



Sandigo Solar
Farms:
Preliminary
Environmental
Assessment
Scoping Report

November 2017

Sandigo Solar Farms

Preliminary Environmental Assessment Scoping Report

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Abbreviations

AC	alternating current
ACHAR	Aboriginal Cultural Heritage Assessment Report
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
BDAR	Biodiversity Development Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
CEMP	Construction Environmental Management Plan
Cwlth	Commonwealth
DC	direct current
DoE	Department of Environment (Cwlth)
DoP	Department of Planning (NSW) (now DPE)
DPE	Department of Planning and Environment (NSW)
EEC	Endangered Ecological Community
EIS	environmental impact statement
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
GWh	gigawatt hours
Ha	hectares
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICNG	Interim Construction Noise Guideline
ISEPP	State Environmental Planning Policy (Infrastructure) 2007 (NSW)
km	kilometre
km ²	square kilometre
kV	kilovolt
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LLS Act	<i>Local Land Services Amendment Act 2016</i>
m	metres
MNES	Matters of National Environmental Significance (under the EPBC Act)
MW	megawatts

NPW Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
OEH	Office of Environment and Heritage (NSW)
PCT	Plant Community Type
PEA	Preliminary Environmental Assessment
PCU	power conversion unit
RAP	Registered Aboriginal Party
RET	Renewable Energy Target
RMS	Roads and Maritime Service
SEARs	Secretary's environmental assessment requirements
SEPP	State Environmental Planning Policy
SSD	State significant development
TEC	Threatened Ecological Community (listed under the EPBC Act)

1 Introduction

1.1 Project overview

The proposed Sandigo Solar Farms project is a utility-scale renewable energy project that would comprise up to two solar farms located at Sandigo in NSW, one each at Kywong and Glen Moira, generating up to a combined total of 300 megawatts (MW) (AC). The location of the solar farms was chosen because of the relatively high solar irradiance in the region and the capacity of the TransGrid electricity networks to transmit the power generated by the farms.

General information about the project is provided in Table 1.1. The proposed project area in relation to the wider landscape is shown in Figure 1.1.

Table 1.1 Sandigo Solar Farms: project details

Detail	Kywong	Glen Moira
Address	174 Mitchells Road, Sandigo, New South Wales, 2700	43 Malwa Lane, Sandigo, New South Wales, 2700
Proponent	ESCO Pacific	ESCO Pacific
Council	Narrandera Shire Council	Narrandera Shire Council
Titles	<ul style="list-style-type: none"> Lot 33, 35, 55, 108, 109 on Plan 754550 Lot 4 on Plan 607982 Lot 70, 71 on Plan 754559 Lot 1 on Plan 802754 	<ul style="list-style-type: none"> Lot 1 on Plan 576714
Total indicative area	1109 ha	313 ha
Land Use	Cropping, grazing – high level of ground disturbance	Cropping, grazing – high level of ground disturbance
Capacity	Up to 300 MW (AC)	Up to 230 MW (AC)
	In total – both sites combined: up to 300 MW (AC)	
Connection	TransGrid: <ul style="list-style-type: none"> 330kV Transmission line # 63 132kV Transmission line #99F T132kV Transmission line #994 	TransGrid: <ul style="list-style-type: none"> 132kV Transmission line #99F 132kV Transmission line #994

1.2 Site details

The proposed Kywong and Glen Moira solar farms are located approximately 27 km and 22 km southeast of Narranderra, respectively, and 114 km and 122 km north of Albury, within the Narrandera Local Government Area (LGA). Narrandera Shire is located in the Riverina region of southwestern New South Wales and is crossed by the Sturt and Newell Highways. The region's main land use is rural and consists predominantly of irrigated land, with primary income derived from agriculture.

