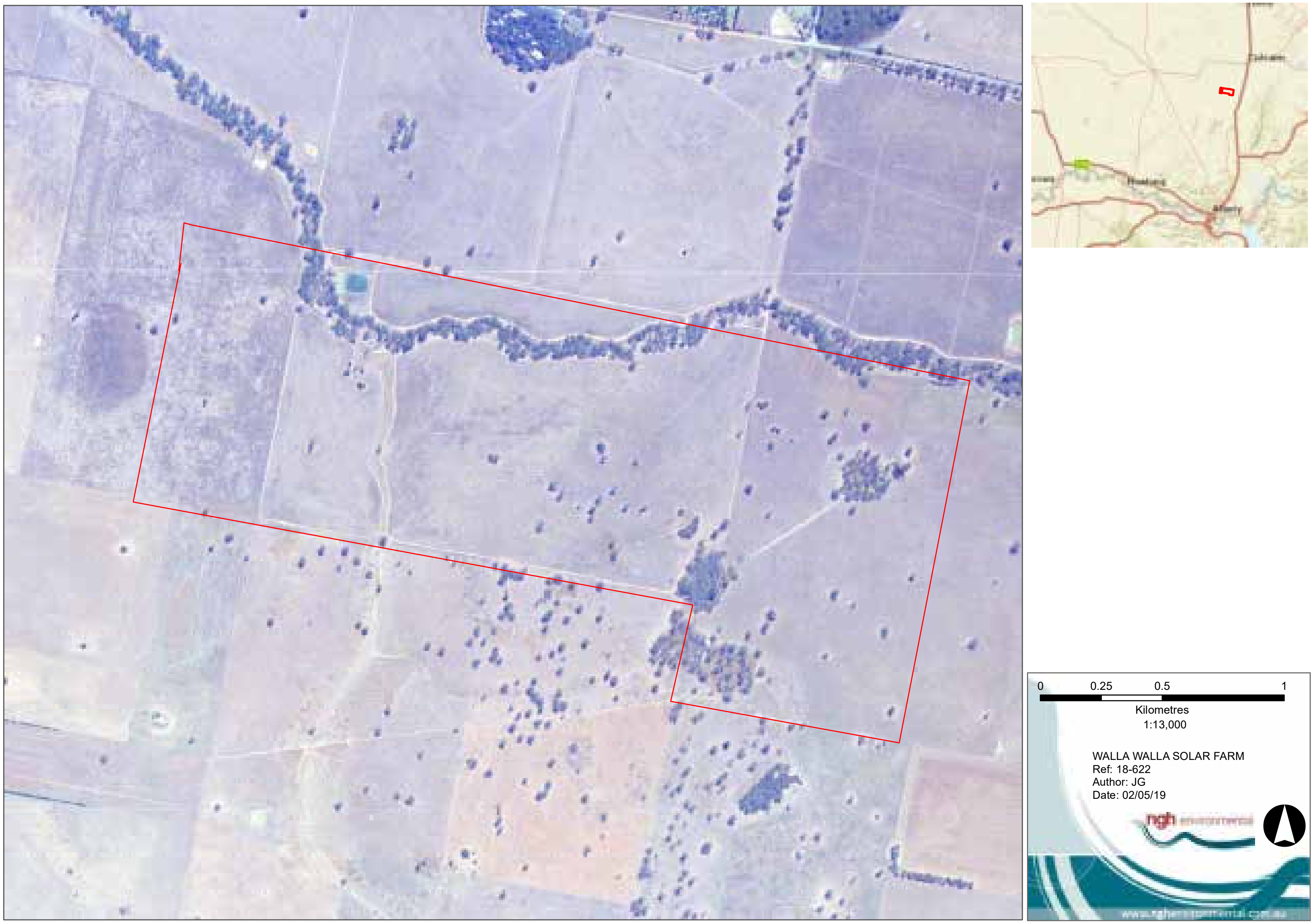

Figure 6 Aerial Imagery 1996

Figure 7 Aerial Imagery 1990

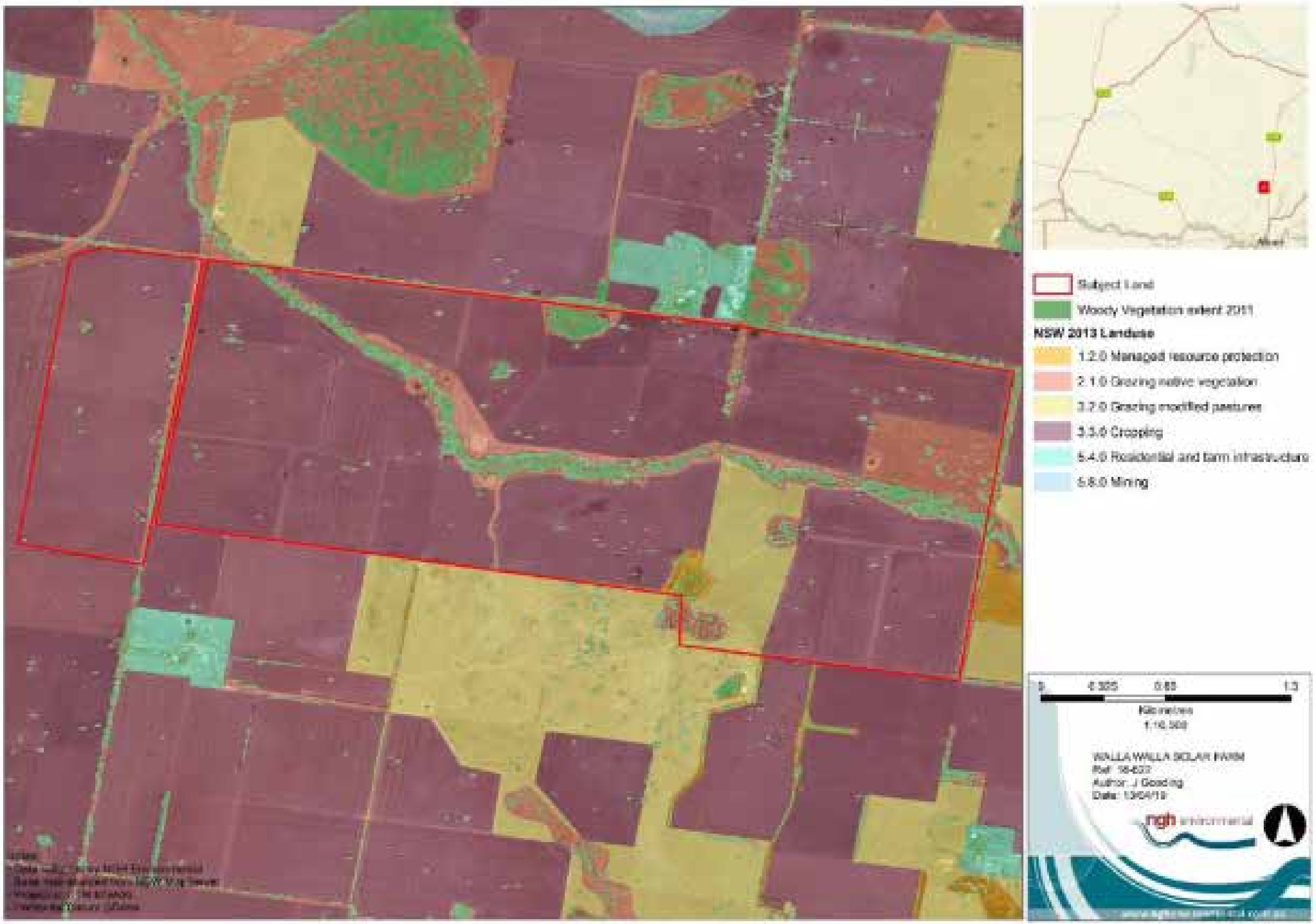

Figure 8 Woody Vegetation Extent and 2017 Landuse Mapping

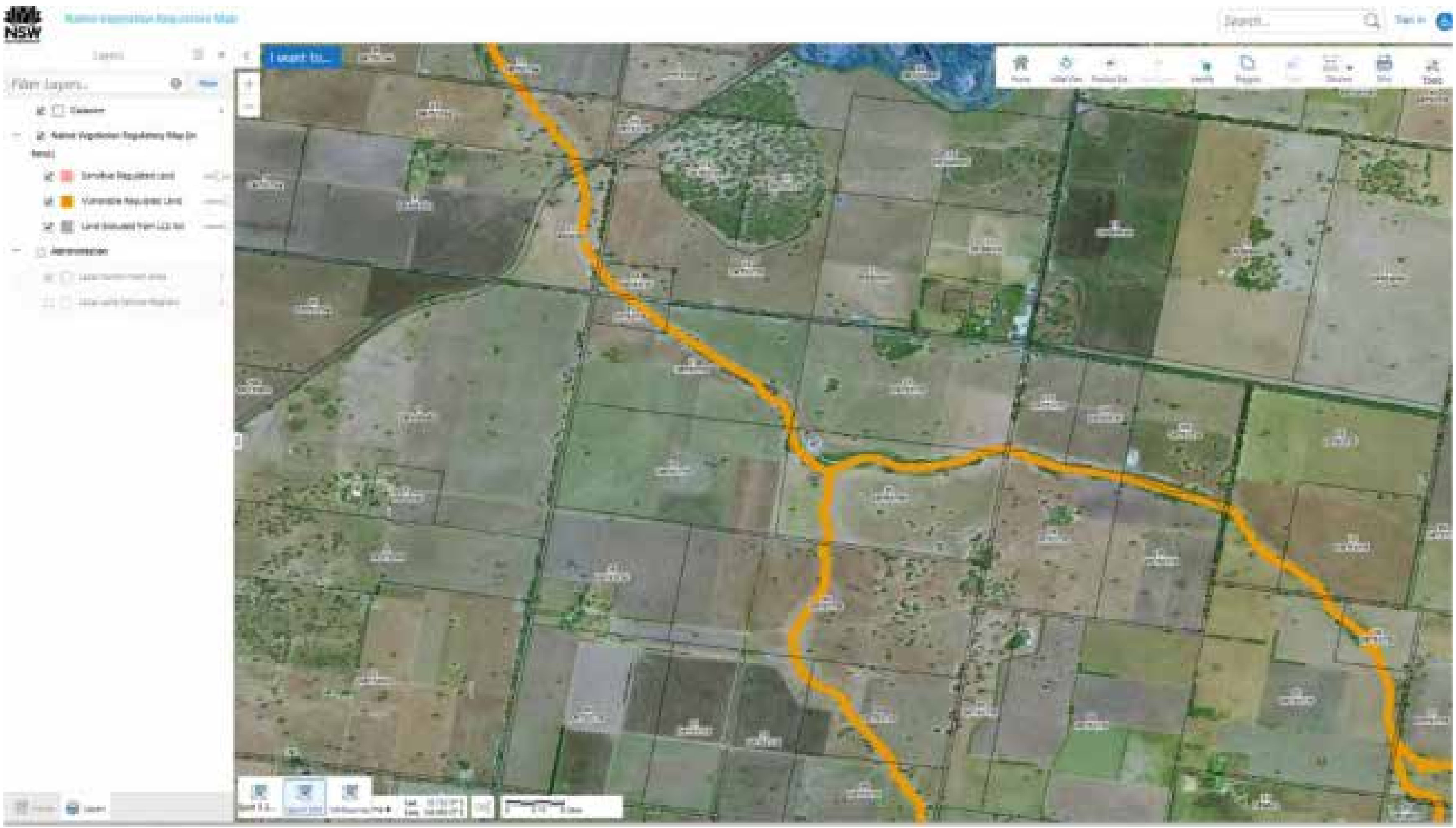

Figure 9 Native Vegetation Regulatory Mapping

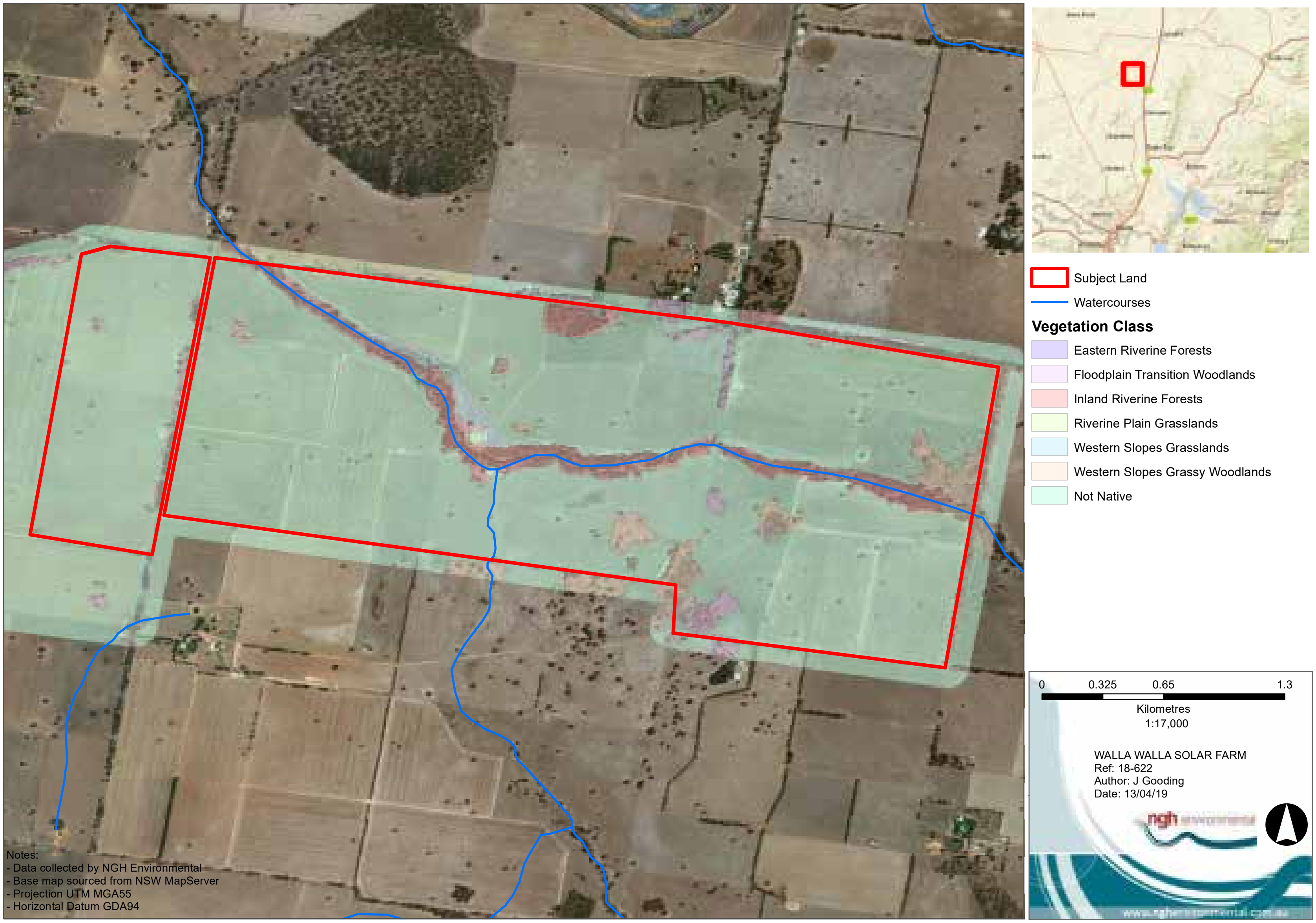

Figure 10 State Vegetation Mapping

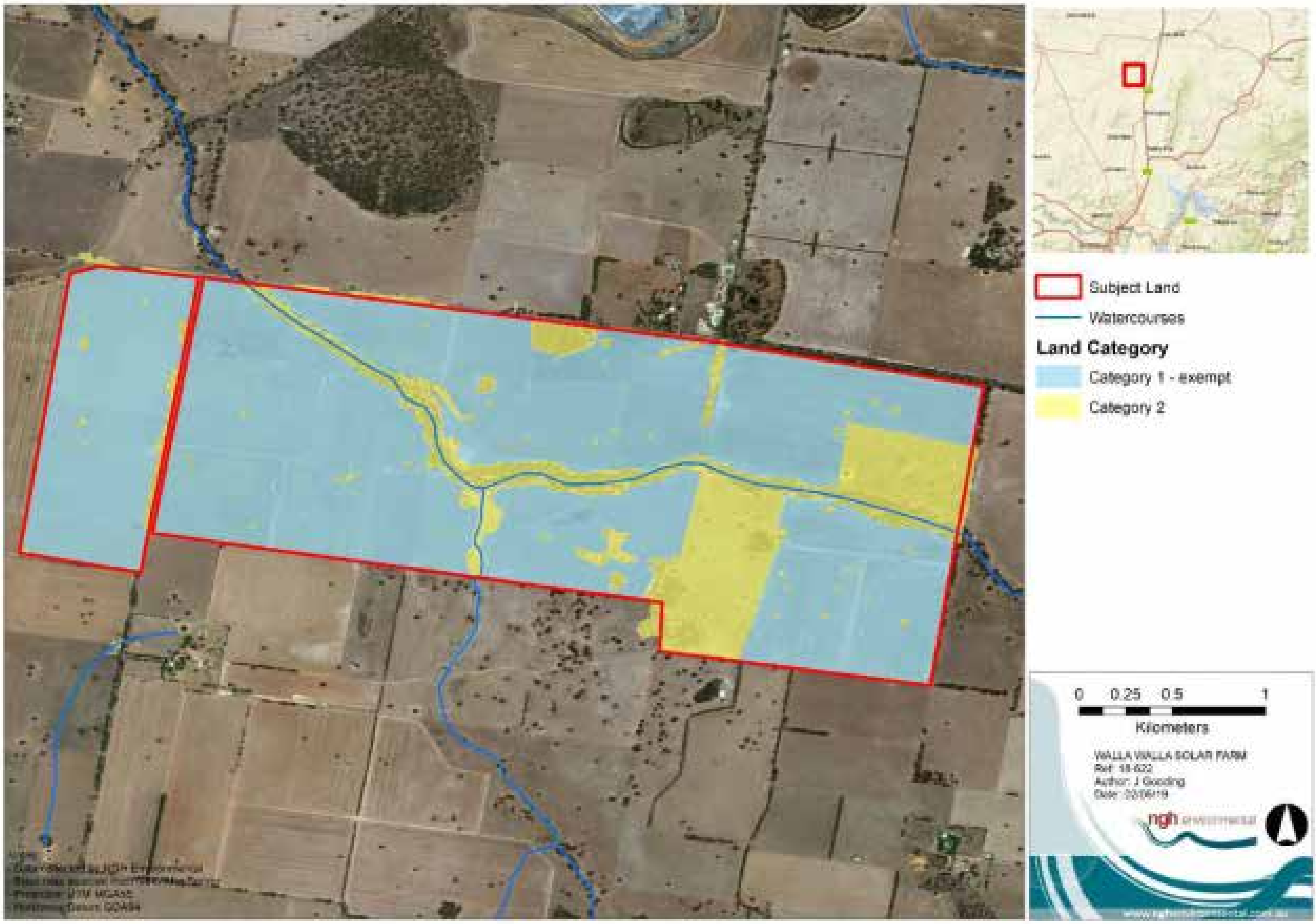

Figure 11 Land Categorisation Map

Office of Environment & Heritage
NSW GOVERNMENT

Your reference:	SSD 9874
Our reference:	DOC19/309449
Contact:	Miranda Kerr Ph 02 6022 0607
Date:	29 May 2019

Julie Gooding
Environmental Consultant - Ecologist
NGH Environmental
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Via email: julie.g@nghenvironmental.com.au

Dear Julie

RE: Walla Walla Solar Farm BDAR – Identification of category 1-exempt land

I refer to your emails dated 13 and 20 May 2019 seeking comment from the Office and Environment and Heritage (OEH) about the identification of category 1-exempt land on the site of the proposed Walla Walla Solar Farm in Greater Hume Shire.

We have reviewed the letter dated 20 May 2019 describing the methods used to evaluate land categorisation for the proposal site, noting that the original submission dated 13 May was revised based on verbal feedback provided by Miranda Kerr on Monday 20 May. This response relates to guidance provided by OEH to NGH Environmental for identifying category 1-exempt land at the proposed Finley South Solar Farm on 9 April 2019 (**Attachment A**).

OEH considers the determination of category 1-exempt and category 2-regulated land as shown in Figure 11 'Land Categorisation Map' to be a reasonable approximation of those categories likely to be mapped on the Native Vegetation Regulatory (NVR) map.

As recommended by OEH, the method used by NGH Environmental for determining these categories includes multiple lines of evidence, i.e. aerial imagery with multiple dates, 2017 land use data OEH 2011 woody vegetation extent, and information from the NVR map portal. We support the precautionary approach to classifying Lot 88 into category 2-regulated land.

We note that the NVR Map Method assigns landuse category 2.1.0 'Grazing native vegetation' to category 2-regulated land. Part of Lot 109 DP 753735 is mapped by the 2017 Land Use dataset as 2.1.0.

Use of mapping products to determine presence of exotic vegetation does not follow the NVR Map method. Any identification of non-native vegetation on land where the Biodiversity Assessment Method (BAM) applies is not relevant to the determination of category 1-exempt land. This information, including reference to the Riverina State Vegetation Mapping (VISID_4469), is part of the BAM assessment.

Recommended actions:

- Consistent with the information provided on the OEH Biodiversity Reforms FAQ website, the area of land determined to be category 1-exempt land should be clearly indicated in the application for planning approval submitted to a consent authority.
- We suggest that the document be revised to remove Figure 2 and Figure 10 and any text relating to identification of non-native vegetation undertaken for the BAM assessment. This information would be relevant to the Biodiversity Development Assessment Report (BDAR).

Please note that a development on category 1-exempt land may involve other biodiversity impacts for which a BDAR will still be required if:

- The development will have a prescribed impact on land mapped on the biodiversity values map (prescribed impacts are listed in clause 6.1 of the BC Regulation), not including native vegetation clearing associated with the prescribed impact.
- A test of significance finds that a significant impact on threatened species, ecological communities or their habitats is likely to result from the proposed development.

If you have any questions regarding this matter, please contact Miranda Kerr on (02) 6022 0607 or email rog.southwest@environment.nsw.gov.au.

Yours sincerely

ANDREW FISHER
Senior Team Leader Planning
South West Branch
Conservation and Regional Delivery
Office of Environment & Heritage

ATTACHMENT A Emailed guidance from OEH to NGH Environmental for approximating the NVR map 'category 1-exempt land' (Finley South Solar Farm).

APPENDIX B PLOT FIELD DATA

Exotic	Scientific Name	Common Name	plot 1		plot 2		plot 3		plot 4		plot 5		plot 6		plot 7		plot 8		plot 9		plot 10	
			76_grazed		277_planted		277_grazed		76_grazed		76_wetland		76_grassland		76_roadside		76_roadside		exotic		5_wetland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	TREES																					
	Brachychiton populneus	Kurrajong															1	24				
	Eucalyptus blakelyi	Blakely's Red Gum					4	1														
	Eucalyptus camaldulensis	River Red Gum																			20	12
	Eucalyptus melliodora	Yellow Box			2	1																
	Eucalyptus microcarpa	Western Grey Box	12.5	2					5	5	15	1			30	4	15	2				
	Eucalyptus sideroxylon	Mugga Ironbark			5	2																
*	*Schinus molle var. areira*	Pepper Tree															5	1				
	Melia azedarach	White Cedar															0.5	4				
	SHRUBS																					
*	*Prunus sp.*														0.1	3						
	FORBS																					
	Alternanthera denticulata	Lesser Joyweed									0.1	1									0.2	60
*	*Arctotheca calendula*	Capeweed			0.1	5	0.1	5			0.1	30										
*	*Brassica sp.*				0.1	20																
*	*Carthamus lanatus*	Saffron Thistle																			0.1	8
*	*Cirsium Vulgare*	Spear Thistle									0.1	1									0.1	1
*	*Conyza sp.*	Fleabane																			0.1	1
*	*Cucumis sp.*																					
	Cymbonotus preissianus	Austral Bear's Ear									0.1	1										

Exotic	Scientific Name	Common Name	plot 1		plot 2		plot 3		plot 4		plot 5		plot 6		plot 7		plot 8		plot 9		plot 10	
			76_grazed		277_planted		277_grazed		76_grazed		76_wetland		76_grassland		76_roadside		76_roadside		exotic		5_wetland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Dichondra sp.																					
*	*Echium plantagineum*	Patterson's Curse																				
	Einadia nutans	Climbing Saltbush													0.1	5						
	Erodium sp.																					
	Euphorbia drummondii	Caustic weed											0.1	10	0.1	5						
*	*Hypochaeris radicata*	Catsear					0.1	1					0.1	1			0.1	1			0.1	30
*	*Lactuca serriola*	Prickly Lettuce																			0.1	2
*	*Lepidium africanum*	Common Peppercress															0.1	2				
	Lythrum hyssopifolia	Hyssop Loosestrife									0.1	1										
*	*Malva parviflora*	Mallow	0.1	1			0.1	1	0.1	3												
*	*Malva sp.*														0.1	2	0.1	10				
*	*Medicago sativa*	Lucerne																				
*	*Medicago sp.*						1	500													1	500
	Oxalis perennans																0.1	20				
	Oxalis sp.																					
	Persicaria sp.	Knot weed																				
*	*Plantago lanceolata*														0.5	200						
*	*Polygonum aviculare*	Wireweed	0.1	1	0.1	5			0.1	2	0.1	10										
	Pratia sp.																					
*	*Romulea rosea*	Onion Grass											0.1	10								
	Rumex brownii	Swamp Dock																			0.1	1

Exotic	Scientific Name	Common Name	plot 1 76_grazed		plot 2 277_planted		plot 3 277_grazed		plot 4 76_grazed		plot 5 76_wetland		plot 6 76_grassland		plot 7 76_roadside		plot 8 76_roadside		plot 9 exotic		plot 10 5_wetland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	*Rumex obtusifolius*	Broadleaf Dock																				
*	*Rumex sp. Exotic*										0.1	1										
	Rumex sp. native																					
	Sida corrugata	Corrugated Sida													0.2	50	0.5	45				
	Sida cunninghamii	Ridge Sida																				
*	*Silybum marianum*	Variegated Thistle																				
*	*Sonchus oleraceus*	Sow Thistle									0.1	1			0.1	2						
*	*Tribulus terrestris*	Cat-head																				
*	*Trifolium sp.*	Clover			1	100					0.5	100	0.1	20					20	6000		
*	*Trifolium subterraneum*	Subterranean Clover																	0.1	150		
	Unidentified forb	Unidentified																	0.1	1	0.1	1
	Unidentified forb	Unidentified																			0.2	5
*	*Sanguisorba minor subsp. muricata*	Sheep's Burnet													0.1	25						
	GRASSES AND GRASSLIKE																					
*	*Anthosachae scabra*	Native Wheat													0.1	100						
	Aristida behriana	Bunch Wiregrass																				
	Austrostipa blackii														0.2	30						
	Austrostipa scabra	Speargrass													0.1	30						

Exotic	Scientific Name	Common Name	plot 1		plot 2		plot 3		plot 4		plot 5		plot 6		plot 7		plot 8		plot 9		plot 10	
			76_grazed		277_planted		277_grazed		76_grazed		76_wetland		76_grassland		76_roadside		76_roadside		exotic		5_wetland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	*Avena fatua*	Wild Oats					1	500									10	1000				
*	*Avena sp.*	Unidentified													1	500						
*	*Briza minor*	Shivery Grass									0.1	1										
*	*Bromus catharticus*	Praire Grass													0.1	10						
*	*Bromus diandrus*	Great Brome					0.2	50	0.2	100					30	5000	20	1000				
*	*Bromus molliformis*	Soft Brome			10	1000	1	500			0.5	100	1	100								
	Carex sp.																				0.1	1
*	*Cenchrus clandestinus*	Kikuyu																				
	Chloris truncata	Windmill Grass									0.3	50	15	1000			0.1	5				
	Cynodon dactylon	Common Couch			0.1	5	0.1	5	0.1	10	0.5	10									0.1	10
	Cyperus sp.										5	100										
	Eleocharis sp.																				0.1	1
	Enteropogon ramosus	Curly Windmill Grass															0.2	20				
	Eragrostis sp.	A love Grass																				
*	*Hordeum leporinum*	Barley Grass	5	1000	40	1000	40	1000	30	1000	10	1000	15	1000	0.1	200	0.1	50				
*	*Isolepis marginata*	Green Sedge																				
	Juncus sp. 1	Rush																			0.1	4
	Juncus sp. 2	Rush																			0.1	50
	Juncus subsecundus	Finger Rush													0.1	50						
	Juncus usitatus	Rush									10	200										

Exotic	Scientific Name	Common Name	plot 1		plot 2		plot 3		plot 4		plot 5		plot 6		plot 7		plot 8		plot 9		plot 10	
			76_grazed		277_planted		277_grazed		76_grazed		76_wetland		76_grassland		76_roadside		76_roadside		exotic		5_wetland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	*Lolium sp.*	Rye Grass	1	100			10	1000	2	1000	10	1000	15	1000	0.5	1000	0.1	200	5	1000	0.1	80
	Lomandra filiformis	Wattle Matt-rush													0.5	100						
	Panicum effusum	Hairy Panic																				
	Panicum sp.																				0.2	50
*	*Paspalum dilatatum*	Paspalum													0.1	2						
*	*Pentachistus aeoides*	False Hair Grass									0.1	20										
*	*Phalaris aquatica*	Phalaris							0.1	10	5	50	2	50			0.1	5	60	500		
	Rytidosperma auriculatum	Lobed Wallaby Grass																				
	Rytidosperma sp. 1	Wallaby Grass									1	20	1	100	0.1	100	25	750				
	Rytidosperma sp. 2	Wallaby Grass													0.2	150						
	Rytidosperma sp. 3	Wallaby Grass																				
*	*Triticum aestivum*	Wheat													0.5	1000						
*	*Vulpia myuros*	Rats Tail Grass											15	1000								
	Vulpia sp.	Silver Grass																	0.1	20		

Exotic	Scientific Name	Common Name	plot 11		plot 12		plot 13		plot 14		plot 15		plot 16		plot 17		plot 18		plot 19		plot 20	
			5_grazed		5_low		5_wetland		76_grazed		76_grassland		5_wetland		exotic		76_wetland		76_grassland		76_woodland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	TREES																					
	Brachychiton populneus	Kurrajong																				
	Eucalyptus blakelyi	Blakely's Red Gum																				
	Eucalyptus camaldulensis	River Red Gum	10	1	0.2	1	15	6					10	8								
	Eucalyptus melliodora	Yellow Box																				
	Eucalyptus microcarpa	Western Grey Box							0.2	1											18	1
	Eucalyptus sideroxylon	Mugga Ironbark																				
*	*Schinus molle var. areira*	Pepper Tree																				
	Melia azedarach	White Cedar																				
	SHRUBS																					
*	*Prunus sp.*																					
	FORBS																					
	Alternanthera denticulata	Lesser Joyweed																				
*	*Arctotheca calendula*	Capeweed									0.1	2										
*	*Brassica sp.*																0.1	1				
*	*Carthamus lanatus*	Saffron Thistle																				
*	*Cirsium Vulgare*	Spear Thistle																				
*	*Conyza sp.*	Fleabane																				
*	*Cucumis sp.*																					
	Cymbonotus preissianus	Austral Bear's Ear																				

Exotic	Scientific Name	Common Name	plot 11		plot 12		plot 13		plot 14		plot 15		plot 16		plot 17		plot 18		plot 19		plot 20	
			5_grazed		5_low		5_wetland		76_grazed		76_grassland		5_wetland		exotic		76_wetland		76_grassland		76_woodland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Dichondra sp.								0.1	30												
*	*Echium plantagineum*	Patterson's Curse							0.1	10												
	Einadia nutans	Climbing Saltbush																				
	Erodium sp.								0.1	9	0.1	10							0.1	1		
	Euphorbia drummondii	Caustic weed			0.1	25	0.1	2									0.1	2	0.1	6		
*	*Hypochaeris radicata*	Catsear					0.1	20	2	600	0.1	12									0.1	1
*	*Lactuca serriola*	Prickly Lettuce							0.1	2												
*	*Lepidium africanum*	Common Peppercress																				
	Lythrum hyssopifolia	Hyssop Loosestrife							0.1	5												
*	*Malva parviflora*	Mallow																				
*	*Malva sp.*																				0.1	20
*	*Medicago sativa*	Lucerne																			0.1	3
*	*Medicago sp.*																					
	Mentha sp.								0.1	2												
	Oxalis perennans										0.1	15			0.01	60	0.5	200	0.1	3	0.1	5
	Oxalis sp.																					
	Persicaria sp.	Knot weed																				
*	*Plantago lanceolata*																					
*	*Polygonum aviculare*	Wireweed	0.1	15			0.1	7	0.1	3									0.1	50	0.1	20
	Pratia sp.																					

Exotic	Scientific Name	Common Name	plot 11		plot 12		plot 13		plot 14		plot 15		plot 16		plot 17		plot 18		plot 19		plot 20	
			5_grazed		5_low		5_wetland		76_grazed		76_grassland		5_wetland		exotic		76_wetland		76_grassland		76_woodland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	*Romulea rosea*	Onion Grass					0.1	25	0.1	150	0.1	30					0.1	10				
	Rumex brownii	Swamp Dock																				
*	*Rumex obtusifolius*	Broadleaf Dock											0.2	7								
*	*Rumex sp. Exotic*														0.1	3						
	Rumex sp. native		0.1	2																		
	Sida corrugata	Corrugated Sida																				
	Sida cunninghamii	Ridge Sida																	0.1	4		
*	*Silybum marianum*	Variegated Thistle																				
*	*Sonchus oleraceus*	Sow Thistle							0.3	50	0.1	6										
*	*Tribulus terrestris*	Cat-head																				
*	*Trifolium sp.*	Clover			15	1000	0.1	2	0.1	40									0.1	5	0.1	5
*	*Trifolium subterraneum*	Subterranean Clover							0.5	500	0.1	50	0.1	20			10	1000				
	Unidentified forb	Unidentified													20	1000						
	Unidentified forb	Unidentified							0.1	2												
*	*Sanguisorba minor subsp. muricata*	Sheep's Burnet																				
	GRASSES AND GRASS LIKE																					
*	*Anthosachae scabra*	Native Wheat																				
	Aristida behriana	Bunch Wiregrass			0.1	1																

Exotic	Scientific Name	Common Name	plot 11		plot 12		plot 13		plot 14		plot 15		plot 16		plot 17		plot 18		plot 19		plot 20	
			5_grazed		5_low		5_wetland		76_grazed		76_grassland		5_wetland		exotic		76_wetland		76_grassland		76_woodland	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Austrostipa blackii																					
	Austrostipa scabra	Speargrass																				
*	*Avena fatua*	Wild Oats																				
*	*Avena sp.*	Unidentified																				
*	*Briza minor*	Shivery Grass																				
*	*Bromus catharticus*	Praire Grass																				
*	*Bromus diandrus*	Great Brome																	0.1	10		
*	*Bromus molliformis*	Soft Brome			0.1	2			0.5	50	0.1	100			0.2	250	0.1	150				
	Carex sp.												0.5	400			1	100			0.1	15
*	*Cenchrus clandestinus*	Kikuyu			10	200																
	Chloris truncata	Windmill Grass							0.1	1	5	1000	0.1	1			2	500	35	500	0.5	50
	Cynodon dactylon	Common Couch			10	1000					0.5	150					0.1	3				
	Cyperus sp.																					
	Eleocharis sp.																					
	Enteropogon ramosus	Curly Windmill Grass																				
	Eragrostis sp.	A love Grass																				
*	*Hordeum leporinum*	Barley Grass	0.1	10	60	1000	15	200			0.1	40	0.1	5	0.01	20	25	1000	40		25	500
*	*Isolepis marginata*	Green Sedge																				
	Juncus sp. 1	Rush							0.5	50	0.2	18	50	150	0.01	4	0.5	30			0.1	1
	Juncus sp. 2	Rush							0.1	1												

Exotic	Scientific Name	Common Name	**plot 11**		**plot 12**		**plot 13**		**plot 14**		**plot 15**		**plot 16**		**plot 17**		**plot 18**		**plot 19**		**plot 20**	
			5_grazed		5_low		5_wetland		76_grazed		76_grassland		5_wetland		exotic		76_wetland		76_grassland		76_woodland	
			%	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**
	Juncus subsecundus	Finger Rush					15	200														
	Juncus usitatus	Rush																				
*	*Lolium sp.*	Rye Grass	60	2000	10	1000	2	1000	5	1000	0.5	1000	1	1000	0.5	500	1	1000	0.5		1	200
	Lomandra filiformis	Wattle Matt-rush																				
	Panicum effusum	Hairy Panic											0.5	150								
	Panicum sp.												2	150								
*	*Paspalum dilatatum*	Paspalum																				
*	*Pentachistus aeoides*	False Hair Grass																				
*	*Phalaris aquatica*	Phalaris	0.1	100	0.1	11	0.1	4	3	150	0.5	30				200					30	200
	Rytidosperma auriculatum	Lobed Wallaby Grass									0.1	500										
	Rytidosperma sp. 1	Wallaby Grass					1	300	0.1	10							5	0.1			0.1	4
	Rytidosperma sp. 2	Wallaby Grass																			0.1	2
	Rytidosperma sp. 3	Wallaby Grass			0.1	1																
*	*Triticum aestivum*	Wheat																				
*	*Vulpia myuros*	Rats Tail Grass									5	5000	0.1	15								
	Vulpia sp.	Silver Grass			0.1	200			5	1000					20	1000	0.5	50	10			

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	TREES																					
	Brachychiton populneus	Kurrajong																				
	Eucalyptus blakelyi	Blakely's Red Gum																			7	1
	Eucalyptus camaldulensis	River Red Gum							10	8							20	36				
	Eucalyptus melliodora	Yellow Box									12	1										
	Eucalyptus microcarpa	Western Grey Box																	30	3		
	Eucalyptus sideroxylon	Mugga Ironbark																				
*	*Schinus molle var. areira*	Pepper Tree																				
	Melia azedarach	White Cedar																				
	SHRUBS																					
*	*Prunus sp.*																					
	FORBS																					
	Alternanthera denticulata	Lesser Joyweed																				
*	*Arctotheca calendula*	Capeweed																			5	50
*	*Brassica sp.*																					
*	*Brassica napus*	*Canola*																				
*	*Carthamus lanatus*	Saffron Thistle	0.1	1									0.1	5								
*	*Cirsium Vulgare*	Spear Thistle																				
*	*Citrullus lanatus lanatus*	Camel Melon													0.1	1						

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
*	*Conyza sp.*	Fleabane																				
*	*Cucumis myriocarpus*	Paddy Melon					0.1	1														
	Cymbonotus preissianus	Austral Bear's Ear																				
	Dichondra sp.																					
*	*Echium plantagineum*	Patterson's Curse													0.1	2						
	Einadia nutans	Climbing Saltbush																				
	Erodium sp.		0.1	2											0.1	1						
*	*Erodium botrys*	Long Storksbill																				
	Euphorbia drummondii	Caustic weed	0.1	50	0.1	10	0.1	20					0.1	20	0.1	5						
*	*Hypochaeris radicata*	Catsear	0.1	20	0.1	20	0.1	3	0.1	5					0.1	20						
*	*Lactuca serriola*	Prickly Lettuce			0.1	5																
*	*Lepidium africanum*	Common Peppercress																				
	Lythrum hyssopifolia	Hyssop Loosestrife																				
*	*Malva parviflora*	Mallow																			20	100+
*	*Malva sp.*										0.1	30										
*	*Medicago arabica*	Spotted Burr Medic																				
*	*Medicago sativa*	Lucerne																				
*	*Medicago sp.*		0.1	50	0.1	20																
	Mentha sp.																					
	Oxalis perennans		2.1	20			0.1	2														

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Oxalis sp.				0.1	1																
	Persicaria sp.	Knot weed			0.1	5	0.1	1														
*	*Plantago lanceolata*																					
*	*Polygonum aviculare*	Wireweed			0.5	100													0.1	1		
	Pratia sp.				0.1	50																
*	*Romulea rosea*	Onion Grass	0.1	50			0.1	3	0.1	100												
	Rumex brownii	Swamp Dock			0.1	1			0.1	1												
*	*Rumex obtusifolius*	Broadleaf Dock																				
*	*Rumex sp. Exotic*	Dock																				
	Rumex sp. native	Dock																				
*	*Solanum nigrum*	Blackberry Nightshade																			0.1	1
	Sida corrugata	Corrugated Sida																				
	Sida cunninghamii	Ridge Sida					0.1	1														
*	*Silybum marianum*	Variegated Thistle			0.1	10															2.5	60
*	*Sonchus oleraceus*	Sow Thistle							0.1	1												
*	*Tribulus terrestris*	Cat-head									0.1	20										
*	*Trifolium sp.*	Clover							0.1	5											0.1	50
*	*Trifolium subterraneum*	Subterranean Clover																				
	Unidentified forb	Unidentified																				

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Unidentified forb	Unidentified																				
*	*Sanguisorba minor subsp. muricata*	Sheep's Burnet																				
*	*Xanthium spinosum*	Bathurst Burr													0.1	2					0.1	1
	GRASSES AND GRASSLIKE																					
*	*Anthosachae scabra*	Native Wheat															0.1	20				
	Aristida behriana	Bunch Wiregrass																				
	Austrostipa blackii																					
	Austrostipa scabra	Speargrass																				
*	*Avena fatua*	Wild Oats											0.5	500	5	1000			1	500		
*	*Avena sp.*	Unidentified																				
*	*Briza minor*	Shivery Grass																				
*	*Bromus catharticus*	Praire Grass															1	1000				
*	*Bromus diandrus*	Great Brome	0.1	50	0.1	50	10		0.5	200									1	500		
*	*Bromus molliformis*	Soft Brome											0.1	100	0.1	100						
	Carex sp.		0.1	20			0.1	20														
*	*Cenchrus clandestinus*	Kikuyu																				
	Chloris truncata	Windmill Grass	45	300			40	1000	0.1	20			15	1000	2	150						
	Cynodon dactylon	Common Couch					0.1	20														
	Cyperus sp.																					