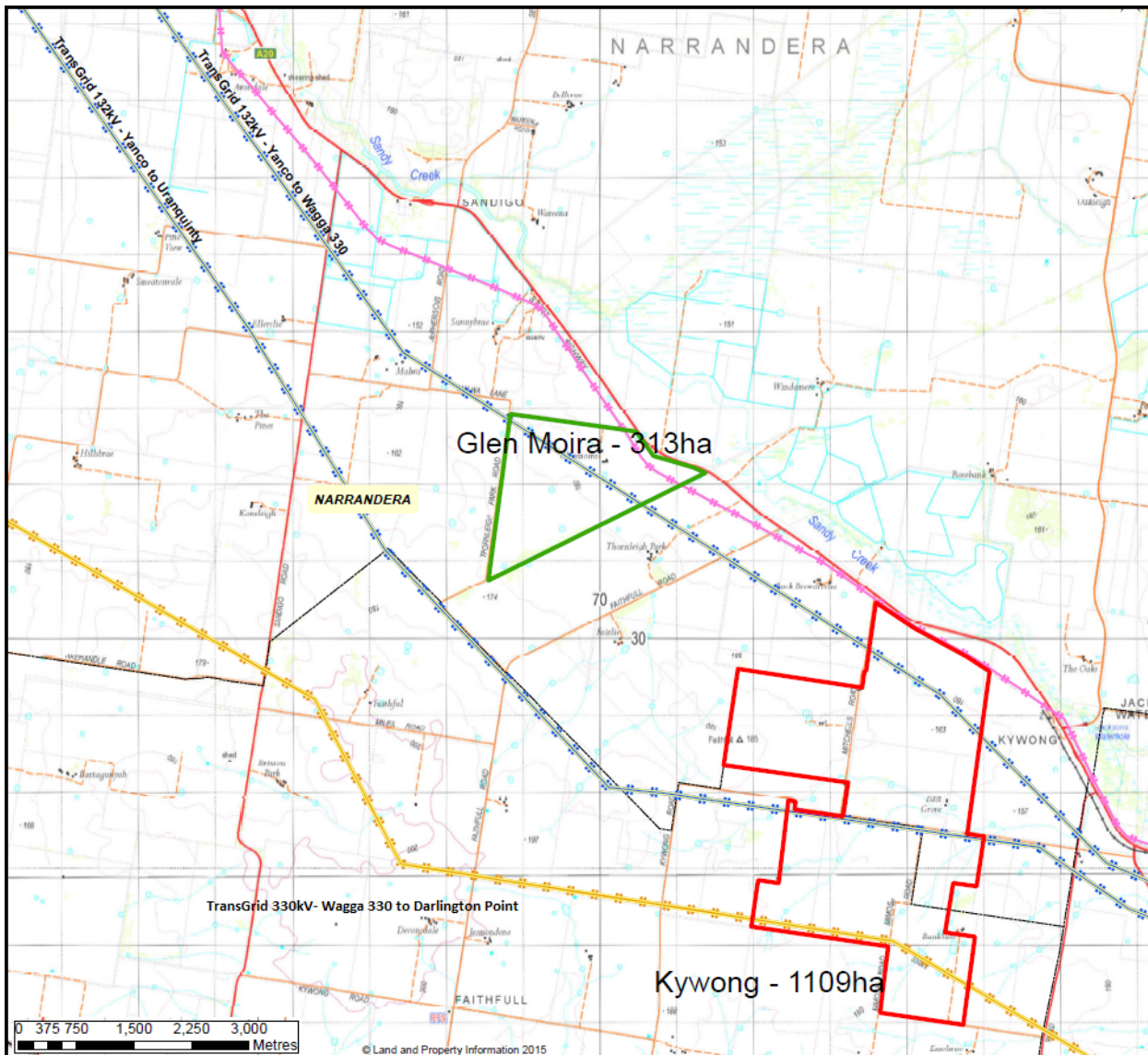


Figure 1.1 Project location

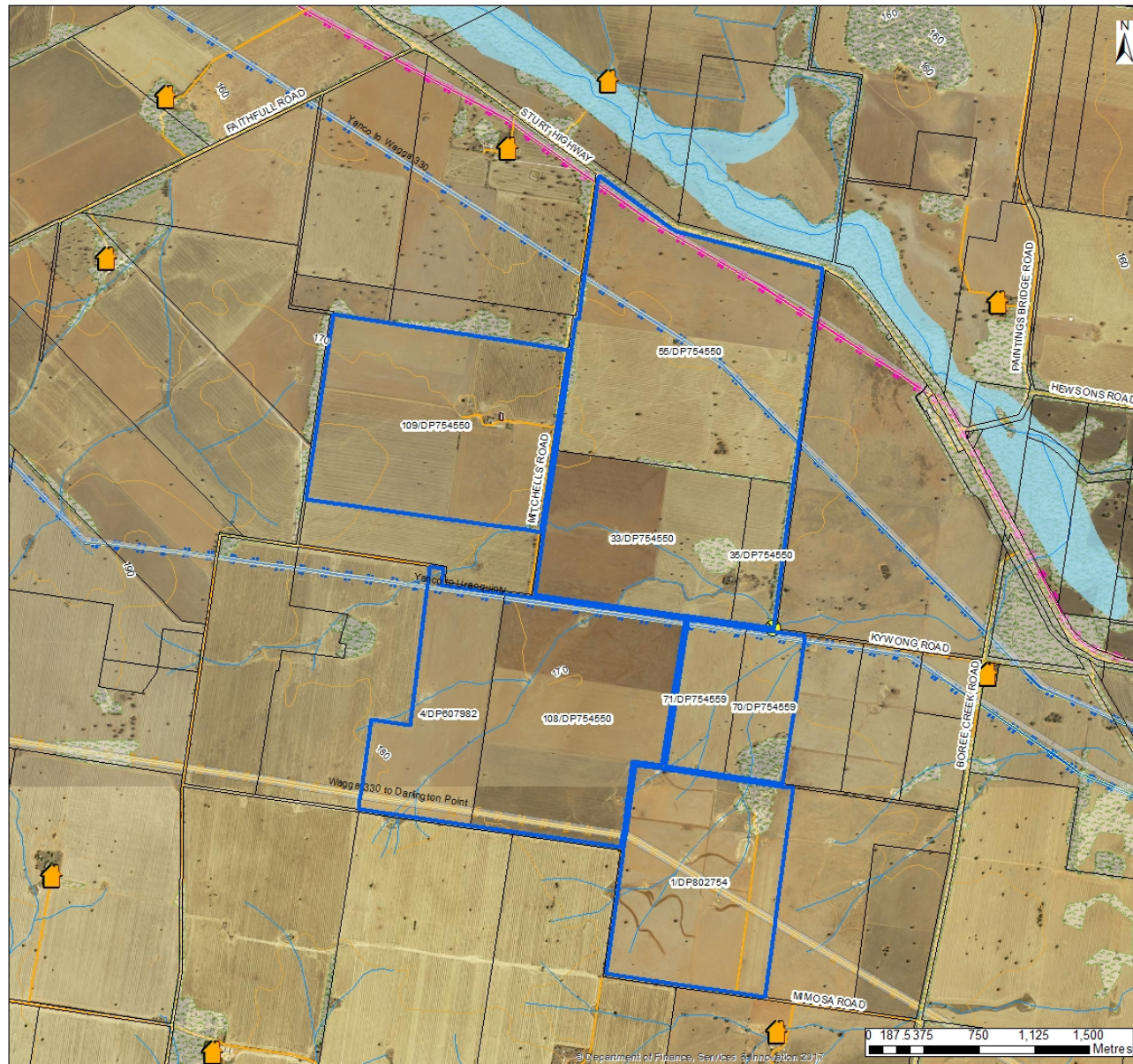
A map of the proposed Kywong solar farm is shown in Figure 1.2 and Glen Moira in Figure 1.3. Each site is located within the property of a single landholder both of who are engaged in agricultural and grazing activities. The land on both sites comprises gently sloping open paddocks. Due to a long history of agriculture and grazing, the project area is highly modified.

The nearest major road is the Sturt highway located immediately north of Kywong and immediately east of Glen Moira (see Figure 1.1). Rural blocks bound Kywong to its east, west and south, and Glen Moira to its north, southeast and west.

1.3 Proponent

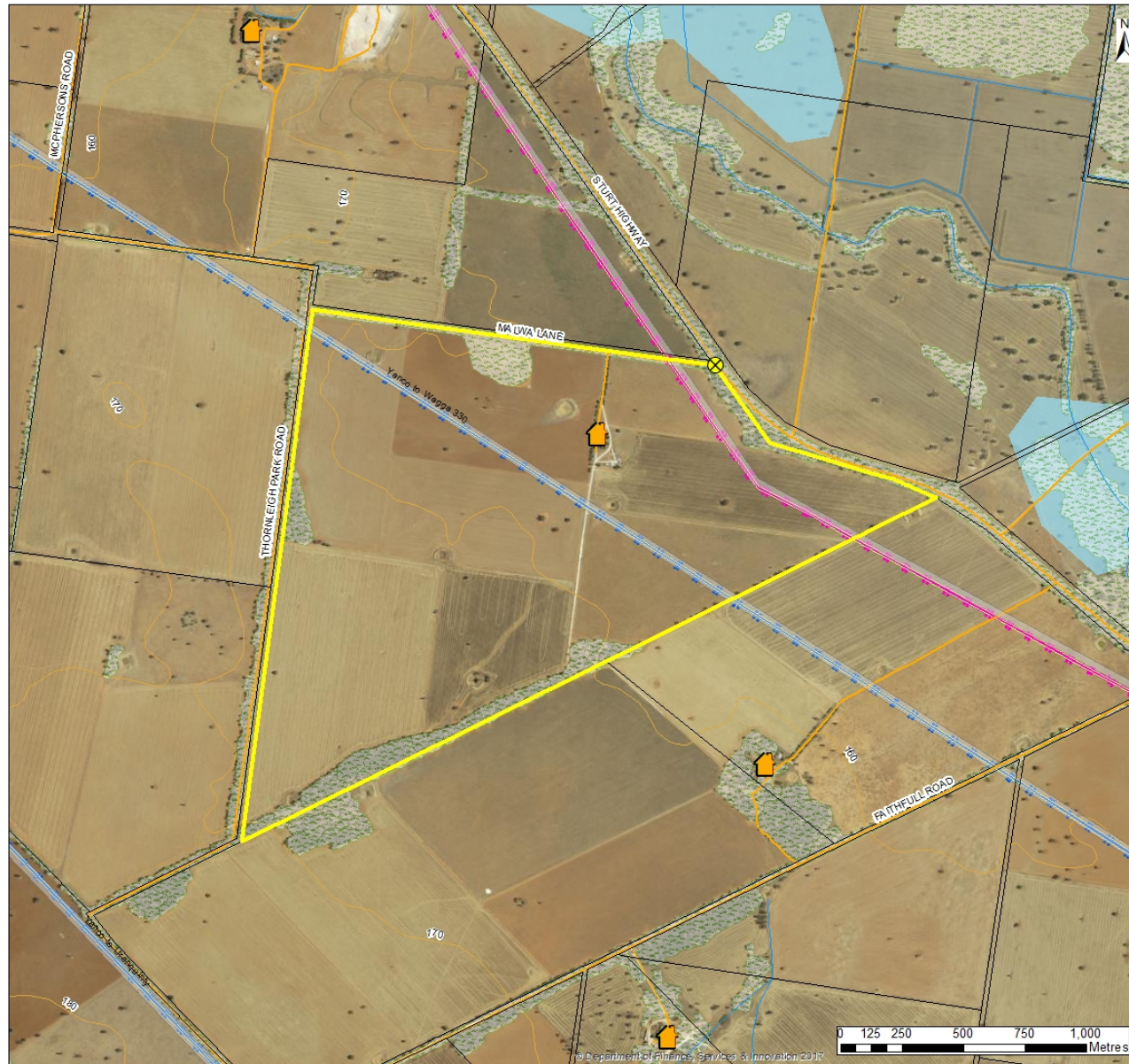
ESCO Pacific is an Australian developer of ground-mounted utility-scale solar farms. The company was founded in 2015 to develop renewable energy assets under the then recently revised Australian Renewable Energy Target (RET).

Headquartered in Melbourne, ESCO Pacific has a highly experienced management team of energy, infrastructure, development and corporate finance professionals with specific experience in developing, and delivering to market, utility-scale renewable energy projects in Australia and internationally.



PROJECT Sandigo Solar Farms		
MAP TITLE Kywong site map		
Landowner		
Title Info Lot 1 on Plan 802754 Lot 4 on Plan 607982 Lots 33, 35, 55, 108, 109 on Plan 754550 Lots 70, 71 on Plan 754559		
LEGEND <div> <div>Study Area (2822 acres / 1142 ha)</div> <div>Sensitive Receivers</div> <div>Proposed Access</div> <div>Cadastral Boundary</div> <div>Easement</div> <div>Watercourses</div> <div>Land Subject to Inundation</div> <div>Remnant Vegetation - LEP</div> <div>General Cultural Area</div> <div>Roads / Tracks</div> <div>Essential Energy 66 kV line</div> <div>TransGrid 132kV Transmission Line</div> <div>TransGrid 330kV Transmission Line</div> <div>Elevation Contour</div> </div>		
<div> <div>ESCO</div> <div>Pacific</div> </div>		
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DATE 1/11/2017	SCALE 1:25,000	Page Size A3
STATUS DRAFT	PRODUCED C. Berge	APPROVED A. Hawke
MAP No. KYW_LAY_003_03_Proposed_Extent		REV 02

Figure 1.2 Kywong site map



PROJECT Sandigo Solar Farms		
MAP TITLE Glen Moira site map		
Landowner		
Title Info Lot 1 on Plan 576714		
LEGEND <div> <div>Study Area (773 acres / 313 hectares)</div> <div>Sensitive Receivers</div> <div>Proposed Access</div> <div>Easement</div> <div>Cadastral Boundary</div> <div>Roads / Tracks</div> <div>Watercourses</div> <div>Remnant Vegetation - LEP</div> <div>Land Subject to Inundation</div> <div>Essential Energy 66 kV line</div> <div>TransGrid 132kV Transmission Line</div> <div>TransGrid 330kV Transmission Line</div> <div>Elevation Contour</div> </div>		
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MAP No. WRI_LAY_002_03_Proposed Extent		REV 01

Figure 1.3 Glen Moira site map

ESCO Pacific has a one gigawatt pipeline of projects in NSW, Queensland and Victoria that in November 2017 included:

- the 148 MW Ross River Solar Farm, near Townsville, with construction works commencing in late-2017
- six additional approved projects in Queensland, totalling 500 MW
- the 170 MW Finley Solar farm in NSW, determination of planning consent predicted by the end of 2017
- two projects in Victoria totalling 235 MW (approvals due early 2018).

1.4 Capital investment value

The proposed Sandigo Solar Farms project is currently in the feasibility and design stage. The capital investment value of the project, while not yet finally determined, is estimated to be \$240,000,000 for a 300 MW project. The capital cost of the project will exceed the \$30 million threshold for it to be classified as a State significant development (SSD), as defined under the State Environmental Planning Policy (State and Regional Development) 2011 (see Section 4.2.2).

1.5 This report

This Preliminary Environmental Assessment Scoping Report (PEA Scoping Report) has been prepared in accordance with the requirements of the Department of Planning and Environment (DPE) for projects identified as SSDs and therefore requiring an Environmental Impact Statement (EIS) to be prepared under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The report will support a request to DPE from ESCO Pacific for the Secretary's Environmental Assessment Requirements (SEARs) for the EIS.

The report:

- describes the proposed development, including project justification and alternatives considered
- outlines permissibility and strategic planning requirements for the project under NSW and Commonwealth legislative frameworks
- describes the existing environmental and social context of the project
- provides a preliminary assessment of project impacts and management
- sets out previous, current and proposed stakeholder consultation
- proposes environmental assessment requirements for incorporation into the SEARs.

2 Development description

The proposed Sandigo Solar Farms are a utility scale renewable energy project that would generate up to 300 MW of clean and renewable electricity. The solar farms would comprise up to 900,000 solar photovoltaic modules, known more commonly as 'PV Modules' or 'solar panels'. The solar panels use the same type of technology used in residential solar installations located commonly throughout Australia, however are larger in size.

The solar panels would be installed on ground-mounted frames that would slowly track the daily horizontal movement of the sun. They would generate direct current (DC) electricity that would be inverted to alternating current (AC), which is the standard form of electricity used throughout Australia.

2.1 Design and configuration

The solar panels and horizontal tracking systems would be mounted in rows that would be electrically connected into arrays before being inverted from DC to AC electricity via containerised power conversion units. The electricity would then be fed, via an on-site, high voltage power reticulation system, into the local electricity network.

2.1.1 Grid and road access

The proposed project sites provide potential access to the existing electricity network via the single 330kV (Wagga 330 to Darlington Point) and two 132 kV (Yanco to Wagga 330 & Yanco to Uranquinty) transmission lines that transect the Kywong site, and the 132 kV (Yanco to Wagga 330) transmission line that also transects the Glen Moira site (see Figure 1.1).

Access to the sites during construction and operation is expected to be from Sturt Highway, located immediately north of the Kywong site and immediately east of the Glen Moira site (see Figure 1.2 and Figure 1.3).