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Eleocharis sp.																					
	Enteropogon ramosus	Curly Windmill Grass																				
	Eragrostis sp.	A love Grass			3	500																
*	*Hordeum leporinum*	Barley Grass	10	1000	5	200			0.1	100	80	1000	2	1000			0.5	500	10	1000		
*	*Isolepis marginata*	Green Sedge			0.1	2			0.1	2												
	Juncus sp. 1	Rush	0.1	1	25	300	0.5	9														
	Juncus sp. 2	Rush							0.2	50												
	Juncus subsecundus	Finger Rush																				
	Juncus usitatus	Rush							0.1	10			0.2	20								
*	*Lolium sp.*	Rye Grass	0.1		0.1	200	0.1	50	1	500			0.1	500	0.1	100	0.5	100	10	1000	20	1000
	Lomandra filiformis	Wattle Matt-rush																				
	Microlaena stipoides	Weeping Meadow Grass															10	1000				
	Panicum effusum	Hairy Panic																				
	Panicum sp.																					
*	*Paspalum dilatatum*	Paspalum																				
*	*Pentachistus aeoides*	False Hair Grass																				
*	*Phalaris aquatica*	Phalaris	2	50	10	100	0.5	30	70						10	100			5	50	0.1	1
	Rytidosperma auriculatum	Lobed Wallaby Grass																				

Exotic	Scientific Name	Common Name	plot 21		plot 22		plot 23		plot 24		plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
			76_grassland		76_wetland		76_grassland		76_grassland		76_grassland		76_grassland		76_grassland		5_Creekline		76_woodland		277_Grazed	
			%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#
	Rytidosperma sp. 1	Wallaby Grass	0.1	8	0.1	50	0.1	1									20	1000				
	Rytidosperma sp. 2	Wallaby Grass																				
	Rytidosperma sp. 3	Wallaby Grass																				
*	*Triticum aestivum*	Wheat																				
*	*Vulpia myuros*	Rats Tail Grass																				
	Vulpia sp.	Silver Grass	0.1	20	0.1	6	10	500	1	1000			2	1000								

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
	TREES							
	Brachychiton populneus	Kurrajong						
	Eucalyptus blakelyi	Blakely's Red Gum						
	Eucalyptus camaldulensis	River Red Gum						
	Eucalyptus melliodora	Yellow Box						
	Eucalyptus microcarpa	Western Grey Box						
	Eucalyptus sideroxylon	Mugga Ironbark						
*	*Schinus molle var. areira*	Pepper Tree						

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
	Melia azedarach	White Cedar						
	SHRUBS							
*	*Prunus sp.*							
	FORBS							
	Alternanthera denticulata	Lesser Joyweed						
*	*Arctotheca calendula*	Capeweed	10	1000	15	200	40	1000
*	*Brassica sp.*							
*	*Brassica napus*	*Canola*					0.1	1
*	*Carthamus lanatus*	Saffron Thistle						
*	*Cirsium Vulgare*	Spear Thistle						
*	*Citrullus lanatus lanatus*	Camel Melon						
*	*Conyza sp.*	Fleabane						
*	*Cucumis myriocarpus*	Paddy Melon						
	Cymbonotus preissianus	Austral Bear's Ear						
	Dichondra sp.	Kidney Weed						
*	*Echium plantagineum*	Patterson's Curse	5	100				
	Einadia nutans	Climbing Saltbush						
	Erodium sp.	Stork'sbill						
*	*Erodium botrys*	Long Storksbill	10	100	20	500	10	500

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
	Euphorbia drummondii	Caustic weed	0.1	1				
*	*Hypochaeris radicata*	Catsear			2	20		
*	*Lactuca serriola*	Prickly Lettuce						
*	*Lepidium africanum*	Common Peppercress						
	Lythrum hyssopifolia	Hyssop Loosestrife						
*	*Malva parviflora*	Mallow						
*	*Malva sp.*							
*	*Medicago arabica*	Spotted Burr Medic					20	200
*	*Medicago sativa*	Lucerne						
*	*Medicago sp.*							
	Mentha sp.							
	Oxalis perennans							
	Oxalis sp.							
	Persicaria sp.	Knot weed						
*	*Plantago lanceolata*							
*	*Portulaca oleracea*	Pigweed	0.5	10				
*	*Polygonum aviculare*	Wireweed						
	Pratia sp.							
*	*Romulea rosea*	Onion Grass	40	1000	45	1000	15	1000
	Rumex brownii	Swamp Dock						

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
*	*Rumex obtusifolius*	Broadleaf Dock						
*	*Rumex sp. Exotic*							
	Rumex sp. native							
	Sida corrugata	Corrugated Sida						
	Sida cunninghamii	Ridge Sida						
*	*Silybum marianum*	Variegated Thistle						
*	*Sonchus oleraceus*	Sow Thistle						
*	*Tribulus terrestris*	Cat-head						
*	*Trifolium sp.*	Clover	0.1	1	5	100		
*	*Trifolium subterraneum*	Subterranean Clover						
	Unidentified forb	Unidentified						
	Unidentified forb	Unidentified						
*	*Sanguisorba minor subsp. muricata*	Sheep's Burnet						
*	*Xanthium spinosum*	Bathurst Burr						
GRASSES AND GRASSLIKE								
*	*Anthosachae scabra*	Native Wheat						
	Aristida behriana	Bunch Wiregrass						
	Austrostipa blackii							

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
	Austrostipa scabra	Speargrass						
*	*Avena fatua*	Wild Oats						
*	*Avena sp.*	Unidentified						
*	*Briza minor*	Shivery Grass						
*	*Bromus catharticus*	Praire Grass						
*	*Bromus diandrus*	Great Brome						
*	*Bromus molliformis*	Soft Brome						
	Carex sp.							
*	*Cenchrus clandestinus*	Kikuyu						
	Chloris truncata	Windmill Grass			5	1000		
	Cynodon dactylon	Common Couch						
	Cyperus sp.							
	Eleocharis sp.							
	Enteropogon ramosus	Curly Windmill Grass			5	100	5	50
	Eragrostis sp.	A love Grass						
*	*Hordeum leporinum*	Barley Grass					3	150
*	*Isolepis marginata*	Green Sedge						
	Juncus sp. 1	Rush			0.1	1	0.1	1
	Juncus sp. 2	Rush						
	Juncus subsecundus	Finger Rush						

Exotic	Scientific Name	Common Name	Plot 31		Plot 32		Plot 33	
			Exotic		76_Grassland		76_Grassland	
			%	#	%	#	%	#
	Juncus usitatus	Rush						
*	*Lolium sp.*	Rye Grass					3	150
	Lomandra filiformis	Wattle Matt-rush						
	Microlaena stipoides	Weeping Meadow Grass						
	Panicum effusum	Hairy Panic						
	Panicum sp.							
*	*Paspalum dilatatum*	Paspalum						
*	*Pentachistus aeoides*	False Hair Grass						
*	*Phalaris aquatica*	Phalaris	5	50	2	50	5	50
	Rytidosperma auriculatum	Lobed Wallaby Grass						
	Rytidosperma sp. 1	Wallaby Grass						
	Rytidosperma sp. 2	Wallaby Grass						
	Rytidosperma sp. 3	Wallaby Grass						
*	*Triticum aestivum*	Wheat						
*	*Vulpia myuros*	Rats Tail Grass						
	Vulpia sp.	Silver Grass						

APPENDIX C PADDOCK TREES

Paddock Tree	Latitude	Longitude	Species Name	PCT	DBH (Cm)	Above Benchmark (50 cm)	Hollows Present	Paddock Tree Class	Removal Required
1	146.953263	-35.745388	Yellow Box	277	200	Yes	No	Class 3	Yes
2	146.961932	-35.741106	Grey Box	76	90	Yes	Yes	Class 3	Yes
3	146.964167	-35.745513	Grey Box	76	300	Yes	Yes	Class 3	Yes
4	146.965147	-35.744801	Grey Box	76	200	Yes	Yes	Class 3	Yes
5	146.965799	-35.746765	Grey Box	76	69	Yes	No	Class 3	Yes
6	146.966283	-35.747035	Grey Box	76	70	Yes	No	Class 3	Yes
7	146.966699	-35.746506	Grey Box	76	100	Yes	Yes	Class 3	Yes
8	146.970326	-35.746664	Grey Box	76	200	Yes	Yes	Class 3	Yes
9	146.97106	-35.746136	Grey Box	76	100	Yes	Yes	Class 3	Yes
10	146.97297	-35.746428	White Cypress	76	60	Yes	No	Class 3	Yes
11	146.970617	-35.742922	Grey Box	76	85	Yes	Yes	Class 3	Yes
12	146.968554	-35.742765	Grey Box	76	90	Yes	Yes	Class 3	Yes
13	146.94834	-35.739938	Grey Box	76	90	Yes	Yes	Class 3	Yes
14	146.945336	-35.740729	Yellow Box	277	100	Yes	Yes	Class 3	No
15	146.943913	-35.743634	Blakely’s Red Gum	277	100	Yes	No	Class 3	No
16	146.945269	-35.745619	Yellow Box	277	90	Yes	Yes	Class 3	Yes
17	146.945174	-35.745768	Yellow Box	277	100	Yes	Yes	Class 3	Yes
18	146.944946	-35.7465	Blakely’s Red Gum	277	100	Yes	Yes	Class 3	Yes
19	146.945226	-35.746707	Yellow Box	277	90	Yes	Yes	Class 3	Yes
20	146.944576	-35.746987	Blakely’s Red Gum	277	100	Yes	Yes	Class 3	Yes
21	146.961145	-35.74779	Grey Box	277	100	Yes	Yes	Class 3	Yes

Paddock Tree	Latitude	Longitude	Species Name	PCT	DBH (Cm)	Above Benchmark (50 cm)	Hollows Present	Paddock Tree Class	Removal Required
22	146.977335	-35.754221	River Red Gum	5	200	Yes	Yes	Class 3	Yes
23	146.977909	-35.754398	Grey Box	76	100	Yes	Yes	Class 3	Yes
24	146.977199	-35.755594	Stag	0	0	n/a	No	Class 1	No
25	146.975406	-35.752328	Grey Box	76	90	Yes	No	Class 3	Yes
26	146.974884	-35.751756	Grey Box	76	90	Yes	No	Class 3	Yes
27	146.981923	-35.746048	Grey Box	76	300	Yes	Yes	Class 3	Yes
28	146.982541	-35.745257	Grey Box	76	300	Yes	No	Class 3	Yes
29	146.983742	-35.744708	Grey Box	76	200	Yes	Yes	Class 3	Yes
30	146.984655	-35.745134	Yellow Box	277	100	Yes	Yes	Class 3	Yes
31	146.979287	-35.7519	Unknown	76	30	Yes	No	Class 3	No
32	146.983	-35.752471	Grey Box	76	200	Yes	Yes	Class 3	Yes
33	146.98241	-35.752971	Grey Box	76	200	Yes	Yes	Class 3	Yes
34	146.981958	-35.753756	Grey Box	76	48	No	Yes	Class 2	Yes
35	146.981279	-35.755164	Grey Box	76	200	Yes	Yes	Class 3	Yes
36	146.981742	-35.756821	Grey Box	76	80	Yes	Yes	Class 3	Yes
37	146.98304	-35.755875	Grey Box	76	100	Yes	Yes	Class 3	Yes
38	146.983356	-35.754288	Grey Box	76	200	Yes	Yes	Class 3	Yes
39	146.985464	-35.751797	Grey Box	76	200	Yes	Yes	Class 3	Yes
40	146.985078	-35.755321	Grey Box	76	100	Yes	Yes	Class 3	Yes
41	146.979107	-35.756742	Grey Box	76	200	Yes	Yes	Class 3	No
42	146.978845	-35.754963	Grey Box	76	200	Yes	Yes	Class 3	Yes
43	146.979136	-35.753015	White Cedar	5	20	No	No	Class 2	Yes
44	146.979498	-35.753769	Grey Box	76	100	Yes	Yes	Class 3	Yes
45	146.969059	-35.752803	Stag	0	n/a	n/a	No	Class 1	Yes

Paddock Tree	Latitude	Longitude	Species Name	PCT	DBH (Cm)	Above Benchmark (50 cm)	Hollows Present	Paddock Tree Class	Removal Required
46	146.967685	-35.751302	Grey Box	76	100	Yes	Yes	Class 3	Yes
47	146.967695	-35.751217	Grey Box	76	100	Yes	Yes	Class 3	Yes
48	146.967649	-35.751169	Grey Box	76	90	Yes	Yes	Class 3	Yes
49	146.96456	-35.751082	Grey Box	76	95	Yes	Yes	Class 3	No
50	146.964741	-35.753132	Grey Box	76	100	Yes	Yes	Class 3	No
51	146.962565	-35.751122	Grey Box	76	100	Yes	No	Class 3	No
52	146.959568	-35.750134	Grey Box	76	80	Yes	Yes	Class 3	Yes
53	146.955843	-35.748087	Grey Box	76	200	Yes	Yes	Class 3	Yes
54	146.955823	-35.748293	Grey Box	76	200	Yes	Yes	Class 3	Yes
55	146.953604	-35.75076	Yellow Box	277	80	Yes	Yes	Class 3	Yes
56	146.953676	-35.75071	Yellow Box	277	300	Yes	Yes	Class 3	Yes
57	146.950635	-35.747355	Blakely's Red Gum	277	100	Yes	No	Class 3	Yes
58	146.950773	-35.747663	Yellow Box	277	100	Yes	No	Class 3	Yes
59	146.981517	-35.744734	Grey Box	76	90	Yes	Yes	Class 3	Yes
60	146.970849	-35.741955	River Red Gum	5	80	Yes	No	Class 3	No
61	146.970667	-35.741847	River Red Gum	5	80	Yes	Yes	Class 3	No
62	146.962061	-35.741079	Grey Box	76	65	Yes	No	Class 3	Yes
63	146.98222	-35.746444	Grey Box	76	90	Yes	Yes	Class 3	Yes
64	146.972556	-35.741542	River Red Gum	5	90	Yes	No	Class 3	No

Paddock Tree	Latitude	Longitude	Species Name	PCT	DBH (Cm)	Above Benchmark (50 cm)	Hollows Present	Paddock Tree Class	Removal Required
65			Grey Box	76	90	Yes	Yes	Class 3	Yes

APPENDIX D FAUNA SPECIES

Species Group	Scientific Name	Common Name	Threatened Species	14/11/18 Opportunistic	11/06/19 Opportunistic	11/06/19 Plot a	11/06/19 Plot b	11/06/19 Plot c
Aves	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill			O			
Aves	*Chenonetta jubata*	Wood Duck						O
Aves	*Climacteris picumnus*	Brown Treecreeper	Vulnerable BC Act		H			
Aves	*Colluricincla harmonica*	Grey Shrike-thrush			H			
Aves	*Corvus coronoides*	Australian Raven		O			H	H
Aves	*Corvus mellori*	Little Raven					H	O
Aves	*Cracticus nigrogularis*	Pied Butcherbird						O
Aves	*Cracticus tibicen*	Australian Magpie		O		O	O	O
Aves	*Cracticus torquatus*	Grey Butcherbird					H	
Aves	*Eolophus roseicapillus*	Galah		O		O		O
Aves	*Grallina cyanoleuca*	Peewee				H	H	O
Aves	*Manorina melanocephala*	Noisy Miner					O	
Aves	*Pardalotus striatus*	Striated Pardalote		O				
Aves	*Petrochlidon nigricans*	Tree Martin		O				
Aves	*Petroica phoenicea*	Flame Robin	Vulnerable BC Act		O			
Aves	*Platycercus eximius*	Eastern Rosella		O		O		O
Aves	*Podargus strigoides*	Tawny Frogmouth		O	O			
Aves	*Psephotus haematonotus*	Red-rumped Parrot			O			
Aves	*Rhipidura leucophrys*	Willy Wagtail			O			

Species Group	Scientific Name	Common Name	Threatened Species	14/11/18 Opportunistic	11/06/19 Opportunistic	11/06/19 Plot a	11/06/19 Plot b	11/06/19 Plot c
Aves	*Sturnus vulgaris*	Common Starling		O	O			
Mammals	*Macropus giganteus*	Eastern Grey Kangaroo			O			
Mammals	*Pseudocheirus perginus*	Common Ringtail Possum			O			
Mammals	*Petaurus norfolcensis*	Squirrel Glider	Vulnerable BC Act		O			
Mammals	*Trichosurus vulpecula*	Common Brushtail Possum		O				
Reptiles	*Varanus varius*	Lace-Monitor		O				
Amphibians	*Crinia parinsignifera*	Beeping Froglet						H

O=Observed

H= Heard

APPENDIX E PROTECTED MATTERS SEARCH RESULTS

Australian Government
Department of the Environment and Energy

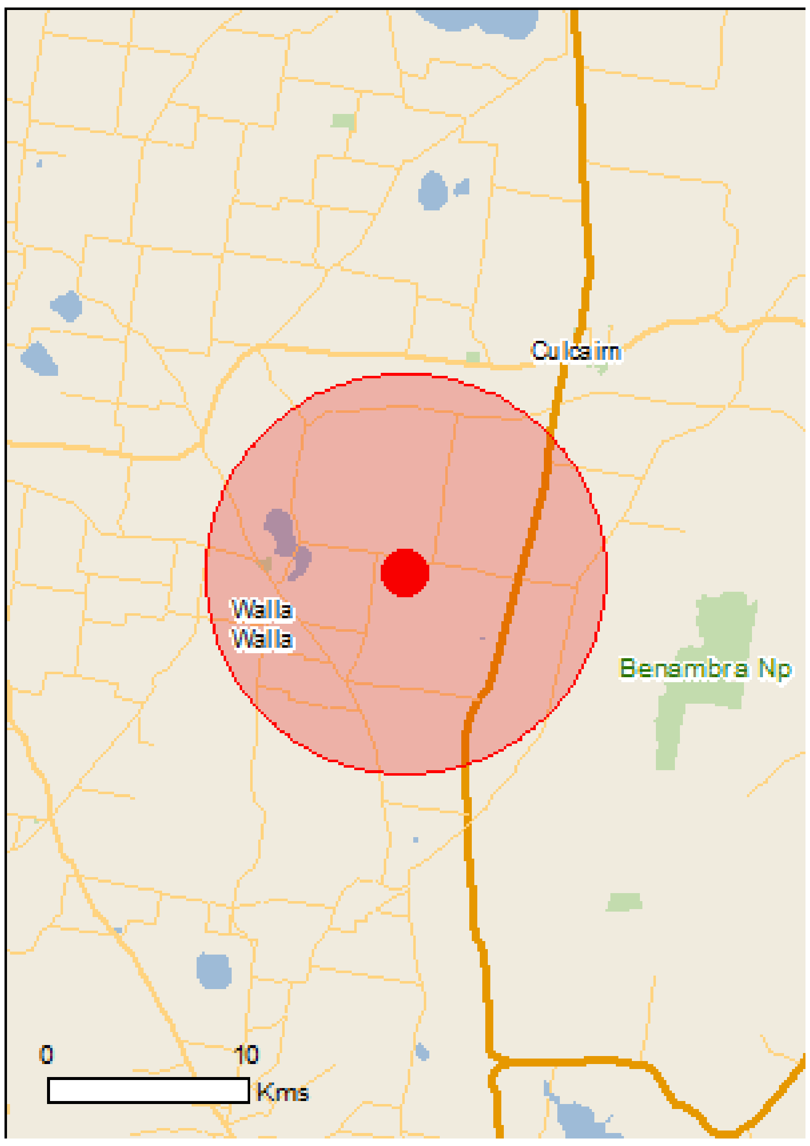
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 26/09/19 15:20:29



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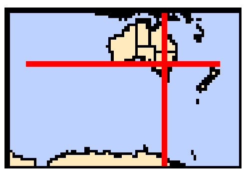

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	7
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	27
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	30
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	600 - 700km upstream
Barmah forest	100 - 150km upstream
Gunbower forest	200 - 300km upstream
Hattah-kulkyne lakes	400 - 500km upstream
Nsw central murray state forests	100 - 150km upstream
Riverland	500 - 600km upstream
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis		
Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Galaxias rostratus		
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
Crinia sloanei		
Sloane's Froglet [59151]	Endangered	Species or species habitat likely to occur within area
Litoria raniformis		
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog [1828]	Vulnerable	Species or species habitat likely to occur within area
Insects		
Synemon plana		
Golden Sun Moth [25234]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Plants		
Ammobium craspedioides		
Yass Daisy [20758]	Vulnerable	Species or species habitat may occur within area
Amphibromus fluitans		
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area
Caladenia arenaria		
Sand-hill Spider-orchid [9275]	Endangered	Species or species habitat may occur within area
Prasophyllum petilum		
Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Prasophyllum validum		
Sturdy Leek-orchid [10268]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		

Name	Status	Type of Presence
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Walla Walla Swamp (Gum Swamp)	NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-35.74611 146.96398

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX F EPBC SPECIES HABITAT ASSESSMENT

The tables in this appendix present the habitat evaluation for threatened species, ecological communities and endangered populations listed from the EPBC Act Protected Matters Report.

The likelihood of occurrence is based on presence of habitat, proximity of nearest records and mobility of the species (where relevant). The assessment of potential impact is based on the nature of the proposal, the ecology of the species and its likelihood of occurrence. The following classifications are used:

Presence of habitat:

Present: Potential or known habitat is present within the study area

Absent: No potential or known habitat is present within the study area

Likelihood of occurrence

Unlikely: Species known or predicted within the locality but unlikely to occur in the study area

Possible: Species could occur in the study area

Present: Species was recorded during the field investigations

Possible to be impacted

No: The proposal would not impact this species or its habitats. No further assessment would be necessary at this stage of the project.

Yes: The proposal could impact this species or its habitats. Further investigation into the likelihood and consequence of the impact of the proposal on these species would be considered under the EPBC Act for the EIS.

F.1 FLORA SPECIES

Species	Habitat requirements	Presence Of habitat	Likelihood Of occurrence	Potential Impact
Flora				
Ammobium craspedioides Yass Daisy BC – V EPBC – V **IBRA Sub-region: Inland Slopes**	Found in moist or dry forest communities, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos*, *E. rubida*).	**Present** Woodland present but understory heavily grazed and degraded.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.
Amphibromus fluitans River Swamp Wallaby Grass EPBC – V BC - V **IBRA Sub-region: Inland Slopes, Lower Slopes**	*Amphibromus fluitans* grows mostly in permanent swamps. The species needs wetlands which are at least moderately fertile and which have some bare ground, conditions which are produced by seasonally-fluctuating water levels. Habitats in south-western NSW include swamp margins in mud, dam and tank beds in hard clay and in semi-dry mud of lagoons with *Potamogeton* and *Chamaeraphis* species. Flowering time is from spring to autumn or November to March. Disturbance regimes are not known, although the species requires periodic flooding of its habitat to maintain wet conditions. Wetlands inhabited by this species that are converted to deep, permanent dams are unsuitable for continued habitation by this species. The species has shown a level of resistance to salinization of habitat in experimental tests.	**Absent** No permanent swamps or waterbodies with vegetation in study area.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence Of habitat	Likelihood Of occurrence	Potential Impact
	Has been observed covering several hectares in area. The species is also recorded as occasional to common in populations.			
Caladenia arenaria Sand-hill Spider Orchid EPBC – E BC – E **IBRA Sub-region: Inland Slopes, Lower Slopes**	Found mostly on the south west plains and western south west slopes. The Sand-hill Spider Orchid is currently only known to occur in the Riverina between Urana and Narranderra. Occurs in woodland with sandy soil, especially that's dominated by White Cypress Pine (*Callitris glaucophylla*). Many of the associated species in the understorey are different at each of the populations or are species that are widespread and occur in a range of habitats. It is apparent that *C. arenaria* has fairly broad habitat tolerances, occurring in *Callitris glaucophylla - Eucalyptus melliodora* (Yellow Box) woodlands, *Callitris glaucophylla – Allocasuarina luehmannii* woodlands and woodlands dominated by a mixture of *Callitris glaucophylla*, *E. dwyeri* (Dwyer's Redgum) and *Acacia doratoxylon* (Currawang). Soils vary from skeletal soils over sandstone to clay loams.	**Absent** Woodland present but understory heavily grazed and degraded.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.
Swainsona recta Small Purple-pea EPBC – E BC – E **IBRA Sub-region: Inland Slopes, Lower Slopes**	Occurs in grassland and open woodland, often on stony hillsides, dominated by one or more of the following: *Callitris endichleri*, *C. glaucophylla*, *Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. melliodora*, *E. microcarpa*, *E. nortonii* and *E. polyanthemos*. Requires a forb-rich grassy groundlayer dominated by *Themeda triandra*, *Poa sieberiana var. sieberiana* or *Austrostipa spp*. Resprouts in autumn and winter from a woody root. It flowers in spring, peaking over two to three weeks in October.	**Absent** Woodland present but understory heavily grazed and degraded.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence Of habitat	Likelihood Of occurrence	Potential Impact
Prasophyllum petilum Tarengo Leek Orchid EPBC – E BC – E **IBRA Sub-region: Inland Slopes**	The flower-spike emerges in mid spring to early summer from a hole near the base of the leaf. Natural populations are known from a total of four sites in NSW: Boorowa, Captains Flat, Ilford and Delegate. Also occurs at Hall in the Australian Capital Territory. Grows in patchy woodland in fertile soils. Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock *Poa labillardieri* Black Gum *Eucalyptus aggregata* and tea-trees *Leptospermum* spp. at Captains Flat and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT). Apparently highly susceptible to grazing, being retained only at little-grazed travelling stock reserves (Boorowa & Delegate) and in cemeteries (Captains Flat, Ilford and Hall). Co-occurring species include *Pentapogon quadrifidus, Schoenus apogon, Drosera peltata, Sebaea ovata* and *Haloragis heterophylla.*	**Absent** Woodland present but understory heavily grazed and degraded.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.
Prasophyllum validum Sturdy Leek-orchid EPBC – V **IBRA Sub-region: Inland Slopes**	The Sturdy Leek-orchid tends to grow in drier woodland habitats, generally with a low sparse understorey. In Victoria, it occurs in box and box-ironbark woodland with overstorey trees including Eucalyptus polyanthemos, Eucalyptus albens, Eucalyptus macrorhyncha, Eucalyptus viminalis and Callitris glaucophylla, and an open grassy to sparsely shrubby understorey including Themeda triandra, Joycea pallida, Arthropodium strictum, Acacia verniciflua, Bursaria spinosa, Grevillea alpine and Grevillea dryophylla. Soils vary from heavy clays to sandy loams.	**Absent** Woodland present but understory heavily grazed and degraded.	**Unlikely** Vegetation surveys indicate that this species is not present.	**No** No suitable habitat would be impacted by the proposal.
EEC				

Species	Habitat requirements	Presence Of habitat	Likelihood Of occurrence	Potential Impact
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland BC – E EPBC – CE **IBRA Sub-region: Inland Slopes, Lower Slopes**	Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles.	**Present** Characteristic. tree species present in development site	**Likely** Development site within known distribution	**Yes** Assessment against EPBC Vegetation threshold required
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EPBC- E **IBRA Sub-region: Inland Slopes**	Generally occurs in landscapes of low-relief such as flat to undulating plains, low slopes and rises and, to a lesser extent, drainage depressions and flats. The tree canopy is dominated (≥ 50% canopy crown cover) by *Eucalyptus microcarpa* (Grey Box). Widespread associated tree species that may be present include: *Allocasuarina luehmannii* (Buloke), *Brachychiton populneus* (Kurrajong), *Callitris glaucophylla* (White Cypress Pine), *Eucalyptus albens* (White Box), *E. camaldulensis* (River Red Gum), *E. conica* (Fuzzy Box), *E. leucoxylon* (Yellow Gum, SA Blue Gum), *E. melliodora* (Yellow Box) and *E. populnea* (Bimble Box, Poplar Box). The ground layer also is highly variable in development and composition, ranging from almost absent to mostly grassy to forb-rich. Derived grasslands are a special state of the ecological community, whereby the canopy and mid layers have been mostly removed	**Present** Characteristic. tree species present in development site	**Likely** Site is highly disturbed	**Yes** Assessment against EPBC Vegetation threshold required

Species	Habitat requirements	Presence Of habitat	Likelihood Of occurrence	Potential Impact
	to <10% crown cover but the native ground layer remains largely intact, with 50% or more of the total vegetation cover being native.			
Weeping Myall Woodlands EPBC – E	The Weeping Myall Woodlands occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland, with one small outlying patch in northern Victoria. Occurs in a range from open woodlands to woodlands, generally 4-12 m high, in which Weeping Myall (*Acacia pendula*) trees are the sole or dominant overstorey species Weeping Myall trees often occur in monotypic stands, however other vegetation may also occur in the ecological community, though not as dominant species. These include: Western Rosewood (*Alectryon oleifolius subsp. elongatus*); Poplar Box (*Eucalyptus populnea*); or Black Box (*Eucalyptus largiflorens*). Grey Mistletoe (*Amyema quandang*) commonly occurs on the branches of Weeping Myall trees throughout the ecological community's range.	**Absent** No Weeping Myall (*Acacia pendula*) in study area.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.

F.2 FAUNA SPECIES

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Fauna				
Aves				
Anthochaera phrygia Regent Honeyeater BC - CE EPBC – CE **IBRA Sub-region: Inland Slopes, Lower Slopes**	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS, 1999 177 /id) (Pizzey, 1997). A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forest associations and wet lowland coastal forests (NPWS, 1999 177 /id) (Pizzey, 1997).	**Present** River Red Gum Forests and Box-Gum Woodland present in development site	**Possible** Study area within known distribution of species	**Yes** Aos Required
Botaurus poiciloptilus Australasian Bittern EPBC – E BC - E **IBRA Sub-region: Inland Slopes, Lower Slopes**	In NSW, this species occurs along the coast and is frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. Occurs in permanent freshwater wetlands with tall, dense vegetation. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over muddy or peaty substrate. Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	**Absent** No permanent wetlands in study area.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Calidris ferruginea Curlew Sandpiper EPBC – CE BC - E **IBRA Sub-region: Inland Slopes, Lower Slopes**	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. This species does not breed in Australia. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds.	**Marginal** Ephemeral creek line and dams in study area. No bare mud or sand edges	**Possible** Study area within known distribution of species.	**No** Marginal habitat and unlikely to occur.
Polytelis swainsonii Superb Parrot EPBC - V BC – V **IBRA Sub-region: Inland Slopes, Lower Slopes**	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. Inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	**Present** Box-Gum Woodland, River Red Gum Forests and Grey Box Woodland present in study area.	**Possible** Known records within 10 km of development site.	**Yes** AoS required
Rostratula australis Australian Painted Snipe BC - E EPBC – E	Little is known of the ecology, habitat requirements and reproductive biology of Australian Painted Snipe. They feed in shallow water or at the waters' edge and on mudflats, taking seeds and invertebrates such as insects, worms, molluscs and crustaceans. Females, which are larger and more brightly coloured than males, are thought to sometimes be polyandrous, mating with several males and leaving each one to incubate and raise chicks. Inhabits inland and coastal shallow freshwater wetlands. The species occurs in both ephemeral and permanent	**Absent** No mudflats in study area.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
IBRA Sub-region: Inland Slopes, Lower Slopes	wetlands, particularly where there is a cover of vegetation, including grasses, Lignum and Samphire. Individuals have also been known to use artificial habitats, such as sewage ponds, dams and waterlogged grassland. Nests on the ground amongst tall vegetation, such as grass tussocks or reeds. Forages nocturnally on mud flats and in shallow water. Breeding is often in response to local conditions; generally occurs from September to December.			
Grantiella picta Painted Honeyeater BC – V EPBC – V **IBRA Sub-region: Inland Slopes, Lower Slopes**	The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	**Present** Associated Vegetation types of Grey Box Woodland and Box-Gum Woodland present in development sites	**Possible** Development site within known distribution	**Yes** AoS required
Lathamus discolour Swift Parrot EPBC – CE **IBRA Sub-region: Inland Slopes, Lower Slopes**	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*. Commonly used lerp infested trees include Grey Box *E. microcarpa*, Grey	**Present** Feed trees of Grey Box and Yellow Box present in development site	**Possible** Development site within known distribution. May forage in development site on occasion.	**Yes** AoS required

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
	Box *E. moluccana* and Blackbutt *E. pilularis* and Yellow Box *E. melliodiora.* Return to home foraging sites on a cyclic basis depending on food availability.			
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew EPBC – CE	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The Eastern Curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline. The Eastern Curlew roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. It occasionally roosts on reef-flats, in the shallow water of lagoons and other near-coastal wetlands.	**Absent** Study area is not within coastal landforms.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.
Mammals				
Dasyurus maculatus maculatus (SE mainland population) Spotted-tailed Quoll BC - V EPBC – E **IBRA Sub-region: Inland Slopes, Lower Slopes**	Tiger Quolls are found in a range of forest habitats, from rainforest to open forest, coastal heath and inland riparian forest. They require forest with suitable den sites such as rock crevices, small caves, rocky-cliff faces. hollow logs, burrows and tree hollows. The Tiger Quoll has a large home range and can cover considerable distances (more than 6km) overnight. It is largely nocturnal and solitary.	**Absent** No forests, rock crevices, caves, cliff faces in study area.Very few hollow logs.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat EPBC – V BC - V **IBRA Sub-region: Inland Slopes, Lower Slopes**	Corben's Long-eared Bat occurs from the south eastern side of the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. The Species inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. The species roosts in tree hollows, crevices, and under loose bark, and breeds in autumn with one or two young born in late spring to early summer.	**Present** Hollow-bearing trees in study area.	**Possible** Study area within known distribution of species.	**Yes** Aos Undertaken
Pteropus poliocephalus Grey-headed Flying-fox EPBC – V **IBRA Sub-region: Inland Slopes, lower slopes**	Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source, often in stands of riparian rainforest, Paperbark or Casuarina forest, and are commonly found in gullies, close to water, or in vegetation with a dense canopy. Forage on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia,* and fruits of rainforest trees and vines. Travel up to 50 km to forage. Annual mating commences in January with single young born each October or November. Site fidelity to camps is high with some camps being used for over a century.	**Absent** No riparian rainforest, gullies or vegetation with dense canopies, in study area.	**Unlikely** No breeding camps in development site. suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.
Phascolarctos cinereus	Occurs in eastern Australia, from north-eastern Queensland to south-eastern South Australia and to the west of the Great Dividing Range. In NSW it mainly occurs on the central and north coasts with some populations in the western	**Present**	**Possible**	**Yes**

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Koala BC - V EPBC - V **IBRA Sub-region: Inland Slopes, Lower Slopes**	region. It was historically abundant on the south coast of NSW, but now occurs in sparse and possibly disjunct populations. The koala inhabits a range of eucalypt forest and woodland communities, including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains.	Eucalypt Woodlands in study area.	Suitable habitat present.	EPBC Koala habitat assessment required
Amphibians				
Litoria raniformis Southern Bell Frog EPBC –V BC – E **IBRA Sub-region: Inland Slopes, Lower Slopes**	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Breeding occurs during the warmer months and is triggered by flooding or a significant rise in water levels. During the breeding season animals are found floating amongst aquatic vegetation (especially cumbungi or Common Reeds) within or at the edge of slow-moving streams, marshes, lagoons, lakes, farm dams and rice crops. Outside the breeding season animals disperse away from the water and take shelter beneath ground debris such as fallen timber and bark, rocks, grass clumps and in deep soil cracks.	**Absent** No aquatic vegetation in farm dams.	**Unlikely** No suitable habitat	**No** No suitable habitat would be impacted by the proposal.
Reptiles				
Aprasia parapulchella	Only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst,	**Absent**	**Unlikely**	**No**

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard EPBC – V BC – V **IBRA Sub-region: Inland Slopes, Lower Slopes**	Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites. Feeds on the larvae and eggs of the ants with which it shares its burrows. It is thought that this species lays 2 eggs inside the ant nests during summer; the young first appear in March. Best detected from September to February.	No predominantly native grassy groundlayer or rocky outcrops in study area.	No suitable habitat present.	No suitable habitat would be impacted by the proposal.
Delma impar Striped Legless Lizard EPBC - V BC – V **IBRA Sub-region: Inland Slopes**	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. Also occurs in the ACT, Victoria and south-eastern South Australia. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo and Wallaby. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter. Actively hunts for spiders, crickets, moth larvae and cockroaches. Animals have been recorded moving at least 20m in one day, and up to 50m over several weeks.	**Absent** No tussock grasslands or surface rocks in study area.	**Unlikely** No suitable habitat present.	**No** No suitable habitat would be impacted by the proposal.
Fish				

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Maccullochella peelii Murray Cod EPBC – V **IBRA Sub-region: Inland Slopes**	Grow up to a maximum size of 1200mm. Found extensively throughout the Murray Darling Basin in the south-eastern region of Australia. Murray cod are able to live in a wide range of habitats from clear, rocky streams in the upper western slopes regions of New South Wales to the slow flowing, turbid rivers and billabongs of the western plains. Generally, they are found in waters up to 5m deep and in sheltered areas with cover from rocks, timber or overhanging banks. The most common components of adult cod's diet include crustaceans such as yabbies, shrimp and crayfish, and fish such as the introduced common carp, goldfish and redfin perch, and the native fishes bony herring, catfish, golden perch, western carp gudgeon and even other cod. It appears that Murray cod prefer protected spawning sites, and typically spawn large (3.0-3.5mm diameter) adhesive eggs onto firm substrates such as hollow logs, rocks, pipes and clay banks, from spring to early summer.	**Absent** No deep streams with shelter	**Unlikely-** No suitable habitat present.	**No-** No suitable habitat would be impacted by the proposal.
Macquaria australasica Macquarie Perch EPBC – E **IBRA Sub-region: Inland Slopes**	Macquarie perch grow to a maximum size of 400mm. They are found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury and Shoalhaven catchments. The conservation status of the different populations is not well known, but there have been long-term declines in their abundance. Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries. They are quiet, furtive fish that feed on aquatic insects, crustaceans and molluscs. Sexual maturity occurs at two years for males and three years for females. Macquarie perch spawn in spring or summer in shallow upland streams or flowing parts of rivers. Females produce around 50,000-100,000 eggs which settle among stones and gravel of the stream or riverbed.	**Absent** No deep rocky holes with plenty of cover	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Flathead Galaxias *Galaxius rostratus* CE EPBC CE FM **IBRA Sub-region: Inland Slopes**	Below 150 m in altitude. Billabongs, lakes, swamps, and rivers, with preference for still or slow-flowing waters.	**Absent** Above 150 m in altitude.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.
Migratory Species				
Apus pacificus Fork-tailed Swift EPBC – M	This migratory marine species is a non-breeding visitor to Australia and has been recorded in all regions of NSW. Found across a range of habitats from inland open plains to wooded areas. They are mainly exclusively aerial flying from < 1m to 300 m above ground.	**Present** Aerial species wo	**Possible** Study area within known distribution of species.	**No** Exclusively aerial species and not dependent on habitat in development site
Motacilla flava Yellow Wagtail EPBC - M	This migratory terrestrial species migrates from Africa to Australia in summer and breeds in Europe. Foraging habitat in Australia comprises mostly well-watered open grasslands and the fringes of Wetlands. Roosts in Mangroves and other dense vegetation.	**Absent**	**Unlikely** Study area within known distribution of species.	**No** No suitable habitat would be impacted by the proposal.
Myiagra cyanoleuca Satin Flycatcher EPBC - M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily	**Absent** No forests or gullies in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
	forested gullies, but not rainforests. The Satin Flycatcher is a migratory species, moving northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring.			
Rhipidura rufifrons Rufous Fantail EPBC - M	The Rufous Fantail is found in northern and eastern coastal Australia, being more common in the north. The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas. Strongly migratory in the south of its range, it moves northwards in winter, and virtually disappears from Victoria and New South Wales at this time.	**Absent** No wet forests, woodlands, mangroves or swamps in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.
Actitis hypoleucos Common Sandpiper EPBC - CE	This migratory wetland species is found along all Australian coastlines and many inland areas. They are active birds that will pursue invertebrates over rocks. Breeding habitat is mainly in Europe.	**Absent** No wetlands, mangroves or coastal landforms in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.
Calidris acuminate Sharp-tailed Sandpiper EPBC - M	This migratory wetland species wades mud in estuarine habitats feeding on invertebrates. They are widespread throughout much of NSW but are sparse in the south-central and lower western regions. Breeding habitat is in Northern Siberia.	**Absent** No mangroves or coastal landforms in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.
Calidris ferruginea Curlew Sandpiper EPBC - M	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of	**Marginal** Farm dams and ephemeral creek	**Possible** Study area within known distribution of species.	**No** Marginal habitat and unlikely to occur.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
	mud or sand. They occur in both fresh and brackish waters. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh. This species does not breed in Australia. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds.	line in the study area.		
Calidris melanotos Pectoral Sandpiper EPBC - M	This species breeds in high-arctic tundra from the Yamal Peninsula eastwards to the Bearing Strait in Siberia and in arctic Alaska and Canada. It is known to migrate mostly through the USA and Mexico and spends most of its non-breeding months in South America. A small number of these birds are known to reach Australia and are believed to be concentrated in south-eastern Australia. This species prefers freshwater mudflats.	**Absent** No freshwater mudflats in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.
Gallinago hardwickii Latham's Snipe, Japanese Snipe EPBC - M	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. Latham's Snipe does not breed within Australia.	**Present** Modified or artificial wetlands occur in the form of farm dams in study area.	**Possible** Study area within known distribution of species.	**No** No suitable habitat would be impacted by the proposal.
Hirundapus caudacutus White-throated Needletail EPBC - M	This migratory terrestrial species occurs in Australia from late spring to early autumn. Found across a range of habitats more often over woodland areas, where it is almost exclusively aerial. Large tracts of native vegetation may be a key habitat requirement for this species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces	**Present** Some trees are present along creek line in the study area.	**Possible** Study area within known distribution of species.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew EPBC – M	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. The Eastern Curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on salt flats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the tideline. The Eastern Curlew roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. It occasionally roosts on reef-flats, in the shallow water of lagoons and other near-coastal wetlands.	**Absent** No coastal landforms, mangroves or wetlands in the in study area.	**Unlikely** No suitable habitat in study area.	**No** No suitable habitat would be impacted by the proposal.

Species	Habitat requirements	Presence of habitat	Likelihood of occurrence	Potential impact
CE BC = listed as Critically Endangered under Schedule 1 of the NSW *Biodiversity Conservation Act 2016* CE EPBC = listed as Critically Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.* E BC = listed as Endangered under Schedule 1 of the NSW *Biodiversity Conservation Act 2016* E EPBC = listed as Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.* V BC = listed as Vulnerable under Schedule 1 of the NSW *Biodiversity Conservation Act 2016* V EPBC = listed as Vulnerable under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.* M EPBC = listed as Migratory under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999.* CE FM = listed as Critically Endangered under Schedule 4A of the NSW *Fisheries Management Act 1994.* E FM = listed as Endangered under Schedule 4 of the NSW *Fisheries Management Act 1994.* V FM = listed as Vulnerable under Schedule 5 of the NSW *Fisheries Management Act 1994.*		**CAMBA = Chinese-Australia Migratory Bird Agreement** **JAMBA = Japan-Australia Migratory Bird Agreement**		

APPENDIX G EPBC ASSESSMENT OF SIGNIFICANT IMPACT

The *Environment Protection and Biodiversity Conservation Act* 1999 specifies factors to be taken into account in deciding whether a development is likely to significantly affect EECs, threatened species and migratory species, listed at the Commonwealth level. The following assessments assesses the significance of the likely impacts associated with the proposed works on:

CRITICALLY ENDANGERED SPECIES (Table 12-1)

Swift Parrot – (*Lathamus discolor*) – CE.

Regent Honeyeater (*Anthochaera phrygia*) – CE.

VULNERABLE SPECIES (Table 12-2)

Superb Parrot (*Polytelis swainsonii*) – V.

Painted Honeyeater (*Grantiella picta*) – V.

Corben's Long-eared Bat (*Nyctophilus corbeni*) – V.

White-throated Needletail (*Hirundapus caudacutus*) – V.

MIGRATORY SPECIES

Fork-tailed Swift (*Apus pacificus*) – M.

White-throated Needletail (*Hirundapus caudacutus*) –- M.

Table 12-1 Assessment of significance for critically endangered EPBC species

Critically Endangered Species (Swift Parrot and Regent Honeyeater)
a) Will the action lead to a long-term decrease in the size of a population of a species?
Swift Parrot
Swift Parrots can forage in lerp infested Grey Box and Yellow Box trees. Potential foraging habitat for Swift Parrots occurs within the development site and would be removed by the proposal. Surveys did not detect these species and no known records occur within the development site. The development site is not considered known habitat but provides potential foraging habitat. The proposal would involve the removal of around 10.1 ha of Grey Box woodland and 0.7 ha of River Red gum Woodland. There would also be some disturbance associated with construction, including noise, vibration, light. The quality of potential habitat for these species is low, being largely cleared and highly disturbed by agriculture. Given the relatively small amount of habitat to be removed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of this species is minimal.
Regent Honeyeater
The Regent Honeyeater is considered to occur as a single population throughout its range. No known records occur with the development site and they were not detected during the site surveys. The development site is not considered known habitat but provides potential foraging habitat.