2.1.2 Key elements

Key elements of the proposed solar farm development at the Kywong and Glen Moira sites include the following:

- Solar panels would be installed in regular arrays.
- Each solar panel would be fixed to a metal mounting structure. The mounting structure would be piled or screwed into the ground without the need for any concrete. The mounting structure would slowly and silently track (in a single axis) the horizontal movement of the sun. There is also an alternative option to install a fixed tilt mounting structure. Both mounting structure options would not exceed 4 m in height.
- Above ground DC cabling will connect each module in a string (up to 900,000 modules in total) to field combiner boxes mounted underneath the solar panels. The combiner boxes would sit approximately 1 m off the ground.
- Underground DC cabling would run from the combiner boxes to the central inverters.
- Central inverters, step up transformers and switchgear would be located in 40 foot containers or container skid pads. A power conversion unit (PCU) within each array block would convert the DC

electricity generated by the solar panels into AC electricity for connection to the national electricity grid.

- Underground AC cabling would run from the PCUs to a centralised solar substation.
- A main step up transformer and associated equipment in the solar substation would convert the on-site AC reticulated 33 kV electricity to 132 kV or 330 kV electricity for connection via high voltage cable to the transmission lines that traverse the sites, where it would enter the local electricity network.
- Internal vehicle access tracks would be constructed from the entrance point at each site to each PCU and to the solar substation to allow for maintenance of the site.
- Perimeter safety fencing would be installed around each site and a fixed, closed-circuit television (CCTV) system established within the fence perimeters.
- Supervisory control and data acquisition (SCADA) control systems would monitor the performance of the equipment.
- A site office and maintenance building would be installed at one of the sites to service each site
- Temporary infrastructure would be put in place during site construction including site compounds and storage areas.

2.1.3 Potential for battery storage

The proposal will also include the potential for battery storage to be installed on site.

Solar Farms are an intermittent source of energy. Battery storage systems can be used either to smooth the fluctuating energy produced by the solar farm or to store the excess energy during low demand periods which can be subsequently used during higher demand periods or when solar energy is unavailable (e.g. at night).

The batteries can also compensate for frequency variations in the electricity grid which are caused by intermittent renewable generators as well as fluctuations in consumption. Batteries can store electricity from the grid or feed electricity into the grid in a matter of seconds and compensate for the fluctuations caused by renewables or resulting from power plant outage or irregularities in consumption.

In addition to the shifting of electricity output, energy storage on the site can contribute to:

- improved reliability of the electricity network and reduced electricity costs associated with grid upgrades to deal with peak energy demand
- improved sustainable outcomes by combining clean energy generation with clean energy storage.

2.2 Construction

The construction process at the two sites would involve the following activities:

- Site access and establishment.
- Civil works: limited grading, compaction, stormwater drainage and sediment controls and dust suppression.
- Installation of the mounting structures: rows of driven piles would be pneumatically driven into the ground using specialist equipment, and steel mounting structures would then be attached to the piles. If required, ground screws may replace the need for driven piles.
- Installation of the solar panels onto the mounting structures.
- Installation and connection of the solar panels to the combiner boxes.
- Installation of the power conversion stations.

- Possible installation of a battery storage facility.
- Connection of the combiner boxes to the power conversion stations and underground cabling.
- Connection of the power conversion stations to form the onsite power reticulation system to evacuate power from the site.
- Grid connection works taking power from the onsite reticulation system to the local electricity grid.
- Commissioning and testing.

The proposed Sandigo Solar Farms would be expected to create up to 130 jobs during construction, which would take up to 9 months.

Construction activities would be undertaken during standard hours for construction works. Any construction or commissioning activities outside of these standard working hours would require approval from relevant authorities. Any affected local residences would be informed of the timing and duration of the proposed activities, prior to the commencement of any works.

2.3 Operation

The project is anticipated to operate for up to 40 years. A minimal number of personnel, up to four full-time and eight part-time positions across the two sites, would be required for the operation and maintenance of the project.

Operational activities involve monitoring of equipment on a daily basis, full servicing of inverters and substation equipment on a quarterly basis, and cleaning of the solar panels at regular intervals depending on how the system performs benchmarked to weather conditions.

It is expected the solar panels would need cleaning, on average, two to four times during any calendar year. Any water required for cleaning of the panels would be brought in from offsite. There would be no storage of hazardous or dangerous goods or materials on site during the operation of the project.

2.4 Decommissioning

At the end of its operational life, the solar farm would be decommissioned and the site rehabilitated, with the aim of returning it to its pre-existing condition. All above-ground and underground infrastructure will be removed, allowing the pre-existing agricultural land use activities to resume, or new land uses in the area to be established.

3 Justification and alternatives considered

3.1 Project justification

Since 2001, the Commonwealth Government has mandated the use of energy from renewable resources in electricity generation. In 2009, the RET scheme mandated that 20% of Australia's electricity supply was to come from renewable sources by 2020 (NSW Trade and Investment 2013).

In 2011, the RET was split into two parts comprising a large-scale RET scheme and a small-scale renewable energy scheme. The large scale RET scheme created a financial incentive to establish and expand renewable power stations such as solar farms, wind farms and hydro-electric power stations and deliver the majority of the 2020 target. The target has since been adjusted and the current RET is 33,000 GWh by 2020 (Clean Energy Regulator 2017).

The RET scheme sits within the broader context of Australia's need to reduce greenhouse gas emissions to meet its commitments under the 1997 Kyoto Protocol and revised emissions target under the 2015 Paris Agreement (Commonwealth of Australia 2015).

The Sandigo Solar Farms would contribute Australia's greenhouse gas commitments by reducing emissions associated with energy use and contributing to the achievement of the RET. The solar farm would also be part of the transition away from fossil fuel reliance to cleaner electricity generation, and the transition to increased energy security through a more diverse energy mix.

At a State level, the Sandigo Solar Farms proposal is consistent with current goals and targets for renewable energy generation in NSW. These include (NSW Trade and Investment 2013):

- supporting the achievement of the RET
- attracting renewable energy investment and projects
- building community support for renewable energy
- attracting and growing expertise in renewable energy.

Other project benefits are expected to include (DoI 2016):

- employment opportunities during construction, including engagement of local contractors and materials and service providers
- long-term local employment opportunities over the life of the project
- contributions to local infrastructure improvements
- education and training of contractors and local residents
- rent received from workers accommodated in the area.

3.2 Alternatives

3.2.1 Site selection

ESCO Pacific has undergone a process of constraints and opportunities analysis to identify potential project sites in NSW and other States. This process has included consideration of factors such as:

- regulatory settings for renewable energy projects
- solar irradiation levels
- access to and capacity of existing energy grids

- potential for land acquisition
- land suitability (topography, existing land use, flood risk, zoning etc.)
- need to minimise environmental and social impacts (e.g. avoiding sensitive environments or areas of cultural heritage value).

The proposed locations for the Sandigo Solar Farms emerged as highly prospective sites for the development of a solar project, particularly due to the proximity of the two 132 kV Transgrid transmission lines and the 330 kV Transgrid transmission line. Accordingly, a decision was made to initiate pre-development investigations and activities.

3.2.2 Project design and configuration

The design and configuration of the project would take into account the findings of EIS studies and investigations. This would include consideration of environmental and social factors such as the need to:

- identify and operate within any environmental constraints (such as avoiding areas within the project area that may be of conservation significance)
- minimise disruption to local landholders
- minimise amenity issues
- take into account the expectations and any concerns of the local community and Narrandera Shire Council.

These considerations will be balanced against the need to achieve design, construction and operational efficiencies to reduce projects costs and maximise solar yields.

Even during pre-development planning, emphasis has been placed on the avoidance and minimisation of impacts on areas of environmental sensitivity (see Section 5.2.2).

4 Permissibility and strategic planning

4.1 Commonwealth legislation

4.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), administered by the Commonwealth Department of the Environment (DoE), requires approval from the Environment Minister for actions likely to have a significant impact on a Matter of National Environmental Significance (MNES).

The EPBC Act identifies the following nine MNES:

- World Heritage properties
- National heritage places
- Wetlands of international significance (Ramsar wetlands)
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mining)
- Water resources (relating to coal seam gas development and large coal mining development).

Any proposed action likely to have a significant impact on the following must be referred to the DoE to determine whether the action is a 'controlled action' and include:

- Actions that have a significant impact on MNES
- Actions that (indirectly or directly) have a significant environmental impact on Commonwealth land
- Actions carried out by the Commonwealth Government

The assessment of the significance of the impact is based on the criteria listed in the DoE's *Significant Impact Guidelines 1.1* (DoE 2003). Should the Environment Minister decide the action will be taken in a manner that will ensure it will be likely to not have an adverse impact on the MNES, approval will be granted.

This PEA Scoping Report considers the requirement for an 'EPBC Referral' to the Minister and this will be further assessed during the EIS process.

4.1.2 Native Title Act 1993

The *Native Title Act 1993* provides a national framework for the recognition and protection of native title i.e. the rights and interests, recognised by common law, possessed under traditional laws and customs of Aboriginal and Torres Strait Islander people.

The Act recognises the ownership (or set of rights and interest) of land or waters by Aboriginal and Torres Strait Island groups prior to European Settlement, and provides a mechanism for determining where native title exists, who holds it, and identifies compensation for actions affecting it. The Act establishes ways in which future dealings affecting native title may proceed and sets standards for those dealings.

People who hold native title have a right to practice their traditional laws and customs, whilst respecting Australian laws, and have a right to a) be consulted with regarding any proposed action on their land b) receive compensation for that action. In areas where native title existence has not been determined, a compensation application can be made by a registered native title body corporate or group of people asserting native title rights.

No Native Title Determination Applications, Determinations of Native Title, or Indigenous Land Use Agreements exist over the project sites and Native Title will not be further considered during the EIS process.

4.1.3 Commonwealth Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* enables the Australian Government to respond to requests to protect areas and objects of particular significance to Aboriginal people, if it appears that state or territory laws have not provided effective protection.

The Australian Government can make a declaration to protect an area, object or class of objects from a threat of injury or desecration. However the government cannot make a declaration unless an Aboriginal person or group of persons has requested it. A declaration is only made if the relevant processes of the state or territory have been exhausted.

This PEA Scoping Report considers the potential presence of Aboriginal heritage within the project area and this will be further assessed during the EIS process.

4.2 New South Wales legislation

4.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the principle legislation regulating land use in NSW and is administered by DPE. The EP&A Act sets a framework for approval of developments in NSW and requires relevant planning authorities to assess potential environment and social impacts of proposed development or land-use change. The Act prescribes relevant planning bodies, environmental planning instruments, environmental assessment, and liability with regards to contaminated land.

The proposed project supports a number of objects of the EP&A by promoting and encouraging social, economic and environmental wellbeing through use of land for power generation using renewable sources.

Specifically, the project supports the following objects of the EP&A Act (and is also consistent with the remaining objects of the Act):

(a) to encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,

(ii) the promotion and co-ordination of the orderly and economic use and development of land,

(iii) the protection, provision and co-ordination of communication and utility services,

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and

(vii) ecologically sustainable development

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Development of the Sandigo Solar Farms would be assessed under Part 4 'Development Assessment' of the EP&A Act (see Section 4.2.2, below).

4.2.2 State Environmental Planning Policy (State and Regional Development) 2011

The State Environmental Planning Policy (State and Regional Development) 2011 aims to identify development that is of State significance and confer functions on joint regional planning panels to determine development applications.

Under Clause 20 of Schedule 1 of the policy, the following is considered a State significant development (SSD):

Development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that:

(a) has a capital investment value of more than \$30 million, or

(b) has a capital investment value of more than \$10 million and is located in an environmentally sensitive area of State significance.

The Sandigo Solar Farms project would be classified as an SSD under Part 4 of the EP&A Act, as it has a capital investment value of more than \$30 million.

As an SSD, the project would be assessed by DPE and require approval from the Minister for Planning and Environment. SSDs require the preparation of an EIS detailing potential environmental impacts as a result of the project and appropriate management measures. The EIS would be prepared in accordance with the requirements of the DPE SEARs.

The Sandigo Solar Farm is considered an SSD and will therefore require the preparation of an EIS and approval from the Minister for Planning and Environment.

4.2.3 State Environmental Planning Policy (Infrastructure) 2007

The State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State by providing for the development of electricity generating works on any land in a prescribed rural, industrial or special use zone for which there is consent, including large-scale solar energy systems.

Division 3, Part 4 of ISEPP specifically refers to solar energy systems, stating that (except as provided by subclause (8)), *development for the purpose of a solar energy system may be carried out by any person with consent on any land*. However, large-scale solar developments are still required to be broadly compatible with local land use objectives such as those outlined in an LEP (see Section 4.2.5).

ISEPP allows for the development of large-scale solar energy systems with consent even on land prescribed for rural use, although compatibility with local land use objectives needs to be considered.

4.2.4 State Environment Planning Policy No. 44 – Koala Habitat Protection

State Environment Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) requires that for Development Applications ‘potential koala habitat’ must be determined. Such habitats are defined as having 15 per cent of trees of the species listed in the SEPP 44. The applicant must then ascertain whether the potential habitat is ‘core koala habitat’ (i.e. has a population of breeding koalas). If the site has core habitat then a koala plan of management must be prepared by the applicant. Should Koalas, or potential Koala habitat be identified within the study area, a Plan of Management may be required in consultation with the Director-General of the Office of Environment and Heritage (OEH).

This PEA Scoping Report considers the presence of Koala habitat within the project area, concluding that no habitat is present and a Plan of Management would not be required (see Section 5.2).

4.2.5 Narrandera Local Environmental Plan 2013

The project site is located within the Narrandera Shire Council boundaries and would therefore be subject to the relevant provisions of the 2013 Narrandera Local Environmental Plan (Narrandera LEP).

Aims of Narrandera LEP

The Narrandera LEP provides local environmental planning provisions for land in Narrandera in accordance with the relevant standard environmental planning instrument under section 33A of the EP&A Act.

The aims of the plan are:

- to protect, enhance and conserve agricultural land through the proper management, development and conservation of natural and man-made resources,
- to encourage a range of housing, employment, recreation and community facilities to meet the needs of existing and future residents of Narrandera,
- to promote the efficient and equitable provision of public services, infrastructure and amenities,
- to conserve environmental heritage.