The proposal would involve the removal of around 10.1 ha of Grey Box woodland and 0.7 ha of River Red gum Woodland. There would also be some disturbance associated with construction, including noise, vibration, light. The quality of potential habitat for these species is low, being largely cleared and highly disturbed by agriculture. Given the relatively small amount of habitat to be removed, and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of this species is minimal.

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

Swift Parrot

The proposal would involve the removal of around 10.8 ha of potential foraging habitat. There would also be some disturbance associated with construction. The development site is not considered known habitat.

The quality of habitat in the development site is low, being highly fragmented and partially cleared from agriculture and the area of habitat to be removed is relatively small in the context of the Swift Parrots range across South Eastern Australia. In this context, while removal of this habitat could reduce the area of occupancy, it would not be enough to have a significant impact on these species.

Regent Honeyeater

The proposal would involve the removal of around 10.8 ha of potential foraging habitat. There would also be some disturbance associated with construction. The development site is not considered known habitat.

The quality of habitat in the development site is low, being highly fragmented and partially cleared from agriculture and the area of habitat to be removed is relatively small in the context of the Swift Parrots range across South Eastern Australia. In this context, while removal of this habitat could reduce the area of occupancy, it would not be enough to have a significant impact on these species.

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

Swift Parrot

The Swift Parrot occurs as a single migratory population (Saunders & Tzaros, 2011) The proposal would involve the removal of around 10.8 ha of potential habitat. There would also be some disturbance associated with construction. The development site is not considered known habitat.

The area of habitat to be removed is relatively small in the context of the Swift Parrots range across South-Eastern Australia and would not disrupt habitat connectivity for the migratory Swift Parrot. 62 ha of remnant vegetation would still remain within or adjacent to the development site and migratory movement would not be impacted. The proposal would not fragment an existing population of this species into two or more populations.

Regent Honeyeater

The Regent honeyeater population comprises a single population that moves throughout its range of South Eastern Australia. The proposal would involve the removal of around 10.8 ha of potential habitat. There would also be some disturbance associated with construction.

The area of habitat to be removed is relatively small in the context of the Regent Honeyeaters range across South-Eastern Australia and would not disrupt habitat connectivity for the Regent Honeyeater. 62 ha of remnant vegetation would remain within or adjacent to the development site and movement would not be impacted. The proposal would not fragment an existing population of this species into two or more populations.

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

Swift Parrot

Habitat critical to the survival of the Swift Parrot includes those areas of priority habitat for which the Swift Parrot has a level of site fidelity or are identified by the recovery team. The development site is not known habitat nor within a mapped important area identified by OEH and is unlikely to be habitat critical to the survival of the species.

Regent Honeyeater

Critical habitat for the survival of the Regent Honeyeater listed in the national recovery plan includes

- any breeding or foraging habitat where the species is likely to occur (as defined by the distribution map)
- Any newly discovered breeding or foraging locations

The development site falls within the mapped areas of where this species is likely to occur but not within a key breeding area. 10.8 ha of habitat would be removed; however, this vegetation is of low habitat quality comprised of smaller isolated patches within a cleared and disturbed agricultural landscape.

e) Will the action disrupt the breeding cycle of the species?

Swift Parrot

Swift Parrots breed only in Tasmania, migrating to the mainland in autumn and winter. The likelihood of the action disrupting the breeding cycle of a population of these species is minimal.

Regent Honeyeater

Four key breeding areas occur in the known range of the Regent Honeyeater. The development site is not within a known breeding area for the Regent Honeyeater; thus, the proposal is unlikely to disrupt the breeding cycle of the species.

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

Swift Parrot

The proposal would involve the removal of around 10.8 ha of foraging habitat. There would also be some disturbance associated with construction, which could decrease the quality of some habitat in the short-term. The development site is not considered known habitat and is considered potential foraging habitat only.

The area of habitat to be removed is relatively small in the context of the Swift Parrots range across South-Eastern Australia and would not disrupt habitat connectivity. Approximately 63ha of similar or better-quality habitat would remain within or adjacent to the development site. With the implementation of the recommended mitigation measures, the likelihood of the action modifying, destroying, removing, isolating, or decreasing the availability or quality of habitat to the extent that these species would be likely to decline is minimal.

Regent Honeyeater

The proposal would involve the removal of around 10.8 ha of foraging habitat, comprised of smaller isolated patches. This habitat is considered low quality having been partially cleared and degraded from intense agricultural activities. There would also be some disturbance associated with construction, which could decrease the quality of some habitat in the short-term. The development site is not considered known habitat and is considered potential foraging habitat only.

While the proposal may reduce the availability of habitat, this habitat is considered low quality. 63ha of similar or better-quality habitat would remain within or adjacent to the development site that could provide foraging habitat for the Regent Honeyeater. The likelihood of the action modifying, destroying, removing, isolating, or decreasing the availability or quality of habitat to the extent that these species would be likely to decline is minimal.

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

Swift Parrot and Regent Honeyeater

The proposal will modify the current land use, potentially creating additional shelter habitat for predatory invasive species such as foxes and cats, which are considered likely to be locally prevalent regardless of the proposal. Management protocols will be prepared and implemented as part of the Flora and Fauna Management Plan for the proposal which will monitor and manage these species within the development site. These species are already widespread in a rural environment and the proposal is not anticipated to increase the numbers of feral pest animals.

There is a risk that invasive weed could be introduced to the proposal area via machinery, vehicles, and materials during construction. With the implementation of the recommended mitigation measures, including restricting vehicle movements to sealed tracks, the likelihood of the action resulting in harmful invasive species becoming established in the vulnerable species' habitat is minimal.

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

Swift Parrot

Beak and Feather Disease could impact the Swift Parrot; however, the proposal is not considered likely to act as a vector for the disease. With the implementation of the recommended mitigation measures, the likelihood of the action resulting in the introduction of diseases that may cause the species to decline is minimal.

Regent Honeyeater

The proposal is not considered to act as a vector for any diseases to the Regent Honeyeater.

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

Swift Parrot

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

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

The proposal would not interfere with any of these objectives.

Regent Honeyeater

The National Recovery Plan for the Regent Honeyeater lists the following objectives;

1. Reverse the long-term population trend to decline and increase the number of regent honeyeaters to a level where there is a viable, wild breeding population even in poor breeding years.

2. Enhance the condition of habitat across the regent honeyeater ranges to maximise survival and reproductive success and provide refugia during periods of extreme environmental fluctuation.

The proposal would not substantially interfere with any of these objectives.

Conclusion

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

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

A referral to the Federal Department of Environment is not considered necessary.

Table 12-2 Assessment of significance for vulnerable species

Vulnerable Species (Superb Parrot & Painted Honeyeater)

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

Superb Parrot

No records of the Superb Parrot occur within the development site and no known population of Superb Parrot occurs within the development site. The development site is not considered known habitat but provides potential foraging habitat. The breeding population of Superb Parrots *Polytelis swainsonii* is approximately 6500. The species is somewhat mobile, and typically utilises foraging habitat within 10 km of breeding habitat (SPRAT, 2017).

The development site is not part of a core breeding area for the Superb Parrot (Baker Gabb, 2011). Thus, an important population is not considered to occur in the development site and no impacts are anticipated to an important population of Superb Parrot.

Painted Honeyeater

No records of the Painted Honeyeater occur within the development site and no known population occurs within the development site. The presence of mistletoe provides potential foraging and breeding habitat. The development site is not part of a key management site listed by OEH, thus an important population is not considered to occur in the development site and no impacts are anticipated to an important population of Painted Honeyeater.

Corben's Long-eared Bat

No records of the Corben's Long-eared Bat occur within the development site and no known population of Corben's Long-eared Bat occurs within the development site. The presence of Box-Gum Woodland and hollow bearing trees provides potential foraging and roosting habitat for this species. The development site is not part of a key management site listed by OEH, thus an important population is not considered to occur in the development site and no impacts are anticipated to an important population of Corben's Long-eared Bat.

White-throated Needletail

No records of the White-throated Needletail occur within the development site and no known population of White-throated Needletail occurs within the development site. The development site is not considered known habitat but provides potential foraging habitat. The subspecies *caudacutus* is the key breeding population that affects the Needletails that occur in Australia (SPRAT, 2019). However, this subspecies *caudacutus* only breeds outside of Australia, thus an important population is not considered to occur in the development site and no impacts are anticipated to an important population of White-throated Needletail.

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

Superb Parrot

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

Painted Honeyeater

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

Corben's Long-eared Bat

As an important population is not considered to occur within the development site, the action is not considered to reduce the area of occupancy of an important population. The broader proposal area will continue to contain suitable areas of roosting and foraging habitat of a sufficient size and quality to maintain individuals of the species within the proposal area and the wider locality.

White-throated Needletail

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

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

Superb Parrot

As the individuals of the species are not considered to form an important population, the action is not considered to fragment an existing important population. Native vegetation will be planted along the perimeter of the development area to screen solar farm infrastructure, adding to the habitat potential of the site. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

Painted Honeyeater

As the individuals of the species are not considered to form an important population, the action is not considered to fragment an existing important population. Native vegetation will be planted along the perimeter of the development area to screen solar farm infrastructure, adding to the habitat potential of the site. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

Corben's Long-eared Bat

As the individuals of the species are not considered to form an important population, the action is not considered to fragment an existing important population. Native vegetation will be planted along the perimeter of the development area to screen solar farm infrastructure, adding to the habitat potential of the site. As the species is highly mobile, the proposal will not impact on its movement within or across the development site.

White-throated Needletail

As the individuals of the species are not considered to form an important population, the action is not considered to fragment an existing important population. Native vegetation will be planted along the perimeter of the development area to screen solar farm infrastructure, adding to the habitat potential of the site. As the species is highly mobile and predominately aerial, the proposal will not impact on its movement within or across the development site.

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

Superb Parrot, Painted Honeyeater, Corben's Long-eared Bat and White-throated Needletail

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these protected species. The proposed development is not located near any critical habitat for and species listed on the register.

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

Superb Parrot

No known important population occurs within the proposal area. Three main breeding areas for the superb parrot occur in NSW. The nearest known breeding area to the proposal area occurs in the South West Slopes near Wagga Wagga, around 100km north of Walla Walla (Baker Gabb, 2011). Within the South West Slopes, the Superb Parrot breeds in hollows in River Red Gum, Blakely's Red Gum, Apple Box, Grey Box, White Box and Red Box species. The nests are usually located near water and the same nest hollows are used in successive years. The action would not disrupt the breeding cycle of an important population.

Painted Honeyeater

No known important populations occur within the proposal area.

Corben's Long-eared Bat

No known important population occurs within the proposal area.

White-throated Needletail

This species does not breed in Australia.

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

Superb Parrot

The proposal will remove approximately 10.8 ha of woodland vegetation in the development site. Approximately 63 ha of similar or better-quality habitat would remain in or adjacent to the development site. This modification and removal of habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as extensive habitat will remain in the locality.

Painted Honeyeater

The proposal will remove approximately 10.8 ha of woodland vegetation in the development site. Approximately 63 ha of similar or better-quality habitat would remain in or adjacent to the development site. This modification and removal of habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as extensive habitat will remain in the locality.

Corben's Long-eared Bat

The proposal will remove approximately 10.8 ha of woodland vegetation in the development site, which includes 73 hollow bearing trees. Approximately 63 ha of similar or better-quality habitat would remain in or adjacent to the development site. This modification and removal of habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as extensive habitat will remain in the locality.

White-throated Needletail

The proposal will remove approximately 10.8 ha of woodland vegetation in the development site. Approximately 63 ha of similar or better-quality habitat would remain in or adjacent to the development site. This modification and removal of habitat is not considered likely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, as extensive habitat will remain in the locality.

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

Superb Parrot, Painted Honeyeater, Corben's Long-eared Bat and White-throated Needletail

The proposal is not considered likely to result in invasive species becoming established within the Superb Parrot's habitat. Competition with Noisy Miners for breeding and foraging habitat and resources is a major threat to the species and cause for the decline in population numbers. Noisy Miners are already present at the development site. The proposal is unlikely to result in invasive species such as these that are harmful to the habitat of the Superb Parrot.

The proposal will modify the current land use, potentially creating additional shelter habitat for predatory invasive species such as foxes and cats, which are considered likely to be locally prevalent regardless of the proposal. Management protocols will be prepared and implemented as part of the Flora and Fauna Management Plan for the proposal which will monitor and manage these species within the development site.

h) Will the action introduce disease that may cause the species to decline?
Superb Parrot
Beak and Feather Disease has been proven to impact the Superb Parrot (DoE, 2017), however the proposal is not considered likely to act as a vector for the disease.
Painted Honeyeater
The proposal is not considered to act as a vector for any diseases to the Painted Honeyeater.
Corben's Long-eared Bat
The proposal is not considered to act as a vector for any diseases to the Corben's Long-eared Bat.
White-throated Needletail
The proposal is not considered to act as a vector for any diseases to the White-throated Needletail.
i) Will the action interfere substantially with the recovery of the species?
Superb Parrot
Core breeding areas and surrounding habitat are considered important to the recovery of the species. The nearest known breeding area to the proposal area occurs in the South West Slopes near Wagga Wagga, approximately 100km north of the development site. Habitats across the broader proposal area will remain available to the species and given its mobility, the proposal would not restrict the movements of the species across the development site. The proposal is unlikely to interfere with the recovery of the Superb Parrot.
Painted Honeyeater
No recovery plan has been developed for the Painted Honeyeater.
Corben's Long-eared Bat
No recovery plan has been developed for the Corben's Long-eared Bat.
White-throated Needletail
No recovery plan has been developed for the White-throated Needletail
Conclusion
A significant impact to this species is considered unlikely, on the basis that the proposal would not: • Lead to a reduction of the size or area of occupancy of an important population, or fragment or disrupt the breeding cycle of a population. • Affect habitat critical to the survival of these species. • Affect habitat or introduce disease such that these species would decline. • Introduce invasive species harmful to the species.

- Interfere with the recovery of these species.

A referral to the Federal Department of Environment is not considered necessary.

Migratory Species (Fork-tailed Swift and White-throated needletail)

An assessment of significance for migratory species must establish whether the habitat on the proposed site is considered "important habitat" as defined in the EPBC Act.

"Important habitat" for migratory species is described as:

1. *Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or*
2. *Habitat that is of critical importance to the species at particular lifecycle stages; and/or*
3. *Habitat utilised by a migratory species which is at the limit of the species range; and/or*
4. *Habitat within an area where the species is declining.*

The habitat within the proposal site is not considered important habitat for the Fork-tailed Swift or the White-throated Needletail.

a) Will the action substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles, or altering hydrological cycles), destroy, or isolate an area of important habitat for a migratory species?

Fork-tailed Swift & White-throated Needletail

The Fork-tailed Swift and the White-throated Needletail are almost exclusively aerial and are considered unlikely to rely on the habitats present within the proposal site. The habitats within the proposal site are not considered important habitat. Therefore, the action is unlikely to substantially modify, destroy or isolate an area of important habitat for either species.

b) Will the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?

Fork-tailed Swift & White-throated Needletail

The Fork-tailed Swift and the White-throated Needletail are almost exclusively aerial and are considered unlikely to rely on the habitats present within the proposal site. The habitats within the proposal site are not considered important habitat. Therefore, the action is unlikely to substantially modify, destroy or isolate an area of important habitat for either species.

c) Will the action seriously disrupt the lifecycle (breeding, feeding, migration, or resting behaviour) of an ecologically significant proportion of the population of a migratory species?

Fork-tailed Swift & White-throated Needletail

The Fork-tailed Swift and the White-throated Needletail are almost exclusively aerial and are considered unlikely to rely on the habitats present within the proposal site. The area is not considered to support an ecologically significant proportion of the population of the species. Therefore, the action is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of either species.

Conclusion

The project site area contains habitat that could potentially be used by the Fork-tailed Swift or the White-throated Needletail. Of the four criteria for significant impact for a migratory species, the project is unlikely to cause a significant impact to any criteria. The proposal is therefore considered unlikely to significantly impact the Fork-tailed Swift or the White-throated Needletail.

APPENDIX H BAM CREDIT CALCULATIONS

BAM Credit Summary Report

Proposal Details

Assessment Id
00013164/BAAS18074/19/00013165

Proposal Name
Walla Walla Solar Farm

BAM data last updated *
30/08/2019

Assessor Name
Julie Gooding

Report Created
26/09/2019

BAM Data version *
13

Assessor Number
BAAS18074

BAM Case Status
Finalised

Date Finalised
26/09/2019

Assessment Revision
0

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

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	Potential SAII	Ecosystem credits
Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion								
1	277_Grazed	12.1	0.2	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							Subtotal	**0**

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013164/BAAS18074/19/00013165	Walla Walla Solar Farm	30/08/2019
Assessor Name	Assessor Number	BAM Data version *
Julie Gooding	BAAS18074	13
Proponent Names	Report Created	BAM Case Status
BE PRO W Pty Ltd, BE PRO W PTY LTD	26/09/2019	Finalised
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	26/09/2019

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
White Box Yellow Box Blakely’s Red Gum Woodland	Endangered Ecological Community	277-Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
277-Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	0.2	0.00
76-Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	37.2	160.00
5-River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Not a TEC	1.3	9.00

5-River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	**Like-for-like credit retirement options**			
	Class	Trading group	HBT	IBRA region
	Inland Riverine Forests This includes PCT's: 2, 5, 7, 8, 9, 10, 11, 36, 78, 112, 233, 234, 249, 356, 362	Inland Riverine Forests - < 50% cleared group (including Tier 7 or higher).	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
76-Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions This includes PCT's: 76, 80, 81, 82, 101, 110, 237, 248	-	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

277-Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	White Box Yellow Box Blakely's Red Gum Woodland This includes PCT's: 2, 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 506, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1601, 1606, 1608, 1611, 1691, 1693, 1695, 1698	-	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Area	Credits
Diuris tricolor / Pine Donkey Orchid	1.1	14.00
Hieraaetus morphnoides / Little Eagle	10.8	87.00
Myotis macropus / Southern Myotis	1.5	19.00
Petaurus norfolcensis / Squirrel Glider	8.2	89.00

Diuris tricolor/ Pine Donkey Orchid	5_Creekline	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Diuris tricolor/Pine Donkey Orchid	Any in NSW
	5_Wetland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Diuris tricolor/Pine Donkey Orchid	Any in NSW
	76_Roadside	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Diuris tricolor/Pine Donkey Orchid	Any in NSW
	76_Wetland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Diuris tricolor/Pine Donkey Orchid	Any in NSW
Hieraaetus morphnoides/ Little Eagle	5_Creekline	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Hieraaetus morphnoides/Little Eagle	Any in NSW
	5_Grazed	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Hieraaetus morphnoides/Little Eagle	Any in NSW

Hieraaetus morphnoides/ Little Eagle	5_Grazed	
	5_Wetland	**Like-for-like credit retirement options** Spp: IBRA region **Hieraaetus morphnoides**/Little Eagle: Any in NSW
	76_Grazed	**Like-for-like credit retirement options** Spp: IBRA region **Hieraaetus morphnoides**/Little Eagle: Any in NSW
	76_Roadside	**Like-for-like credit retirement options** Spp: IBRA region **Hieraaetus morphnoides**/Little Eagle: Any in NSW

Myotis macropus/ Southern Myotis	5_Creekline	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Myotis macropus/Southern Myotis	Any in NSW
	5_Grazed	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Myotis macropus/Southern Myotis	Any in NSW
	5_Wetland	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Myotis macropus/Southern Myotis	Any in NSW
	76_Grazed	**Like-for-like credit retirement options**	
		Spp	IBRA region

		Myotis macropus/Southern Myotis	Any in NSW
Petaurus norfolcensis/ Squirrel Glider	5_Creekline	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Petaurus norfolcensis/Squirrel Glider	Any in NSW
	5_Grazed	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Petaurus norfolcensis/Squirrel Glider	Any in NSW
	5_Low	**Like-for-like credit retirement options**	
		Spp	IBRA region
		Petaurus norfolcensis/Squirrel Glider	Any in NSW

Petaurus norfolcensis/ Squirrel Glider	5_Low	
	5_Wetland	**Like-for-like credit retirement options** Spp: **Petaurus norfolcensis**/Squirrel Glider IBRA region: Any in NSW
	76_Grazed	**Like-for-like credit retirement options** Spp: **Petaurus norfolcensis**/Squirrel Glider IBRA region: Any in NSW
	76_Roadside	**Like-for-like credit retirement options** Spp: **Petaurus norfolcensis**/Squirrel Glider IBRA region: Any in NSW

River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.								
5	5_Grazed	11.4	0.1	0.25	High Sensitivity to Potential Gain	1.50		0
7	5_Low	5.6	0.6	0.25	High Sensitivity to Potential Gain	1.50		0
8	5_Wetland	41.9	0.2	0.25	High Sensitivity to Potential Gain	1.50		3
9	5_Creekline	40.7	0.4	0.25	High Sensitivity to Potential Gain	1.50		6
							Subtotal	**9**
Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions								
2	76_Grazed	20.2	10.0	0.25	High Sensitivity to Potential Gain	2.00		101
3	76_Wetland	20.0	3.2	0.25	High Sensitivity to Potential Gain	2.00		32
4	76_Derived_Grassland	2.2	23.9	0.25	High Sensitivity to Potential Gain	2.00		26
6	76_Roadside	40.5	0.0	0.25	High Sensitivity to Potential Gain	2.00		1
							Subtotal	**160**
							Total	**169**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Diuris tricolor / Pine Donkey Orchid (Flora)						
76_Roadside	40.5	0.04	0.25	1.5	False	1
5_Wetland	41.9	0.22	0.25	1.5	False	3

76_Wetland	20.0	0.5	0.25	1.5	False	4
5_Creekline	40.7	0.38	0.25	1.5	False	6
					Subtotal	**14**
Hieraaetus morphnoides / Little Eagle (Fauna)						
5_Wetland	41.9	0.22	0.25	1.5	N/A	3
76_Roadside	40.5	0.04	0.25	1.5	N/A	1
5_Grazed	11.4	0.14	0.25	1.5	N/A	1
76_Grazed	20.2	10.03	0.25	1.5	N/A	76
5_Creekline	40.7	0.38	0.25	1.5	N/A	6
					Subtotal	**87**
Myotis macropus / Southern Myotis (Fauna)						
76_Grazed	20.2	0.98	0.25	2	False	10
5_Grazed	11.4	0.04	0.25	2	False	0
5_Wetland	41.9	0.22	0.25	2	False	5
5_Creekline	40.7	0.22	0.25	2	False	4
					Subtotal	**19**
Petaurus norfolcensis / Squirrel Glider (Fauna)						
76_Grazed	20.2	7.42	0.25	2	False	75
76_Roadside	40.5	0.04	0.25	2	False	1
5_Wetland	41.9	0.22	0.25	2	False	5
5_Low	5.6	0.04	0.25	2	False	0

5_Creekline	40.7	0.38	0.25	2	False	8
5_Grazed	11.4	0.06	0.25	2	False	0
					Subtotal	**89**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013164/BAAS18074/19/00013663	Walla Walla Solar Farm - Paddock Trees	30/08/2019
Assessor Name	**Report Created**	**BAM Data version ***
Julie Gooding	26/09/2019	13
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS18074	Finalised	20/09/2019
Assessment Revision	**Assessment Type**	
0	Paddock Trees	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Paddock Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
277-Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion			
3	True	6.0	6
3	False	2.0	2
3	True	2.0	2
3	False	1.0	1
			11
5-River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.			
3	True	1.0	1
2	False	1.0	1
			2
76-Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions			
3	True	32.0	32
3	False	6.0	5
3	False	1.0	1

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013164/BAAS18074/19/00013663	Walla Walla Solar Farm - Paddock Trees	30/08/2019
Assessor Name	Assessor Number	BAM Data version *
Julie Gooding	BAAS18074	13
Proponent Names	Report Created	Date Finalised
	26/09/2019	20/09/2019
Assessment Revision	Assessment Type	BAM Case Status
0	Paddock Trees	Finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Ecosystem Credit Summary

PCT	TEC	Credits
76-Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	39.00
277-Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	11.00
5-River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.	Not a TEC	2.00

Credit classes for 5	Like-for-like options			
	Class	Trading group	HBT	IBRA region
	Inland Riverine Forests	Inland Riverine Forests - < 50% cleared group	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Credit classes for 76	**Like-for-like options**			
	TEC	Trading group	HBT	IBRA region

	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	-	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Credit classes for 277	**Like-for-like options**			
	TEC	Trading group	HBT	IBRA region
	White Box Yellow Box Blakely's Red Gum Woodland	-	Yes	Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

2	True	1.0	1
			39
			52

APPENDIX I BIODIVERSITY ENHANCEMENT PLAN

NOTES REGARDING WALLA WALLA PV PLANT

TO : FRV SOLAR

Report prepared by Kylie Durant

20/09/2019
Final Updated 30/09/19

DISCLAIMER: The following comments are made in context of the information and discussion points supplied by Mark Love of FRV during a joint site visit on 12/09/2019 in the context of preparing a voluntary biodiversity plan that is separate from the consent and EIS process

Costings are a guide only

This document relates to the proposed Walla Walla Solar Farm a large 300MW ac Utility scale Solar project being developed by FRV. The site area covers approx. 605 Hectares of existing mixed-use agricultural land and is located off Benambra Road, Walla Walla NSW

PURPOSE:
To highlight opportunities for conservation management and restoration and provide technical input to a biodiversity plan

Landscape values

The FRV Walla Walla Solar Farm site is intersected by a well vegetated section of Back Creek with several ephemeral wetland areas on the property in various conditions, both to the north and south of the creek.

In terms of landscape connectivity, the creek forms the most important continuous link in this local landscape. There are significant ephemeral swamps and wetlands to the north and a significant "patch" of degraded open woodland to the south, as well as some planted tree lines.

The eastern end of the Benambra Rd roadside is significant vegetation (*Hume Shire Roadside Plan 1998)*. A significant tree line also runs along the eastern boundary in an old Crown Road Reserve, and along the end of Weeamara Rd south of Benambra Rd to the creek.

In the broader landscape the Gum Swamp Reserve to the west and the Benambra National Park/Tabletop range in the east are the most significant features.

The creek, existing wetland remnants Excl 2, 3, 4, 5, 7 and the Weeamara Rd corridor are the most valuable biodiversity assets on the property that would benefit from fencing and the control of stock access.

In terms of locally significant species, the site is within 5km of sites that have been used by Brolgas and Bush Stone Curlews in the past. The creek is very likely to have Squirrel Gliders. The suite of NSW threatened woodland birds are also commonly found in this area.

Dam rehabilitation for biodiversity

The decision to retain and rehabilitate dam sites on the property should be considered in the context of the management of the site in general and although there would be localised benefits for various frog and birds species of retaining permanent water, the natural ephemeral wetland sites would be a “natural” setting in which to concentrate rehabilitation efforts.

Another consideration is the requirement for stock water points and other on-farm requirements (dust control on tracks, washing panels?). Although there is a trough system, I would recommend an analysis of the final paddock layout and grazing regime to be employed before decommissioning any dams, and this use would need to be considered if looking at any active rehabilitation.

Retaining multiple water sources can also encourage high kangaroo numbers and overgrazing by Kangaroos can impact the recovery of restoration areas.

The dams on the property east of Schneider’s Rd are mostly within existing exclusion areas already so will benefit from the passive rehabilitation through exclusion of stock, and revegetation surrounding them. Most dams were observed to be very low at the time of inspection, and it would be typical of dams in this landscape to have rapidly fluctuating water levels, and it is difficult to maintain fringing and aquatic vegetation under those circumstances.

The dam areas if retained would benefit from placement of coarse woody debri both in and around the dams and this could be achieved by relocating any material from and clearing being undertaken.

More active rehabilitation could be considered if FRV wanted to. For example, using earthworks to create a range of deep and shallow area in a dam can enhance the habitat values for various species. Creation of vegetated islands, or standing dead timber in the water can benefit water birds, although most of the dams here are small and would make that logistically difficult.

Connectivity

As a general concept, landscape connectivity can be enhanced for a wide range of species by reducing the gaps in vegetation to less than 100m, in a landscape that has larger remnants in it.

The creek is by far the most important connectivity asset. There is opportunity to enhance a link along the Weeamara Laneway to the creek by revegetating a small section to the creek.

Excl 3, 4 ,5 and 7 are all retained patches that are within 1km of the creek and could potentially benefit from connecting vegetation if that was within the scope of the farm design.

Revegetation methodology - Background

Tubestock revegetation is suitable for former pasture and crop areas. Preparation requires spraying to control exotic cover and then ripping or cultivation when the site has a dry profile. The intention of ripping is to break the compaction of the soil, allow moisture penetration and retention in preparation for planting and create a weed-free “bed” for fast planting. Deep ripping refers to 30-40cm – some of these soil types may only require regular cultivation. Spraying with a knockdown chemical should occur the Spring before planting is to go ahead and then again after the Autumn break and just before planting. Planting in this district generally occurs from June to September (see attachment 1 Site Preparation).

Direct Seeding is a suitable method where there is low fertility and usually some native groundcover left. The seeder is towed on the back of a ute so needs to be able to manoeuvre in the site. If there is exotic weed cover (annual species) a 1m wide strip is sprayed with a knockdown at the same time as seeding.

All site recommendations would come from the Southwest Slopes Revegetation Guide – Walla Walla Site Profile. Specific site species recommendations are not included in this document.

Revegetation of the 5 m buffer zones on the boundary

This area is suitable for tubestock planting only. I would recommend a configuration that has at least 3 rows of plants. Due to the narrowness of this buffer, you may consider cultivation of the area rather than putting in multiple riplines with a single tyne. There is scope to adapt to the machinery that is on site –a multi-tyned cultivation instrument, a multi-tyned ripper, a rotary hoe attachment or disc equipment could be used.

Revegetation design should match the objective - screening, connectivity or biodiversity and ecosystem benefit. Method also has to be suited to the history of the site – is it developed perennial pasture/crop or unfertilised area will remnant native cover.

For a Grassy Woodland ecosystem restoration site the recommended spacings are 600 per ha (4mX 4m) with 80% understorey species and 20% trees.

In some parts of the buffer where screening is required, you may choose very close spacings (eg. 2-3m) and increase the % of understorey species.

Where there are existing trees you can expect that tree regeneration will occur after site preparation.

Tree guards are recommended if there are rabbits and hares and no control is undertaken, but they are not a standard practice for on-farm revegetation in the area.

Revegetation areas

For the 50m buffers, a more standard approach to revegetation is appropriate. The sites should be ripped parallel to the fencing at 4m spacings and planted 600 per ha (a 4x4m grid) with 80% shrubs, 20% trees.

Complementary roadside planting

There would be opportunity for supplementing the roadside vegetation along Schneider's Rd and the section of the Benambra Rd west of the creek with the agreement of Greater Hume Council. Addition of understorey plants such as wattles and other shrubs at intervals along the road could be done. Tubestock would be the most appropriate method here.

Nest boxes

The purpose of nest boxes needs to be articulated so recommendations can be made.

If there is a hollow-dependent species identified as using the site and hollows are limited, then there is ecological benefit in investing in specifically designed nest boxes.

If it just for community engagement, then a range of boxes suited to locally-occurring hollow-dependent species may be installed.

A long term management plan is required for maintenance of the boxes.

Stock Management

Our recommendation is that all areas with revegetation should have stock excluded for at least 5 years. If stock grazing is necessary for weed or fire management then short crash grazing can be undertaken. In our management agreement, that is not to exceed 10 days per calendar year.

In the exclusion areas, crash grazing should NOT occur between November and February to allow native species to reproduce and set seed. In the wetland sites, grazing is not recommended in the Winter months either.

Fencing

We recommend only wildlife friendly fencing with no barb wire to ensure there is lower risk of entanglement to gliding possums and owls.

Potential to link to Gum Swamp

The most significant natural feature in proximity to the site is the Gum Swamp. This is largely public land under the governance of a community committee, and they are often in need of funds for fencing, maintenance and wish to develop interpretive signage and visitor facilities.

FRV Walla Walla PV Farm

Holbrook

FRV Walla Walla PV Plant Site recommendations				
Map ref	Description	Notes	approx costs	approx num/km
Back Creek	Potential to fence and manage stock access and direct seed selected understorey species	Most of this creek is fenced off already and if stock are going to be grazing the site I would recommend fencing it off to stock and undertaking some sort of understorey planting. The creek would be suitable for direct seeding where the ute could get around amongst the regrowth. If the existing fences were to remain, then direct seeding by machine is an option in some most of the creek. If the fencing was to be moved in closer to the creek then tubestock and/or hand direct seeding would be more appropriate	fence - $8-10K per km erected Seed and Machine direct seeding $500/km	2.66km 5km
Dam 1, 2, 3, 6, 8, 9	Dam - exclude stock and revegetate	These are already included within exclusion areas and within the boundary buffer zone - recommend planting with tubestock as part of the buffer planting Allow passive regeneration of fringing vegetation	General revegetation costs	
Dam 4	not inspected	Could be fenced and revegetated		
Dam5	Dam - stock access point and fence and revegetate	Could either be left in the paddock or included in the boundary buffer with a stock access point.		

Dam 7 , 11, 12, 13, 14	Dams included in Exclusion areas	This is included in marked exclusion areas		
Dam 10	Dam - exclude stock and revegetate	This is adjacent to the creek and if the dam is to remain I would recommend fencing it in to the creek site		
Dam 15	Dam - maintain existing fencing	Manage stock access		
Excl1	Severely degraded gilgai formation. Exclude from grazing	Recommend maintaining existing internal fencing so this becomes part of the creekscape area to reduce further degradation by stock access. The site has been sown with exotic pasture species so has limited chance of natural recovery. Recommend addition of coarse woody debri and could attempt active regeneration by weed control and hand direct seeding - need to assess further.	Needs to be explored further	
Excl2	Degraded gilgai formation but potential for recovery	High priority for stock exclusion and recommend addition of some coarse woody debri.	Included in creek fencing above	
Excl3&4	Intact ephemeral Redgum swamps	High priority for stock exclusion	fence - $8-10K per km erected	800m

Excl5	Intact ephemeral Redgum swamp - potential to fence and exclude grazing	High priority for stock exclusion	fence - $8-10K per km erected	500m
Excl7	Intact Redgum Wetland	Maintain existing fencing and exclude regular stock grazing		
Reveg1	50m reveg corridor buffer	This site is exotic pasture and/or crop. Recommend tubestock planting at 4X4m spacing 80% understorey, 20% trees	fence - $8-10K per km erected Tubestock planted $2.50 each	1.2km 3600 plants
Reveg2	50 m corridor screen and biodiversity link	This site is exotic pasture and/or crop. Recommend tubestock planting at 2X4m spacing 80% understorey, 20% trees	fence - $8-10K per km erected Tubestock planted $2.50 each	700m 4200 plants

Reveg3	50 m corridor screen and biodiversity link tubestock	This site is exotic pasture and/or crop. Recommend tubestock planting at 2X4m spacing 80% understorey, 20% trees	fence - $8-10K per km erected Tubestock planted $2.50 each	350m 2200 plants
WLane	Remnant Grey Box and add understorey	Recommend retaining this corridor for linkage to other remnant vegetation in the areas Undertake weed control in whole corridor - would expect some regeneration of Grey Box trees Fence, rip and plant the 300m to create a corridor to creek (10m corridor proposed, 3 rows)	fence - $8-10K per km erected Tubestock planted $2.50 each	300m 240 plants
5m buffer plantings	Grey Box/Redgum/Yellow Box	Recommend to space 3 lines 1.5m apart and plant at 4m spacings alternating across the rows Where particular screening is required can make spacings 3m in those sections	Tubestock planted $2.50 each	12000 plants (for whole boundary)
Roadside planting	Addition of understorey species along the section of Benambra Rd and Schneiders Rd	2.2km of roadside with some plants added.	Tubestock planted $2.50 - $3 each	550 plants

Proposed Seed Production area (SPA)	Potential to establish a SPA in partnership with Murray Local Land Services (MLLS)	Would have to be negotiated with MLLS		

Holbrook Landcare Network

REVEGETATION

Bushlinks

Site preparation for tube stock

SPRING

SUMMER

AUTUMN

WINTER

SPRING

Spray out exotic perennial pasture

- If you are planting in perennial pasture dominated site, spraying the site the Spring prior to planting is the ideal preparation , and you may then only require one spray in Autumn

Order plants

- Order plants early to guarantee supply of desired species
- Consult with your local nursery and the "Southwest Slopes Revegetation Guide" (online at www.holbrooklandcare.org.au)for appropriate plants for your area

Control rabbits and hares at site and surrounds

- Coordinate with neighbours if necessary, deal with burrows and surface dwelling rabbits
- Avoid the need for labour intensive and expensive tree guards

Ripping—where appropriate

- Rip before the Autumn break, while the ground is hard and dry to get deep shattering of the soil
- Rip lines should be spaced a minimum of 4 metres apart and at least 40cm deep
- Do not rip under the drip-line of existing trees., through wet areas or where there is erosion hazard

Crash graze/slash grass and spray rip lines before frosts, but about 10 days after rain

- Seek appropriate agronomic advice on sprays and rates of chemical
- Spray rip lines only —broad scale spraying of site not recommended
- If no rip lines, spot herbicide application 1 square metre per plant

Re-spray one month prior to planting if required

- Only non-residual herbicides are recommended for use
- If no chemicals to be used, consider slashing/grazing again

Plant seedlings mid July to September

- For 400 plants per ha, plant every 6 m for rip lines that are 4m apart
- For 600 plants per ha, plant every 4 metres for rip lines 4m apart

Check for vermin or stock damage first week after planting

- Inspect for vermin such as rabbits, hares and **act** on any specific problems
- Check that there is no stock entry to plantation

Check plants regularly post-planting

- Watch and act on weed regrowth through Spring and early summer.
- Monitor insects such as grasshoppers, Rutherglen bugs etc. Spot spraying may be undertaken if necessary
- Damage can be caused by frost, birds , kangaroos and wombats
- Remember to shut the gate on the way out!!

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REVEGETATION

Ripping

Before ripping, landowners should contact Dial-Before-You-Dig to check the location of utilities.

- Ripping should be done when the profile is dry to *shatter* the soil (not slice) and reduce the risk of air pockets forming, especially in clay soils.
- Rip lines should be spaced 4 metres apart, and at least 40cm deep.
- If the rip has resulted in air spaces, running a tractor wheel or cultivating over the rip line may be appropriate.

- On undulating or hilly land, rip lines should be along the contour to minimise soil erosion.
- Mounding may be recommended in specific soil types, especially sites prone to waterlogging, but it is the exception rather than the rule.

When is ripping NOT appropriate?

Native grass sites—IF planting is appropriate at all, then native grass areas should be direct seeded to prevent disturbance and the invasion of weeds.

Steep Land– slopes must be safe to work on and the appropriate equipment used. If accessible, rip on the contour. Choose appropriate equipment (eg. bulldozer rather than tractor).

Erodible lands— sites with existing active erosion, erodible soil types (including subsoil) or at risk of sheet erosion. Rip lines can catch and redirect water if not designed properly. Seek advice before ripping in erosion prone areas.

Spraying

- The area covered by herbicide spraying should be no wider than 50cm along either side of the rip line.
- If weed regrowth is excessive, over spraying with some chemicals is possible at certain times of the year when the plants are dormant. Consult with your nursery or professional for advice.

What if I don't want to use chemicals?

Site preparation is about reducing the competition for moisture, light and nutrients for the seedling, and this can be achieved in other ways.

- **Reduce the biomass**—slashing or using grazing to knock down the grass load.
- **Scalping** (taking the top 1-2cm of soil off) the planting site may be appropriate in sites with low erosion risk. As you are scraping off the nutrients present in the top layer, there is usually some residual effect before regrowth occurs. Scalping over large areas is not recommended, except under VERY specific circumstances (eg sheep camp restoration).

Tree Guards?

Advantages

- Can provide protection from rabbits and hares where control difficult
- Can provide protection from frost

Disadvantages

- Significant cost per unit
- Significant labour cost to install
- Require maintenance and eventual removal

Watering?

Good site preparation and the timing of planting in late Winter/early Spring is recommended to eliminate the need for watering over the first Summer.

Assessing losses— Vegetation growth in the first Spring can often make it difficult to see the plants. Assess the site properly before making a decision. We recommend to wait until the end of the second or third Spring to assess for replanting UNLESS there has been a specific grazing incursion or insect attack.

For more information please contact Holbrook Landcare Network

Phone: (02) 6036 3181 Mobile: 0418 198 522
Email: kyliedurant@holbrooklandcare.org.au
http://www.holbrooklandcare.org.au/bushlinks

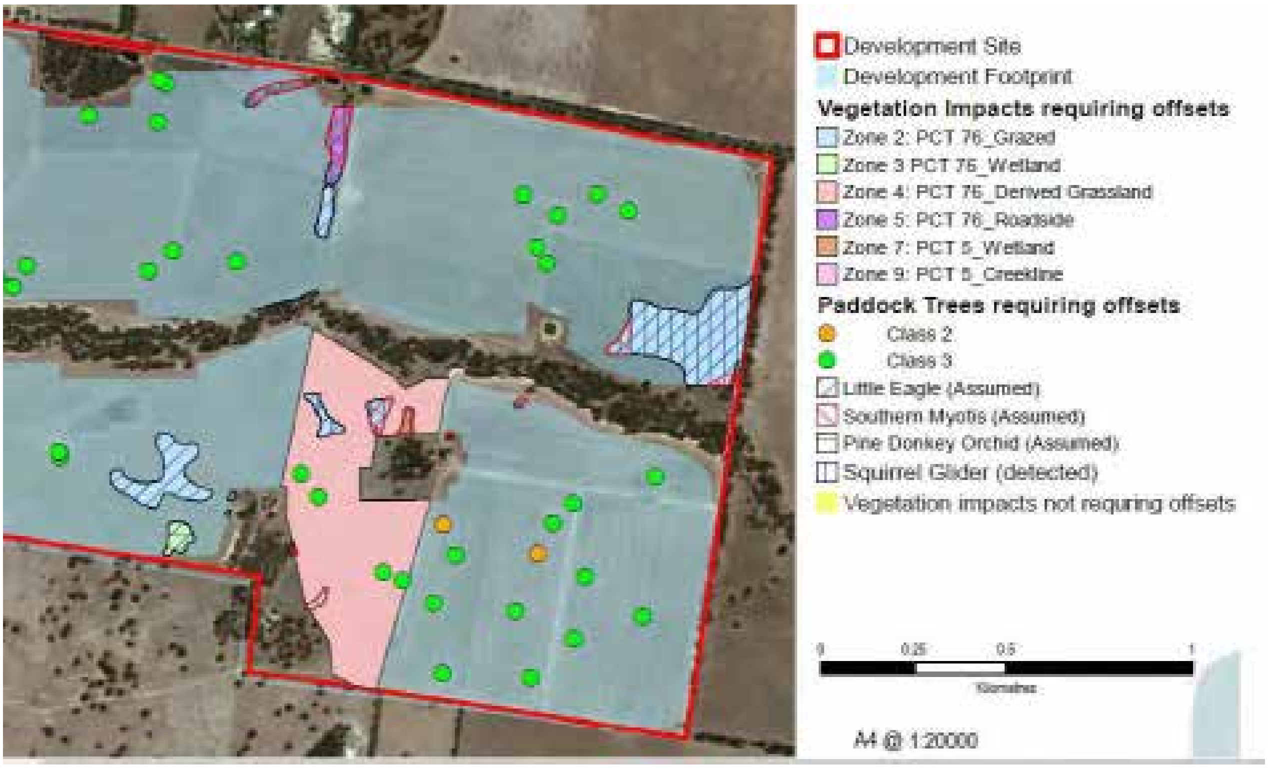
APPENDIX J ASSESSMENT OF INFRASTRUCTURE IMPACTS TO GRASSLAND

Walla Walla Solar Farm

Zone 4: PCT76_Derived Grassland Analysis

The Walla Wala Solar Farm is a proposed 300MW ac Tracker mounted utility scale Solar Farm located on lands off Benambra Road, Walla Walla, NSW, 2659

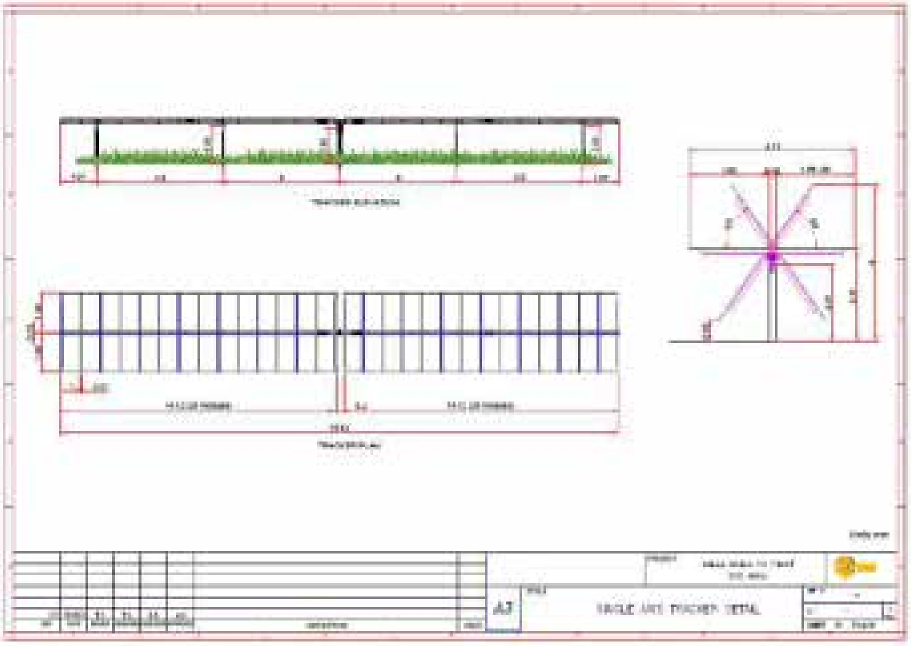
During an ecological assessment carried out by Julie Gooding Environmental Consultant - Accredited NSW BAM Assessor (BAAS18074) of NGH, an area of Grey Box derived grasslands (PCT 76_derived grassland) was identified which is shown in pink below.