Land zoning

The proposed Sandigo Solar Farms and transmission line routes are located on land zoned RU1 – Primary Production. The objectives of the RU1 zone include the following:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base
- to encourage diversity in primary industry enterprises and systems appropriate for the area
- to minimise the fragmentation and alienation of resource lands
- to minimise conflict between land uses within this zone and land uses within adjoining zones

The primary objective of the RU1 zone is to encourage primary production. Electricity generating works are prohibited in RU1 zones, however, under the ISEPP, development of electricity generation works is potentially allowed on any land with consent, particularly if there is compatibility with local

land use objectives. In addition, the solar farm will have minimal impact on the ground surface and once the farm is decommissioned the site would be able to be returned to its existing state.

Additional local provisions

The Narrandera LEP contains a number of additional local provisions relating to matters such as earthworks, flood planning, stormwater management, terrestrial biodiversity, groundwater vulnerability, riparian land and watercourses, wetlands, salinity, development on river front areas, development on riverbeds and banks and airspace operations. Only the terrestrial biodiversity provisions are applicable to the project area.

Subdivision

The Kywong and Glen Moira sites are both located within zone AF for subdivision. Section 4.1 of the LEP states that the size of any lot resulting from a subdivision of land to which this clause applies is not to be less than 400 hectares. No exemption exists at Council level, so subdivision, if required, may not comply with the LEP. ESCO Pacific has been consulting with Narrandera Shire Council regarding the potential need for subdivision and the implications for project approvals. This will be considered further during the EIS process.

It is expected that the Sandigo Solar Farms project would be subject to the relevant provisions of the Narrandera LEP. This PEA Scoping Report considers the implications of the terrestrial biodiversity provisions (see Section 5.2) and these and other provisions will be considered further during the EIS process.

4.2.6 Riverina Murray Regional Plan 2036

The proposed Sandigo Solar Farms fall within the Riverina Murray region of NSW. DPE has prepared the *Riverina Murray Regional Plan 2036* (RMRP) for the region which provides a 20-year blueprint for the future of the Riverina Murray (DPE 2017).

The plan sets out the NSW Government's vision for the Riverina Murray, which is to create a diversified economy founded on Australia's food bowl, iconic waterways and a strong network of vibrant and connected communities.

The Government has set four goals for the region to achieve this vision:

- a growing and diverse economy
- a healthy environment with pristine waterways
- efficient transport and infrastructure networks
- strong, connected and healthy communities.

The development of the Sandigo Solar Farms is consistent with these objectives, in particular the development of a growing and diverse economy.

The compatibility of the Sandigo Solar Farms with the objectives of the RMRP will be considered further during the EIS process.

4.2.7 Roads Act 1993

The *Roads Act 1993* (Roads Act) provides a framework for the management of roads in NSW. It provides for the classification of roads and the declaration of the Roads and Maritime Services (RMS) and other public authorities as roads authorities for both classified and unclassified roads. The Roads Act confers functions on RMS and other roads authorities, and allows distribution of such functions between RMS and other roads authorities.

The Roads Act sets out procedures for the opening and closing of public roads and regulates the carrying out of various activities on public roads.

A traffic assessment report outlining any requirements for use of roads in the area will be included as part of the Sandigo Solar Farms EIS. If required, approval from the RMS or local council will be sought under section 138 of the Roads Act.

4.2.8 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) commenced on 25 August 2017 as part of the NSW Government's new framework for the conservation of biodiversity. It supersedes the *Native Vegetation Act 2003*, *Threatened Species Conservation Act 1995*, *Nature Conservation Trust Act 2001* and sections of the *National Parks & Wildlife Act 1974*. The BC Act governs the management and conservation of biodiversity in NSW, which includes all flora, fauna and ecological communities, consistent with principles of ecologically sustainable development (as described in section 6(2) of the *Protection of the Environment Administration Act 1991*). The BC Act establishes (amongst others):

- a framework to avoid, minimize and offset the impacts of proposed development and land use change on biodiversity
- a scientific method for assessing the likely impacts on biodiversity values of proposed development and land use change, for calculating measures to offset those impacts and for assessing improvements in biodiversity values
- a market-based conservation mechanisms through which the biodiversity impacts of development and land use change can be offset at landscape and site scales.

The potential for impacts on biodiversity as a result of the Sandigo Solar Farms has been considered in this Scoping Report (see Section 5.2) and will be addressed further during the EIS process.

4.2.9 Local Land Services Amendment Act 2016

The *Local Land Services Act 2013* (LLS Act) was amended on 25 August 2017 in relation to native vegetation land management and clearance in rural areas, replacing the *Native Vegetation Act 2003*, as part of the NSW Government's new framework for the conservation of biodiversity. The LLS Act provides a framework for the management of local land services which include programs and advisory services relating to agricultural production, biosecurity, natural resource management (including management of native vegetation, weeds and pests) and emergency management.

The LLS Act aims to ensure natural resources are managed in accordance with the principles of ecologically sustainable development (as described in section 6(2) of the *Protection of the Environment Administration Act 1991*) in the social, economic and environmental interests of the State.

The management of local land services, specifically relating to native vegetation clearance on rural land, and the management of weeds, has been considered in this Scoping Report (see Section 5.2) and will be addressed further during the EIS process.

4.2.10 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) provides a statutory framework for the management of biosecurity risks from diseases, pests (plant and animal) and contaminants which have the potential to cause harm to the environment, people and the economy. The Biosecurity Act aims to reduce risks by: preventing the entry of diseases, pests and contaminants into NSW; identifying, containing and eradicating new entries; and minimising potential impacts through appropriate management

The Biosecurity Act has provisions in place for: conferring a power, function or right; or imposing an obligation, for the prevention of the introduction, or control or eradication of invasive pests (such as weeds and animals pests) which threaten ecosystems, habitats or species.

Under the Biosecurity Act, Local Control Authorities such as local councils have may appoint authorised officers to enforce weed management and provide direction on complying with obligations under the Biosecurity Act.

The potential for the Sandigo Solar Farms to result in noxious weed impacts will be considered during the EIS process.

4.2.11 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act) is the key legislation governing the State's care, control and management of all national parks, historic sites, nature reserves and Aboriginal areas. State conservation areas, karst conservation reserves and regional parks are also administered under the Act.

Places or objects of Aboriginal cultural heritage on or in the vicinity of the site will need to be managed in accordance with this Act. Clause 86 of this Act states: a person must not harm or desecrate an object that the person knows is an Aboriginal object.

Section 87 of the NPW Act establishes defences against prosecution under s.86 (1), (2) or (4) - harming or desecrating Aboriginal objects and Aboriginal places. The defences are as follows:

1. An Aboriginal Heritage Impact Permit (AHIP) authorising the harm (s.87(1))
2. Exercising due diligence to establish Aboriginal Objects will not be harmed (s.87(2)). Due diligence may be achieved by compliance with requirements set out in the National Parks and Wildlife Regulation 2009 (the NPW Regulation) or a code of practice adopted or prescribed by the NPW Regulation (s.87(3)).

Under Section 89J of the EP&A Act, an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974* would not be required for an SSD, unless the requirement of an environmental planning instrument for consultation or concurrence specifies that it applies to an SSD.