Given the perceived expectation that a solar farm would significantly impact on this area of grassland it was initially regarded as requiring biodiversity offsets for impacts to the entire area of derived grassland.

However, FRV have completed detailed analysis of the actual / real impact of a solar farm based on current construction methods, a realistic and workable design coupled with significant experience in developing, constructing and managing operational assets across Australia.

During the Operational phase of assets within Australia and, whilst reviewing assets globally, it has become evident that grasses and other vegetation are able to continue growing underneath the panels and tracker systems. This is in part due to the rotational characteristics of the technology which allows diffused light and moisture to penetrate the ground but also potentially that additional shading assists in moisture retention underneath the panel / tracker area.



Rotational nature of tracker infrastructure

Evidence of Grass Growth under Operational asset in QLD, Australia – Lilyvale Solar Farm 100MW ac

Based on this evidence FRV undertook an internal modelling exercise which examined the actual impact of Solar Farm infrastructure within the Zone 4: PCT76_Derived Grassland area based on the following:

1. A number of uprights (posts) that support the Tracker / panels – each post was measured for its steel thickness with a conservative 20CM X 20cmSq impact area – regardless of the fact that the actual post will be Based on an I section profile (A).
2. 720 Tracker units that could be installed within the 29.3 ha area (A)
3. Inverter bases within the area – Based on SMA Modular technology (B)
4. Two 4m wide access tracks that cross the area (C)

The table of calculation can be found here:

Walla Walla Solar Farm - Land Usage Impact Analysis			23.9 Hectare Native Vegetation - Grasses		
Site	Walla Walla				
Capacity (DC)	362000000	W	14258075.15		
AC Capacity	300000000	W	11816084.38		
Solar Farm Land Area	6068000	m^2	0.039386948	239000	m^2
Tracker	30x4m				
Module	330	W			
Road Width	4	m			
Tracker		Unit			
Modules / Row	60	N/A			
# Posts / Tracker	9	#			
Area of Each Post	0.04	m^2			
# Trackers (Approx.)	18283	#	720.10		
Assumed non grazable area under modules/Tracker	25	m^2			
Post Area Land Impact	**6582**	**m^2**	259.24		
Land Impact of total tracker + posts	**463653**	**m^2**	18261.86	A	
Inverter Blocks		Unit			
Block Capacity	5000000	W			
Block Width	2.44	m			
Block Length	12.19	m			
Block QTY	72	#	2.84		
Area of Total Inverter Blocks	**2141.5392**	**m^2**	84.35	B	
Other Areas		Unit			
Access Roads (assume 4m width)	72800	m^2	2867.37		
O&M Compound	2400	m^2	0		
Total Other Areas	75200	m^2	2867.37	C	
Total Grazing Land Loss			**21213.58**		
% Loss			**8.88%**		
% Ground Contact (Ignores Screening Areas, Module Shading)			1.34%		

Total impacted grass area within the 23.9 Hectares due to tracks / infrastructure = A+B+C = 21,213Msq

Total impact on Vegetation within the 23.9 Hectares area as a % = 8.88%

This analysis demonstrates that within the 23.9 Hectare area only 21,213 sq meters of land is impacted by the solar farm infrastructure equating to 8.88% of its area.

APPENDIX I CAPITAL INVESTMENT VALUE REPORT

(CONFIDENTIAL)

APPENDIX J WALLA WALLA FLOOD STUDY

NGH Environmental

Walla Walla Solar Farm - Site Flood Assessment

Final Report

October 2019

Cover photograph: Benambra Road looking east across Back Creek.

Table of contents

Table index

Figure index

Appendices

1. Introduction

FRV Services Australia (FRV) proposes to develop a solar farm on a 605 hectare site located 4 km north east of Walla Walla. GHD was engaged by NGH Environmental to undertake an assessment of existing flooding conditions and risks associated with the proposed development.

The location of the assessment property is shown on Figure 1. There are two waterways aligned through the site as shown. The waterway entering at the eastern boundary of the assessment site is Back Creek. The waterway entering at the southern boundary of the assessment site is Middle Creek.

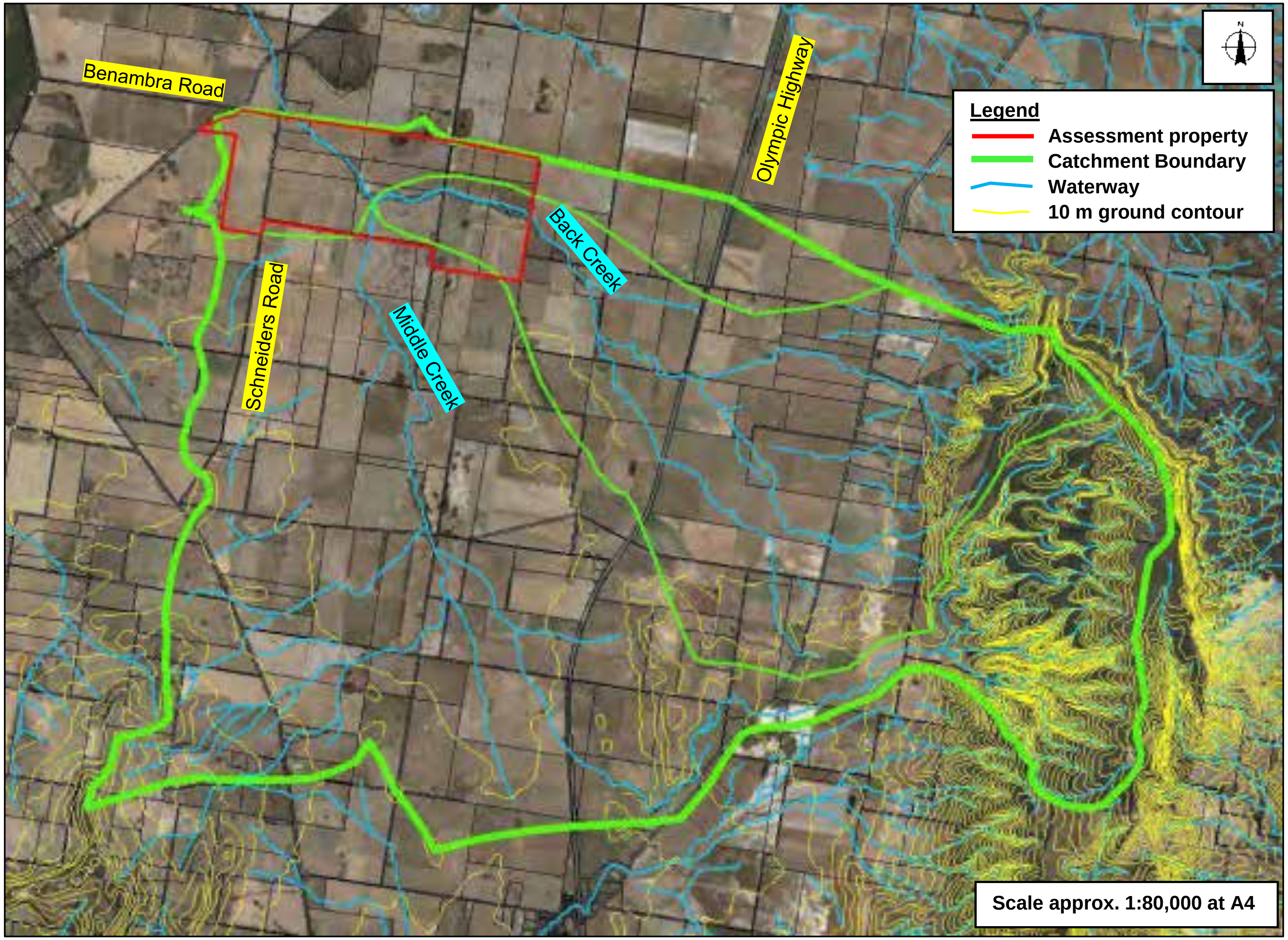


Figure 1 Locality Plan / Catchment Plan

2. Site and Development Description

2.1 Site Description

The 605 hectares assessment site is located on the south side of Benambra Road as shown on Figure 2. The western boundary of the assessment property is located 500 m west of Schneiders Road. The eastern and southern boundaries adjoin rural land use properties.

The whole of the assessment site is currently a rural land use property. There are no buildings located on the property.

An incised channel is present along the Back Creek route (refer to Photographs 1 and 2 in Figure 3). The creek corridor is covered with native trees. No formal waterway structures are present along the Back Creek route within the assessment site. An informal existing access crossing is present due south of Weeamera Road.

Benambra Road is only marginally raised at Back Creek (refer to Figure 4 – Photograph 3). The roadway culvert structure present is a low flow culvert capacity structure only. The road will overtop during minor flood events.

The Middle Creek waterway route is characteristic of a broad depression (refer to Photograph 4 in Figure 4). There is no incised channel present. The depression is covered by pasture with no tree cover.

Small woodlands and scattered trees are present over the remainder of the site.

The eastern half of the assessment site falls in a generally westerly direction (refer to ground surface contours in Figure 2). The western half of the site falls towards the Back Creek crossing of Benambra Road, located 200 m west of Schneiders Road.

The highest parts of the assessment site are located in the south west corner (up to 218 m AHD) and the south east corner (up to 231 m AHD). Ground surface elevations along the Benambra Road frontage vary from 205 to 216 m AHD.

Back Creek crosses under a decommissioned railway line (Corowa-Culcairn Railway) approximately 900 m downstream of the assessment site (i.e. downstream of Benambra Road). The railway line embankment remains intact with a large 50 m overall span bridge structure present at Back Creek. Back Creek flows into the Billabong Creek 8 km downstream of the assessment site.

2.2 Development Description

The proposal involves the construction of a ground mounted solar array which would generate around 300 MW AC of renewable energy. The solar farm would connect via the substation and transmission line directly into the TransGrid 330 kV transmission network which passes through the property.

The preliminary development proposal layout is provided in Appendix A.

The layout features:

- Substation located in the north western corner of the site
- Solar panel fields
- Inverter stations for controlling the solar panels in their vicinity
- Network of vehicle access roads

Those parts of the site which are not proposed to be developed include the Back Creek waterway corridor and a number of woodland areas.

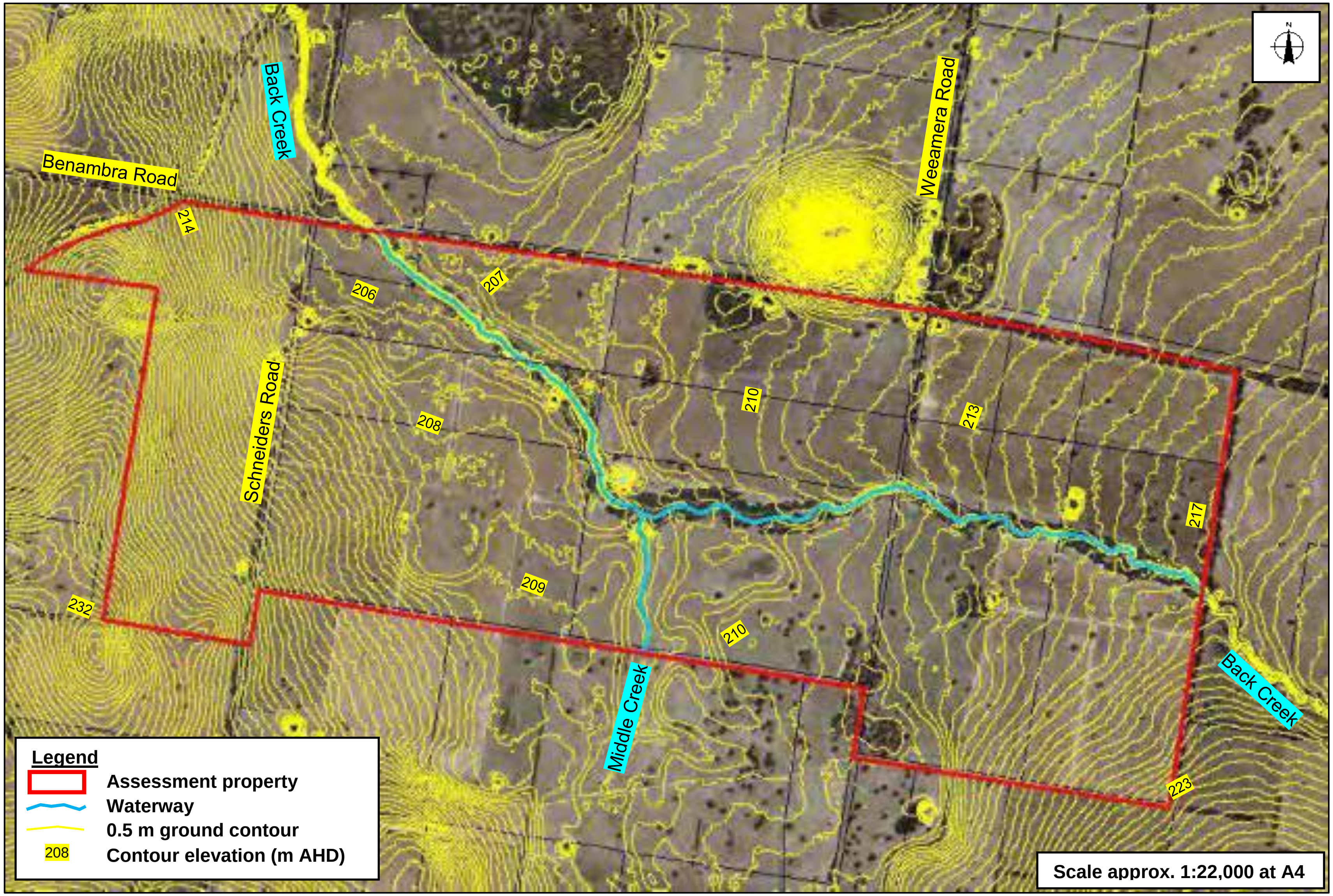


Figure 2 Local Features Plan

Figure 3 Photographs 1 and 2

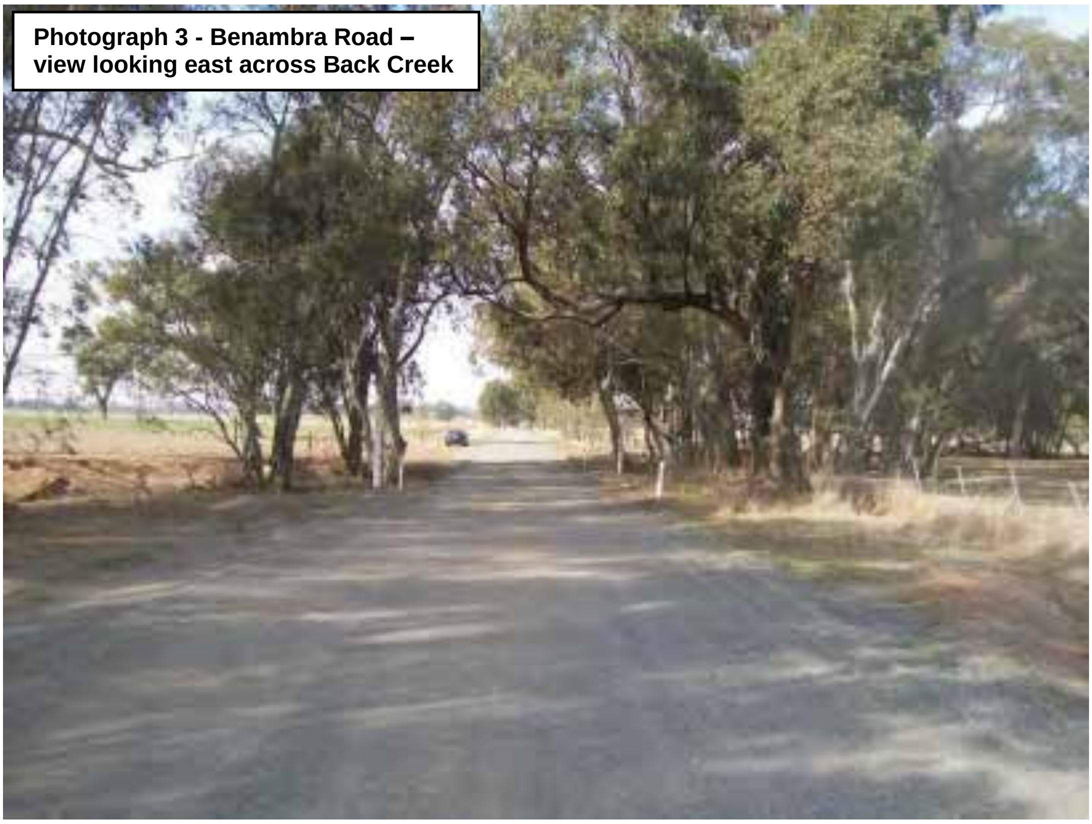


Figure 4 Photographs 3 and 4

3. Hydrology

3.1 Catchment Description

The Back Creek catchment draining to Benambra Road is shown on Figure 1.

The catchment extends into a hill range, 6 km east of the Olympic Highway. The upper catchment area drains westwards crossing the Olympic Highway and the adjoining Melbourne-Sydney Railway at multiple culvert structures.

The terrain west of the Olympic Highway is flatter, generally draining northwards towards the assessment property.

The majority of the Back Creek catchment has been predominantly cleared for agriculture, with the exception of the steeper hillside areas located in the upper catchment.

The west side catchment boundary of the Back Creek / Middle Creek catchment abuts the Petries Creek catchment which drains into the Walla Walla township and ultimately Gum Swamp on the north side of Walla Walla.

3.2 Design Flow Estimates

Design flow estimates for Back Creek and Middle Creek were estimated using a simplified approach as described below.

Design flow estimates for the adjoining Petries Creek catchment at Walla Walla are documented in the Walla Walla Flood Study report (GHD, 2017). The Walla Walla Flood Study estimates are based on Regional Flood Frequency Estimation (RFFE) derived estimates, which are consistent with design flow estimates used for other nearby town flood studies at Jindera and Henty.

The adopted 5% and 1% annual exceedance probability (AEP) design flow estimates for the flood assessment are given in Table 1. They are consistent with the estimates derived for the adjoining Walla Walla Flood Study after adjusting for the differences in catchment area.

The Probable Maximum Flood (PMF) estimates given in Table 1 coincide with approximately 12 times the 1% AEP design flow. This is consistent with typical PMF to 1% AEP flow ratios for catchments of this size.

3.3 Adjustments to Back Creek flows upstream of Middle Creek

The eastern most part of the catchment is a relatively steep hillside area (refer to Figure 1). Most of this hillside area drains into the Middle Creek subcatchment. It is possible however that in large flood events, overflows from the Middle Creek subcatchment spill into the Back Creek catchment.

Modelling of flooding conditions within the upper catchment hillside area was outside the scope of this assessment. It was however assumed for the purpose of this assessment that the uppermost portion of the Middle Creek catchment spills into the Back Creek catchment.

The Back Creek design flow estimates were subsequently adjusted upwards to reflect this assumption (refer to Table 1). The Middle Creek design flow estimates were retained without adjustment.

Table 1 Design Flows

Location	Catchment Area (km²)	Peak Design Flow (m^3/s)		
		5% AEP	1% AEP	PMF
Middle Creek at Back Creek junction	57.7	52	87	1,000
Back Creek upstream of Middle Creek junction – no overflows from Middle Creek	27.6	32	53	600
Back Creek upstream of Middle Creek junction – overflows from Middle Creek	40.0 (adjusted – see Note 1)	41	69	800
Back Creek at Benambra Road	93.8	75	125	1,500

Note on Table 1:

1. The adjusted catchment area is based on the assumption that there are significant overflows from the Middle Creek catchment into the Back Creek catchment within the upper catchment hillside area east of the Olympic Highway (refer to catchment plan in Figure 1).

4. Hydraulics

4.1 Terrain Data

LiDAR terrain elevation data was available for the assessment site and surrounding area. The LiDAR dataset details are as follows:

- Data acquired in 2014
- Source data processed to a 5 m digital elevation model (DEM)
- Vertical accuracy +/- 0.9 m (95% confidence interval)

The above LiDAR dataset overlaps with a 2013 LiDAR dataset, which was obtained for use as part of the Walla Walla Flood Study (GHD, 2017). The 2013 dataset has a vertical accuracy of 0.3 m (95% confidence interval).

A comparison of the 2014 LiDAR dataset with the 2013 dataset showed generally good agreement. The accuracy of the 2014 LiDAR data is however not compatible with what should be used for determining flood levels to be used for the setting of minimum floor levels for development which is sensitive to flooding (e.g. during the detailed design phase of this project).

4.2 Hydraulic Model

The HEC-RAS hydraulic model was used to simulate flooding conditions within Back Creek and Middle Creek. The modelling was undertaken as follows:

- Cross sections extracted at intervals from the 5 m grid LiDAR dataset. Cross sections were orientated perpendicular to predominant flow direction.
- Mannings roughness values assigned based on observed and expected typical conditions. Main channel roughness of 0.06 adopted for Back Creek channel and woodland corridor. Mannings roughness of 0.04 adopted elsewhere.
- Steady state flow inputs as per Table 1.

The resultant modelled flood extents are shown on Figure 5. The reliability of the flood extents is limited by the accuracy of the terrain data set used for the modelling.

4.3 Description of Flooding Conditions

4.3.1 5% AEP Flood

The 5% AEP flood extent results in the inundation of 15% of the development property (refer to Figure 5). The width of the 5% AEP flood extent generally varies from 120 m to 250 m as shown on Figure 5, with the exception of the area to the east of the Middle Creek / Back Creek junction where broader inundation is present.

Velocities and flood depths will be highest within the incised Back Creek channel. The 20% AEP flood depth typically varies from 1.0 to 3.0 m within the incised channel. The average in-channel velocity typically varies from 0.5 to 1.5 m/s.

The overbank 5% AEP flood depth is generally less than 0.5 m. Average overbank velocities are generally expected to be in the vicinity of 0.5 to 1.0 m/s.

Although an incised waterway is not present along the Middle Creek route, it is still a high conveyance zone. In a 5% AEP event, the modelled flood depth in the base of the Middle Creek depression is typically 1.0 to 1.3 m. Average velocities are in the vicinity of 0.5 m/s.

4.3.2 1% AEP Flooding

The 1% AEP flood results in the inundation of 31% of the development site (refer to Figure 5).

The 1% AEP flood levels are typically 0.2 to 0.3 m higher in comparison to the 5% AEP flood levels. Velocities will also be slightly higher.

The 1% AEP extent is generally relatively well confined, with the exception of the Back Creek south bank area upstream of the Middle Creek junction. Broad inundation on the south side of Back Creek upstream of the Middle Creek junction occurs in a 1% AEP flood as shown on Figure 5. The 1% AEP flood depths for this area and the other areas outside the 5% AEP extent will typically not be more than 0.3 m, although there will be some localised areas where the flood depth is greater than 0.3 m.

4.3.3 PMF

The PMF results in the inundation of 72% of the development site (refer to Figure 5). PMF flood levels are up to 2 m above the 1% AEP flood levels.

The PMF extent is what can be expected in the most extreme flood event possible. The probability of the PMF occurring is extremely small.

4.3.4 General Flooding Conditions

Given the catchment size, the time interval between the commencement of the flood inducing rainfall and the peak of the flood is typically expected to be in the vicinity of 1 to 6 hours. Higher intensity rainfall will result in a shorter response time whilst rainfall spread over a longer period will increase the available warning time.

The duration of extensive out of channel flooding is not expected to typically exceed 3 to 12 hours. There may however be flood events when flows in the creek channel remain high for extended periods exceeding 12 hours, including overflows across Benambra Road.

Benambra Road is not expected to be trafficable in a 5% AEP event. The threshold for Benambra Road overflows is expected to be less than the 20% AEP event.

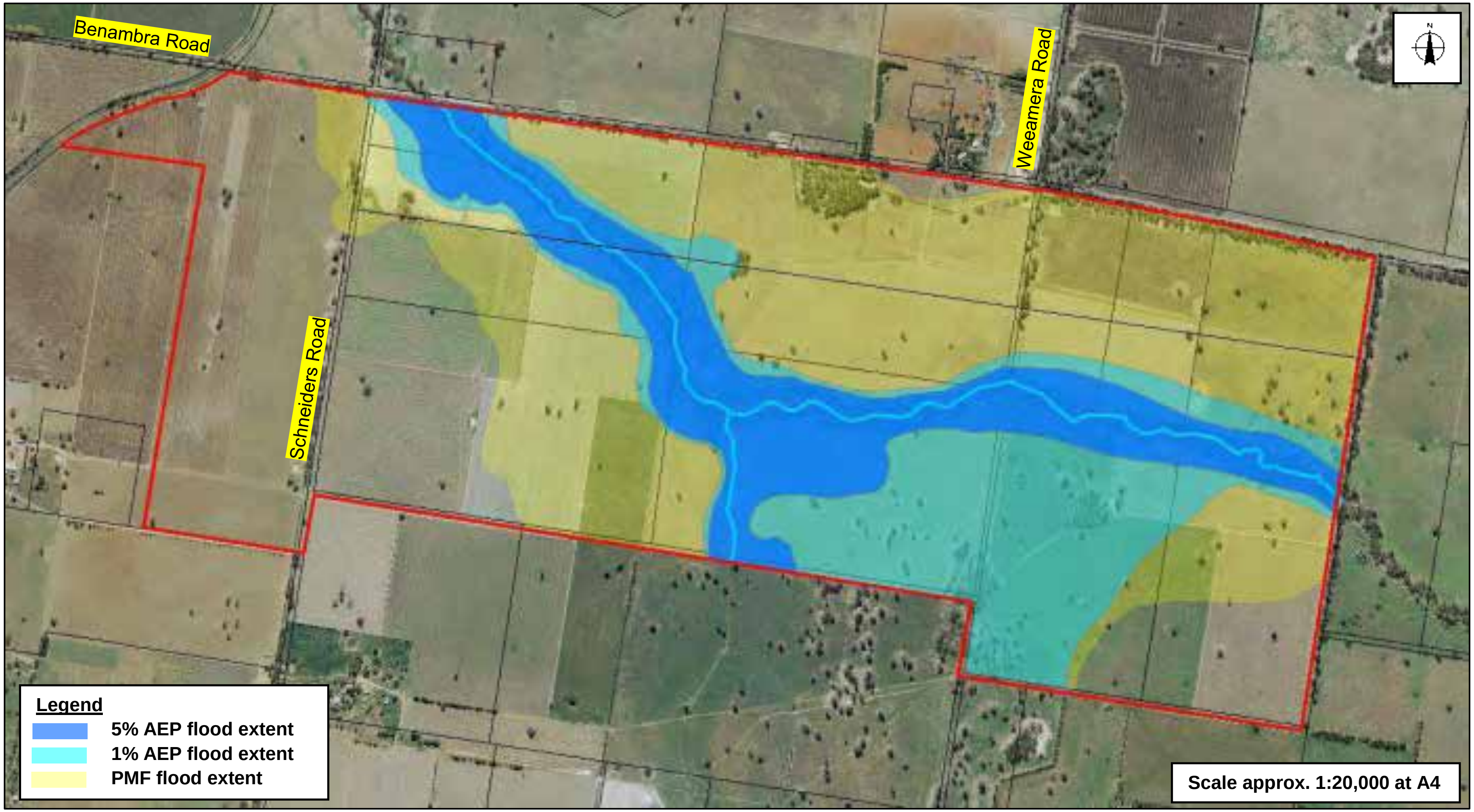


Figure 5 Flood Extent Plan

5. Potential Impacts of Flooding on the Development

5.1 Development Description

The development proposal layout plan is provided in Appendix A.

The layout features:

- Substation building located in the north western corner of the site.
- 72 inverter stations (inverter stations) for controlling the solar panels in their vicinity
- Approximately 900,000 solar panels occupying the majority of the site with the exception of the development exclusion zones

The development components likely to be most sensitive to flooding impacts are expected to be the buildings and equipment associated with the substation facility.

The inverter stations are also expected to be sensitive to flooding impacts. Approximately 72 inverter stations are expected to be scattered across the site. The footprint dimensions of the inverter stations are expected to be approximately 3 m x 12 m. The inverter units would be constructed on concrete footings generally 0.3 m above ground level.

The 2 x 1 m solar panels are expected to be attached to a horizontal steel frame member (rack) which is supported by steel pole (pile) mounts. Row lengths will depend on the detailed design but could be up to 100m. The space between the rows is expected to vary between 8 m and 14 m.

The panels are able to pivot to maximise their efficiency as the sun moves across the sky. The panels can also be pivoted to a horizontal position during a flood event to minimise the risk of the panels being submerged in floodwater and subject to possible debris impacts. The panels even in a vertical position are well clear of the ground meaning that even without pivoting to the horizontal position, the panels should generally be elevated well above the floodwater height.

5.2 Flood Based Development Controls

The following approach is nominated for limiting potential flooding impacts on the development:

- Item 1 - Substation zone should be located in a portion of the site, which has very limited flood risk.
- Item 2 – Inverter stations should where possible be located on land which is located outside the higher conveyance areas.
- Item 3 - Solar panel mounts and panel elevations should be designed to minimise flood damage.
- Item 4 - Development should comply with the minimum setback distances from waterways.

5.3 Development Impacts

5.3.1 Substation

The development layout (refer to Appendix A) positions the substation in the north western corner of the site. This is the highest portion of the site, which adjoins road frontage (Benambra Road).

The substation footprint is located wholly outside the PMF extent.

Given the above, the risk of Back Creek flooding impacting on the substation is extremely low.

Consideration should be given to elevating the floor level of any substation facility buildings above the ground level (say by 0.3 m) to minimise the risk of any local runoff flooding.

5.3.2 Inverter Stations

The following flood based controls are nominated for the power stations:

- Floor level of the inverter stations should be elevated above the 1% AEP flood levels with an appropriate freeboard added.
- Inverter stations should preferable be located wholly outside or close to the outer edge of the 5% AEP flood extent (i.e. outside the more frequently flooded, higher conveyance, higher hazard flood areas).

The hydraulic modelling undertaken as part of the current assessment is simplified one dimensional modelling using the HEC-RAS model. The modelling has been undertaken using a low accuracy specification DEM dataset.

For the purpose of detailed design of the power stations (i.e. identification of floor elevation heights) it is desirable that 1% AEP flood levels at the location of each of the power stations is identified. The minimum power station design floor height would then coincide with the 1% AEP flood level plus an appropriate freeboard allowance.

Hydraulic conditions on the site are complex. This warrants the use of a two dimensional hydraulic model (e.g. TUFLOW or similar) for the purpose of identifying 1% AEP flood levels for the setting of inverter station floor levels at the time of detailed design. The hydraulic modelling should also be undertaken with a higher accuracy DEM terrain dataset than is currently available.

The current assessment hydraulic modelling indicates that the depth of 1% AEP flooding outside the 5% AEP flood extent will generally not exceed 0.3 m. A 1% AEP flood depth of 0.3 m and an applied freeboard of 0.3 m would position the floor level of an inverter station 0.6 m above the ground surface.

5.3.3 Solar Panel Fields

To minimise the potential for floodwater to impact on the solar panels, the detailed design approach adopted should aim to position the solar panels, when in a horizontal pivoted position, an appropriate freeboard amount above the 1% AEP flood levels to minimise the risk of floodwater damaging the panels.

To this end, the bottom side of the horizontal frame support member should be designed to be elevated above the 1% AEP flood level plus an appropriate freeboard allowance.

Outside the 5% AEP flood extent, the base of the horizontal support frame and / or solar panels will need to be elevated typically no more than 0.6 m above the ground assuming that a freeboard of say 0.3 m is applied.

5.3.4 Perimeter Fencing

Where perimeter fencing around the outside of the development side crosses the waterways at Back Creek and Middle Creek, the fencing will need to be designed to not excessively capture debris carried by floodwater. Excessive debris capture will lead to higher forces on the fence and likely resulting damage.

Where the perimeter fencing crosses the proposed 5% AEP flood extent zone, it is proposed that the lower portions of the fence will consist of a hinged type flood gate arrangement. The flood gates will be free to pivot outwards in the downstream direction and allow debris to pass downstream underneath the flood gate, thereby minimising the risk of debris becoming trapped and obstructing floodwater.

5.4 Potential Risk to Life, Health and Safety

The proposed developed is expected to pose an extremely low risk in relation to the safety of persons who may be present on the site during flooding.

The reasons for this are as follows:

- The nature of the proposed development is such that no persons will be occupying the site, except when carrying out maintenance and any other temporary work related activities. There are no habitable buildings proposed for the site.
- The expected limited need for actions to minimise property flood damage (i.e. no need for persons to be on-site during flooding), assuming that the solar panels are able to be pivoted to a horizontal position remotely.

6. Impact of the Development on Flooding

6.1 Potential Causes

Development on a floodplain can lead to changes in flooding conditions as a result of the following causes:

- Raising of ground levels (i.e. filling associated with the development, including building pads and raised access tracks).
- Structures obstructing flow (e.g. buildings, bridges / culvert crossings, pole mounts in the case of solar fields, fences).

The above can lead to floodwater being redirected, thereby exacerbating flooding where the additional flow is diverted to. It can also lead to higher flood levels and velocities.

Higher flood levels and velocities are of particular concern where they occur on adjoining properties. In these circumstances, development has effectively increased the flood risk of the adjoining property.

6.2 Proposed Development Issues

6.2.1 Substation

The largest potential obstruction to flow on the finished development site will be the substation facility buildings.

The substation has been located wholly outside the flood affected area. There is therefore no risk that the substation will result in impacts on flooding conditions.

6.2.2 Power Stations

There are 72 proposed inverter stations located on the site (refer to the development layout plan in Appendix A). The preliminary design footprint for each power station is 18 m^2 (6 m x 3 m).

Inverter stations located within the 1% AEP flood extent will lead to a localised increase in flood level due to floodwater being obstructed by the power station pad / footing. The invert station pads are proposed to be elevated at the 1% AEP flood level plus an appropriate freeboard.

The impacts of the inverter stations on flooding conditions are expected to be acceptable for the following reasons:

- Inverter stations will be predominantly located outside the 5% AEP inundation extent zone.
- Any localised increases in flood level are expected to largely dissipate within the development property.
- There is no existing flood sensitive development within the adjoining properties in close proximity to either Back Creek or Middle Creek.

6.2.3 Solar Panels

The design intent of the solar panels and their supports will be to minimise the potential for floodwater obstruction (refer to Section 5.3.3). This will be achieved by:

- Positioned of the solar panel fields predominantly outside the 5% AEP flood extent
- Ensuring that the horizontal support frame members and the solar panels themselves are elevated above the 1% AEP flood level when in a horizontal pivoted position
- The low density of the vertical member pile supports

Given the above design approach, the solar panels and their support frames are expected to pose a very limited risk in relation to altering off-site flooding conditions.

6.2.4 Fencing

All fencing crossing the 5% AEP flood inundation extent should be designed with the objective of minimising the extent to which the fencing traps debris and obstructs floodwater. This is particularly important for the boundary perimeter fencing, where obstructions will affect the adjoining property.

An appropriate fence design will be identified during detailed design. This is likely to be in the form of the lower portion of the fence line consisting of a hinged flood gate, designed to open outwards in the downstream direction during a flood thereby allowing debris to pass through below the hinged flood gate.

The impacts of site fencing on flooding can therefore be adequately minimised providing an appropriate fence design is adopted.

6.2.5 Access Roads

The proposed alignment of the internal access roads is shown on the development layout plan included in Appendix A.

The following controls are nominated for the access roads:

- Access roads located within the 1% AEP inundation extents should not be raised more than 100 mm above the adjoining ground surface level.
- Access roads located within 100 metres of the upstream property boundaries (Back Creek – eastern boundary, Middle Creek – southern boundary) should not be raised more than 60 mm above the existing ground surface.

Compliance with the above will ensure that the access roads do not lead to the excessive obstruction of floodwater.

The preliminary access road design arrangement has the outer surface of the access roads positioned at existing ground level, with 3% camber to the road centreline. Based on this arrangement, the crown of the access road will be typically 0.06 m above the existing ground level.

The development layout plan does shows one crossing of the Back Creek waterway and one crossing of the Middle Creek waterway. The detailed design arrangements for these two crossings should demonstrate that the two crossings are not likely to excessively obstruct floodwater.

A ford type crossing will achieve this and will be suited for the Middle Creek crossing, where no incised channel is present. Either a ford type crossing, or a low flow culvert structure, or a modified form of the existing informal structure will be best suited for the Back Creek crossing.

6.3 Impacts of Development on Floodplain Environmental Values

The development layout (refer to Appendix A) includes a development corridor buffer zone extending over and either side of the length of Back Creek. This development buffer zone encompasses the woodlands on either side of Back Creek. The development is not therefore expected to impact on the floodplain environmental values (e.g. woodland native trees) within the Back Creek corridor.

The environmental assessment is being undertaken by NGH Environmental for the development site.

7. Summary and Conclusions

Flooding from Back Creek and Middle Creek affects parts of the development site.

The extent of 5% and 1% AEP flooding from the two creeks is shown on Figure 5. The 5% AEP flood inundates 15% of the development site. The 1% AEP flood extent inundates 31% of the development site.

The property damage flood risk posed to the development is assessed as very low for the following reasons:

- Development will be largely excluded from within the 5% AEP flood extent.
- The development infrastructure most sensitive to flooding impacts will be positioned outside the 1% AEP flood event or above the 1% AEP flood level.

The flood risk posed to life, health and safety from the development is assessed to be extremely low. The reasons for this are:

- No permanent occupants / residents on site (no habitable dwellings).
- No need for persons to be on the site during a flood event with pivoting of the solar panels to a horizontal position expected to be initiated remotely.

The risk posed by the development in relation to the potential for the development to adversely affect offsite flooding conditions can be adequately mitigated provided that:

- Site filling is limited to that associated with the substation facilities, the 72 inverter stations and height limited access tracks.
- The solar panels when a horizontal pivoted position and the supporting horizontal racks (if applicable) are wholly elevated above the 1% AEP flood level.
- Site fencing within the 5% AEP extent is designed to minimise the potential for debris blockage.

The risk posed by the development to flood dependent environmental values is assessed to be low. The reasons for this are:

- The Back Creek corridor including the adjoining woodland on either side of the creek is wholly positioned outside the development area and will not therefore be affected.
- Existing site drainage characteristics will be largely retained, given the absence of land filling with the exception of the substation, power stations and access tracks.

In summary, the key findings of this assessment are:

- The proposed development activity appears compatible with the identified flood risk for the site.
- The development is not expected to cause adverse impacts on flooding conditions on the surrounding rural land use properties.

This assessment has been completed to provide input into the planning approval process and the design of the preliminary layout. It is recommended that two dimensional hydraulic modelling be undertaken at the time of detailed design for the purpose of identifying 1% AEP flood levels for the setting of minimum floor heights for flood sensitive components of the development. The hydraulic modelling during detailed design should be undertaken with a higher accuracy acquired DEM terrain dataset than is currently available.

8. References

GHD Pty Ltd (February 2017). *Walla Walla Flood Study, Floodplain Risk Management Study and Plan – Flood Study Final Report*. Prepared for Greater Hume Shire Council.

Appendices

Appendix A – Development Layout Plan

Walla Walla PV Plant – General Layout


CONSTRUCTION COMPOUND
MAIN SITE ENTRANCE
O&M AREA
Security Fence
Property Boundary
Native Vegetation Screening
5 - 50 m
Firebreak (Asset Protection Zone)
10 m
Setback
5 m
PV Array
Indicative Drawing - Not to Scale

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APPENDIX K VISUAL IMPACT ASSESSMENT

Powering a Sustainable Future

Visual Impact Assessment

WALLA WALLA SOLAR FARM

OCTOBER 2019

ngh environmental

www.nghenvironmental.com.au

Document Verification

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NGH Environmental prints all documents on environmentally sustainable paper including paper made from bagasse (a by-product of sugar production) or recycled paper.

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CONTENTS

TABLES

FIGURES

Terms and definitions

AEP	Annual exceedance probability
BLM	Bureau of Land Management
CEMP	Construction Environmental Management Plan
CSEP	Community and Stakeholder Engagement Plan
CSER	Community and Stakeholder Engagement Report
DECC	Department of Climate Change (now BCD)
DECCW	Department of Climate Change and Water (now BCD)
DOEE	Department of the Environment and Energy (Commonwealth)
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment (DPIE)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DOEE)
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000* (NSW)
EPA	(NSW) Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ha	Hectares
Heritage Act	*Heritage Act 1977* (NSW)
HAZMAT	Hazardous Materials
Hz	Hertz
km	Kilometres
kV	Kilovolts
LCU	Landscape character unit
LEP	Local Environment Plan
LGA	Local government area
LMZ	Landscape management zone
LRET	Large-scale Renewable Energy Target
m	Metres
mm	Millimetres
MVA	Megavolt-ampere
MW	Megawatt
MWh	Megawatt hours
NML	Noise management levels
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water

POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PV	Photovoltaic
RE Act	*Renewable Energy (Electricity) Act 2000* (Commonwealth)
REAP	Renewable Energy Action Plan (NSW)
SEARs	Secretary's Environmental Assessment Requirements
Sensitive Receiver	A place or object that is sensitive to a particular environmental impact. e.g. school, place of worship, residence, heritage building/structure, pipeline (for vibration/blasting). These may be separately defined by government and industry policies and guidelines
sp/spp	Species/multiple species
SRD SEPP	*State Environmental Planning Policy (State and Regional Development) 2011 (NSW)*
SSD	State significant development
VIA	Visual Impact Assessment
V	Volts
ZVI	Zone of visual influence
The proposal	The construction and operation of the proposed solar farm
The proponent	FRV Services Australia Pty Ltd
Subject land	All land within the affected lot boundaries. The subject land comprises Lots 16, 17, 20, 21, 87, 88, 89, 108, 109 118 of DP 753735, Lot 3 253113, Lot 1 DP 933189, Lot A DP 376389 and Lot 1 DP 1069452, approximately 807 ha.
Development site	The area of land that is subject to the proposal. The development site is made up of 605 ha and includes the location of the proposed transmission line outside of the subject land. The development site is the area surveyed for this assessment prior to identified constraints and exclusions.
Development footprint	The area of land that is directly impacted by the proposal including solar array design, perimeter fence, access roads, transmission line footprint and areas used to store construction materials. The development footprint is approximately 493 ha.

1 INTRODUCTION

This Visual Impact Assessment (VIA) was undertaken to accompany the Environmental Impact Statement (EIS) for the proposed Walla Walla Solar Farm (proposal). It provides a full assessment of the visual impacts associated with the proposal, including:

- Landscape character and scenic vistas.
- Stakeholder values regarding visual amenity.
- Potential impacts on representative viewpoints.
- Addressing requirements of the SEARs.
- Addressing the requirements of the NSW Large-scale Solar Energy Guidelines (DPE, 2018).

The VIA includes a strategy to address identified impacts, including onsite vegetation screening, general design measures and a process to verify the actual visual impacts of the proposal. This improves the reliability of the measures and provides a trigger to undertake additional mitigation if required.

SECRETARY'S REQUIREMENTS

The EIS must also address the following specific issues:

Visual –

Including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners.

RELATED KEY COMMUNITY CONCERNS & QUERIES

As part of the community engagement, the proposal's visual impact was deemed one of two of the proposed solar farm's largest community impacts. The greatest visual impacts were raised from direct neighbours whose outlook from their homesteads and businesses is towards the proposal.

Main community group affected:
DIRECT NEIGHBOURS
(specifically R1, R2, R3, R4, R5, and R6)

Four direct neighbours (R1, R2, R5 and R6) (and the two subject landowners – R3 and R4) have houses and/or working land with a direct outlook on the subject land.

1. Direct visual impact
2. Location of substation
3. Design of vegetation screening
4. Glare / reflectivity, and night
5. Indirect (local /regional) visual

2 APPROACH

The VIA was completed in the following stages:

1. Background investigations and mapping, including identifying Land Character Units (LCUs), defining where infrastructure may be visible in the landscape, and identifying key viewpoints such as major travel routes, potential residences and built up areas.
2. Field survey including reconnaissance, ground truthing and photography, and understand the likely sensitivity of LCUs within the landscape.
3. Consultation, including understanding community values and documenting community perception.
4. Impact assessment, describing the potential impact on visual amenity during construction and operation of the proposal.
5. Visual impact mitigation measures were developed in consultation with near neighbours including significant vegetation buffers and screening for people who would have a view of the residence.

The impact assessment methodology used in this VIA for operational impacts is based on the Bureau of Land Management (BLM) Visual Resource Management System, developed by the BLM, US Department of the Interior (n.d.). The BLM developed a systematic process to analyse the visual impact of proposed developments. The basic philosophy states that the degree to which a development affects the visual landscape depends on the visual contrast imposed by the project. Key steps undertaken to assess the visual impact are as follows:

- Define Landscape Management Zones (LMZ) for the representative viewpoints, based on:
  - The scenic quality of the study area's LCU.
  - The expected sensitivity at representative viewpoints.
  - The proximity of each representative viewpoint.
- Evaluate the degree of contrast the solar farm would generate at representative viewpoints in consideration of the management objectives of the relevant LMZ.
- Determine the acceptability of the contrast with the management objectives of the relevant LMZ; this is the resultant visual impact, rated as high, medium or low.

For the purpose of this VIA, a maximum rotation height of 4 m for the solar array was used as the basis for visual impacts from the majority of selected viewpoints. The TransGrid substation, with an approximate maximum height of 21 m was assessed for viewpoint 8 only. This VIS functions by comparing existing views from selected viewpoints to views of proposal infrastructure without mitigation measures (but with existing obstacles e.g. roadside trees and hills). Unmitigated views from viewpoints are then compared with projected views after mitigation measures proposed by FRV have been implemented.

2.1 PHOTOMONTAGES

Photomontages were prepared for selected viewpoints to provide a realistic impression of the operational solar farm. The viewpoints for the photomontages were selected based on distance to the development site, frequency of view from a public place and the location of the nearest sensitive residences. These are considered to be either the most potentially sensitive viewpoints or representative of a range of similar viewpoints.

A number of photomontages were also prepared for selected residences that have specific visual concerns about the proposal. These montages have not been included in this report due to privacy and were produced as part of the community engagement process. Each montage shows a specific view from a particular residence and has been provided to the relevant resident. The photomontages were produced to facilitate discussion between the affected resident and the proponent.

The photomontages show an artist's impressions of the proposed solar farm and the extent of the view, based on available knowledge of the proposed activity at the time of preparation. Actual infrastructure types and location may be subject to change.

2.2 COMMUNITY VALUES

Community consultation specific to the assessment of visual impacts for the proposal was conducted for near neighbours and the broader community.

2.2.1 Nearest neighbours

- During January 2019, adjoining landholders were visited in person by Bison Energy including 5 uninvolved residences within a 2 km radius of the proposal.
- In May 2019, Urbaine Architecture visited the homes of residents identified through the engagement process that requested a visual montage. Montages of what the proposal may look like, including rendered images of solar panels, were created and provided to the relevant landowners in June 2019.
- Two open community meetings were held in May and July 2019 in Culcairn and Walla Walla, respectively.
- Between May and July inclusive, fliers with details about the proposal were posted on physical community noticeboards, the project's website and the Boarder Mail newspaper. Contact details for all residences within 3 km of the proposal were obtained during the community engagement process and all of these residents were invited to the second community meeting by email.
- All residents within a 3 km radius that requested follow up with the proponent during the community engagement period were contacted as per their requested contact method. This included face-to-face meetings, phone calls, emails and letters.
- In July 2019, FRV purchased the proposal and proceeded to engage with near neighbours, including screening options and modifying the layout design to minimise visual and noise impacts on nearby residences.
- FRV used the results of the initial VIA to develop a detailed Landscape Plan that includes clear setbacks and significant vegetation buffers.
- Third and fourth community meetings were held in Walla Walla to present the final (pre-approval) design that would be submitted in the EIS to DPIE for assessment.

2.2.2 Broader community

A project website was developed to provide information and updates. The website went live in March 2019 and is updated periodically. An online comments section was also made available for the public to leave feedback or comments.

Community open days were held on 7 May, 9 July, 23 and 24 September 2019, inviting all interested parties to query and comment on the proposal. The first open day was advertised through the *Eastern Riverina Chronicle*, ABC radio segment and by direct invitation to known landholders within a 3 km radius. Fliers advertising the second and third meetings were posted on numerous public noticeboards within Walla Walla and Culcairn, the project website and all known interested members of the community (approximately 70 registered parties) were invited individually. The second, third and fourth community open days were advertised in the *Boarder Mail* newspaper.

Feedback forms

A feedback form was prepared to better understand the community's values and concerns regarding the proposal. Forms were distributed at the community open days and electronically through the project website, with the public encouraged to return the forms.

2.3 LANDSCAPE CHARACTER

LCUs take into account topography, vegetation, land use, and other distinct landscape features. They are a way to summarise differences in the receiving environment that may affect the visual impact of the proposed solar farm at different locations.

Four LCUs were identified within Walla Walla and surrounding areas:

- Rural (including agricultural lands).
- Residential (viewpoints near rural residence/homes).
- Industrial (major roads, electrical and other built infrastructure).
- Commercial (businesses, town centre).

The scenic quality was rated in each LCU as follows:

- A high scenic quality rating describes areas with outstanding, unusual or diverse features.
- A moderate scenic quality rating applies to areas with the features and variety normally present in the character type.
- A low scenic quality rating is given to areas lacking features and variety.

The four LCUs identified are characterised in Table 2-1 in terms of their scenic quality.

Table 2-1 Key features of LCUs within Walla Walla and surrounds

Rural LCU
Rural and agricultural lands within the study area are used predominantly for agriculture, grazing and rotational cropping of grains, cereals and pulses. The development site is positioned slightly lower in the landscape at approximately 220 m above sea level than the surrounds, however surrounding agricultural land use is generally located on land that is relatively flat to undulating. Expansive views within this LCU are generally limited given the undulating relief and screening provided by vegetation. Secondary sealed and unsealed roads including Benambra Road, Schneiders Road, Weeamera Road and Greenvale Road are the main vantage points from which to view agricultural areas. From the road corridors, agricultural and grazing land can be viewed openly. Patches of native and planted vegetation screen views of agricultural land from roadways. In addition to sections of road, overhead transmission lines are visible that reinforce rectilinear shapes and are common in rural landscapes. Surrounding blocks are made up of primary production land uses, with residences within this landscape being sparsely distributed but more concentrated towards the Walla Walla townsite to the west. Residences are commonly associated with some additional vegetation plantings. Other infrastructure includes agricultural sheds, buildings and low open fences. **Scenic quality is considered moderate. Built elements are production-related and include linear fences, powerlines, roads, agricultural buildings and rural homes. Forms are typically uniform, of undulating elevation and linear. This LCU is common and the dominant LCU in the study area. The proposed solar farm is located within this LCU.**
Residential LCU
Residential areas of Walla Walla and surrounds include viewpoints from the road near resident's homes. Much like the Rural LCU, the area is relatively flat to undulating with expansive views generally limited given the undulating relief and screening provided by vegetation. Views of the proposal from the area of concentrated residential dwellings located towards Walla Walla are blocked by sloping hillside and distance. Residents are broadly and unevenly distributed over the landscape, with properties commonly associated with additional vegetation planting and screening. Three uninvolved residences (R1a, R1b and R2) and one uninvolved hospitality business (R5a) overlook the proposal area. R1a is located within 80 m leased boundary of the proposal, directly north of Benambra Road. **Scenic quality is considered moderate. Views vary in colour and form, and the proportion of large lot agriculture and smaller lot residential vary between residences, normal in this character type. Built elements include linear fences, powerlines, roads, agricultural buildings and rural homes. This LCU is common in the study area.**
Industrial LCU
Industrial areas within the study area include the major Olympic Highway and Benambra Road, powerlines, large transmission lines and additional HV overhead lines, decommissioned railway line and Boral's aggregate quarry on Hurricane Hill. Common features in the LCU include the two-way sealed road, road reserve, fencing, powerlines and regular small and large vehicles. **Scenic quality is considered low, with features matching the land use. Some screening is present along Benambra Road, Weeamera Roads and Olympic Highway, with broken views of surrounding rural land visible through existing native vegetation. The majority of residential homes are also screened from view by undulating landform and vegetation, which also breaks up expansive views of surrounding rural and residential land. This LCU is common in the study area, with the development site located approximately 2.5 km off Olympic Highway.**
Commercial LCU

Commercial lands within the study area include primarily the Walla Walla central business district, made up of two churches, post office, hotel, bowling club etc. The development site is not visible from the Walla Walla townsite, and as such is excluded from the assessment.

Orange Grove Gardens has been classified as moderate to high rural or residential LCU for the sake of this impact assessment.

Scenic quality from Orange Grove Gardens is considered moderate to high, given the elevation and the nature of the business. A distant and limited view of the proposal is already partially screened with mature native vegetation, breaking up any expansive view of the proposal.

The BLM methodology requires identification of representative viewpoints in the study area. These may be travel routes such as roads, waterways and recreational tracks, residential areas, tourist facilities, houses and farmland.

12 representative viewpoints were identified using the BLM methodology and within the Zone of Visual Influence (ZVI) and are mapped in Figure 2-1.

The predicted sensitivity of each viewpoint can be determined considering its proximity to the development site and factors such as use, scenic quality and regional significance.

Criteria for proximity are as follows:

- Foreground 0 – 1 km.
- Middle ground 1 – 2 km.
- Background More than 2 km.

Criteria for scenic quality are as follows:

- High sensitivity:
  - high use routes or areas.
  - routes or areas of national or state significance.
  - areas with high scenic quality.
- Moderate sensitivity:
  - moderate use routes or areas.
  - routes or areas of regional or local significance.
  - areas with moderate scenic quality.
- Low sensitivity:
  - low use routes or areas.
  - routes or areas of low local significance.
  - areas with low scenic quality.

Considering the sensitivity of local viewpoints, the following assessments were made:

- **Rural viewpoints** were assessed as generally having a moderate to low scenic quality given the surrounding agricultural activities. Rural views are located on moderate to low routes, or areas only accessed by local traffic. As motorists use local roads, views increase as vehicles approach the development site. View durations are generally short as vehicle speeds are up to 100 km/hr, and the expected number of local vehicles on these local roads is considered to be low to moderate. Regional and local significance is low, with scenic quality being moderate.

- **Residential viewpoints** were assessed as generally having a moderate to high sensitivity. If there was a view to the solar farm, the view duration could be expected to be high from a residence.
- **Industrial viewpoints** were assessed as having low sensitivity and include Hurricane Hill Quarry, Olympic Highway and areas around existing powerlines. Any views from these areas would be fleeting due to vehicle speed, hard to discern and fragmented by existing roadside vegetation. Built structure is more commonly functional than aesthetic in these settings.
- **Commercial viewpoints** of Orange Grove Gardens were assessed as having moderate to high sensitivity given its location in the landscape and nature of operations.

The sensitivity of each viewpoint is provided in Table 2-2.

Table 2-2 Representative viewpoints and assessed proximity, scenic quality and sensitivity

ID	LCU	Distance to site	Scenic quality	Sensitivity
1	Rural	Background	Moderate	Low
2	Industrial	Background	Low	Low
3	Residential	Background	Moderate	Moderate
4	Residential	Background	Low	Moderate
5	Rural	Foreground	Moderate	Low
6	Residential	Foreground	Moderate	High
7	Rural	Foreground	Low	Moderate
8	Residential	Foreground	Moderate	Moderate
9	Rural	Foreground	Low	Low
10	Residential	Background	Low	Moderate
11	Residential	Middle-ground	Moderate	Moderate
12	Residential	Foreground	Moderate	Moderate

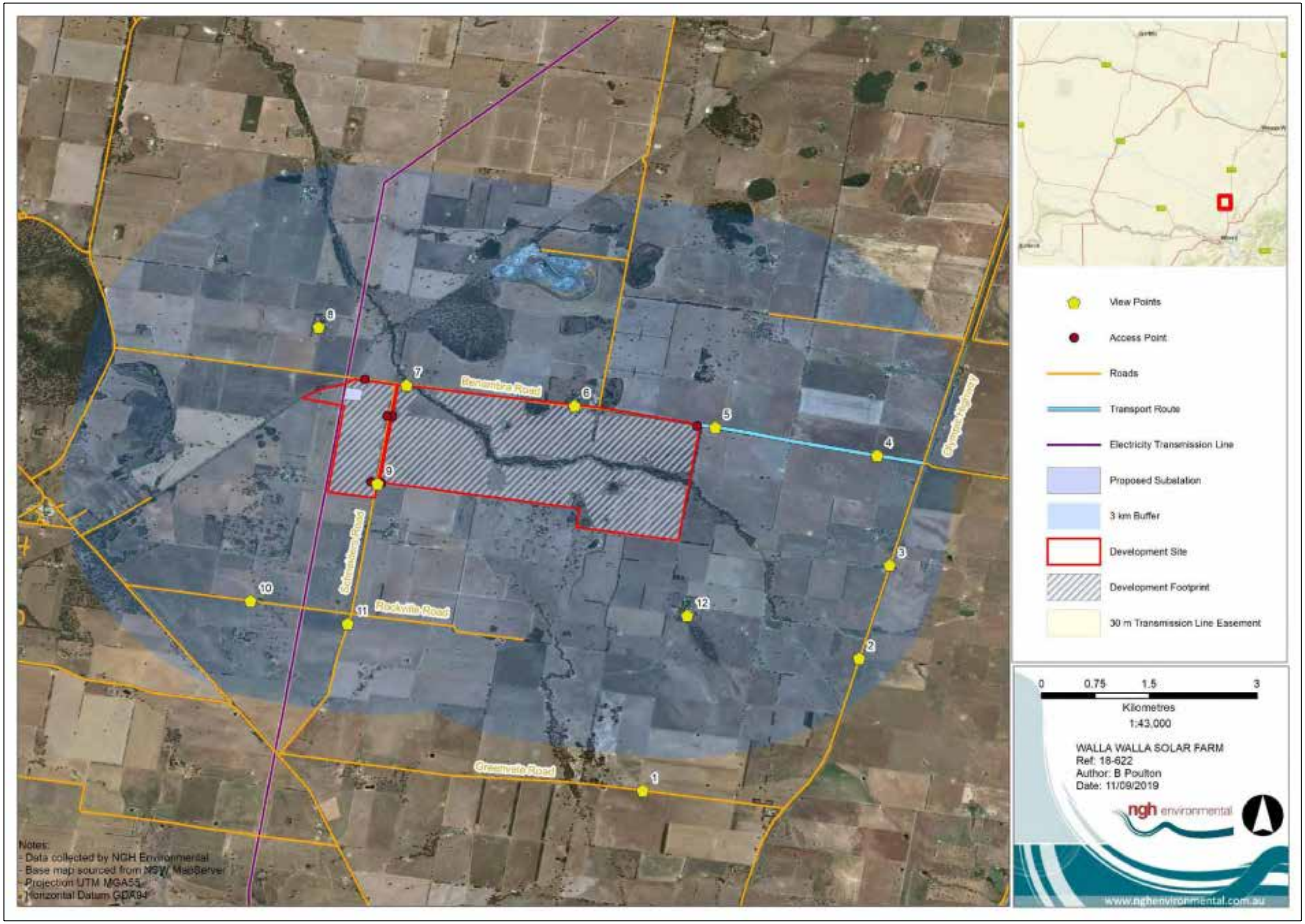

Figure 2-1 Location of representative viewpoints

2.4 DEFINITION OF LANDSCAPE MANAGEMENT ZONES

Visual LMZs were assigned to each representative viewpoint. The zones were derived by combining scenic quality (from the LCUs described in Table 2-1), viewer sensitivity and the distance to the proposed solar farm. Combined they produce a three-tiered management hierarchy: A – C, as shown in Table 2-3.

Table 2-3 Visual Landscape Management Zone decision matrix

		Proximity / sensitivity						
		Foreground High	Middle ground High	Background High	Foreground Moderate	Middle ground Moderate	Background Moderate	Foreground Low
Scenic quality	**High**	A	A	A	A	B	B	B
	Moderate	A	B	B	B	B	C	C
	Low	B	B	B	B	C	C	C

Each zone has associated objectives to guide management of visual change and to help evaluate proposed project impacts. These are shown in Table 2-4.

Table 2-4 Visual Landscape Management Zone management objectives

Management priority	Management objectives
A	Maximise retention of existing visual amenity. Landscapes are least able to absorb change. Developments may lead to a major change.
B	Maintain existing visual amenity, where possible. Protect dominant visual features. Developments may be allowed to be visually apparent.
C	Less importance for retaining existing visual amenity. Landscapes are able to absorb change. Developments may be allowed to dominate but should reflect existing forms and colours where possible.

3 POTENTIAL IMPACTS

An operational visual impact assessment has been conducted considering:

- The proposed solar farm components.
- The potential for the proposed solar farm to be viewed from representative viewpoints.
- The degree of contrast the proposed solar farm would have within the identified LMZ. LMZs were assigned to viewpoints based on the results of the field work, and the contrast at that viewpoint was evaluated, as described below.
- The potential impact from glare.

3.1 EVALUATION CRITERIA

The ratings for the degree of contrast created by the proposed solar farm at each viewpoint have the following definitions (U.S. Department of the Interior, n.d.):

- High contrast: the proposal would be dominant within the landscape and generally not overlooked by the observer; the visual change would not be absorbed.
- Medium contrast: the proposed activity would be moderately dominant and noticed; the visual change would be partially absorbed.
- Low contrast: the proposed activity would be seen but would not attract attention; the visual change would be well absorbed.
- Indistinct: contrast would not be seen or would not attract attention; the visual change would be imperceptible.

To determine if the objectives for the VLM zone are met, the contrast rating for the viewpoint is compared with the relevant management objectives to give a visual impact level. The visual impact level is consequently defined as:

- High impact: contrast is greater than what is acceptable.
- Medium impact: contrast is acceptable.
- Low impact: visual contrast is little or not perceived and is acceptable.

For high impact viewpoints, mitigation must be considered.

3.2 PHOTOMONTAGES

Photomontages of the project shown within the existing context were prepared by Urbaine Architecture to assist in the impact assessment of the proposal. Three viewpoints were selected for the production of photomontages as they were determined to have the greatest potential for visual impact and best represent a range of distances and locations with differing views. Photomontages are based on a worst-case scenario of the project without the inclusion of proposed mitigation measures (i.e. vegetative screening). Where infrastructure is discernible in the landscape, rendered images have been included to provide clarity.

3.3 EVALUATION RESULTS

Table 2-2 evaluates the expected level of visual impact from the-representative viewpoints, while section 7.2 shows the proposed expected view (photomontage) of the solar farm without any mitigation measures (i.e. vegetative screening or setbacks) and then with proposed mitigation measures. Following changes to the proposal design to reduce visual impacts on nearby residents, no high impact viewpoints were identified.

A total of three viewpoints for photomontages were selected, which are generally viewpoints determined to have the greatest potential for visual impact and best represent a range of distances and locations with differing views.

4 RESULTS SUMMARY

4.1 MEDIUM IMPACT – MITIGATION SHOULD BE CONSIDERED

Medium impacts are seen for 5 viewpoints.

Orange Grove Gardens has been recognised as having a potential impact due to its location in the landscape and the nature of the business, however the business is located over 800 m from the proposal and existing vegetative screening fragments the view of the development site. As a mitigation strategy, the solar array has been set back to make way for a significant vegetation screening buffer of 50 m, as proposed in the Detailed Landscaping Plan.

Viewpoint 6 is located approximately 80 m of the development site boundary with views overlooking the proposal. Existing vegetation and topography partially screen views of the development site. Dominant views would continue to be grazed and cropped agricultural land with the solar farm and associated infrastructure clearly visible in the middle ground. The form of the infrastructure, with maximum ration height of 4 m and in rectangular arrays, is not incongruous with the existing low-lying rectangular forms in this agricultural area. Due to the close proximity of R1a and R1b to the proposal, a substantial setback and screening vegetation would be implemented as a priority, to minimise the visual impact on these residences as much as practicable.

The viewpoint located on public locations along Benambra Road, and is representative of residences in the immediate area. Minor vegetation screening exists in the form of roadside vegetation, which provides minimal screening of the development site. The proposal would be highly visible to representative residences. On-site vegetative screening as a mitigation strategy has been considered in consultation with landowners and would be included in a Landscaping Plan approved prior to construction.

Viewpoints 5, 7 and 8 are also located within 1 km of the proposal and are representative of views from R2 and motorists along Benambra Road. Viewpoints have been assessed as having a moderate impact due the visibility of the TransGrid substation from R2. Solar arrays and the substation entrance would be clearly visible to motorists travelling along Benambra Road.

Existing native vegetation occurs along Benambra Road and is also sparsely present along Schneiders Road. Where dams and patches of native vegetation are to be enhanced for biodiversity, this would aid to break up views from local roads. The proposed location for the TransGrid substation was selected for providing minimal visual impact on R2 compared to the alternatives available.

4.2 LOW IMPACT – NO MITIGATION

Low impacts are seen for arterial roads, residences and businesses, where views of the solar farm infrastructure would be difficult to perceive or is indistinct. Visual impacts on involved landholders who would benefit financially from the proposal are also considered low. Low impacts are expected for the majority of the study area and representative viewpoints due to distance to infrastructure, existing vegetative screening, retained on-site vegetation and the overall undulating terrain of the area. No mitigation is required for these locations.

5 GLARE

The potential for glare associated with non-concentrating PV systems that do not involve mirrors or lenses is relatively limited. PV solar panels are designed to reflect as little sunlight as possible, generally around 2% of the light received (Spaven Consulting, 2011), resulting in negligible glare or reflection. The reason for this is that PV panels are designed to absorb as much solar energy as possible in order to generate the maximum amount of electricity. The panels will not generally create noticeable glare compared with an existing roof or building surface (DoP, 2010). Seen from above (such as from an aircraft) they appear dark grey and do not cause a glare or reflectivity hazard. Solar PV farms have been installed on a number of airports around the world such as Darwin Airport.

Onsite infrastructure that may cause glare or reflections, depending on the sun angle, include:

- Steel array mounting - array mounting would be steel.
- Temporary site offices, sheds, PV boxes or PV skids.
- Perimeter fencing.
- Permanent staff amenities.

This infrastructure would be relatively dispersed and unlikely to present a glare or reflectivity hazard to residences, motorists or aircraft.

6 POTENTIAL CUMULATIVE IMPACTS

Adverse cumulative impacts occur when the infrastructure or activities at the solar farm site exacerbate the negative impacts of other infrastructure or activities occurring nearby. The location of Culcairn Solar Farm in proximity to the proposal and residences is shown in Figure 6-1.

6.1 CONSTRUCTION

During construction, the additional traffic and dust generation impacts are probably the greatest potential for cumulative visual impacts. The visual impact of increased traffic movements to the site would be predominantly limited to construction. A Traffic Management Plan (TMP) would be developed to minimise vehicle movements and dust as much as practical for construction. Should both of these proposed solar farm proposals be approved, the TMP would include scheduling of vehicle movements to ensure congestion along the shared transport route of Benambra Road is minimised.

Generally, adverse cumulative visual impacts are anticipated to be manageable due to the existing and retained vegetative screening and undulating terrain of the site that blocks out most views almost entirely. Specifically, screening to soften cumulative impacts near viewpoints 6 and 8 has been recommended on Benambra Road. Since FRV have relocated the primary construction access to the north eastern corner of the development site, residences on Benambra Road would be minimally impacted by the proposal. Should the Culcairn Solar Farm proposal be approved, and Benambra and Weeamera Roads are selected as a preferred construction transport route, visual disturbance for Residence 1a and 1b and Residence 2 would be exacerbated.

6.2 OPERATION

The operational view of the solar farm may generate a cumulative impact in contrast to existing agricultural views with Culcairn Solar Farm, should both projects proceed to operation. Before development of the detailed Landscaping Plan cumulative visual impacts would have been more noticeable for Residence 1a, Residence 1b and Residence 2, with two solar farms proposed within 1 km. Generally, adverse cumulative visual impacts are anticipated to be manageable due to the existing and retained vegetative screening and undulating nature of the site that blocks out the majority of views. Specifically, screening to soften cumulative impacts has been recommended.

During operation, excepting unusual maintenance operations such as inverter or transformer replacement, a small maintenance team using standard vehicles are all that would be required. Cumulative visual traffic impacts are considered manageable.

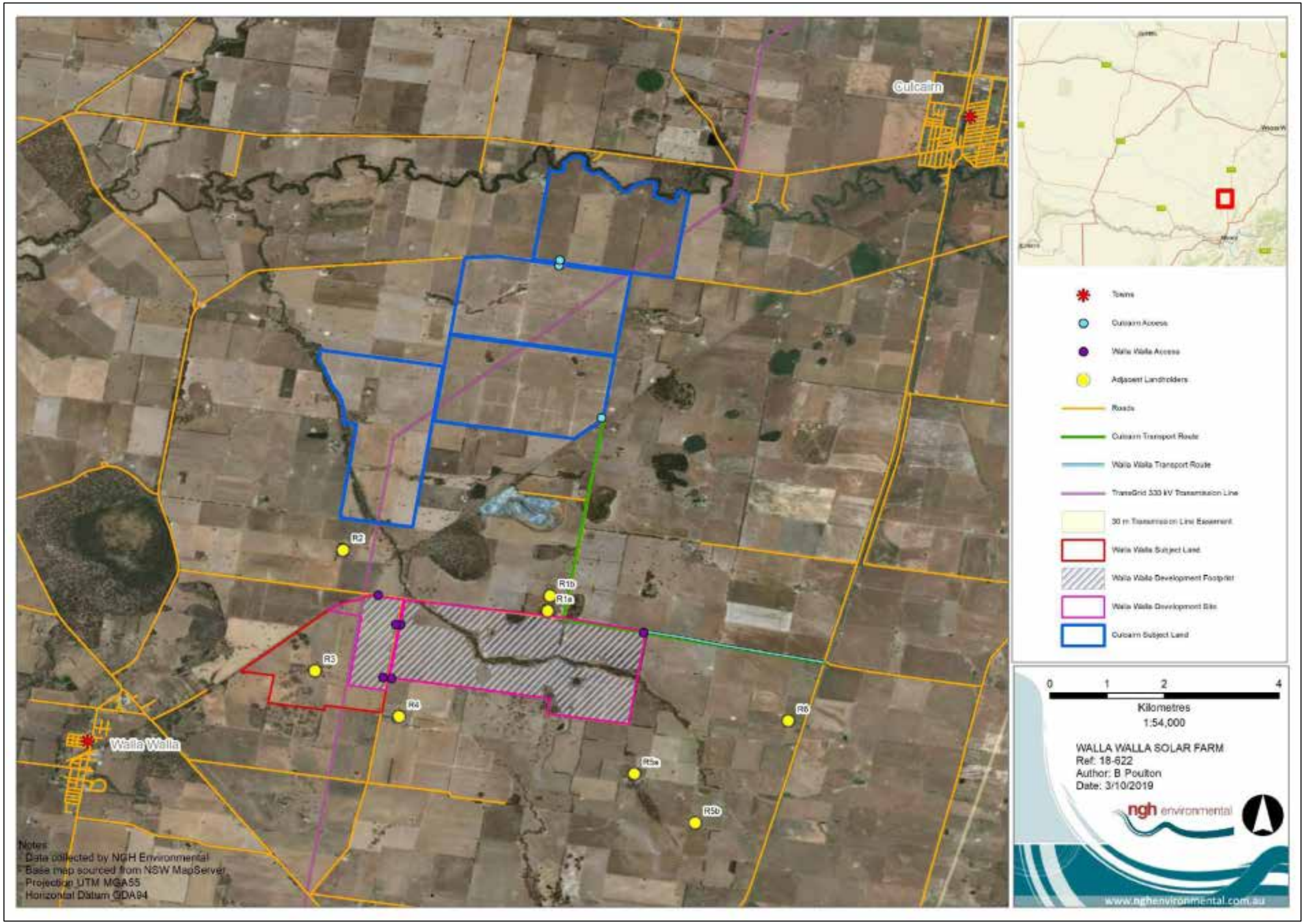

Figure 6-1 Cumulative impacts and proximity to the proposed Culcairn Solar Farm

7 MITIGATION STRATEGY

7.1 DETAILED LANDSCAPE PLAN

Screening vegetation has been considered in accordance with the draft planting layout provided in Figure 7-1 and Appendix E of the EIS. The purpose of the screening is to break up the view into the site. Screening requirements include:

- Plantings would be more than one row deep and where practical, planted on the outside of the permitter fence, to break up views of infrastructure including the fencing.
- The plant species to be used in the screen are recommended to be native, derived from the naturally occurring vegetation community in this area. They should be fast growing with mixed canopy height. Species selection could be undertaken in consultation with affected near neighbours and a botanist, horticulturalist or landscape architect.
- The timing is recommended to be chosen to ensure the best chance of survival and can commence during the construction of the proposal if timing suits.
- The screen would be maintained for the operational life of the solar farm. Dead plants would be replaced. Pruning and weeding would be undertaken as required to maintain the screen's visual amenity and effectiveness in breaking up views.

Figure 7-1 Detailed Landscape Plan

7.2 NEAR NEIGHBOURS

A number of visual concerns were raised by near neighbours and the general public. This includes devaluation of properties and homes reliant on their visual aspect (not land productivity), glare, removal of vegetation and change in land use.

Several adjacent landowners agreed that vegetation planting would assist in breaking up the views. Proposed vegetative screening locations based on initial consultation and visual concern can be seen below in Figure 7-1.

Changes made to the proposal layout following community engagement to minimise visual impacts on near neighbours include:

7.2.1 Residences 1a and 1b

Mitigation measures

As R1 is the closest resident to the proposal. R1a specifically is approximately 80 m north from the property boundary while R1b is approximately 350 m north of the property boundary. FRV have provided the following mitigation measures:

- Changed the site access. Originally, 3 main access points were proposed along the Benambra Road, with traffic travelling past these residences, creating unnecessary dust and noise impacts. FRV have abandoned these access points and created one single main access point to the north-east of the project, now approximately 1.4 km away from these residences, therefore dramatically reducing the impact.
- Existing, mature boundary vegetation would now be retained.
- Altered the solar array design layout, setting-back solar panels directly opposite the R1a and R1b homesteads. This is referred to as a 'visual set-back' and would be undeveloped and left as grazing paddocks. This would allow for more 'natural' view from the homesteads and create a sense of space.
- After this setback an extensive 50 m vegetation buffer would be implemented. A detailed landscaping plan has been created:
  - Specific species that would effectively develop across the understory, mid- and top-canopy structures.
  - Specific species (shrubs and trees) that encourage foraging, pollination and habitat creation for local insects, birds and fauna.
  - Erecting nesting and faunal boxes to encourage wildlife use of the area.
  - Connect to existing vegetation to create an ecological corridor for local and seasonal wildlife.
- From this vegetation buffer, a further 10 m setback would be allocated for the Asset Protection Zone (APZ).
- After the APZ, only then would the solar farm security fence be installed.
- An additional 5 m minimum setback would occur before the solar array.
- From R1a, a 400 m radius 'inverter exclusion zone' would be implemented. Therefore, the design has been altered so no inverters would be installed within 400 m, to further reduce visuals.

Unmitigated impact	High
Residual impact	Moderate

Figure 7-2 Mitigation setback and landscaping for Residences 1a and 1b

a) Existing undeveloped view

b) Infrastructure superimposed (prior to screening)

c) Infrastructure superimposed with proposed vegetation screening

Figure 7-3 Existing, original infrastructure and mitigated views from viewpoint 6

7.2.2 Residence 2

Mitigation measures

R2 is located approximately 800 m north-west from the proposal. FRV have provided the following mitigation measures:

- Changed the site access. Originally, 3 main access points were proposed along the Benambra Road, with traffic travelling in close proximity to their driveway, creating unnecessary dust and noise impacts. FRV have closed these proposed access points and created one single main access point to the north east of the project, now approximately 4.4 km away from these residences, therefore dramatically reducing the impact.
- FRV have also changed the location of the proposed O&M facilities, which was originally proposed beside the TransGrid substation. It would now be located at the main access point, 4.4 km away from R2, therefore reducing any impact in the long term for this resident.
- FRV reinvestigated the location of the substation and have moved this piece of infrastructure 100 m south to accommodate the views of R2. This was at significant cost and time to FRV.
- By altering the location of the substation, mature boundary vegetation can now be retained, further protecting the views of R2.
- Solar panels have not been proposed in the most north-western section of the development site.
- Along with FRV moving the substation, an extensive 50 m vegetation buffer would be implemented. A detailed landscaping plan has been created:
  - Specific species that would effectively develop across the understory, mid- and top-canopy structures.
  - Specific species (shrubs and trees) that encourage foraging, pollination and habitat creation for local insects, birds and fauna.
  - Erecting nesting and faunal boxes to encourage wildlife use of the area.
  - Connect to existing vegetation to create an ecological corridor for local and seasonal wildlife.
- Additional screening would be implemented in the north-west boundaries including 5 m and 10m buffers which would also help facilitate views of the project from R2.
- From the substation, a further 10 m setback would be established for the APZ.
- After the APZ, only then would the solar farm security fence be installed. After further consultation, FRV decided to not implement the security fence close to the property boundary and instead closer to the solar array and further away from R2.
- An additional 5 m minimum setback will would be implemented before the solar array.

Unmitigated impact	Moderate
Residual impact	Low

Figure 7-4 Substation relocation and landscaping for Residence 2

a) Existing undeveloped view

b) Infrastructure superimposed (prior to screening)

c) Infrastructure superimposed with proposed vegetation screening

Figure 7-5 Existing, original infrastructure and mitigated views from viewpoint 7

7.2.3 Residence 5a

Mitigation measures

R5a is located approximately 800 m south-east from the proposal. FRV have provided the following mitigation measures:

- Altered the solar array design layout, setting-back solar panels at least 65 m from the southern property boundary.
- Implementing this setback, has allowed FRV to therefore utilise this area and implement further mitigation by offering an extensive 50 m vegetation buffer along the full length of the southern boundary and 100 m travelling north along the eastern boundary. Following this 50 m buffer, an additional 5 m vegetation buffer would travel the full length of the eastern boundary to complement the existing mature vegetation that is present along the majority of the boundary. A detailed landscaping plan has been created:
    - Specific species that would effectively develop across the understory, mid- and top-canopy structures.
    - Specific species (shrubs and trees) that encourage foraging, pollination and habitat creation for local insects, birds and fauna.
    - Erecting nesting and faunal boxes to encourage wildlife use of the area.
    - Connect to existing vegetation to create an ecological corridor for local and seasonal wildlife.
- From this vegetation buffer, a further 10 m setback would occur for the APZ.
- After the APZ, only then would the solar farm security fence be installed.
- An additional 5 m minimum setback would occur before the solar array.

Unmitigated impact	Moderate
Residual impact	Low

Figure 7-6 Mitigation setback and landscaping for Orange Grove Gardens

a) Existing undeveloped view

b) Infrastructure superimposed (prior to screening)

c) Infrastructure superimposed with vegetation screening

Figure 7-7 Existing, original infrastructure and mitigated views from viewpoint 12

7.2.4 Residence 6

Mitigation measures

R6 is located approx. 2.2 km east from the proposal, with their dwelling surrounded by mature vegetation and therefore will have no views of the proposal from their dwelling itself. FRV have provided the following mitigation measures;

- Altered the solar array design layout, setting-back solar panels, committing to at least 30m from the adjoining property boundary to any solar infrastructure.
- Implementing this setback, has allowed FRV to therefore utilise this area and implement further mitigation by offering an 5m vegetation buffer along the eastern boundary. This will complement the mature vegetation which already exists along the majority of the eastern boundary. A detailed landscaping plan has been created;
  - Specific species that would effectively develop across the understory, mid- and top-canopy structures;
  - Specific species (shrubs and trees) that encourage foraging, pollination and habitat creation for local insects, birds and fauna; and
  - Erecting nesting and faunal boxes to encourage wildlife use of the area.
  - Connect to existing vegetation to create an ecological corridor for local and seasonal wildlife.
- From this vegetation buffer, a further 10m setback will occur for the APZ.
- After the APZ, only then will the Solar Farm security fence be installed.
- An additional 5m minimum setback will occur before the solar array will occur.

Unmitigated impact	Low
Residual impact	Low

7.3 GENERAL MEASURES

The following measures are recommended to reduce the general visual impact of the development for all residences:

7.3.1 Design

The materials and colour of onsite infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of existing infrastructure or of a colour that will blend with the landscape. Where practical:

- Buildings will be non-reflective and in eucalypt green, beige or muted brown.
- Pole mounts/piles will be non-reflective.
- Security fencing posts and wire will be non-reflective.
- Avoidance of unnecessary lighting, signage and logos.
- Retain and protect existing boundary landscaping.

7.3.2 Construction

- During construction, dust would be controlled in response to visual cues.
- Areas of soil disturbed by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil.

7.3.3 Night lighting

- Comply with all relevant standards, codes of practice and policies.
- Light spill is light that fall outside the area that is intended to be lit and can contribute to glare and waste energy. Spill light above the horizontal plane also contributes to artificial skyglow. All light fittings should be located aimed or shielded to avoid spill. Measures to prevent spill include:
    - Installing light fittings with an opaque cover and flat glass, mounted horizontally on both axes.
    - Mounting lights under part of a building (including awnings, verandah or roof) so light is blocked above the horizontal plane.
    - Design buildings to internalise lights.
- Wherever possible, light should be directed downwards. Mitigation measures include:
    - Installing direction fittings, such as floodlights or spotlights.
    - Use higher mounting heights that allow lower main beam angles that are closer to the vertical.
    - Lighting of all-night operations need to be downward facing of a peach colour and shielded.
- Operational light from the proposal must be directed downwards, or inwards towards the work area.
- Light fittings that are specifically designed to minimise light shining near to or above the horizontal plane should be used.
- Energy efficient globes include LEDs and high-pressure sodium.
- Where floodlights are required, wherever possible use fittings with asymmetric beams that permit horizontal glazing. These are to be kept at or near parallel to the surface being lit, usually the ground and should prevent light spill. An asymmetric beam also allows the light fitting to be mounted on the edge of an area and avoids the need for fittings to be tilted upwards. Flat glass light fittings should be installed with the glass horizontal to make efficient use of the brightest part of the beam and to eliminate light spill.