The potential for the Sandigo Solar Farms to have an impact upon Aboriginal cultural heritage has been considered in this PEA Scoping Report (see Section 5.3) and will be addressed further during the EIS process.

4.2.12 National Parks and Wildlife Regulation 2009

The NPW Regulation 2009 (cl.80A) assigns the OEH (2010b) *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* as one of the codes of practice that can be complied with pursuant to s.87 of the NPW Act. Disturbed land is defined by cl.80B (4) as;

"...disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable". Examples given in the notes to cl.80B (4) include "construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure)".

The presence and extent of ground disturbance is a key determinant in establishing the cultural heritage potential of an area under the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*.

The potential for the Sandigo Solar Farms to have an impact upon Aboriginal cultural heritage has been considered in this PEA Scoping Report (see Section 5.3) and will be addressed further during the EIS process.

4.2.13 Heritage Act 1977

The *Heritage Act 1977* provides a legal framework for the management of items and places of State heritage significance, providing for their protection. The Act encourages conservation of the State's heritage and provides for the identification and registration of items of State heritage significance.

Under Section 89J of the EP&A Act, an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977* would not be required for an SSD.

Any existing or unknown or other potential unknown State heritage items will be managed under the Act.

The potential for the Sandigo Solar Farms to have an impact upon historic cultural heritage has been considered in this PEA Scoping Report (see Section 5.5) and will be addressed further during the EIS process.

4.2.14 Protection of the Environment Act 1997

The *Protection of the Environment Operations Act* (POEO Act) provides the regulatory framework to protect the environment of NSW, including land, air and water. It is the key piece of environment protection legislation administered by the EPA. PA 2.49 and PA 2.50 of the Act set out obligations regarding the receiving of wastes to be stored, processed or disposed on site and the classification of those wastes.

The control and mitigation measures for greenhouse gas emissions associated with the project will also be managed under this Act.

The EIS process for the Sandigo Solar Farms will consider emissions to land, air and water, including greenhouse gas emissions.

4.2.15 Crown Lands Act 1989

The *Crown Lands Act 1989*, administered by the Minister for Crown Lands, regulates the management of Crown land for the benefit of the people of New South Wales and in particular to provide for:

- a) a proper assessment of Crown land,
- b) the management of Crown land having regard to the principles of Crown land management contained in this Act,
- c) the proper development and conservation of Crown land having regard to those principles,
- d) the regulation of the conditions under which Crown land is permitted to be occupied, used, sold, leased, licensed or otherwise dealt with,
- e) the reservation or dedication of Crown land for public purposes and the management and use of the reserved or dedicated land, and
- f) the collection, recording and dissemination of information in relation to Crown land.

Under Part 3 of the Act, a land assessment is required to be undertaken for any matters affecting Crown Land.

The potential impacts of the Sandigo Solar Farms on Crown Land (if any) will be addressed during the EIS process.

5 Preliminary impact identification and assessment

5.1 Project issues and risks

The proposed development of the Sandigo Solar Farms may result in a number of potential environmental and social impacts, both positive and negative. The nature and extent of these potential impacts will need to be assessed during the EIS process so that effective avoidance, management and mitigation measures can be incorporated into project design, construction, operation and eventual decommissioning.

The project as a whole is expected to be a relatively low risk development compared with many SSDs due to the inherently low impact nature of solar farm construction and operation, and the location of the project in an area that has a long history of disturbance from agricultural and grazing activities and is distant from areas of high environmental sensitivity.

An initial assessment of environmental and social risks by ESCO Pacific has identified three higher priority areas of potential impact that will require particular focus during the EIS process:

- potential impacts on ecological values such as local habitat for threatened and endangered species
- potential impacts on Aboriginal cultural heritage, which require specific assessment and consultation
- potential impacts on hydrology and water resources.

These higher priority impacts are assessed in Sections 5.2 to 5.4.

The initial assessment of environmental and social risks also identified a number of lower priority potential environmental or social impacts:

- land use compatibility and impacts
- traffic and transport
- socio-economic impacts
- noise impacts
- air quality and dust
- visual amenity
- airfield impacts
- historic heritage
- electric and magnetic fields
- bushfire hazard
- battery storage hazards
- contamination
- waste management.

These lower priority impacts are considered lower risk than the three higher priority impacts and/or to be readily manageable by implementing standard environmental management and mitigation procedures. The lower priority impacts are assessed in Section 5.5.

5.2 Biodiversity

5.2.1 Existing conditions

Preliminary site assessment

A preliminary biodiversity site assessment was undertaken from 17 to 19 October 2017 by two qualified ecologists from Ecolink Consulting (**Attachment A**) and Figures 5.1 and 5.2. The project area was walked and/or driven to assess the location and quality of habitats that were present.

The project area includes a mixture of grazed and cropped paddocks with houses and supporting infrastructure. Native vegetation is largely absent, with scattered paddock trees the only remnants of the historic vegetation communities that once covered the project area. Where more intact native vegetation does occur, it is largely restricted to the boundaries of the project areas, although an area of grassland (RP17) persists within the project area at the Glen Moira site (see **Attachment A** – Appendix 1 and Figure 1b). Dominant crops within the project area include Wheat *Triticum aestivum*, Barley *Hordeum* spp. and Canola *Brassica napus*, grown in rotation, interspersed with years in which the paddocks are sowed with Rye-grass *Lolium* spp. and Lucerne *Medicago sativa* subsp. *sativa* for grazing. Dams occur on both sites and appeared to have been lined with clay and this, in combination with regular grazing by sheep and crop rotation, has resulted in the absence of fringing or aquatic native vegetation and low ecological values are attributed to them. These dams are of low ecological value and do not provide significant habitat for any threatened species (see Plate 5.1).

A number of fauna species were recorded during the field assessment, comprising native and introduced birds and mammals. No amphibians or reptiles were observed during the recent assessments. The state significant Grey-crowned Babbler *Pomatostomus temporalis* (Plate 5.2) and White-fronted Chats *Epthianura albifrons*, which are listed as Vulnerable on the BC Act were the only threatened species recorded during the current assessments. All of the other species recorded in the project area are considered common to the Riverina and agricultural landscapes in southern Australia. The remnant woodlands and derived grasslands that are largely confined to the perimeters of the project area provide low to medium quality habitat for a range of common species. The Grey-crowned Babbler was recorded in these patches of vegetation and there is the potential that other threatened species occur in smaller numbers, at different times of the year, or in a more cryptic form (such as threatened flora species).

Crops accounted for a large portion of the sites and provided very low quality habitat for native flora and fauna. Grazed pasture was dominated by a range of pasture grasses and environmental weeds and accounted for most of the remaining portion of the project area. The grazed pasture provided low quality habitat for grassland adapted species, including White-fronted Chats, and potentially for Plains-wanderer *Pedionomus torquatus* and Spotted Harrier *Circus assimilis*, which were not recorded during the current assessment, but which may occur. However this type of habitat is widespread within the landscape and unlikely to be limiting for any species.