8 SAFEGUARDS AND MITIGATION MEASURES

Table 8-1 Safeguards and mitigation measures for visual impacts

No.	Safeguards and mitigation measures	C	O	D
VA1	Screening would be required on-site, generally in accordance with the Landscape Plan developed in consultation with neighbouring landholders. • Plantings would be more than one row deep and where practical, planted on specific sections outside of the permitter fence, to break up views of infrastructure including the fencing. Screening within the vicinity of Residences 1a and 1b and 2 and 5a would be within a 15 m buffer to allow for maximum screening. • The plant species to be used in the screen would be native and derived from the naturally occurring vegetation community in the area. They should be fast growing and comprise a mixture of trees and shrubs capable of reaching a height of 3 to 4 m within 10 years. Species selection is being undertaken in consultation with affected near neighbours and a landscape architect. • Planting would be 2 months of completion of construction, so actual views of infrastructure are known or during winter/spring to increase the chance of plant survival. • The screen would be maintained for the operational life of the solar farm. Dead plants would be replaced. Pruning and weeding would be undertaken as required to maintain the screen's visual amenity and effectiveness in breaking up views.	C	O	D
VA2	Prior to the commencement of construction, a detailed landscape plan will be prepared including: • Screening location. • Species type. • Planting density and spacing. • Method for planting. • Descriptive measures that would be implemented to ensure vegetative screening is successful (i.e. irrigation or other watering method). A program to manage, monitor and report on the effectiveness of implemented measures.	Design stage		
VA3	The materials and colour of onsite infrastructure would, where practical, be non-reflective and in keeping with the materials and colouring of existing infrastructure or of a colour that would blend with the landscape.	Design stage		
VA4	During construction, dust would be controlled in response to visual cues. Areas of soil disturbed by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil.	C		
VA5	Construction night lighting would be minimised to the maximum extent possible (i.e. manually operated safety lighting at main component locations). It would be directed away from roads and residents so as not to cause light spill that may be hazardous to drivers.	C	O	D

No.	Safeguards and mitigation measures	C	O	D
VA6	The vast majority on construction vehicles would enter the development site via the north eastern entrance on Benambra Road, 2.6 km off Olympic Highway to minimise impact on residences.	**C**		

C: Construction; O: Operation; D: Decommissioning

9 REFERENCES

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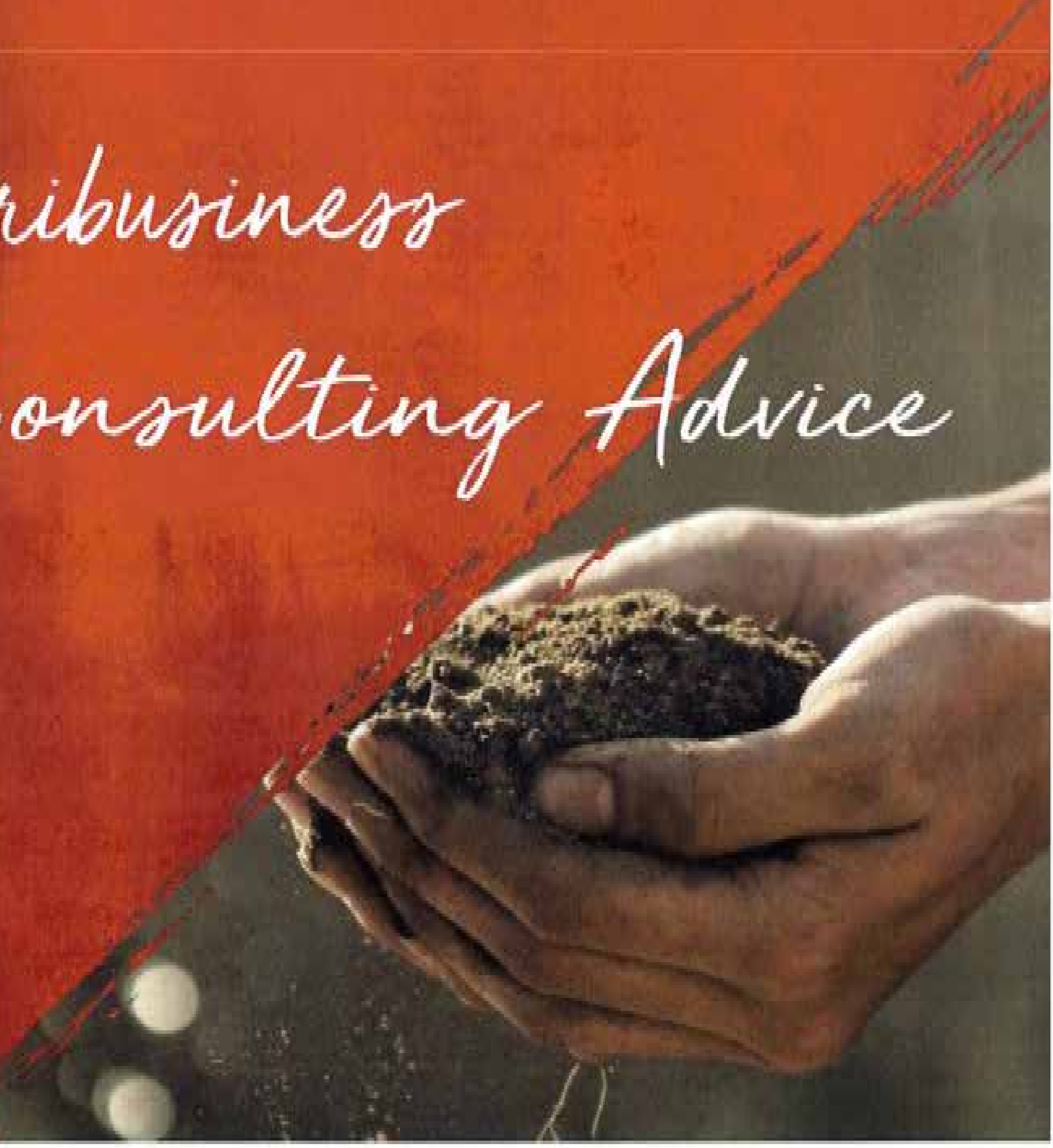
APPENDIX L AGRIBUSINESS CONSULTING ADVICE – WALLA WALLA SOLAR FARM

JLL | Achieve Ambitions

"Walla Walla Solar Farm"
Benambra Road
Walla Walla NSW 2659

Date of Advice: 28 June 2019

Agribusiness Consulting Advice



Executive Summary

Instructing Party	Bison Energy.
Date of Advice	28 June 2019.
Purpose	Consulting advice to assist in understanding any likely value impacts on the agricultural land market within the vicinity of the proposed Walla Walla Solar Farm.
Report Summary	This report has been prepared to provide readers with an understanding of the influences solar power projects may have on the value trends of surrounding real estate markets and more specifically the market immediately surrounding the proposed "Walla Walla Solar Farm".

Our study of operating and proposed solar farm projects throughout Australia and more specifically New South Wales indicates an increasing trend of solar farm development which supported a growing consumer demand for clean energy and significant government support for the sector. We also note significant growth in the sector over the past few years as a preferred investment option for corporate and institutional investors.

Our study of the agricultural market value trends within 30 radial kilometres of the proposed "Walla Walla Solar" Farm indicates the predominant land owner type comprises family farmers and larger scale corporate farming entities. As a result the value drivers for the local land market are primarily those surrounding the production of livestock, cereals and oilseeds.

Within the subject market, buyer demand and market sentiment has been high and has driven significant value growth over the past 3 years. The majority of this value growth has been driven by corporate and family scale primary producers seeking to increase the scale of their current enterprises on the back of several years of favourable commodity prices, particularly in the beef and lamb sectors. A secondary influence has been producers seeking to enter the region from other drought affected areas of northern New South Wales and Queensland.

Given the primary drivers of value within the subject market are related to agricultural production, we consider the proximity of the proposed "Walla Walla Solar Farm" would be a low level consideration of owners and prospective purchasers of land in the area and unlikely to influence land value trends.

We have also conducted a study of the market surrounding the Coleambally Solar Project in order to study the impact an existing solar project has had on local market values.

Valuer

Jones Lang LaSalle Advisory Services Pty Ltd

Will Gurry – AAPI
Certified Practicing Valuer
Head of Agribusiness
JLL Valuations & Advisory – Agribusiness

This is a summary only. It must not be relied on for any purpose. JLL's valuation of this asset is subject to assumptions, conditions and limitations. Those are set out in the full valuation report prepared in relation to the asset.

Critical Assumptions, Conditions and Limitations

Information Relied Upon	We have relied upon the accuracy, sufficiency and consistency of the information supplied to us. JLL accepts no liability for any inaccuracies contained in the information provided by *Bison Energy* or other parties, or for conclusions which are drawn either wholly or partially from that information. Should inaccuracies be subsequently discovered, we reserve the right to amend our valuation assessment.
Desktop Nature of Advice Provided	In preparing this advice we have not inspected the property and therefore our advice should be considered of a desktop nature only. Given the lack of inspection we accept no liability for any inaccuracies in comments within this report relating directly to the subject property.
Reliance	Reliance on this report is permitted only: – By a party expressly identified by the report *(Bison Energy)* as being permitted to rely on it; and – When the given party has received the report directly from JLL. We confirm that insofar as any service agreement exists between the parties, any warranties that agreement requires be given at the time of the provision of this report are hereby given. Our report is confidential to the party or parties to which it is addressed, for the specific purpose to which it refers. No responsibility is accepted to any third parties. Neither the whole of the report or any part of it or any reference to it, may be published in any document, statement or circular or in any communication with third parties without our prior written approval of the form and context in which it will appear.

Contents

Appendices

1 Australian Clean Energy Industry

Clean Energy Market Overview

Australia is one of the fastest growing renewable energy markets globally. In the recent report released by the *Clean Energy Council*, 'Clean Energy Australia Report 2019', 21 percent of Australia's electricity was generated through renewable energy resources in 2018. This increased from 17 percent in 2017, as more than 2.3 gigawatts of new renewable energy capacity entered the market. 38 projects were completed throughout the year as investment in large-scale clean energy projects doubled to more than $20 billion.

A summary of the individual projects currently generating solar power are listed below. According to the *Clean Energy Council*, there were a further 87 large-scale renewable energy projects under construction or financially committed at the beginning of 2019.

Renewable Energy Projects Completed in 2018				
Technology	State	Owner	Project	Capacity (MW)
Wind	NSW	*Partners Group and CWP Renewables*	Sapphire Wind Farm	270.0
Wind	QLD	*RATCH*	Mt Emerald Wind Farm	181.0
Solar	NSW	Neoen	Coleambally Solar Farm	150.0
Wind	VIC	*ACCIONA*	Mt Gellibrand - Stage 1	138.0
Solar	QLD	APA Group	Darling Downs Solar Farm	138.0
Solar	QLD	FRV	Clare Solar Farm	128.0
Solar	QLD	Sun Metals	Sun Metals Solar Farm	124.0
Wind	NSW	*Infigen Energy*	Bodangora Wind Farm	113.0
Solar	VIC	Foresight Solar	Bannerton Solar Farm	110.0
Solar	VIC	Wirsol Energy	Wemen Solar Farm	110.0
Solar	QLD	Lighthouse Solar	Emerald Solar Park	90.0
Solar	QLD	Edify Energy	Whitsunday Solar Farm	69.0
Solar	QLD	Edify Energy	Hamilton Solar Farm	69.0
Solar	NSW	Neoen	Parkes Solar Farm	66.0
Solar	VIC	Wirsol Energy and Edify Energy	Gannawarra Solar Farm - Stage 1	60.0
Solar	NSW	First Solar	Manildra Solar Farm	56.0
Wind	VIC	*Tilt Renewables*	Salt Creek Wind Farm	54.0
Solar	QLD	Genex	Kidston Solar Project - Stage 1	50.0
Wind	QLD	*Windlab and Eurus Energy*	Kennedy Energy Park - Wind	43.5
Solar	NSW	Neoen	Griffith Solar Farm	36.0
Wind	VIC	*Windlab*	Kiata Wind Farm	31.0
Wind	VIC	*Pacific Hydro*	Yaloak South Wind Farm	29.0
Solar	NSW	Neoen	Dubbo Solar Hub	29.0
Bioenergy	QLD	*MSF Sugar*	Tableland Sugar Mill	24.0
Solar	WA	APA Group	Emu Downs Solar Farm	20.0
Solar	QLD	Overland Sun Farming	Hughenden Solar Farm	20.0
Solar	VIC	Impact Investment Group/Australian Solar Group	Swan Hill Solar Farm	19.0
Solar	QLD	Canadian Solar	Longreach Solar Farm	17.0
Solar	QLD	Windlab and Eurus Energy	Kennedy Energy Park - Solar	15.0
Solar	QLD	Conergy	Lakeland Solar and Storage Project	13.0
Solar	QLD	Ydot Projects	Dunblane Solar Farm	11.0
Solar	NSW	New Gullen Range Wind Farm	Gullen Range Solar Farm	10.0
Solar	WA	Carnegie/Lend Lease	Northam Solar Farm	10.0
Wind	VIC	*BayWa r.e.*	Maroona Wind Farm	7.0
Solar	SA	SSE Australia	Whyalla Solar Farm - Stage 1	6.0
Solar	QLD	Epho	Brisbane Airport	6.0
Solar	SA	Renew Power Group	Peterborough Solar Farm	5.0
Solar	QLD	Canadian Solar and Scouller	Normanton Solar Farm	5.0

Source: Clean Energy Council (2019)

Solar Energy Market Overview

Australia has the highest average solar radiation per square metre of any continent in the world and as such, there has been strong interest in developing solar energy infrastructure.

The 'Clean Energy Australia Report 2019' highlighted the fact that 28 large-scale solar projects were completed in 2018, with the amount of new capacity installed more than 14 times higher than the sector's previous best year. At the end of 2018, 59 large-scale solar projects were either under construction or financially committed.

In terms of the state share of large-scale renewable energy projects, Queensland, Victoria and New South Wales attracted the largest amounts of investment and capacity. The following table highlights the particulars.

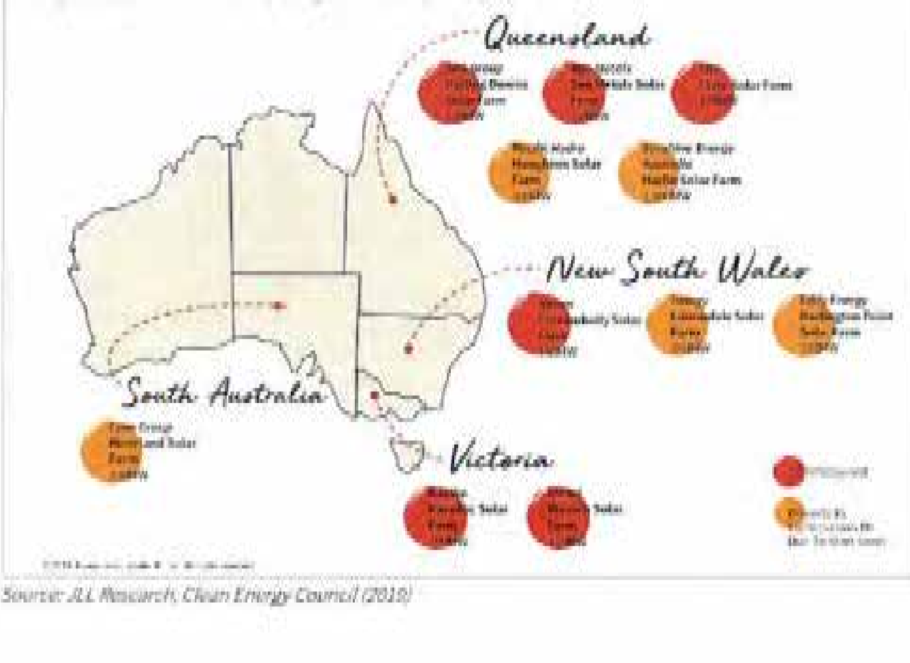
2018 Large-Scale Renewable Energy Capacity and Investment By State				
State	Number of renewable energy projects under construction or about to start	Capacity of those projects (MW)	% of new national renewable energy capacity by state	Investment (AU$m)
Queensland	20	3,287	30%	4,344
Victoria	19	3,181	29%	4,479
New South Wales	18	2,648	24%	3,709
South Australia	8	1,681	15%	2,638
Western Australia	3	70	1%	150
Tasmania	1	112	1%	280
Total	69	10,979	100%	15,600

Source: Clean Energy Council (2018)

To meet it's RET for 33,000 gigawatt hours by 2020, the Australian Government has supported large-scale project development through the provision of generation certificates (which may be sold or traded to Renewable Energy Target (RET) liable entities). Furthermore, since their creation in 2012 the *Clean Energy Finance Corporation (CEFC)* and the *Australian Renewable Energy Agency (ARENA)* have been instrumental in encouraging institution investment in the development of many large-scale solar photovoltaic (PV) projects.

Growth has also been driven by the collapse in the costs associated with making solar panels over the past five years. There is a distinct trend in the continued growth in the size of large-scale solar plants. 2018 not only produced a record number of projects being completed but also the six largest solar plants nationally. The following map illustrates the largest solar plants currently commissioned in Australia.

Largest Solar Plants By Megawatt Capacity



Source: JLL Research, Clean Energy Council (2019)

The following table list of projects currently being developed (or due to start soon) and highlights both the continued growth in the size of solar projects as well as the strength of the current levels of investment in large-scale solar projects nationwide. The list includes only those projects with a proposed capacity greater than 150 megawatts.

Solar Projects With A Proposed Capacity Greater Than 150 Megawatts			
State	Project	Ownership	Capacity (Megawatts)
QLD	Hadin Solar Farm	*Sunshine Energy Australia*	1,500
QLD	Haughton Solar Farm	*Pacific Hydro*	500
NSW	Limondale Solar Farm	*Innogy*	349
SA	Riverland Solar Farm	*Lyon Group*	330
QLD	Rodds Bay Solar Farm	*Renew Estate*	300
SA	Bungala Solar Farm	*Enel Green Power & DIF (Dutch Infrastructure Fund)*	220
SA	Solar River Project - Stage 1	*Alt Energy*	220
VIC	Kiamal Solar Farm -Stage 1	*Flow Power/Total Eren*	200
SA	Solar River Project - Stage 2	*Alt Energy*	200
NSW	Sunraysia Solar Farm	*Maoneng*	200
NSW	Finley Solar Farm	*ESCO Pacific*	175
QLD	Daydream Solar Farm	*Edify Energy*	150

Source: Clean Energy Council (2018)

The major solar plant owners and developers which have been instrumental in developing Australia's large scale solar energy power industry to date are listed below.

Major Large Scale Solar Plant Owners			
Abengoa Solar	Enel Green Power	Impact Investment Group	Snowy Hydro Limited
AGL Energy	Energy Development Limited	Innogy	Stellata Energy
AltEnergy	Epuron	Lyon Group	Sun Brilliance
APA Group	Ergon Energy	Maoneng Australia	Sunshine Energy Australia
Belectric	ESCO Pacific	Neoen Australia	Synergy
Beijing Jingneng Clean Energy Australia	First Solar	Pacific Hydro	Total Eren
Conergy	Flow Power	Powering Australian Renewables Fund (PARF)	WestGen
Denham Capital	Foresight Group	RATCH Australia	Wirsol
Dutch Infrastructure Fund	Fotowatio Renewable Ventures	Renew Estate	
Edify Energy	GE Energy Financial Services	Sandfire Resources	
Eco Energy World	Goldwind Capital Australia	Sgouller Energy	

Source: JLL Research (2019)

Major Large - Scale Solar Plant Developers		
AGL Energy	Fotowatio Renewable Ventures (FRV)	Overland Sun Farming
APA Group	Genex Power	Photon Energy
Canadian Solar	Goldwind Capital Australia	RATCH Australia
Conergy	Impact Investment Group	Reach Solar Energy
CS Energy Ltd	Island Green Power	Sandfire Resources
Edify Energy	Joule Energy	Sgouller Energy
Elecnor Australia Pty Ltd	Juwi Australia	Snowy Hydro Limited
Energy Development Limited	LMS Energy	Sunpower Australia
Equis Energy	Lyon Group	UGL Limited
Ergon Energy	Maoneng Australia	Wirsol
ESCO Pacific	Neoen Group	YD Projects
First Solar	OTOC Australia	

Source: JLL Research (2019)

New South Wales Solar Project Development Overview

The share of renewable energy (solar, wind and bioenergy) in New South Wales increased from 4 percent in 2013 to 9 percent in 2017. In 2019, there is more renewable generation capacity under construction than in any other Australian state or territory. Current projects will generate an extra 1,000 megawatts (worth A$2.3 billion) and projects in the approval phase will provide a further 7,900 megawatts (worth A$9.4 billion). New South Wales has a strong pipeline of over 40 renewable energy projects with planning approval, totalling 5,700 megawatts.

There are currently nine major operating large-scale solar farms in New South Wales with a total capacity of approximately 500 megawatts. Six of these were commissioned in 2018 representing 305 megawatts and $475 million in investment.

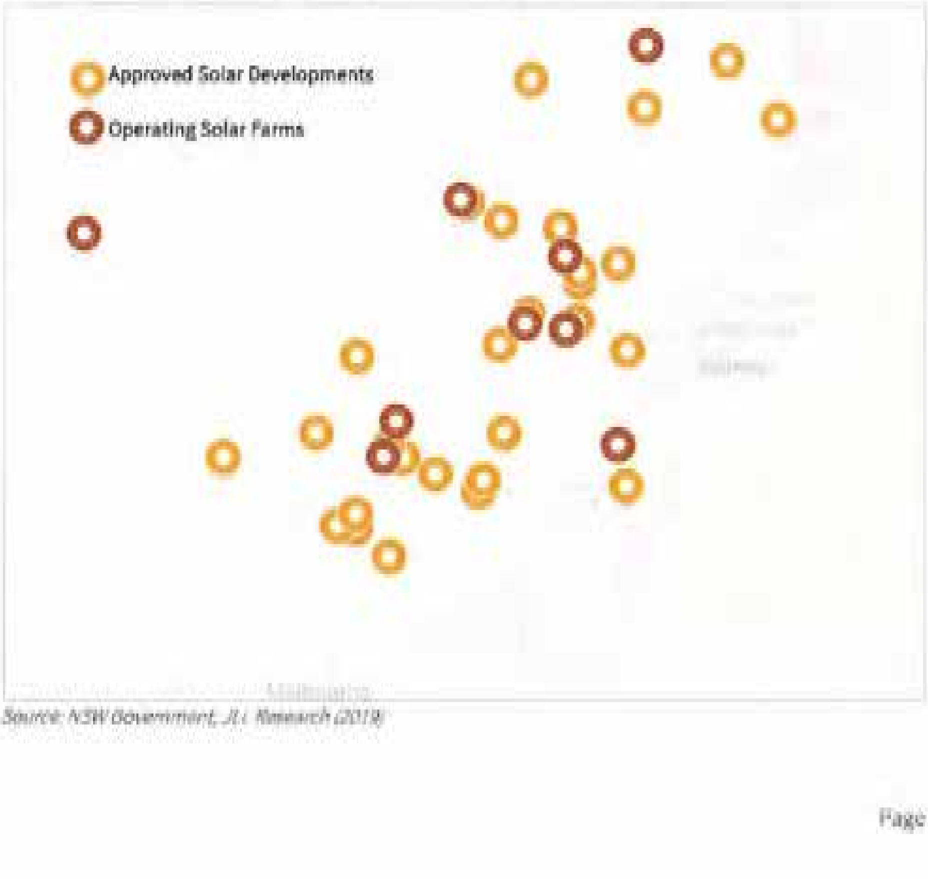
Solar Farm	Capacity (Megawatts)	Size of Land Holding (Hectares)	Ownership
Coleambally Solar Farm	150	560	*Neoen Australia*
Nyngan Solar Plant	102	250	*AGL*
Parkes Solar Farm	55	210	*Neoen Australia*
Moree Solar Farm	56	300	*Fotowatio Renewable Ventures*
Broken Hill Solar Plant	53	200	*AGL*
Manildra Solar Power Plant	48.5	120	*First Solar*
Griffith Solar Farm	36	100	*Neoen Australia*
Dubbo Solar Hub	24	50	*Neoen Australia*
Gullen Solar Farm	10	28	*BJCE Australia*

Source: JLL Research (2019)

Another seven large-scale solar projects are under construction representing a further 530 megawatts of capacity and approximately $720 million in investment. Furthermore, there are almost 70 solar farms with, or seeking planning approval in New South Wales with the capacity to generate more than 10,000 megawatts of energy.

Notable among these include the construction approval which was gained in December 2018 for the development of what is to be New South Wales' largest (and one of Australia's biggest) solar farms. "Yarrabee Solar Farm" 23 kilometres from Narrandera is a 900 megawatt project being developed by Australian firm, *Reach Solar Energy*. The $1 billion project spanning 2,600 hectares is expected to start producing electricity by 2020 and will connect to the grid via a new 300 kilovolt substation to be built next to the existing Wagga to Darlington Point power transmission line.

The following map shows the locations of the operating large-scale solar farms, as well as those which have been approved by the New South Wales Government. Although all efforts have been undertaken to compile a comprehensive list of approved solar project, this may not be an exhaustive representation of the current project approvals in New South Wales.



Source: NSW Government, JLL Research (2019)

Site Selection Overview

The suitability of the site for the development of large scale, ground mounted solar projects is critical to reducing the likelihood and extent of land use conflicts and environmental and social impacts.

In December 2018, the *New South Wales Government* released the **Large-Scale Solar Energy Guideline: For State Significant Development.**

In accordance with the **EP&A Act** and the **State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP)**, a solar energy project is State significant development if it is not permissible without consent, and:

- Has a capital investment value of more than $30 million; or
- Has a capital investment value of more than $10 million and is in an environmentally sensitive area of State significance.

The guideline highlighted a variety of technical and commercial factors that need to be considered when selecting a site for a solar development, as shown in the table below.

Strategic context	Whether the project is consistent with local or state planning strategies, and government policies such as climate change and energy policies, including the capability of the project to contribute the energy security and reliability.
Land use conflicts	Assessment of the compatibility of the solar project with the existing land uses on the site and adjacent land, during construction, operation and after decommissioning. This requires reference to the zoning provisions applying to the land, and consideration of post-development remediation.
Traffic and transport	Consideration of whether the local and classified road network can accommodate the traffic generated by the construction of the solar project, and the need for any road upgrades and ongoing maintenance.

Source: New South Wales Government (2019)

The guidelines also include the following issues for careful consideration during the site selection process, although they do not preclude large-scale solar energy development.

Visibility and topography	Sites with high visibility and/or in proximity to significant scenic, historic or cultural landscapes.
Biodiversity	Areas with native vegetation or habitats of threatened species or ecological communities within and adjacent to the site.
Residences	Residential zones or urbanised areas.
Agriculture	Important agricultural lands, including Biophysical Strategic Agricultural Land (BSAL), irrigated cropping land, and land and soil capability classes 1, 2 and 3.
Natural Hazards	Areas subject to natural hazards such as flooding and land instability.
Resources	Prospective resource developments, including areas covered by exploration licences, and mining and petroleum production leases.
Crown Lands	If any part of the project or associated transmission or distribution infrastructure will cross Crown Lands, it may be subject to legislative requirements that restrict access to the land.

Source: New South Wales Government (2018)

Ultimately, assuming the site is located outside any significant environmental areas, the two key technical criteria are:

- Proximity to a suitable grid connection point; and
- Maximum solar irradiation.

Competent site selection and due diligence, and likewise engaging early with the network service providers and competent consultants to understand the suitability of the site from a connection point of view, is essential to this stage of development.

2 Local Area Solar Development Activity

Walla Walla Solar Project

Bison Energy * proposed to develop a solar farm approximately 4 radial kilometres north-east of the township of Walla Walla and approximately 9 radial kilometres south-west of Culcairn in southern New South Wales. It is located within the Greater Hume Local Government Area. The aggregation of properties are situated to the southern side of Benambra Road and comprise the following lots.

Walla Walla Solar Project	
Lot	Plan
16, 17, 20, 21, 87, 88, 89, 108, 109, 118	DP 753735
1	DP 1089452

Source: Bison Energy

According to the scoping report submitted for project assessment to the New South Wales Government, the capital investment value of the proposal is estimated at approximately $399 million. The 300 megawatt (MW) solar farm would occupy around 605 hectares of rural land currently used for primary production (cropping and grazing). The land is classed Primary Production (RU1). The proposed site in its immediate surrounds is shown in the following map.

Source: Google Earth

In the interim since this report was commissioned by Bison Energy - the original developer for the proposal - FRV Services Australia (FRV) acquired the project in July 2019 and will be the developer moving forward. FRV have been operating in Australia since 2010 and have a number of operational projects across Australia.

Nearby Solar Development

Within the proximity of the Walla Walla Solar Project, there are three other large-scale solar farms proposed by various proponents. The details of these other proposals are included below.

Culcairn Solar Farm

The Culcairn Solar Project Proposal includes the construction and operation of a solar photovoltaic (PV) energy generation facility with an estimated capacity of 400 megawatts and associated infrastructure, including a grid connection and battery storage. The applicant is *Neoen Australia Pty Ltd*.

The project is proposed for the location on Weeamera Road, approximately 5 radial kilometres southwest of Culcairn. The subject land covers 1,351 hectares with a development footprint of approximately 1,256 hectares. The development site is zoned RU1 – Primary Production pursuant to the Greater Hume Local Environmental Plan, with a minimum lot size of 100 hectares.

Jindera Solar Farm

Jindera Solar Farm Pty Ltd has proposed a solar farm development at Glenellen, north of Jindera, New South Wales. The 130 megawatt solar farm would occupy around 519 hectares of rural land currently used for agriculture with a development footprint of 337 hectares.

The proposal is located within the New South Wales South Western Slopes region in the Greater Hume Local Government Area, approximately 6 radial kilometres north of Jindera in the suburb of Glenellen. The proposal area is bound by Urana Road, National Road, and Ortlipp Road and intersected by Walla Walla Jinder Road, Spakes Road, Glenellen Road and Klimbergs Lane.

Proposed transmission lines would connect to an existing *TransGrid* substation located 600 metres to the south-east of the proposal. Local land use is primarily agricultural (cropping and grazing). Land is classed Primary Production – RU1.

Jindera Solar Farm Pty Ltd is based in New South Wales. It is a partnership involving *Hanwha Energy Corporation* and *Green Switch Australia*. *Hanwha Energy* is a major owner of solar farms in the USA and Asia. *Green Switch Australia* is a developer that specialises in creating utility scale solar projects.

According to the *SEARs* submission, the proposal would have an estimated capital investment in excess of $30 million. The actual value of the proposal will be in excess of $100 million.

Glenellen Solar Farm

The proposed Glenellen Solar Farm development is a circa 200 megawatt utility scale electricity generation works. The proposal, made by *Glenellen Solar Farm Pty Ltd*, is located on land within the Greater Hume Local Government Area approximately 4 kilometres north east of Jindera, and 20 kilometres north of Albury in southern New South Wales. Access to the site is via the western part of Lindner Road, leading to Ortlipp Road on the north western side. Drumwood Road is on the south eastern side of the site.

A *TransGrid* substation is located adjacent to the site on Ortlipp Road, which will serve as the grid connection point. The identified land is currently utilised for grazing and/or cultivation by landholders included in the project. Land is classed Primary Production – RU1.

The footprint and scale of GSF will be refined through the development of the project EIS. The anticipated capital investment value of the development is circa $200 million, however this investment value is subject to further project development and design.

We provide a map indicating the location of the nearby solar projects below.

Source: Google Earth

3 Subject Market

Local Market Commentary

The subject property is located in the eastern Riverina region of the broader Murray region in southern New South Wales.

The Riverina is one of the more productive and agricultural diverse region in Australia. The region benefits from a combination of high quality soil types, favourable climatic conditions and access to multiple water sources. The occurrence of several climate classes, differing terrains, soils and ecosystems all contribute to the wide variety of biophysical features noted in the Riverina.

Agricultural land occupies approximately 78 percent of the Riverina region according to the *Australian Bureau of Agricultural and Resource Economics & Science (ABARES)*. In 2017/18, the gross value of agricultural production in the Riverina region was $2.5 billion, accounting for 19 percent of the total gross value of agricultural production in New South Wales ($13 billion). The most important commodities in the region based on the gross value of agricultural production were wheat ($375 million), cotton ($347 million) and cattle ($247 million).

The use of land within the south east region of the Riverina is predominantly dryland grazing and cereal-based cropping. Dryland winter cropping includes cereals, oilseed and pulses. Wheat, barley and canola are the three major crops grown, by value. Crops are grown in varying rotations depending on site characteristics, seasonal variations, market demand and production preferences. Land with access to aquifer water sources incorporates irrigated summer crops into the production mix of the region.

Livestock production for red meat occurs across the Riverina. Enterprises focus on cattle, sheep or both. There are few large-scale sole-livestock operators and the majority of animals come from medium to small family operators.

Mixed-farming enterprises are common within the subject region. The cropping of cereals, pulse and oilseeds combined with the grazing of cattle and sheep provides diversification and production flexibility.

Like the majority of agricultural zones within New South Wales, the last three years has been witness to capital value appreciation as a result of favourable conditions across a number of key value drivers including low interest rates, an easing of the Australian dollar relative to major export partners, improved seasonal conditions and stronger commodity process. This most recent market cycle has followed a fairly long period of market stagnation post the instability associated with a post GFC economy and the extended dry conditions of the 2000s.

Within the Holbrook region, 2018 saw a substantial increase in average farmland values from $7,500 per hectare during 2017 to $9,000 per hectare over the course of 2018. The higher average rainfall in the region has attracted demand for land from drought affected farmers from western and northern New South Wales and Queensland.

The following list highlights sales of agricultural land within a thirty kilometre radius from the Walla Walla Solar Project. Data has been used from June 2017 with property land area ranging from 29 hectares to 957 hectares. The all-inclusive land rates vary between $2,200 to $10,750 per hectares with the data set averaging $7,650 per hectare. Notable movements in the region have included the following.

- *Deloraine Rural Pty Ltd* has been very active in the subject market over the past two years and have consistent paid some of the highest all-inclusive rates per hectare within the data sample. *Deloraine Rural Pty Ltd* is owned by the Laffan family, hereford cattle breeders, which had been farming in the Beveridge Wallan area on the outskirts of Melbourne. In May 2019 the family sold 600 hectares to residential property developers for a reported $200 million.

  Deloraine Rural owner, Edmond Laffan purchased **"Ravenswood"** at 274 Ravenswood Road Holbrook from Jim Heriot in May 2018 for $4.9 million. "Ravenswood" had been principally used to trade and finish cattle. Topography on "Ravenswood" is mostly level, while 75 percent consists of alluvial creek flats on the Billabong Creek system, in addition to granite based loam soils. The property was first listed for private sale at $3.3 million with *Corcoran Parker Oliver*, Wodonga in 2014.

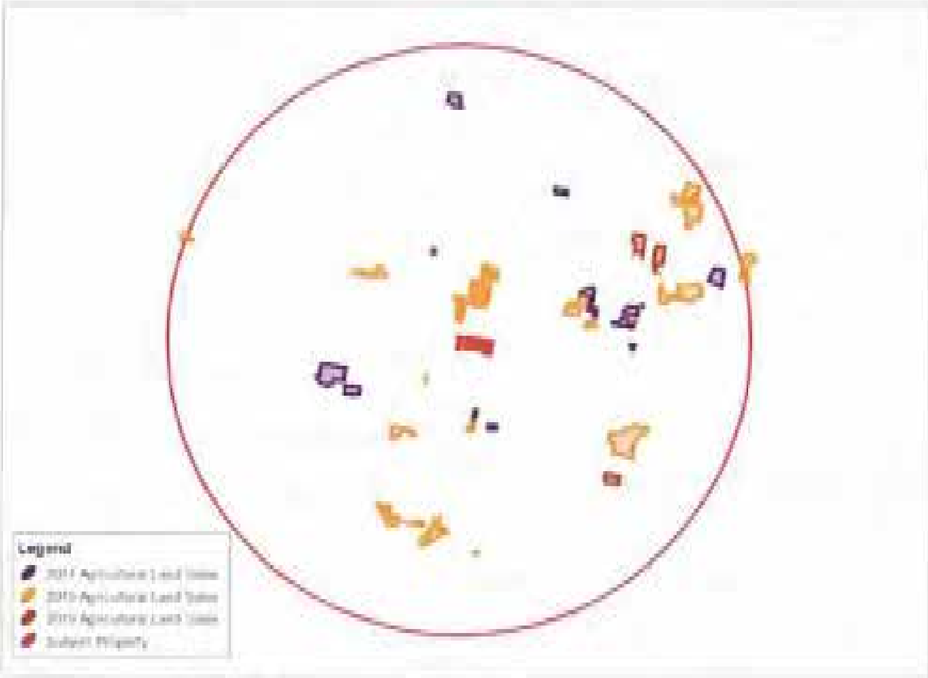
Deloraine Rural Pty Ltd then purchased "Ladykirk" from the Heriot family in June 2018. "Ladykirk" comprises 505 hectares north-west of the Holbrook township and sold for approximately $10,000 per hectare. In January 2019, *Deloraine Rural* also acquired 1431 Culcairn Holbrook Road, Morven from the Heriot family for $3.5 million indicating an all-inclusive rate of $10,626 per hectare.

– **"Cabarita"** at 387 Ravenswood Road, Holbrook sold for $2.9 million in April 2018. The property has been utilised for pasture production and to the breeding and grazing of livestock. The property has been pasture improved with a mix of subterranean clovers and ryegrass. The property sold at auction with the agent *Corcoran Parker*. Advertised listing provided an asking price of $8,645 per hectare.

We provide below a broader list of transactions that have occured within a 30 kilometre radius of the proposed Walla Walla Solar Farm.

Agricultural Land Sales Within the Hume Local Government Area in Proximity to the Walla Walla Solar Project				
Address	Sale Date	Sale Price	Area (Hectares)	All-Inclusive Rate
1750 Culcairn Holbrook Road Morven	16-May-19	$720,000	276.7	$2,602
138 Daly Road Mullengandra	11-Feb-19	$875,000	210.07	$4,165
1431 Culcairn Holbrook Road Morven	11-Jan-19	$3,516,440	330.94	$10,626
Lot 1 Coach Road Culcairn	18-Dec-18	$1,000,000	127.3	$7,855
949 Walla Walla Road Gerogery	17-Dec-18	$900,000	110.8	$8,123
716 Walla Walla Jindera Road Walla Walla	30-Nov-18	$3,000,000	281.01	$10,676
756 Fellow Hills Road Mountain Creek	19-Nov-18	$1,400,000	632.54	$2,213
689 Mountain Creek Road Mountain Creek	12-Oct-18	$4,550,000	957.44	$4,752
78 Walla Walla Road Walla Walla	27-Jul-18	$340,000	44.74	$7,599
806 Ralvona Lane Holbrook	18-Jul-18	$3,700,000	397.2	$9,315
604 Thugga Road Morven	12-Jun-18	$5,286,606	501.95	$10,532
Lot 1 Trigg Road Rand, NSW, 2642	04-Jun-18	$750,000	129.7	$5,783
187 Alma Park Road Walla Walla	22-May-18	$2,158,425	357.5	$6,038
274 Ravenswood Road Holbrook	09-May-18	$4,914,604	473.3	$10,384
245 Heriots Road Cookardinia	10-May-18	$4,798,790	462.13	$10,384
387 Ravenswood Road Holbrook	19-Apr-18	$2,900,000	269.7	$10,753
248 Ralvona Lane Holbrook	21-Dec-17	$3,040,000	304.4	$9,987
267 Jennings Road Culcairn	28-Nov-17	$879,308	124.9	$7,040
633 Henty-Ryan Road Ryan	24-Oct-17	$1,264,750	255.9	$4,942
Fellow Hills Road Mountain Creek	09-Oct-17	$255,789	29.02	$8,814
1057 Fellow Hills Road Mountain Creek	09-Oct-17	$499,942	57.65	$8,672
Fellow Hills Road Mountain Creek	06-Oct-17	$3,315,393	421.09	$7,873
560 Bloomfield Road Burrumbuttock	30-Jun-17	$5,190,000	840.2	$6,177
Lot 1 Walla Walla Road Gerogery	23-Jun-17	$471,724	76.90	$6,129

Source: RP Data



Source: JLL Research and Google Earth

Beyond the market for agricultural land there is a smaller market for lifestyle properties, particularly around local centres like Holbrook. Smaller properties which feature historical homesteads have an aesthetic appeal which draws the interest of individuals looking to retire in rural locations particularly given the proximity to the larger regional centres of Albury/Wodonga and Wagga Wagga.

The mixed zone of rural residential and small farm holdings can be seen around most of the main residential centres. Research completed by the *NSW Department of Primary Industries* in 2018 suggested that within a 20 kilometre radius of the main urban centres of Wagga Wagga and Albury the average farm size is very small (less than 50 hectares).

Significant urban development - both urban housing and lifestyle/rural residential parcels - around the larger regional centres and around villages, now becoming satellite residential areas, often results in fragmentation and an increase in land use conflict.

Solar farms utilising agricultural land (typically of a higher value given its characteristics of timber removal, level to minimum terrain and access to utilities) is emerging as another competing land use.

Local Summary

It is clear from the above discussion and our long term knowledge of the subject market region that its primary value drivers are those associated with primary production and key consideration for buyers are closely aligned with factors such as:

- Domestic and international commodity prices, in particular in the beef, lamb, wool, cereal and oilseed markets;
- Seasonal conditions, both on an annual and long term trend basis;
- Suitability land for the buyers chosen enterprise; and
- Suitability of land for any potential change in land use.

Further to the above, we list below the considerations potential purchasers would most likely have when considering the purchase of a property within the subject market.

- Farm size and scale;
- Land type and the proportion of arable land within the wider holding;
- Soil type;
- Paddock layout; and
- Quality and extent of structural improvements.

We note that to owners and prospective purchases of rural lifestyle properties, that locational proximity to a solar farm which results in a perceived impairment on the aesthetic appeal of the property may have a negative impact on land value. Thus, it is our observation that urban development that is deemed satellite residential and is fragmented from regional centres is more commonly conflicting with the development of agricultural land to green energy initiative (i.e. wind and solar). However, these conflicts are often resolved through the establishment of mature plantings as a natural visual barrier.

4 Comparative Local Market Analysis

4.1 Coleambally Solar Farm

Local Market Commentary

We have reviewed established solar projects and consider the Coleambally Solar Farm to be the most comparable to the proposed Walla Walla by way of characteristics of the surrounding market.

The Coleambally Solar Farm is a 150 megawatt solar farm, and one of the largest currently commissioned in Australia. *Neoen Australia* is the owner of the large-scale solar farm which is located approximately five kilometres north east of Coleambally in the Murrumbidgee Local Government Area of New South Wales. Construction of the solar farm commenced in January 2018. The project consists of approximately 560,000 solar panels installed on 550 hectares of land. At the end of November 2018, the Coleambally Solar Farm began full-scale commercial operation. The solar farm in its immediate surrounds is shown below.

Source: Google Earth

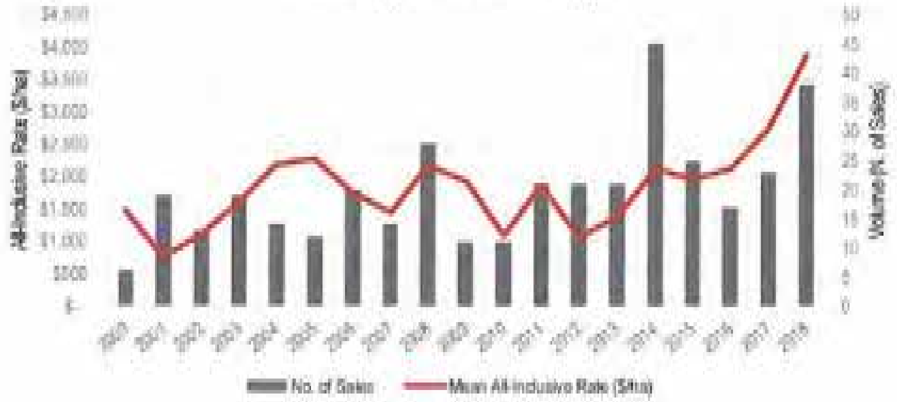
Coleambally Solar Farm is noted to be located approximately 144 radial kilometres to the north west of the Walla Walla Solar farm.

Broad Market Analysis

Having identified a land market with comparable value drivers to the Walla Walla region we have undertaken a study of historic transactions both at a broad level and also within closer proximity to the solar project in order to determine any influences the project may have had on Market Value.

The following graph shows the growth in the all-inclusive rate of agricultural properties larger than 100 hectares since 2000. Since 2016, there has been an acceleration in the appreciation of land values in the Murrumbidgee. The combination of a favourable climate for a range of valuable crops and its strong livestock production history has benefited sellers in this market.

Murrumbidgee Submarket Analysis



Source: RP Data

Land values within the Murrumbidgee Local Government Area (LGA) reflect a broader trend in the southern Murray Darling of strong demand emerging over the past 3 years. Market confidence across a wide range of agricultural sectors remains very high in all price segments. There is a substantial amount of capital looking to invest, however, generally returns on investments have compressed substantially in the last 12 months as a result of competition for assets increasing values across most sectors.

Demand for Irrigated agriculture land has been the driving force behind appreciation of land value within the Murrumbidgee LGA. Strong commodity prices, growing export opportunities and increasingly strategic climate risk management have all factored into this trend.

Our analysis of sales trends at an LGA level indicate both market liquidity and value increased from 2016 to 2018 and appears not to have been adversely impacted by the development of the solar farm.

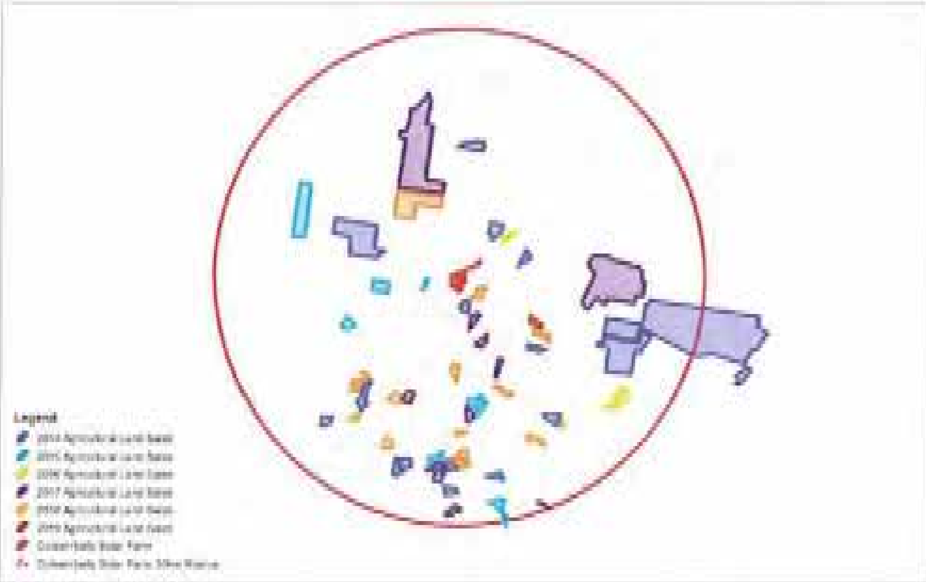
Targeted Market Analysis

Neoen Australia first applied to the Director-General of the Department of Planning and Infrastructure for environmental assessment requirements (DGRs) in January 2017. Analysis of property transactions prior to application and after the competition of construction have been utilised to highlight the local trend in land values.

Irrigated cropping is the predominant land use within the subject area. The property upon which the Coleambally Solar Farm has been developed was a medium scale irrigation property located within the Coleambally irrigation Area. An analysis of land sales within a 30 kilometre radius from Coleambally Solar Farm has been undertaken. Over the past 30 months – the period over which the solar project was proposed and progressed towards full scale operation – an increase in land value in the region has been observed.

Land Sales Within 30 Kilometre Radius From Coleambally Solar Farm 2014 - 2018

Source: RP Data



Source: Google Maps

The Coleambally agricultural land market has been active over the observed period (2014-2019), particularly for properties within the 210-230 hectare area bracket. Larger cropping properties have been subject to increased demand by corporate and institutional investors looking to convert land use away from lower value annual cropping to permanent tree crops such as nuts. The accessibility and availability of water is increasingly influencing land values within the area. Key transactions which have occurred within the region include the following.

- **"Tallinga"** on Macleay Road, Coleambally is located approximately 10 radial kilometres south-east of the town of Darlington point and approximately 45 radial kilometres south of Griffith, being the nearest regional centre. The 1,473 hectare property is predominantly utilised for irrigated cropping purposes. The property was offered via an on market campaign with 58 megalitres of Kerarbury water included in the sale. In August 2018 "Tallinga" sold for $6.855 million to *Optifarm Pty Ltd* with an all-inclusive rate of $4,654 per hectare. It is understood the property was purchased for a higher value alternatives use.
- **"Wallaroo"** 6830 Kidman Way, Coleambally sold in July 2018 for $2.3 million. The 313.68 hectare property achieved an all inclusive rate of $7,332 per hectare. The property is predominantly utilised for irrigated cropping purposes under centre pivot. The property was sold through a public marketing campaign with irrigation water included in the sale. The property sold to a US investment fund which it is understood will develop the property to permanent plantings.

Overall, there has been no definable effect on local agricultural land values as a result of the construction and operation of the Coleambally Solar Project. Demand remains strong in the area for property with a noticeable appreciation in agricultural land value over the past five years.

5 Conclusion

The market study undertaken within this report reveals the subject market land users to be predominately medium to large scale broad hectare agricultural business operators who derive profits from agricultural production from the land through the production of commodities such as beef, lamb, wool, cereals and oilseeds.

Throughout this study and our wider work within the subject property market, we are not aware of any adverse impacts the existence of a solar farm would have on the production of commonly produced commodities on surrounding or nearby land. We therefore do not consider the Walla Walla Solar Farm project likely to have an adverse impact on the productivity of land within the subject market and its ability to provide ongoing financial yields for its operators.

The key market drivers discussed within this report have, for an extended period, driven the changing trends in value of the agricultural land within the subject market. Given the location and productive characteristics of agricultural land within the subject market, we expect these drivers to remain the key influencing factors on agricultural land value.

Our study has also considered the market surrounding the Coleambally Solar Project in order gain an understanding of the impact an established solar project may have on local market values. Analysis at broad and targeted levels indicates the solar project has not has an adverse impact on the local property market and in fact the market has increased considerably in recent years due to a high level of demand from agricultural land users.

Further to the above we are unaware of any other instances of solar farm projects having an adverse impact of agricultural property markets throughout other regions of Australia.

Appendices

A. Copy of Instructions

JLL

Service Proposal – Consultancy Services 21 May 2019

Solar Farm Development Market Study

Dear Mr Simon Zhang

Further to our conversations with David Brown (Head of Strategic Consulting), who facilitated your community consultation, we understand the proposed Walla Walla Solar Farm requires some valuation analysis with regards to impacts on surrounding land values to assist in answering questions from the community. The following details the approach we believe will best support you and the fee proposal for the provision of Consultancy Services as requested by Bison Energy.

Our proposal is a Desktop Market Study considering the impacts on land markets as a result of significant renewable energy developments including:

Market Discussion

- Commentary on our observations from work with properties directly affected by renewable energy development projects as well as properties surrounding projects.
- Statistical analysis on sub-markets in which renewable energy development projects are located to explore the impacts on property values.
- Discussion on the value drivers of agricultural land markets and the impact on drivers energy development projects can have.

Situational and Project Impact Analysis

- A brief description of property, project and local area details.
- Identification of key infrastructure and natural features affected by the property.

Basis:
Desktop Land Market Study.

Form of report:
The report will be provided as a comprehensive Desktop Assessment in line with the scope provided within this letter.

Fee:
[redacted] excluding GST including all disbursements.

Our fee is non-refundable.

Payment term:
Our invoice will be provided upon delivery of the report(s) (Draft or Final). In the instance that you require that we delay formalisation of our advice or release of the report(s), then we may present our account (or portion of our account) at that time.

Payment is expected within 14 days of provision of the invoice.

Timing:
Submission of final report within 15 days from the date of instruction.

- Discussion on the likely negative impact (if any) to the subject property and surrounding properties as a result of the project.

Perceived Property Impacts

- Details of value drivers, trend analysis and advice regarding project impact on the neighbouring and surrounding property sector.

The report will be prepared for Due Diligence purposes and must not be relied upon for any other purpose. Reliance will be limited to Bison Energy only.

In this instance all services will be provided by the Agribusiness team who have a sound knowledge of complexities associated with surrounding land uses and the local market.

JLL requires the full disclosure of all relevant information and matters applicable to the property to be valued that may have an impact upon the value and marketability of the property.

If you do not provide any part of the information requested for whatever reason, we may include limiting conditions to our consultancy service as necessary (including limitations on Reliance).

Should you wish to proceed, reply to this proposal and please complete your billing details below.

We look forward to receiving your confirmation to proceed with the consultancy services and working with you on this assignment.

If you have any queries, please do not hesitate to call.

Kind regards,

Will Gurry
Head of Agribusiness
Valuations & Advisory
t: +61 8 8233 8852 | m: +61 488 553 988
e: will.gurry@ap.jll.com

Reliant Party Details (please complete)

Reliant Party: BE PRO W PTY LTD

Client Contact: Level 14, 380 St Kilda Road, Melbourne Vic 3004, Australia

Date: 22.05.2019

Your Billing Details (please complete)

Billing Entity: BE PRO W PTY LTD

ABN: 26 627 937 473

Address: Level 14, 380 St Kilda Road, Melbourne Vic 3004, Australia

Contact Person: Simon Zhang

Email: simon@bisonenergy.net

Your Ref:
You will receive an invoice as per the Fee Term above. Payment must be made electronically by remitting funds into our corporate account:
Jones Lang LaSalle Australia Pty Limited
HSBC
BSB: 342-011
Account Number: 472651001

Disclaimer, Terms & Conditions:

The Services cover the preparation and provision of a valuation report on the market value of the designated site/property. The report will be provided for your private use only and may not be published, copied or distributed to any third party (including any related entity) without our prior written consent. This proposal is subject to our Standard Terms and Conditions unless we already currently have in place different terms applicable to this proposal. If no such further terms exist, then by agreeing to this quote, you agree to our Business Terms and Conditions attached. This quotation is valid for fourteen (14) days from this email. Should you wish to proceed after 14 days, we reserve the right to review our fee and timing. Our fee is based on the scope above and should it vary, additional fees may be incurred. An hourly rate of $395 per hour excl. GST is chargeable for services not included above and/ or if any significant variation, delay, additional attendances etc. are required.

Liability limited by a scheme approved under Professional Standards Legislation.

STANDARD TERMS AND CONDITIONS OF BUSINESS FOR VALUATIONS

1. Definitions

1.1 In this document:

Agreement means the agreement between JLL and the Client comprising the Proposal and these Standard Terms and Conditions of Business for Valuations.

Asset means the asset/s being valued, as stated in the Proposal.

Client means the client engaging JLL to provide the Services.

Expenses means expenses of JLL related to the provision of the Services, and stated in the Proposal as being payable by the Client.

Fee means the fees payable in return for the Services, as described in the Proposal.

JLL means the entity within the Jones Lang LaSalle corporate group that is providing the Services.

Proposal means JLL's offer to perform Services for the Client.

Services means the services described in the Proposal.

Valuation means the reports or reports produced as the work product of the Services.

2. Services

2.1 JLL must provide the Services to the Client:
- (a) with the skill, care, efficiency and diligence reasonably expected of a service provider experienced in providing the same or similar services;
- (b) in accordance with the reasonable directions of the Client;
- (c) in accordance with all applicable laws; and
- (d) otherwise in accordance with this Agreement.

2.2 The Client acknowledges and agrees that JLL:
- (a) may be required to comply with specific laws relating to its business as a licensed service provider and the Client agrees to provide all reasonable assistance to facilitate such compliance, including executing separate agreements where necessary; and
- (b) must not provide legal, insurance or other professional advice for which it is unlicensed and that such advice does not form part of the Services and may not be relied on even if purportedly given.

3. Client Obligations

The Client must give JLL access to all documents, information, premises, assets and people including (without limitation) the Asset, as reasonably necessary for JLL to provide the Services.

4. Delay

JLL will not be liable to the Client for any delay in the performance of the Services attributable to any event beyond the reasonable control of JLL, including (without limitation) any failure by the Client to fulfil its obligations under **clause 3**.

5. Fees, Expenses and Payment

5.1 The Client must pay JLL the Fee and the Expenses in accordance with this Agreement.

5.2 If the Fee or any part of it remains unpaid thirty days after it was due, thereafter the Client may not use the Valuation for any reason.

6. Indemnity

The Client indemnifies and holds harmless JLL against any action, claim, proceeding, demand, damages, loss, liability, cost or expense (including costs on a solicitor/client basis) ("**Claim**") that JLL incurs in connection with or arising out of this Agreement or the Services. This clause survives the expiry or termination of this Agreement for any reason.

7. Exclusions of, and Limitations on, Liability

7.1 Notwithstanding any other provision of this Agreement, neither party shall in respect of any Claim be liable to the other party for any loss of capital or profit (whether direct or indirect), loss of revenue, loss of opportunity, Loss of goodwill, or any form of indirect, incidental, punitive, consequential or special losses or damages of any kind.

7.2 To the extent permitted by law, the total liability of JLL in relation to this Agreement or the Services, whether arising under contract, statute, tort (including negligence) or otherwise, is limited to the lesser of two times the Fee and AUD500,000.

8. Reliance on Information and Documents

JLL relies on the accuracy and sufficiency of information and documents provided to it by the Client and others. JLL is not liable for anything related to, or arising in any way from, the inaccuracy or insufficiency of such information and documents.

9. Termination

9.1 Either party may terminate this Agreement without reason by giving 30 days' written notice to the other.

9.2 JLL may terminate this Agreement immediately if:
- (a) JLL cannot provide any of the Services due to force majeure;
- (b) JLL considers that there is insufficient information available to provide a Valuation that meets JLL's standards; or
- (c) the Client seeks to have JLL provide a Valuation that JLL does not consider accurate.

9.3 Either party (the first party) may terminate this Agreement immediately if:
- (a) the other party (the second party) breaches this Agreement and fails to remedy such breach within 14 days of being notified of it by the first party;
- (b) the second party is unable to pay its debts when they are due;
- (c) the second party enters into a scheme of arrangement or composition with its creditors;
- (d) the second party is placed under management or administration or a receiver is appointed; or
- (e) a winding up order is made in respect of the second party.

9.4 On termination of the Agreement, the Client must pay JLL:
- (a) all Expenses JLL has incurred;
- (b) if the Services are substantially complete, the Fee; and
- (c) if the Services are not substantially complete, an amount reasonably determined by JLL as being appropriate remuneration for that part of the Services performed to date.

10. Assignment and Variation of Services

10.1 A party must not assign or transfer any of its rights or obligations under this Agreement without the prior written approval of the other party. Such approval must not be unreasonably withheld.

10.2 The Client may vary the Services at any time in writing provided that such variation is within the general scope of the Services initially contemplated, and provided that JLL agrees to the variation. The Client accepts that variation in the Services may result in a change in the Fee and/or the completion date of the Services, and agrees to any such revised Fee and completion date as reasonably determined by JLL. Any variation to the Services will be subject to the same terms and conditions as contained in this Agreement.

11. Currency of Valuations

Each Valuation is current as at its date. Assessed values may change significantly and unexpectedly over short periods. JLL is not liable for Claims relating to such subsequent changes in value. JLL is not liable for Claims relating to reliance upon a Valuation more than 90 days after its date, or earlier if the relying party is aware of anything that may have an effect on the Valuation.

12. Confidentiality

12.1 Each party must maintain the confidentiality of the other party's information (including after termination or expiry of this Agreement) and must not disclose any information received in confidence from the other party, except where required to do so by law.

12.2 The product of JLL's Services is confidential to, and for the use only of, the Client and any other party JLL expressly agrees may see and rely on it. Those parties may use that work product only for its stated purpose. JLL is not liable to any other parties for any reason and the Client indemnifies JLL for any Claim by any such party if it obtained the work product via the Client either directly or indirectly.

13. Intellectual Property Rights

JLL retains all copyright (and other intellectual property rights) in all materials, reports, systems and other deliverables which it produces or develops for the purposes of this Agreement, or which it uses in the provision of the Services. No part of a Valuation or anything else produced by JLL as part of the Services may be reproduced or copied without JLL's prior written consent.

14. General

14.1 Any provision of this Agreement which is void, illegal or otherwise unenforceable will be severed to the extent permitted by law without affecting any other provision of this Agreement.

14.2 The failure or omission of a party at any time to enforce or require compliance with any provision of this Agreement or exercise any right, election or discretion under this Agreement shall not operate as a waiver of that right, election or discretion.

14.3 This Agreement is the entire agreement between the parties in relation to the Services and supersedes all previous agreements, proposals, representations, correspondence and discussions.

14.4 Amendment of this Agreement may only be effected by written agreement of both parties.

14.5 If anything in the Proposal conflicts with these "*Standard Terms And Conditions Of Business For Valuations*", these terms and conditions prevail.

15. Applicable Law

15.1 This Agreement shall be governed and construed by the laws of the State or Territory in which the Asset is located.

15.2 Each of the Client and JLL irrevocably submits to the exclusive jurisdiction of the courts of that State or Territory.

16. GST

16.1 GST has the same meaning as in the GST Law.

16.2 GST Law means the *A New Tax System (Goods and Services Tax) Act 1999* (Cth).

16.3 In addition to paying the Fee and the Expenses (which unless expressly stated otherwise are exclusive of GST), the Client must:

(a) pay to JLL an amount equal to any GST for which JLL is liable on any supply by JLL under or in connection with this Agreement, without deduction or set-off of any other amount; and

(b) make that payment as and when the Fee, Expenses or other consideration (or any part of the Fee, Expenses or other consideration) must be paid or provided.

Contacts

William Gurry

Head of Agribusiness

JLL Agribusiness

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JLL | Achieve Ambitions

APPENDIX M FM ACT HABITAT ASSESSMENT AND ASSESSMENT OF SIGNIFICANCE

M.1 FM ACT HABITAT ASSESSMENT

The table in this Appendix present the habitat evaluation for threatened species and ecological communities listed under the NSW FM Act and those identified as potentially occurring in the area according to the Commonwealth Protected Matters search tool.

The likelihood of occurrence is based on presence of habitat, proximity of nearest records and mobility of the species (where relevant). The assessment of potential impact is based on the nature of the proposal, the ecology of the species and its likelihood of occurrence. The following classifications are used:

Presence of habitat:

Present: Potential or known habitat is present within the study area

Absent: No potential or known habitat is present within the study area

Likelihood of occurrence

Unlikely: Species known or predicted within the locality but unlikely to occur in the study area

Possible: Species could occur in the study area

Present: Species was recorded during the field investigations

Possible to be impacted

No: The proposal would not impact this species or its habitats. No AoS is necessary for this species

Yes: The proposal could impact this species or its habitats. An AoS has been applied to these entities.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Fish				
Flathead Galaxias *Galaxius rostratus* CE EPBC CE FM	Below 150 m in altitude. Billabongs, lakes, swamps, and rivers, with preference for still or slow-flowing waters.	**No** No suitable permanent water above 150 m in altitude.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.
Murray Hardyhead *Craterocephalus fluviatilis* CE FM	Mostly recorded in saline lakes that are moderately acidic to highly alkaline and have relatively low turbidity. Margins of lakes, wetlands, backwaters, and billabongs. Open water, shallow, slow-flowing or still habitats, with sand or silt substrates. Also, deeper habitats with dense aquatic vegetation.	**No** No lakes, backwaters, billabongs with deep water.	**Unlikely** Within historic species distribution.	**No** No suitable habitat in study area.
Stocky Galaxias *Galaxias tantangara* CE FM	Small, cold, clear and fast-flowing alpine creek, flowing through open forest of eucalypts, low shrubs and tussock grass.	**No** No alpine creeks.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Australian Grayling *Prototrocetes marena* E FM	Migrates between rivers, estuaries and coastal seas. Mostly in freshwater rivers and streams, usually in cool, clear waters with gravel substrate and alternating pool and riffle zones.	**No** No coastal habitat.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Eastern Freshwater Cod *Maccullochella ikei* E FM	Clear flowing rivers with rocky substrate and large amounts of in-stream cover.	**No** No flowing rivers.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Eel Tailed Catfish *Tandanus tandanus*	Inhabits slow moving streams, lakes and ponds with fringing vegetation. It swims close to the sand or gravel bottoms. This species is more abundant in lakes than in flowing water.	**No** No flowing rivers.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.

[1] Information sourced from species profiles on NSW DPI species list or the Australian Government's *Species Profiles and Threats* database (SPRAT) unless otherwise stated.

OEH threatened species database: https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what-current

SPRAT: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Olive Perchlet *Ambassis agassizii* E FM	Inhabits the vegetated edges of lakes, creeks, swamps, wetlands and rivers, where it is often associated with woody habitat and aquatic vegetation in areas with little or no flow, particularly backwaters.	**No** No flowing or suitable permanent water.	**Unlikely** Within historic species distribution.	**No** No suitable habitat in study area.
Oxleyan Pygmy Perch *Nannoperca oxleyana* E FM	Coastal lowlands, mostly coastal floodplains in swamps, creeks and lakes of coastal Banksia heath.	**No** No coastal habitat.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Southern Pygmy Perch *Nannoperca australis* E FM	Slow-flowing waters and still, vegetated habitats in small streams, lakes, billabongs and wetlands.	**No** No flowing or suitable permanent water.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.
Southern Purple Spotted Gudgeon *Mogurnda adspersa* E FM	Rivers, creeks, and billabongs with slow-flowing or still waters or in streams with low turbidity. Cover in the form of aquatic or overhanging vegetation, leaf litter, rocks or snags.	**No** No suitable slow-flowing or still permanent water.	**Unlikely** Outside current known species distribution.	**No** No suitable habitat in study area.
Trout Cod *Maccullochella macquariensis* E FM	The species is usually associated with deeper water (pools) and instream cover such as logs and boulders	**No** No suitable permanent water with large woody or rock debris.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Murray Cod *Maccullochella peelii* V EPBC	Slow flowing, turbid water in streams and rivers, favouring deeper water around boulders, undercut banks, overhanging vegetation and logs.	**No** No deep, slow-flowing streams or rivers.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.
Macquarie Perch *Macquaria australasica* E EPBC E FM	Rivers, in clear, deep, rocky holes with plenty of cover including aquatic vegetation, large boulders, large woody debris, and overhanging banks.	**No** No deep water with plenty of cover.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Silver Perch *Bidyanus bidyanus* V FM	Faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin.	**No** No fast-flowing water.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.
Darling River Hardyhead population in the Hunter River catchment *Craterocephalus amniculus* EP FM	North-east part of the Murray-Darling Basin, especially MacIntyre, Namoi and other border rivers. The Hunter River population is the only known occurrence in an eastward flowing river.	**No** Outside Hunter River catchment.	**No** Outside population distribution.	**No** Population not in study area.
Flathead Galaxias *Galaxias rostratus* V FM	Historically collected from a variety of habitats including billabongs, lakes, swamps and rivers, usually in still or slow-flowing waters.	**No** No flowing or suitable permanent water.	**Unlikely** Within species distribution.	**No** No suitable habitat in study area.
Murray-Darling Basin population of Eel-tailed Catfish *Tandanus tandanus* EP FM	Diverse range of freshwater environments including rivers, creeks, lakes, billabongs and lagoons. Clear, sluggish or still waters, but also found in flowing streams with turbid waters. Substrates range from mud to gravel and rock.	**Possible** Small freshwater dams with sand/mud substrate.	**Unlikely** Not recorded in locality.	**No** Species not recorded in locality.
Snowy River population of River Blackfish *Gadopsis marmoratus* EP FM	Clear flowing streams with good instream cover such as woody debris, aquatic vegetation and undercut banks.	**No** Outside Snowy River catchment.	**No** Outside population distribution.	**No** Population not in study area.
Western population of Olive Perchlet *Ambassis agassizii* EP FM	Western (Murray-Darling) population is limited to a few localities in Darling drainage upstream from Bourke.	**No** Outside Darling drainage system upstream from Bourke.	**No** Outside population distribution.	**No** Population not in study area.
Grey Nurse Shark *Carcharias taurus* CE FM	Inshore coastal waters along coast of NSW and southern Queensland.	**No** No coastal habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Scalloped Hammerhead Shark *Sphyrna lewini* E FM	Tropical and warm temperate seas between 45°N and 34°S, inshore and over continental shelf and in adjacent deep water from surface to at least 275 m depth.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Great Hammerhead Shark *Sphyrna mokarran* V FM	Occurs along coastlines, continental shelves and adjacent drop-offs to about 80 m depth.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
White Shark *Carcharodon carcharias* V FM	Inshore habitats to outer continental shelf and slope areas.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Southern Bluefin Tuna *Thunnus maccoyii* E FM	Oceanic waters on seaward side of continental shelf.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Black Rockcod *Epinephelus daemelii* V FM	Caves, gutters and beneath bommies on rocky reefs, from near shore environments to depths of at least 50 m.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
River Blackfish				
Invertebrates				
Darling River Snail *Notopala sublineata* CE FM	Darling River and its tributaries. Artificially introduced hard surfaces including irrigation pipelines.	**No** No artificial surfaces in waterways.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Hanley's River Snail *Notopala hanleyi* CE FM	Artificially introduced hard surfaces including irrigation pipelines.	**No** No artificial surfaces in waterways.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Fitzroy Falls Spiny Crayfish *Euastachus dharawalus* CE FM	Creates burrows in soft stream bed below waterline.	**No** No suitable permanent streams.	**Unlikely** Outside species distribution.	**No** No suitable habitat in study area.
Murray Crayfish *Euastachus armatus* V FM	Lotic waters of southern Murray-Darling Basin. Habitats ranging from pasture to sclerophyll forest, large and small streams. Deep flowing water proximal to clay banks, wood or rock cover.	**No** No suitable permanent lotic habitat	**Possible** Within species distribution.	**No** No suitable habitat in study area.
Marine Slug *Smeagol hilaris* CE FM	Small isolated location at Merry Beach, south of Ulladulla, NSW.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Adams Emerald Dragonfly *Archaeophya adamsi* E FM	Narrow, shaded riffle zones with moss and abundant riparian vegetation in small to moderate sized creeks with gravel or sandy bottoms.	**No** No suitable moist, shaded riffle zones.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Sydney Hawk Dragonfly *Austrocordulia leonardi* E FM	Deep river pools with cooler water and permanent flow.	**No** No deep water or permanent flow.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Alpine Redspot Dragonfly *Austropetalia tonyana* V FM	Amongst rocks, logs and moss within the splash zone of waterfalls or in the nearby stream edge.	**No** No waterfalls or moist rocky streams.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Bousfield Marsh Hopper *Microrchestia bousfieldi* V FM	Mangrove swamps and salt marshes in eastern Australia.	**No** No coastal habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Buchanans Fairy Shrimp *Branchinella buchananensis* V FM	Lake Buchanan in southwest Queensland, and Gidgee and Burkanoko Lakes in northwest NSW.	**No** No lake habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Plants				
Marine Brown Alga *Nereia lophocladia* CE FM	Port Phillip Heads in Victoria and Muttonbird Island, Coffs Harbour in NSW.	**No** No coastal habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Posidonia australis seagrass, Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations EP FM	Coarse sandy to fine silty sediments between the low tide and approximately 10 m in depth.	**No** No marine habitat.	**No** Outside species distribution.	**No** No suitable habitat in study area.
Endangered Ecological Community				
Lowland Darling River aquatic ecological community EEC FM	Natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow diversions to anabranches, the anabranches, and the floodplains of the Darling River within NSW, including Menindee Lakes and Barwon River.	**No** Not in Darling River catchment.	**No** Outside community distribution.	**No** No suitable habitat in study area.
Lowland Lachlan River aquatic ecological community EEC FM	Natural rivers, creeks, streams and associated lagoons, billabongs, lakes, wetlands, paleochannels, floodrunners, effluent streams (those that flow away from the river) and the floodplains of the Lachlan River within NSW, including Lake Brewster, Lake Cargelligo and Lake Cowal.	**No** Not in Lachlan River catchment.	**No** Outside community distribution.	**No** No suitable habitat in study area.

Species and Status	Description of habitat[1]	Presence of habitat	Likelihood of occurrence	Potential for impact?
Lowland Murray River aquatic ecological community EEC FM	Natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River (also known as the River Murray) downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria.	**Yes** Back Creek flows into Billabong Creek	**Yes** Within community distribution.	**Yes** AoS Completed.
Snowy River aquatic ecological community EEC FM	Rivers, creeks and streams of the Snowy River catchment. This includes Snowy, Eucumbene, Thredbo (or Crackenback), Gungarlin Mowamba, Bombala, McLaughlin, Delegate, Pinch and Jacobs Rivers and their tributaries.	**No** Not in Snowy River catchment.	**No** Outside community distribution.	**No** No suitable habitat in study area.

CE FM = listed as Critically Endangered under Schedule 4A of the NSW *Fisheries Management Act 1994.*

E FM = listed as Endangered under Schedule 4 of the NSW *Fisheries Management Act 1994.*

V FM = listed as Vulnerable under Schedule 5 of the NSW *Fisheries Management Act 1994.*

EP = listed as an Endangered Population under Schedule 4 of the NSW *Fisheries Management Act 1994.*

EEC = listed as an Endangered Ecological Community under Schedule 4 of the NSW *Fisheries Management Act 1994.*

M.2 FM ACT ASSESSMENT OF SIGNIFICANCE

The FM Act specifies a set of seven factors which must be considered by decision makers in assessing the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. These factors are collectively referred to as the 'seven-part test' or AoS. The following assessment assesses the significance of the likely impacts associated with the proposed works on:

Ecological Communities

Lowland Murray River aquatic ecological community.

a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Lowland Murray River aquatic ecological community occurs within the study area, though Back Creek and Middle Creek (tributaries of Billabong Creek) are ephemeral and do not provide permanent habitat for any threatened aquatic flora or fauna species listed under the FM Act. None of the key management areas for these threatened species occur in the study area, and they were not recorded during the site visit. None of the key management areas for these threatened aquatic species occur in the study area. Therefore, it is considered unlikely that the proposal would have an adverse impact on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

The Lowland Murray River aquatic ecological community occurs within the study area, though Back Creek and Middle Creek (tributaries of Billabong Creek) are ephemeral and do not provide permanent habitat for any threatened populations of aquatic flora or fauna species listed under the FM Act. None of the key management areas for listed threatened populations occur in the study area and none were recorded during the site visit. No key management areas for threatened aquatic populations occur in the study area. Therefore, it is considered unlikely that the proposal would have an adverse impact on the lifecycle of any viable threatened population of aquatic species, placing them at risk of extinction.

c) in case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinct

i. The Lowland Murray River aquatic ecological community occurs within the study area, though Back Creek and Middle Creek (tributaries of Billabong Creek) are Class 4 ephemeral creeks that run into Billabong Creek following high rainfall events. The proposal would not intrude within 10 m of Back Creek, protecting the integrity of the riparian zone and remnant PCT 5 – River Red Gum herbaceous – grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the Eastern Riverina Bioregion. Middle Creek has been previously cleared, grazed and cropped and is currently dominated by PCT 76 – Grey Box tall grassy woodland (derived grassland) on alluvial loam and clay soils in the NSW South Western Slopes and

Riverina Bioregions. The impacts on these vegetation communities have been extensively addressed in the BDAR (Appendix H). The proposal would not modify natural flows or the extent of the Lowland Murray River EEC such that it would be likely to put this EEC at risk of extinction.

ii. Back Creek and Middle Creek are rarely inundated (unlikely fish habitat) and the proposal would not disrupt natural flows though landform modification. The proposal would not likely contribute to key threatening processes that would place the Lowland Murray River EEC at risk of extinction such as removing woody or rocky substrates, degrade riparian zones of flowing creeks or introduce pest species likely to impact aquatic food webs.

d) in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed,

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

i. Back Creek and Middle Creek are rarely inundated (unlikely fish habitat) and the proposal would not disrupt natural flows though landform modification. Aquatic habitat would not be removed or significantly modified as a result of the proposal.

ii. The proposal does not include any landform modifications that would isolate or fragment aquatic habitat or alter the natural flows of either Back Creek or Middle Creek.

iii. The proposal would not remove, modify or fragment any aquatic habitat. Both Back Creek and Middle Creek would continue to function normally following high rainfall events. No key habitat for any threatened aquatic species or population was identified during background searches or site surveys.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The development site does not include critical habitat for the any threatened aquatic species or populations. No direct or indirect adverse impacts on critical habitat belonging to the Lower Murray River aquatic ecological community are likely to be caused by the proposal.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The development site is not located within or near any aquatic habitat that is part of a recover plan or threat abatement plan for the Lower Murray River aquatic ecological community. It is not anticipated that the proposal would either directly or indirectly impact any such pans.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact or, a key threatening process.

Five (7) key threatening processes (KTP) are relevant to the proposed work including:

- Modification of natural river flows as a result of dams or cut and fill.

- Spawning failures and habitat loss resulting from cold water (or hot water) releases from dams.
- Predation, competition, diseases and habitat modification from introduced fish species.
- Degradation of the riparian (riverbank) zone through stock access and clearing native vegetation, leading to loss of shelter and increased sedimentation.
- Removal

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than 2 ha in extent, may have significant impacts on biological diversity'. It is not expected that roadside vegetation would be impacted as a result of the proposal. However, given that the development area has been previously disturbed and fragmented from clearing for agriculture and construction of Galong Road, the vegetation adjacent to the proposal area that provides important habitat connectivity for this locality would not be impacted, it is considered unlikely for there to be significant impacts on biodiversity.

The removal of dead wood and trees on the ground caused by human activity has been recognised as a factor contributing to loss of biological diversity. Dead wood and dead trees provide essential habitat for a wide variety of native animals and are important to ecosystem function. The proposed works would require the removal of mature trees and stags in the development footprint. As part of the mitigation measures, it has been recommended that coarse woody debris is to be retained and placed in adjacent areas instead of being taken off site where practicable. With the implementation of this measure, the proposal is unlikely to contribute to this KTP.

A number of exotic perennial grasses are already present at the development site including *Chloris gayana* (Rhodes Grass), *Chloris virgata* (Feathertop Rhodes Grass), *Eragrostis curvula* (African Lovegrass), Phalaris *(Phalaris sp.),* Paspalum *(Paspalum dilatatum)* and Cocksfoot (*Dactylis glomerate*). Perennial exotic grasses invade and may dominate native plant communities competing with, and displacing, many native species. Dense monocultures of perennial grasses that develop after invasion threaten local vegetation at all sites that are affected. This may result in local and regional declines of many native species and communities, possibly to the extent that they become endangered. The proposed works involves disturbance that can lead to the establishment of exotic perennial grasses. All of the examples listed above were recorded in the proposal area during the site survey, but Cane Needle Grass, Chilean Needle Grass and Serrated Tussock are also listed within the Hilltops (west) Local Land Services region. These species could therefore occur in the proposal area and potentially spread as a result of disturbance from the proposed works. As part of the mitigation measures, it has been recommended that construction machinery will be cleaned prior to entering and exiting work sites and regular targeted control of priority weeds would be undertaken to reduce the risk of weeds being introduced and spread. With the implementation of this measure, the proposal is unlikely to contribute to this KTP.

A large number of exotic vines and scramblers have become established in New South Wales. Exotic vines and scramblers have significant adverse effects on biodiversity. They typically smother native vegetation and seedlings as well as prevent recruitment, especially in riparian areas. The proposed works involves disturbance that can lead to the establishment of exotic vines and scramblers. During the site survey, no exotic vines or scramblers were identified within the study area. As part of the mitigation measures, it has been recommended that construction machinery will be cleaned prior to entering and exiting work sites, and regular targeted control of weeds would be undertaken to reduce the risk of exotic vines and scramblers being introduced. With the implementation of this measure, the proposal is unlikely to contribute to this KTP.

Tree hollows are cavities form in the trunk or branches of a living or dead tree. Hollows are usually more characteristic of older, mature to over mature trees. Larger, older trees provide a greater density of hollows per tree. As such, large old hollow-bearing trees are relatively more valuable to hollow-using fauna than younger hollow-bearing trees. Many vertebrates are known to select hollows with specific characteristics, indicating that suitable hollows represent a fraction of the total hollow resource. The proposed works would result in the removal of up to 58 HBTs. As part of the mitigation measures, it has been recommended that an ecologist will be onsite to undertake a pre-clearance survey and a clearing survey whilst the tree/s are being removed to reduce the risk of fauna being displaced or injured. With the implementation of this measure, the proposal is unlikely to contribute to this KTP.

Conclusion

The impacts of the proposal on the assessed threatened species and ecological community listed under the FM Act are considered to be manageable. A significant impact is considered unlikely based on the following conclusions:

1. The amount of habitat to be removed or disturbed by the proposal is relatively small in the local context.
2. No fragmentation or isolation of habitat would occur.
3. No substantial contribution to any key threatening process would be expected.

APPENDIX N SOIL ASSESSMENT

SOIL SURVEY REPORT

PROPOSED WALLA WALLA SOLAR FARM

OCTOBER 2019

DM McMahon Pty Ltd
6 Jones St (PO Box 6118)
East Wagga Wagga NSW 2650
t (02) **6931 0510** **www.dmmcmahon.com.au**

SOIL SURVEY REPORT

PROPOSED WALLA WALLA SOLAR FARM

October 2019

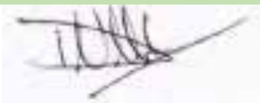
Project brief

At the request of Erwin Budde of NGH Environmental Pty Ltd, soil sampling, analysis and reporting was carried out to assess the site in April 2019 for a proposed solar farm. The document provides information about the site and soil conditions from field observations and laboratory analysis.

Site identification

Address: 161 & 116 Schneiders Road, Walla Walla NSW 2659.
Real property description: Lot 1 (DP 1069452), Lot 3 (DP 253113) & Lots 16, 17, 20, 21, 87, 88, 89, 108, 109 & 118 (DP 753735).
Centre co-ordinate: 497025E 6044089N MGA GDA z55
Property size: (investigated area) 593 ha approximately
Owner: Danny Phegan & Andrew Williams
Local Council Area: Great Hume Shire Council
Present use: Broadacre Agriculture
Development Application Reference: N/A
Report identification: 5550

Certification

Name	Signed	Date	Revision Number
David McMahon CEnvP BAppSc SA GradDip WRM MEnvMgmt		4/10/19	01

Contents

List of Figures

List of Tables

Attachments

DM McMahon Pty Ltd 6 Jones St (PO Box 6118) Wagga Wagga NSW 2650
t (02) **6931 0510** **www.dmmcmahon.com.au**

1.0 Introduction

The report presents the results of a soil survey carried out by DM McMahon Pty Ltd (McMahon) for the proposed Walla Walla Solar Farm near Walla Walla, NSW.

The soil and land survey were commissioned by Erwin Budde of NGH Environmental Pty Ltd and was undertaken in general accordance with the provided scope of works as can be seen in **Section 3**. Zach Bradley and James Halse of McMahon conducted a soil survey on 3 April 2019 using standard soil surveying techniques. The survey was carried out utilising a coring rig to excavate the soil profile to a depth of approximately 1.5 metres. Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification (ASC) (Isbell, 1996). Density of investigation boreholes was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning.

2.0 Site characteristics

A desktop review and investigation of the topography, hydrology, soil, lithology, geology and hydrogeology of the site has been undertaken and are as follows.

2.1 Topography

The site is located over the Walbundrie and Howlong 1:50,000 Topographic Maps (Sheets 8226-N & 8226-S respectively) at an elevation range of approximately 205m to 225m AHD. The landform of the site consists of extremely low relief and shallow alluvial stream channels forming an alluvial plain. One large open drainage known as Back Creek, runs through the site from east to north west. Smaller open depressions and drainage lines feed into the creek from both sides. Back Creek runs into the moderately deep and partly perennial Billabong Creek which lies ~7km north of the site.

2.2 Vegetation

The site is currently used for broad acre agriculture, predominantly grazing and winter cropping. At the time of the soil survey, approximately half of the site was stubble as a result of last year's winter cropping season, with the remaining half dominated by lower lying areas consisting of dry pasture being grazed by cattle. Some broadleaf weed species such as thistles were present on site but were not prevalent. There are established eucalypt trees scattered throughout the property, mostly in clumps and along the drainages, depressions or property boundaries. A more detailed assessment of vegetation present can be seen in the NGH Environmental Scoping Report for the site.

2.3 Weather

The mean rainfall for the Albury Airport AWS weather station (35km away) is approximately 614.6 mm per annum. The wettest months are July, August and October; however, the rainfall is spread relatively evenly throughout the year. The mean maximum temperatures range from 13.2 ºC in July to 32.5 ºC in January and mean minimum temperatures range from 3.1 ºC in July to 16.7 ºC in February. Historical records retrieved from the Albury Airport AWS 072160 weather station (Bureau of Meteorology, 2019).

2.4 Hydrology

The site is located within the Murray River catchment. The large open drainage known as Back Creek runs through the property from the eastern border and exits via the north western site corner. Back Creek is fed by both Middle Creek and Mountain Dam Creek. Middle Creek, fed by Snake

Gully and Hermitage Creek, runs into the site from the south and drains into Back Creek in the center of the property. The confluence of Billabong Creek and Back Creek is approximately 7.4km to the north northwest of the site. Upwards of 12 farm dams are present across the site, holding varying volumes of water, in varying condition. Many man-made drains have been formed in the lower lying areas of the property, designed to shed water to the drainages, assumed to abate water logging in the paddocks.

2.5 Soil & landform

The site lies within the mapping units **Va14** & **Va17** from the Digital Atlas of Australian Soils (CSIRO, 1991).

"Va14"

"Plains of hard alkaline and neutral yellow mottled soils (Dy3.43 and Dy3.42). Associated are various earths (Gn2.2 and Gn2.9) with other undescribed soils. Data are limited. Occurs on sheet(s): 3"

"Va17"

"Flat to gently undulating country with some swamps and broken by an occasional low gravelly or stony ridge or hillock: chief soils are hard alkaline yellow mottled soils (Dy3.43) and (Dr2.33), both containing ironstone gravel and sometimes forming soil complexes. Associated are: ridges and hillocks of (Dr2.32, Dr2.42) and (Um4.1) soils similar to unit Qc3; small flat areas of (Dr2.23); and various undescribed soils in local situations, e.g. subjacent to swamps and on stream terraces. Data are limited. Occurs on sheet(s): 3"

2.6 Geology & lithology

The site geology forms part of the broader Shepparton formation with lithology dominated by Cainozoic alluvium deposits of unconsolidated to poorly consolidated mottled variegated clays and silty clays. This forms the fluvio-lacustrine, floodplain, channel and levee environments found across the site. A deposit of siluro-devonian acid volcanics exists in the very centre of the site running across both sides of Back Creek, this deposit is defined to an area of less than 1km^2.

2.7 Hydrogeology

From the Geoscience Australia hydrogeology dataset, the groundwater beneath the site is described as fractured or fissured, extensive aquifers of low to moderate productivity over the entire extent of the site.

3.0 Investigation scope of works

The specifications for the site investigation and soil survey are as follows, **Table 1**:

Table 1: *Scope of works*

Item	Description	Description
1.	Where available, review provided plans and other general related documents to gain a comprehensive understanding of the proposed project.	-
2.	Undertake a desktop study of local landform, geological, lithological & hydrogeological conditions.	See **Section 2.0**
3.	Conduct Dial Before You Dig search.	-
4.	Carry out field investigations by reference to Guidelines for Surveying Soil and Land Resources (2008) & AS1726:1993 Geotechnical Site Investigations.	30 boreholes in total. Samples of topsoils - A (A1, A2); and subsoils - B (B1, B2) and C horizons were taken when present to adequately classify soils as per the Australian Soil Classification (ASC).
5.	Analyse soils in situ and at NATA accredited laboratory to AS/RMS methods.	10 x Representative samples for topsoil analysis – pH, EC, nutrient and cation status. 12 x representative samples for subsoil analysis – pH, EC, dispersion.
6.	Generate laboratory reports and review results.	-
7.	Compile results in report detailing methodology, desktop study, physical conditions, field work results, test locations, bore logs, in-situ test results, laboratory results and discussion.	-
8.	Recommendations for erosion control and prevention measures and management recommendations for earthworks.	-

4.0 Results

4.1 Field survey

A soil survey was conducted on 3 April 2019 using standard soil surveying techniques, a map of the development site boundary and investigation borehole locations can be seen as follows, **Figure 1**.

Figure 1: *Soil survey investigation borehole locations*

Sampling and classification of in situ soils was carried out as per the Australian Soil and Land Survey Field Handbook (2009) and The Australian Soil Classification, (Isbell, 1996). Density of investigation boreholes was determined via Guidelines for Surveying Soil and Land Resources (2008) where selection of a 'Moderately High (Detailed)' intensity level was deemed appropriate for satisfying the objectives for detailed project planning. Soils encountered were typical of the locale, generally falling into reconnaissance survey classes. Slight variations in profiles exist due to remnant parent formations, drainage plains and the complex soil sequences that are associated with such. Soil moisture contents varied between soil types but were generally found to be moderately moist in the topsoil and usually drier with depth. Free groundwater was not encountered to the investigated depth.

4.2 Typical soil profiles

Soils can be classified into a typical soil profile across the site as per the Australian Soil Classification (ASC) system (Isbell, 1996). Representative photographs from profiles examined on site can be seen below with a brief description of the profile characteristics. All soil boreholes investigated were located on managed agricultural lands. Field soil log sheets can be seen attached. Description of the typical soil type encountered; Chromosols can be seen as follows.

4.2.1 Chromosols

Chromosols have a strong texture contrast between A and B horizons. There is a clear or abrupt textural B horizon in which the upper portion of the horizon (0.2m) is not strongly acid and not sodic. These soils are the most commonly encountered soils under agricultural use in Australia.

Topsoil

Brown fine sandy clay loams, sandy clay loams and loams, granular. pH (1:5 soil/water) 5.4 – 6.6 in the A horizon; to 10-20cm depth. Pronounced A2 horizon on the lower lying areas. Clear boundary to-

Subsoils

Moderately massive structure across the majority of site and granular in the lower lying areas along Back Creek. Hues vary from yellowish-brown to yellowish-red in B and C horizon (where encountered) with significant mottling on alluvial floodplain on the east extent of the site. Light to medium clays, silty and/or sandy clays and silty loams in B horizon and C horizon.

4.3 Laboratory analysis

10 representative topsoil samples were obtained and analysed at a NATA accredited laboratory for the establishment of baseline soil data that may be referred to and used in preparation of a site decommissioning plan. Laboratory COA can be found in the Attachments and topsoil soil parameters can be seen summarised in **Table 2**. 12 subsoil samples were also analysed for pH and EC, and tested for dispersion, **Table 3**.

4.3.1 Topsoil analysis

4.3.1.1 pH & Electrical Conductivity

Topsoil pH (1:5 soil/water) ranged from 5.4 – 6.6 and were on average ‘Moderately acid’. However, topsoils could also be classed as ‘Neutral’ (7.3-6.6); ‘Slightly acid’ (6.5-6.1); ‘Moderately acid’ (6.0-5.6); or ‘Strongly acid’ (5.5-5.1) (Bruce & Rayment, 1982). Electrical Conductivity (EC) ranged from 0.06 to 0.20 dS/m and therefore the salinity rating was ‘low’ to ‘very low’ (Agriculture Victoria, 2011).

4.3.1.2 Cation Exchange Capacity, Exchangeable Sodium Percentage & Dispersion

Cation Exchange Capacity (CEC) ranges from 4.8 to 11.2 cmol (+)/kg. CEC of the soils is rated by Hazelton and Murphy (2007), as ‘low’ (6 – 12) and ‘very low’ (<6). Exchangeable Sodium Percentage (ESP) ranges from 0.57% to 6.5%. Soils are classified as ‘non-sodic’ when the ESP is <6%; and may be sodic if >6% (Agriculture Victoria, 2011).

4.3.1.3 Colwell Phosphorus and Phosphorus Buffering Index

Colwell P (plant available phosphorus) ranges from 28 to 61mg/kg, which is classed as ‘very high’ (Hazelton and Murphy, 2007). Phosphorus Buffering Index (PBI) ranged from 45 to 100 and can be classed as ‘low’ (71-140) to ‘very low’ (36-70), (Agriculture Victoria, 2011).

4.3.1.4 Calcium: Magnesium Ratio

Ca:Mg ratio ideally should be at least 2:1. Higher calcium contents are acceptable however higher magnesium content may result in soil dispersion (Agriculture Victoria, 2011). Ca:Mg determined for topsoils returned results ranging from 2.0 – 11.0.

4.3.1.5 Soil infiltration rates and water holding capacity

Water holding capacity is variable across the site with topsoils determined as moderate to high based on available water by percentage (20 - 28%) and moderate permanent wilting point (~16%). Water holding capacity for subsoils is lower due to a higher clay content which has a lower available water percentage (12-13%) and higher permanent wilting point (25-34%), (Hazleton & Murphy 2007).

Topsoil infiltration based on texture and degree of structure for loam and clay loams with evident peds is inferred to be around 50-90mm/h. This is given a moderate to rapid rating for saturated hydraulic conductivity with rare and occasional runoff (Hazleton & Murphy 2007). Infiltration in subsoils is considered to be very slow with a permeability of less than 5mm per hour. Subsoils are liable to waterlogging where there is a limited topsoil horizon due to the very slow infiltration rates (Hunt & Gilkes 1992).

5.0 Summary of test results

Please see next page.

Table 2: *Topsoil - Results of laboratory testing*

Parameter	UnitS	Sample Identification									
		28, 29	27, 30	20, 21, 22, 23, 24, 25, 26	17, 18, 19	14	13, 15, 16	8, 10, 12	7, 9	3, 4, 5	1, 2, 6, 11
pH (1:5 Water)		5.7	5.7	5.6	5.5	6.1	5.4	6.2	6.4	6.6	5.8
pH (1:5 CaCl2)		5.1	5.1	4.7	5	5.5	4.6	5.4	5.7	5.9	4.9
Electrical Conductivity	dS/m	0.2	0.14	0.13	0.2	0.14	0.11	0.11	0.08	0.07	0.06
Chloride	mg/kg	63	10	25	13	17	<10	<10	<10	<10	<10
Nitrate Nitrogen	mg/kg	32	16	24	41	36	30	29	19	11	11
Ammonium Nitrogen	mg/kg	4	3	3	6	3	5	7	3	2	2
Phosphorus (Colwell)	mg/kg	31	34	30	32	28	35	54	49	61	21
PBI		59	45	100	67	66	79	64	68	53	63
Sulphur (KCl40)	mg/kg	36	37	23	58	7	11	5	5	4	5
CEC	cmol(+)/kg	5.8	5.1	7.7	5.6	11.2	5	6.8	6.5	4.8	3.9
Calcium (Amm-acet.)	cmol(+)/kg	4.1	3.7	4.2	4.1	8.3	2.8	4.7	5	4.1	2.6
Magnesium (Amm-acet.)	cmol(+)/kg	0.5	0.5	2.1	0.7	1.9	0.8	1.1	0.9	0.4	0.7
Sodium (Amm-acet.)	cmol(+)/kg	0.24	0.09	0.5	0.11	0.1	0.03	0.12	0.12	<0.02	0.09
Potassium (Amm-acet.)	cmol(+)/kg	0.24	0.8	0.72	0.74	0.89	1.1	0.88	0.51	0.34	0.5
Available Potassium	mg/kg	360	310	280	290	350	420	350	200	130	200
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	0.2	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
Aluminium % Cations	%	<1.0	<1.0	2.3	<1.0	<1.0	3.8	<1.0	<1.0	<1.0	<1.0
Calcium % Cations	%	71	74	54	73	74	57	69	77	85	66
Magnesium % Cations	%	9.3	9.1	28	12	17	17	16	13	7.5	18
Sodium % Cations (ESP)	%	4.1	1.7	6.5	2	0.85	0.57	1.8	1.9	<1.00	2.3
Potassium % Cations	%	16	16	9.3	13	8	22	13	7.8	7	13
Cal/Mag Ratio		7.6	8	2	6	4.4	3.4	4.3	5.9	11	3.6

Table 3: *Subsoil - Results of laboratory testing*

Pit/Sample	Horizon	pH (1:5 soil/water)	Electrical Conductivity	Dispersion+
Units	**-**	**-**	**µS/cm**	**-**
2/2	A2	6.4	0.04	-
2/3	B	6.0	0.08	*
4/2	A2	5.8	0.07	*
6/3	B1	6.7	0.07	P
7/3	B	7.6	0.15	P
13/2	B	5.6	0.05	*
16/2	B	7.2	0.06	*
17/2	A2	6.9	0.08	P
18/2	B1	7.2	0.06	*
20/2	B1	6.2	0.10	*
21/2	B1	7.7	0.07	C
29/2	B	7.5	0.14	P

+*Dispersion testing results were rated N, P or C being Nil, Partial or Complete dispersion.*

* *Denotes slaking but no dispersion.*

6.0 Comments and recommendations

The discussion and recommendations provided below are based on field observations and testing at discrete locations.

6.1 Potential limitations

Potential landscape limitations have been summarised below, **Table 4**.

Table 4: *Potential landscape limitation assessment.*

Soil Type	Erosion Hazard	Salinity Risk	Acid Soil	Waterlogging Risk	Acid Sulphate Soils	Infrastructure
Chromosol	LOW	LOW	YES	MODERATE	NO	LOW

As follows is the soil landscape map (eSpade, 2019) which has been generally validated by the soil survey through laboratory and field techniques. As such, management practices can be grouped into management classes of Australian Soil Classification (ASC) units with Chromosols being represented across the Va17 soil type, **Figure 2**. This report identifies management practices for ASC units in **Section 6.5** below.

Figure 2: *Digital Atlas of Australian Soils mapping units with development site boundary overlay (**Va14**, **My10**, **Va17**, and **Pb4**)*

6.2 Erosion control

To mitigate the occurrence of erosion the following primary principles should be adhered to, particularly throughout the construction period of the project. Best Management Practices (BMPs) should be employed where applicable to further reduce the risk of potential erosion and sediment control.

- Integrate project design with any site constraints.
- Preserve and stabilise drainageways.
- Minimise the extent and duration of disturbance.
- Control stormwater flows onto, through and from the site in stable drainage structures.
- Install perimeter controls.
- Stabilise disturbed areas promptly.
- Protect steep slopes.
- Employ the use of sediment control measures to prevent off and on-site damage.
- Protect inlets, storm drain outlets and culverts.
- Provide access and general construction controls.
- Inspect and maintain sediment and erosion control measures regularly.

The risk of erosion on site due to construction activities is considered low due to the low relief and generally low salinity and sodicity of topsoils and subsoils. Excavation of subsoils should be limited where possible, and excavated subsoils should be stockpiled and contained to avoid potential dispersion and sediment transfer. Ground cover around the structures should be maintained where possible. Maintenance of ground cover will also aid in the prevention of topsoil losses from wind erosion. Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2A & 2C (DECC, 2008) should be consulted further in the development of an Erosion and Sediment Control Plan (ESCP).

6.3 Acid sulphate soils

Acid sulphate soils is the common name given to naturally occurring soils containing iron sulphides. Exposure of the sulphides present in these soils to oxygen from drainage or excavation will lead to the generation of sulphuric acid. Field pH of these soils in their undisturbed state is generally pH 4 or less.

Landscape characteristics such as; the dominance of mangroves, reeds, rushes and other marine/estuarine or swamp-tolerant vegetation, low lying areas, back swamps or scalded areas of coastal estuaries and floodplains and sulphurous smell following rain after prolonged dry periods (Stone *et al*, 1998) after soil disturbance were not observed. There was no evidence of a jarositic horizon or jarosite precipitates or coatings on any root channels or cracks in the soil.

From the soil survey conducted, it has been assessed that acid sulphate soils are not present on site.

6.4 Potential impacts on salinity, groundwater resources and hydrology

Current operational procedures include dryland cropping and grazing. Associated water features across the investigated area include at least 12 dams and various open drainage channels and depressions. There is one registered groundwater bore on site (Lot 1) and no further registered bores within 500 metres of the site boundary. Most of the paddocks on the higher ground had maintained ground cover or stubble at the time of the investigation. Given the majority of soils on site are classified as ‘non-sodic’ and are of low salinity, the risk of salt build-up in discharge areas is low. However, changing direction of surface waters and any run-on should be avoided as local changes in the water regime are likely to mobilise any salts stores, however low, in the soil. Deep rooted vegetation should be maintained where present and established where absent, ground clearing should be minimised.

6.5 Soil characteristics and management responses

6.5.1 Chromosols

Table 5: *Chromosol characteristics and management responses.*

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Soil surface		
These soils generally have a moderate to weak structure in the surface with a firm to hard setting surface condition.	A firm to hard setting surface will generally have poor initial infiltration resulting in a large proportion of water running off causing erosion.	Surface infiltration rate can be increased through the incorporation of composted organic matter and by maintaining vegetative cover.
	A hard setting surface will also cause poor germination and seedling emergence.	Soil structure and moisture holding capacity can be improved through the incorporation of composted organic matter leading to better seedling establishment.
	A sandy to loamy surface with poor structure can have low soil strength causing trafficability issues.	Trafficability of these soils may be difficult when wet, however the use of gravel road surfaces may improve site access.
	If sandy to loamy surface soil with poor structure and low soil strength is overworked or excessively trafficked there is a high potential to generate dust.	Limit traffic and do not disturb unless necessary to avoid destruction of the limited soil structure. Construct gravel roads on site and limit access off these roads. Consider the use of stabilisation products.
Expansive clays		
These soils contain little to no expansive clays.	-	-
Clay subsoils		
These soils contain non-sodic, slightly acidic to slightly alkaline clay subsoils that may be mottled.	These soils have imperfect drainage and lower landscape positions and can stay wet for extended periods of time. Subsoil permeability is moderate.	Subsoil material is unsuitable for use on the soil surface and should be adequately covered with topsoil. Appropriate drainage design and materials (i.e. sand and gravel) can improve site access for construction. Depending on subsoil structure, plant roots are generally able to extend into the subsoil material without restriction. Gypsum additions can be used to assist structure improvement where required.

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Dispersion		
These soils are generally non-dispersive;	Although not generally dispersive, these soils are still susceptible to rill, sheet and stream bank erosion.	Maintain cover to reduce sheet and rill erosion. Stream bank erosion managed by maintaining vegetative cover and encouraging plants with fibrous root systems. Do not concentrate water flow unless using appropriate erosion and sediment control treatments. Erosion and sediment controls may need to be installed to manage drainage, erosion and prevent movement of sediment off-site.
Salinity		
These soils can have high salt levels (depending on parent material and landscape practices) particularly on lower slopes.	High salt levels will affect plant growth and will also impact water quality if leached or washed off.	If irrigating salty soils, maintain a leaching profile to reduce salt levels (salinity management handbook (DERM 2011) contains thresholds for different plants). Treat salty soils as dispersive soils, even if field testing results are negative, because salt can mask dispersion.
	Salt can cause scalding, erosion and damage to infrastructure.	Discharge salinity expressions can be managed by reducing water inputs and by increasing soil water use at the site or upslope if possible. Soil amelioration with gypsum and planting salt tolerant species may assist scald areas.
Fertility		
These soils generally have a low to moderate fertility.	The sandy surface and pale subsurface layers (where present) generally mean that nutrient content is low in these soils, as is their ability to hold onto nutrients.	Fertiliser additions may improve plant growth, particularly nitrogen, phosphorus, and potassium. To limit leaching/loss of nutrients, specific fertiliser rates should be divided up into regular smaller applications during the growing season, rather than one single application. Increasing organic matter content with composted organics will improve the fertility and assist nutrient retention in these soils.

Soil property	Behaviour of soil to activity or environment	Management responses/measures
Revegetation		
These soils are poorly to imperfectly drained with low to moderate fertility, highly alkaline subsoils and low plant available water holding capacity.	Plant species need be selected that are adapted to these conditions.	Addition of gypsum may be required to alleviate dispersion risk. Increasing organic matter content with composted organics will improve fertility, assist nutrient retention and improve moisture holding capacity of these soils. Relieve any compaction present and ensure adequate fertility for quick establishment. These soils will require frequent, low volume watering due to the dense subsoils. Protect surface with mulch material to reduce raindrop induced crusted or hard setting surface. Fertiliser additions should be divided up into regular smaller applications during the growing season to limit leaching of nutrients. Dense subsoil material significantly restricts plant root extension into the subsoil. Stabilisation and revegetation targets and timeframes should be in accordance with IECA (2008) guidelines.
Soil handling		
Some of these soils have very salty and/ or dispersive subsoils and potentially dusty topsoil.	The objective of soil handling is to minimise off site impacts and maximise the productive capacity of the soil on site consistent with the intended use.	Topsoil stripping should maximise available reserves and should avoid mixing with alkaline, salty and/or sodic subsoils – a simple survey of the site is recommended. Topsoil and subsoil stockpiles should be kept separate. Reinstate soil in the order they were removed (i.e. deeper subsoil below upper subsoil). Final placement of dispersive materials should be covered with adequate topsoil material to protect from erosion. Installation of erosion and sediment control structures may be required where soil is exposed. Trafficability of these soils may be difficult when wet, the use of gravel road surfaces may improve site access. Minimise the handling of topsoil material and ensure traffic is concentrated on constructed road surfaces.

7.0 Notes relating to results

Groundwater

No free groundwater was encountered during the investigation. A groundwater table or seepage may be present at other times and fluctuations in groundwater levels and seepage could occur due to rainfall, changes in temperature and other factors.

Bore hole / test borehole logging

The information supplied in the log sheets is based on a visual and tactile assessment with consideration given to field conditions at the time of testing. The log sheets can include inferred data based on the experience of the consultant as well as factual data from in situ testing.

8.0 Disclaimer

The information contained in this report has been extracted from field and laboratory sources believed to be reliable and accurate. DM McMahon Pty Ltd will not assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

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10.0 Attachments

Attachment	Details
A. Log sheets	6 pages
B. Laboratory reports	20 pages

McMahon EARTH SCIENCE

DOCUMENT ATTACHMENTS

REPORT 2019

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Attachment A : *Log sheets*

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5550
Project:	Walla Walla Solar Farm
Site:	Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
1	1/1	498723 E	1	0.0	0.20	A1	-	+B	5YR 3/3	LOAM	T	4	-	-	GRANULAR	-	-	-	
	1/2	6043939 N	2	0.20	0.40	A2	C	WB	10YR 10/3	ZL	D	3	-	-	GRANULAR	-	-	-	
	1/3		3	0.40	0.50	B1	C	-B	10YR 10/4	MC	D	5	2	R	MASS	-	-	-	$CaCO_3$
	1/4		4	0.50	1.50	B2	D	BY	10YR 4/4	HC	D	6	-	-	MASS				White deposits
2	2/1	498439 E	1	0.00	0.10	A1	-	+B	5YR 3/3	LOAM	T	3	-	-	GRANULAR	-	-	-	
	2/2	6044232 N	2	0.10	0.30	A2	C	WB	10YR 10/3	ZL	D	5	-	-	GRANULAR	-	-	-	
	2/3		3	0.30	1.50	B	C	BY	10YR 4/4	MC	D	6	2	R	MASS	-	-	-	
3	3/1	498872 E	1	0.00	0.20	A1	-	+B	5YR 3/3	FSCL	T	3	-	-	GRANULAR	-	-	-	
	3/2	6044366 N	2	0.20	0.40	A2	C	B	7.5YR 4/2	SCL	D	3	-	-	GRANULAR	-	-	-	
	3/3		3	0.40	0.60	B	C	YB	10YR 5/4	LMC	D	5	2	R, O	MASS	-	-	-	$CaCO_3$
	3/4		4	0.60	1.50	C	D	BY	10YR 4/4	MC	D	6	2	R, D	MASS	-	-	-	
4	4/1	498307 E	1	0.00	0.20	A1	C	+B	5YR 3/3	FSCL	T	5	-	-	GRANULAR	-	-	-	
	4/2	6044565 N	2	0.20	0.25	A2	C	B	7.5YR 4/2	SCL	D	3	-	-	GRANULAR	-	-	-	
	4/3		3	0.25	1.50	B	D	BY	10YR 4/4	MC	D	6	2	R, O	MASS	-	-	-	
5	5/1	498214 E	1	0.00	0.20	A1	-	+B	5YR 3/3	FSCL	T	5	-	-	GRANULAR	-	-	-	
	5/2	6044120 N	2	0.20	0.25	A2	C	B	7.5YR 4/2	ZL	D	3	-	-	GRANULAR	-	-	-	
	5/3		3	0.25	1.00	B1	C	YB	10YR 5/4	LMC	D	6	2	R, D	MASS	-	-	-	
	5/4		4	1.00	1.50	B2	D	BY	10YR 4/4	MC	T	6	-	-	MASS	-	-	-	

SOIL SURVEY FIELD SHEET

McMahon EARTH SCIENCE

Job No:	5550
Project:	Walla Walla Solar Farm
Site:	Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
6	6/1	497904 E	1	0.0	0.20	A1	-	+B	5YR 3/3	FSCL	T	5	-	-	GRANULAR	-	-	-	
	6/2	6044359 N	2	0.20	0.40	A2	C	W	7.5YR 5/4	ZL	D	3	-	-	GRANULAR	-	-	-	
	6/3		3	0.40	1.20	B1	C	YB	10YR 5/4	LMC	D	6	2	R, D	MASS	-	-	-	
	6/4		4	1.20	1.50	B2	D	BY	10YR 4/4	MC	T	6	-	-	MASS	-	-	-	
7	7/1	497704 E	1	0.00	0.20	A1	-	+B	5YR 3/3	FSCL	T	3	-	-	GRANULAR	-	-	-	
	7/2	6044523 N	2	0.20	0.30	A2	D	B	7.5YR 4/2	SCL	D	3	-	-	GRANULAR	-	-	-	
	7/3		3	0.30	1.10	B	D	YB	10YR 5/4	LMC	D	5	2	R	MASS	-	-	-	
	7/4		4	1.10	1.50	C	D	BY	10YR 4/4	LMC	D	5	-	-	MASS	-	-	-	
8	8/1	497706 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	T	3	-	-	GRANULAR	-	-	-	
	8/2	6044262 N	2	0.20	1.50	B	C	YB	10YR 5/4	HC	T	6	2	R	MASS	-	-	-	
9	9/1	497391 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	T	3	-	-	GRANULAR	-	-	-	
	9/2	6044438 N	2	0.20	0.80	B	C	RB	7.5YR 4/4	MC	D	6	2	R, O	MASS	-	-	-	
	9/3		3	0.80	1.50	C	D	YR	10YR 5/6	HC	D	6	2	R, O	MASS	-	-	-	
10	10/1	497095 E	1	0.00	0.20	A	-	+B	5YR 3/3	FSCL	D	3	-	-	GRANULAR	-	-	-	
	10/2	6044263 N	2	0.20	1.00	B	C	B	7.5YR 4/2	MC	D	6	-	-	GRANULAR	-	-	-	
	10/3		3	1.00	1.50	C	D	BY	10YR 4/4	HC	D	6	2	R, Y	MASS	-	-	-	

SOIL SURVEY FIELD SHEET

Job No: 5550
Project: Walla Walla Solar Farm
Site: Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
11	11/1	496921 E	1	0.0	0.15	A1	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	11/2	6044577 N	2	0.15	0.30	A2	C	--BW	7.5YR 4/3	Z/ZL	D	3	-	-	GRANULAR	-	-	-	
	11/3		3	0.30	1.50	B	D	-B	10YR 4/3	MC	D	6	2	O	MASS	-	-	-	
12	12/1	496530 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	12/2	6044688 N	2	0.20	0.30	B1	D	-B	10YR 4/3	SCL	D	4	-	-	GRANULAR	-	-	-	
	12/3		3	0.30	1.50	B2	D	YR	10YR 5/6	HC	D	6	2	R, O	MASS	-	-	-	
13	13/1	495075 E	1	0.00	0.10	A	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	13/2	6045012 N	2	0.10	0.30	B	C	RYB	5YR 3/4	SCL	D	4	-	-	GRANULAR	-	-	-	
	13/3		3	0.30	1.50	C	D	YR	10YR 5/6	MC	D	6	2	R	MASS	-	-	-	
14	14/1	495408 E	1	0.00	0.15	A	-	B	7.5YR 4/2	FSCL	D	4	-	-	GRANULAR	-	-	-	
	14/2	6044612 N	2	0.15	0.30	B	C	YB	10YR 5/4	LOAM	D	5	-	-	GRANULAR	-	-	-	
	14/3		3	0.30	1.50	C	D	+B	5YR 3/3	MC	D	6	2	R	MASS	-	-	-	$CaCO_3$
15	15/1	495052 E	1	0.00	0.20	A	-	RB	7.5YR 4/4	SCL	D	4	-	-	GRANULAR	-	-	-	
	15/2	6044357 N	2	0.20	1.50	B	D	RYB	5YR 3/4	MC	D	5	2	R	MASS	-	-	-	
16	16/1	495250 E	1	0.00	0.30	A	-	RB	7.5YR 4/4	FSCL	D	3	-	-	GRANULAR	-	-	-	
	16/2	6043926 N	2	0.30	1.50	B	D	YR	10YR 5/6	MC	D	5	-	-	MASS	-	-	-	

McMahon EARTH SCIENCE

SOIL SURVEY FIELD SHEET

Job No:	5550
Project:	Walla Walla Solar Farm
Site:	Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
17	17/1	495555 E	1	0.0	0.20	A1	-	-B	10YR 4/3	FSCL	D	3	-	-	GRANULAR	-	-	-	
	17/2	6044596 N	2	0.20	0.30	A2	C	--BW	7.5YR 4/3	ZL	D	3	-	-	GRANULAR	-	-	-	
	17/3		3	0.30	1.50	B	D	YB	10YR 5/4	HC	D	6	-	-	MASS	-	-	-	
18	18/1	495547 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	D	4	-	-	GRANULAR	-	-	-	
	18/2	6044524 N	2	0.20	0.30	B1	C	RYB	5YR 3/4	SCL	D	4	-	-	GRANULAR	-	-	-	
	18/3		3	0.30	1.30	B2	D	YR	10YR 5/6	MC	D	5	-	-	MASS	-	-	-	
	18/4		4	1.30	1.50	C	D	Y	10YR 4/4	HC	D	6	-	-	MASS				
19	19/1	495609 E	1	0.00	0.20	A1	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	19/2	6044032 N	2	0.20	0.60	A2	C	BY	10YR 4/4	SCL	D	4	-	-	GRANULAR	-	-	-	
	19/3		3	0.60	1.50	B	D	YR	10YR 5/6	MC	D	5	2	R, Y, D	MASS	-	-	-	
20	20/1	496127 E	1	0.00	0.20	A	-	+B	5YR 3/3	FSCL	D	4	-	-	GRANULAR	-	-	-	
	20/2	6044135 N	2	0.20	1.00	B1	D	YB	10YR 5/4	MC	D	6	-	-	MASS	-	-	-	
	20/3		3	1.00	1.50	B2	D	GB	10YR 5/2	HC	T	6	2	O	MASS	-	-	-	
21	21/1	496024 E	1	0.00	0.20	A	-	+B	5YR 3/3	FSCL	T	4	-	-	GRANULAR	-	-	-	
	21/2	6043714 N	2	0.20	0.80	B1	D	+B	5YR 3/3	MC	D	6	2	R	MASS	-	-	-	$CaCO_3$
	21/3		3	0.80	1.50	B2	D	BY	10YR 4/4	HC	T	6	2	D	MASS	-	-	-	
22	22/1	496454 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	T	4	-	-	GRANULAR	-	-	-	
	22/2	6043689 N	2	0.20	0.80	B1	D	YB	10YR 5/4	MC	D	5	2	R	MASS	-	-	-	CaCO3
	22/3		3	0.80	1.50	B2	D	BY	10YR 4/4	HC	T	6	-	-	MASS	-	-	-	

SOIL SURVEY FIELD SHEET

Job No:	5550
Project:	Walla Walla Solar Farm
Site:	Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
23	23/1	496943 E	1	0.0	0.20	A	-	B	7.5YR 4/2	FSCL	T	3	2	O	GRANULAR	-	-	-	
	23/2	6043483 N	2	0.20	1.30	B1	D	YB	10YR 5/4	MC	D	6	2	R, D	MASS	-	-	-	
	23/3		3	1.30	1.50	B2	D	YB	10YR 5/4	HC	D	6	2	R	MASS	-	-	-	
24	24/1	497394 E	1	0.00	0.20	A	-	+B	5YR 3/3	FSCL	D	3	-	-	GRANULAR	-	-	-	
	24/2	6043782 N	2	0.20	1.30	B1	C	B	7.5YR 4/2	MC	D	6	2	O	MASS	-	-	-	
	24/3		3	1.30	1.50	B2	D	YB	10YR 5/4	HC	T	6	-	-	MASS	-	-	-	
25	25/1	497848 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	T	3	-	-	GRANULAR	-	-	-	
	25/2	6043562 N	2	0.20	0.60	B1	C	YB	10YR 5/4	MC	D	6	-	-	MASS	-	-	-	
	25/3		3	0.60	1.50	B2	D	BY	10YR 4/4	HC	D	6	2	D	MASS	-	-	-	
26	26/1	498246 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	26/2	6043717 N	2	0.20	0.90	B1	C	YB	10YR 5/4	MC	T	5	-	-	MASS	-	-	-	
	26/3		3	0.90	1.50	B2	D	BY	10YR 4/4	HC	T	5	2	O	MASS	-	-	-	
27	27/1	498090 E	1	0.00	0.10	A	-	B	7.5YR 4/2	FSCL	D	3	-	-	GRANULAR	-	-	-	
	27/2	6043127 N	2	0.10	0.20	B	C	YB	10YR 5/4	SCL	D	4	-	-	GRANULAR	-	-	-	
	27/3		3	0.20	1.50	C	D	Y	10YR 4/4	LMC	D	6	2	D	MASS	-	-	-	
28	28/1	498476 E	1	0.00	0.10	A	-	+B	5YR 3/3	FSCL	T	3	-	-	GRANULAR	-	-	-	
	28/2	6043303 N	2	0.10	0.20	B	C	-B	10YR 4/3	SCL	D	4	2	O	GRANULAR	-	-	-	
	28/3		3	0.20	1.50	C	D	Y	10YR 4/4	LMC	D	5	2	O	MASS	-	-	-	

Job No: 5550
Project: Walla Walla Solar Farm
Site: Walla Walla Solar Farm

Site Identity	Sample	Co-ordinates MGA GDA94 z55	Layer	Layer Top (m)	Layer Bottom (m)	Horizon	Boundary	Colour	Munsell Code	Texture	Moisture	Consistence	Mottles	Mottle Type	Structure	Coarse Fragments	Fragment Size (mm)	Fragment (%)	Comments
29	29/1	498776 E	1	0.0	0.20	A	-	+B	5YR 3/3	FSCL	T	3	-	-	GRANULAR	-	-	-	
	29/2	6043547 N	2	0.20	0.90	B	C	YB	10YR 5/4	MC	T	6	2	D	MASS	-	-	-	
	29/3		3	0.90	1.50	C	D	BY	10YR 4/4	LMC	D	6	2	O	MASS	-	-	-	
30	30/1	498687 E	1	0.00	0.20	A	-	B	7.5YR 4/2	FSCL	T	3	-	-	GRANULAR	-	-	-	
	30/2	6042996 N	2	0.20	1.00	B	C	BY	10YR 4/4	HC	D	6	-	-	MASS	-	-	-	
	30/3		3	1.00	1.30	C	D	Y	10YR 4/4	SC	D	6	Y	D	MASS	-	-	-	

Attachment B : *Laboratory reports*

Nutrient Advantage®

Nutrient Advantage Advice® — Nutrient Report

DM McMahon Pty Ltd
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date:	12/04/2019
Agent/Dealer:	
Advisor/Contact:	D M MCMAHON PTY LTD
Phone:	02 6931 0510
Purchase Order No:	WALLA WALLA

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018866	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 28,29	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
pH (1:5 Water)		5.7
pH (1:5 CaCl2)		5.1
Electrical Conductivity (1:5 water)	dS/m	0.20
Chloride	mg/kg	63
Nitrate Nitrogen	mg/kg	32
Ammonium Nitrogen	mg/kg	4
Phosphorus (Colwell)	mg/kg	31
Phosphorus Buffer Index		59
Sulphur (KCl40)	mg/kg	36
Cation Exch. Cap. (CEC)	cmol(+)/kg	5.8
Calcium (Amm-acet.)	cmol(+)/kg	4.1
Magnesium (Amm-acet.)	cmol(+)/kg	0.5
Sodium (Amm-acet.)	cmol(+)/kg	0.24
Potassium (Amm-acet.)	cmol(+)/kg	0.92
Available Potassium	mg/kg	360
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	71.0
Magnesium % of Cations	%	9.3
Sodium % of Cations (ESP)	%	4.10
Potassium % of Cations	%	16.00
Calcium/Magnesium Ratio		7.6

Analyses conducted by **Nutrient Advantage Laboratory Services**
8 South Road, Werribee VIC 3030
NATA Accreditation No: 11958
Tel: 1800 803 453
Certificate of Analysis is available upon request.
Email: lab.feedback@incitecpivot.com.au

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Nutrient Advantage Advice® Nutrient Report

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018866	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 28,29	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
* One or more components of this test are below their detection limit. The value used is indicative only.

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Nutrient Advantage Advice® — Nutrient Report

DM McMahon Pty Ltd
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WAGGA WAGGA
NSW 2650

Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018867
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 27 & 30
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		5.7
pH (1:5 CaCl2)		5.1
Electrical Conductivity (1:5 water)	dS/m	0.14
Chloride	mg/kg	10
Nitrate Nitrogen	mg/kg	16
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	34
Phosphorus Buffer Index		45
Sulphur (KCl40)	mg/kg	37
Cation Exch. Cap. (CEC)	cmol(+)/kg	5.1
Calcium (Amm-acet.)	cmol(+)/kg	3.7
Magnesium (Amm-acet.)	cmol(+)/kg	0.5
Sodium (Amm-acet.)	cmol(+)/kg	0.09
Potassium (Amm-acet.)	cmol(+)/kg	0.80
Available Potassium	mg/kg	310
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	74.0
Magnesium % of Cations	%	9.1
Sodium % of Cations (ESP)	%	1.70
Potassium % of Cations	%	16.00
Calcium/Magnesium Ratio		8.0

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018867	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 27 & 30	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Nutrient Advantage Advice® Nutrient Report

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WAGGA WAGGA
NSW 2650

Report Print Date:	12/04/2019
Agent/Dealer:	
Advisor/Contact:	D M MCMAHON PTY LTD
Phone:	02 6931 0510
Purchase Order No:	WALLA WALLA

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018868	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 20-26	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

Analyte / Assay	Units	Value
pH (1:5 Water)		5.6
pH (1:5 CaCl2)		4.7
Electrical Conductivity (1:5 water)	dS/m	0.13
Chloride	mg/kg	25
Nitrate Nitrogen	mg/kg	24
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	30
Phosphorus Buffer Index		100
Sulphur (KCl40)	mg/kg	23
Cation Exch. Cap. (CEC)	cmol(+)/kg	7.7
Calcium (Amm-acet.)	cmol(+)/kg	4.2
Magnesium (Amm-acet.)	cmol(+)/kg	2.1
Sodium (Amm-acet.)	cmol(+)/kg	0.50
Potassium (Amm-acet.)	cmol(+)/kg	0.72
Available Potassium	mg/kg	280
Aluminium (KCl)	cmol(+)/kg	0.2
Aluminium % of Cations	%	2.3
Calcium % of Cations	%	54.0
Magnesium % of Cations	%	28.0
Sodium % of Cations (ESP)	%	6.50
Potassium % of Cations	%	9.30
Calcium/Magnesium Ratio		2.0

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018868	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 20-26	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Nutrient Advantage Advice® Nutrient Report

DM McMahon Pty Ltd
PO BOX 6118
WAGGA WAGGA
NSW 2650

Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018869
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 17,18,19
Sample Depth (cm): 0 **To** 10
Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		5.5
pH (1:5 CaCl2)		5.0
Electrical Conductivity (1:5 water)	dS/m	0.20
Chloride	mg/kg	13
Nitrate Nitrogen	mg/kg	41
Ammonium Nitrogen	mg/kg	6
Phosphorus (Colwell)	mg/kg	32
Phosphorus Buffer Index		67
Sulphur (KCl40)	mg/kg	58
Cation Exch. Cap. (CEC)	cmol(+)/kg	5.6
Calcium (Amm-acet.)	cmol(+)/kg	4.1
Magnesium (Amm-acet.)	cmol(+)/kg	0.7
Sodium (Amm-acet.)	cmol(+)/kg	0.11
Potassium (Amm-acet.)	cmol(+)/kg	0.74
Available Potassium	mg/kg	290
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	73.0
Magnesium % of Cations	%	12.0
Sodium % of Cations (ESP)	%	2.00
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio		6.0

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018869	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 17,18,19	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
* One or more components of this test are below their detection limit. The value used is indicative only.

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Nutrient Advantage Advice® — Nutrient Report

DM McMahon Pty Ltd
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WAGGA WAGGA
NSW 2650

Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018870	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 14	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 15		

Analyte / Assay	Units	Value
pH (1:5 Water)		6.1
pH (1:5 CaCl2)		5.5
Electrical Conductivity (1:5 water)	dS/m	0.14
Chloride	mg/kg	17
Nitrate Nitrogen	mg/kg	36
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	28
Phosphorus Buffer Index		66
Sulphur (KCl40)	mg/kg	7
Cation Exch. Cap. (CEC)	cmol(+)/kg	11.2
Calcium (Amm-acet.)	cmol(+)/kg	8.3
Magnesium (Amm-acet.)	cmol(+)/kg	1.9
Sodium (Amm-acet.)	cmol(+)/kg	0.10
Potassium (Amm-acet.)	cmol(+)/kg	0.89
Available Potassium	mg/kg	350
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	74.0
Magnesium % of Cations	%	17.0
Sodium % of Cations (ESP)	%	0.85
Potassium % of Cations	%	8.00
Calcium/Magnesium Ratio		4.4

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018870	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 14	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 15		

The results reported pertain only to the sample submitted.
Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Nutrient Advantage Advice® — Nutrient Report

DM McMahon Pty Ltd
PO BOX 6118

WAGGA WAGGA
NSW 2650

Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018871
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 13,15,16
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		5.4
pH (1:5 CaCl2)		4.6
Electrical Conductivity (1:5 water)	dS/m	0.11
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	30
Ammonium Nitrogen	mg/kg	5
Phosphorus (Colwell)	mg/kg	35
Phosphorus Buffer Index		79
Sulphur (KCl40)	mg/kg	11
Cation Exch. Cap. (CEC)	cmol(+)/kg	5.0
Calcium (Amm-acet.)	cmol(+)/kg	2.8
Magnesium (Amm-acet.)	cmol(+)/kg	0.8
Sodium (Amm-acet.)	cmol(+)/kg	0.03
Potassium (Amm-acet.)	cmol(+)/kg	1.10
Available Potassium	mg/kg	420
Aluminium (KCl)	cmol(+)/kg	0.2
Aluminium % of Cations	%	3.8
Calcium % of Cations	%	57.0
Magnesium % of Cations	%	17.0
Sodium % of Cations (ESP)	%	0.57
Potassium % of Cations	%	22.00
Calcium/Magnesium Ratio		3.4

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8 South Road, Werribee VIC 3030
NATA Accreditation No: 11958
Tel: 1800 803 453
Certificate of Analysis is available upon request.
Email: lab.feedback@incitecpivot.com.au

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018871	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 13,15,16	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

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NSW 2650

Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018872
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 8,10,12
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.2
pH (1:5 CaCl2)		5.4
Electrical Conductivity (1:5 water)	dS/m	0.11
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	29
Ammonium Nitrogen	mg/kg	7
Phosphorus (Colwell)	mg/kg	54
Phosphorus Buffer Index		64
Sulphur (KCl40)	mg/kg	5
Cation Exch. Cap. (CEC)	cmol(+)/kg	6.8
Calcium (Amm-acet.)	cmol(+)/kg	4.7
Magnesium (Amm-acet.)	cmol(+)/kg	1.1
Sodium (Amm-acet.)	cmol(+)/kg	0.12
Potassium (Amm-acet.)	cmol(+)/kg	0.88
Available Potassium	mg/kg	350
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	69.0
Magnesium % of Cations	%	16.0
Sodium % of Cations (ESP)	%	1.80
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio		4.3

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018872	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 8,10,12	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

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Analyses performed on soil dried at 40 degrees Celsius and ground to <2mm (excluding moisture assay)
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Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018873
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 7,9
Sample Depth (cm): 0 **To** 10
Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.4
pH (1:5 CaCl2)		5.7
Electrical Conductivity (1:5 water)	dS/m	0.08
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	19
Ammonium Nitrogen	mg/kg	3
Phosphorus (Colwell)	mg/kg	49
Phosphorus Buffer Index		68
Sulphur (KCl40)	mg/kg	5
Cation Exch. Cap. (CEC)	cmol(+)/kg	6.5
Calcium (Amm-acet.)	cmol(+)/kg	5.0
Magnesium (Amm-acet.)	cmol(+)/kg	0.9
Sodium (Amm-acet.)	cmol(+)/kg	0.12
Potassium (Amm-acet.)	cmol(+)/kg	0.51
Available Potassium	mg/kg	200
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	77.0
Magnesium % of Cations	%	13.0
Sodium % of Cations (ESP)	%	1.90
Potassium % of Cations	%	7.80
Calcium/Magnesium Ratio		5.9

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018873	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 7,9	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018874
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 3,4,5
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		6.6
pH (1:5 CaCl2)		5.9
Electrical Conductivity (1:5 water)	dS/m	0.07
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	11
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	61
Phosphorus Buffer Index		53
Sulphur (KCl40)	mg/kg	4
Cation Exch. Cap. (CEC)	cmol(+)/kg	4.8
Calcium (Amm-acet.)	cmol(+)/kg	4.1
Magnesium (Amm-acet.)	cmol(+)/kg	0.4
Sodium (Amm-acet.)	cmol(+)/kg	<0.02
Potassium (Amm-acet.)	cmol(+)/kg	0.34
Available Potassium	mg/kg	130
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	85.0
Magnesium % of Cations	%	7.5
Sodium % of Cations (ESP)	%	<1.00
Potassium % of Cations	%	7.00
Calcium/Magnesium Ratio		11.0

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018874	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 3,4,5	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

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Report Print Date: 12/04/2019
Agent/Dealer:
Advisor/Contact: D M MCMAHON PTY LTD
Phone: 02 6931 0510
Purchase Order No: WALLA WALLA

Grower Name : D M MCMAHON PTY LTD
Sample No: 022018875
Paddock Name: 5550 WALLA WALLA
Sample Name: SAMPLES 1,2,6,11
Sample Depth (cm): 0 **To** 10

Nearest Town: WAGGA NORTH
Test Code: E11
Sample Type: Soil
Sampling Date: 11/04/2019

Analyte / Assay	Units	Value
pH (1:5 Water)		5.8
pH (1:5 CaCl2)		4.9
Electrical Conductivity (1:5 water)	dS/m	0.06
Chloride	mg/kg	<10
Nitrate Nitrogen	mg/kg	11
Ammonium Nitrogen	mg/kg	2
Phosphorus (Colwell)	mg/kg	21
Phosphorus Buffer Index		63
Sulphur (KCl40)	mg/kg	5
Cation Exch. Cap. (CEC)	cmol(+)/kg	3.9
Calcium (Amm-acet.)	cmol(+)/kg	2.6
Magnesium (Amm-acet.)	cmol(+)/kg	0.7
Sodium (Amm-acet.)	cmol(+)/kg	0.09
Potassium (Amm-acet.)	cmol(+)/kg	0.50
Available Potassium	mg/kg	200
Aluminium (KCl)	cmol(+)/kg	<0.1
Aluminium % of Cations	%	<1.0
Calcium % of Cations	%	66.0
Magnesium % of Cations	%	18.0
Sodium % of Cations (ESP)	%	2.30
Potassium % of Cations	%	13.00
Calcium/Magnesium Ratio		3.6

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Grower Name :	D M MCMAHON PTY LTD	**Nearest Town:**	WAGGA NORTH
Sample No:	022018875	**Test Code:**	E11
Paddock Name:	5550 WALLA WALLA	**Sample Type:**	Soil
Sample Name:	SAMPLES 1,2,6,11	**Sampling Date:**	11/04/2019
Sample Depth (cm):	0 **To** 10		

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APPENDIX O ECONOMIC CONTRIBUTION ANALYSIS

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