Scattered paddock trees were observed throughout the project area which are likely to provide foraging and breeding habitat for a variety of species (Plate 5.3). These trees comprised a mixture of White Cypress Pine *Callitris columellaris*, Western Grey Box *Eucalyptus microcarpa*, Buloke *Allocasuarina luehmannii* or Yellow Box *Eucalyptus melliodora* (in descending order of dominance), over a highly modified and predominantly exotic understorey. Some of these trees are likely to possess hollows. Hollows are generally a limited resource within the landscape, however the disturbed nature of the project area and broader landscape means that it is unlikely that these trees support any threatened species. Many threatened species are hollow dependent, however, illustrating the impact of the loss of hollow bearing trees within the landscape, so these trees will require further assessment. The species that are likely to nest in these trees are likely to be generally common within the landscape, because the removal of other ecological values in the landscape has

reduced the diversity of species that persist near the project area. The scattered paddock trees may provide nesting substrates for raptors – one raptor nest was recorded on the Kywong site, containing a Wedge-tailed Eagle *Aquila audax* chick (Plate 5.4). Given the timing of the current survey it is unlikely that the threatened Little Eagle *Hieraaetus morphnoides* or Square-tailed Kite *Lophoictinia isura* nest within the project area because no nests were observed. The scattered paddock trees may also provide habitat to other threatened species such as Major Mitchell's Cockatoo *Lophocroa leadbeateri*, and Superb Parrots *Polytelis swainsonii*, as they pass through the project area on occasion, when moving between higher quality habitat. However, the trees within the project area do not form a habitat corridor between higher quality habitat, such as occurs within the riparian vegetation associated with Sandy Creek, and, further afield, the Murrumbidgee River, so this is not likely to be a common occurrence.



Plate 5.1 Dam on the Kywong site, surrounded by exotic vegetation



Plate 5.2 Grey-crowned Babbler roosting nest



Plate 5.3 Scattered paddock tree area at the Kywong site

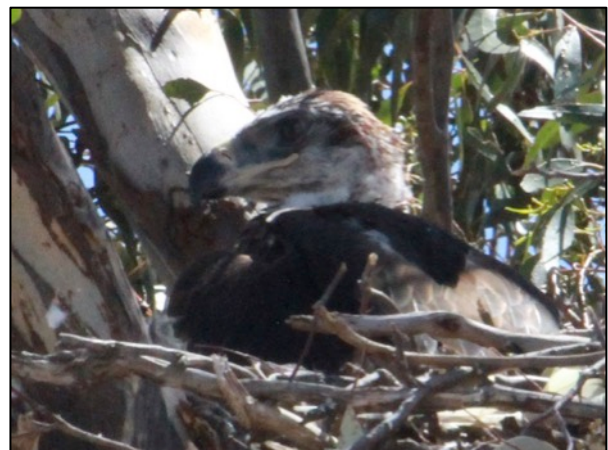


Plate 5.4 Wedge-tailed Eagle nestling

The Narrandera LEP 2013 (Narrandera 2017) maps terrestrial biodiversity areas within the project area including RP10, RP13, and an area of scattered trees in P22 in the Kywong property and RP15a, RP16 and RP17 on the Glen Moira property (see **Attachment A** – Appendix 1, Figure 1b and Figure 1c). The provisions of the Narrandera LEP will be considered when determining the appropriate management of terrestrial biodiversity in the project area during the EIS process.

Threatened species and ecological communities

The desktop assessment, site assessment, and Biodiversity Assessment Methodology calculator identified a number of threatened species that have the potential to occur within the project area and to be impacted by the project. Targeted surveys for these species and potential impacts to them from the project will be further considered during the EIS process.

5.2.2 Preliminary impact assessment and management

To remove or minimise impacts to the ecological values within the project area, remnant native vegetation and the scattered paddock trees will be avoided as far as practicable. A tree survey may be undertaken to accurately locate all scattered trees and inform the design of the solar farm if this cannot be undertaken through aerial photography.

The construction and operation of the solar farm is expected to have a relatively low impact, long term, to the remaining ecological values within the project area. Once the solar farm is built, there will be no greater disturbance to the landscape than is currently experienced by the extant flora and fauna as a result of the current farming practices. Therefore, if the highest quality ecological values can be protected, there is likely to be no significant impact to these values.

In addition to the protection of the ecological values, buffers will be created to ensure indirect impacts do not occur during construction or operation of the Solar Farms. Buffer zones for trees will be based on the size of the tree, specifically the Tree Protection Zone (TPZ) (Standards Australia 2009). TPZs will be avoided where possible so the integrity of the tree can be retained and there are unlikely to be any impacts to these trees. Where trees cannot be avoided, trees that possess hollows will be retained preferentially over those that do not.

Retained patches of native vegetation are unlikely to require a buffer zone, and will be fenced during construction works, and machinery and personnel will be excluded from these areas.

A Construction Environmental Management Plan (CEMP) will be prepared, as well as the development of management protocols, to ensure indirect or inadvertent impacts to areas of ecological value do not occur during the construction and operation of the Solar Farms. The CEMP will also provide induction to construction workers in relation to the protection of these values, including weed management, and provide contingency plans should an EPBC Act threatened species be encountered during works.

5.2.3 Need for further assessment

If the ecological values described above cannot be avoided, a range of threatened species surveys will be undertaken. Some of these surveys are required because there is a moderate, or greater, likelihood that a threatened species may be found within the project area (as discussed above), while others are required because it will be a condition of approval imposed by OEH due to impacts to native vegetation based on their Plant Community Types (PCTs). These surveys will feed into the preparation of a Biodiversity Development Assessment Report (BDAR). For each species identified as potentially requiring a survey, a presentation of the results of the survey, or a robust justification for not undertaking the survey, will be provided in the BDAR. If some PCTs can be avoided entirely, the number of species requiring survey is likely to decrease.

Prior to undertaking any threatened species surveys, OEH will be consulted on the proposed scope to ensure that surveys are not undertaken unnecessarily and that the proposed methods will satisfy their requirements. Survey methods will follow the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation (NSW) 2004) with survey effort reflecting the eventual impact of the final proposed solar farm footprint

(and therefore not provided below). Surveys for Grey-crowned Babbler and White-fronted Chat will not need to be undertaken as they are known to occur within the project area.

In summary, ESCO Pacific proposes managing the potential presence of threatened species habitat during the EIS process by placing a strong primary emphasis on impact avoidance and a strong secondary emphasis on impact minimisation. The company considers that even with the adoption of a conservative approach to avoidance it will have sufficient space within the Kywong and Glen Moira project sites to locate the solar farms.

5.3 Aboriginal cultural heritage

5.3.1 Existing conditions

An Aboriginal cultural heritage due diligence assessment of the Sandigo Solar Farms project area was undertaken by a qualified cultural heritage advisor from Australian Cultural Heritage Management (Vic.) Pty Ltd (ACHM).

The OEH *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010b) (Due Diligence Code) specifies that if the initial assessment process identifies that aboriginal objects or places will or are likely to be harmed, then further investigation and impact assessment is required (Step 5). For SSDs the Due Diligence Code is not required to be followed, as this is superseded by the requirements for the project EIS to address the SEARs in relation to Aboriginal and historic cultural heritage

Sensitive landforms

Previous research indicates that archaeological evidence is likely to be locally found associated with certain landforms. The Due Diligence Code lists five such landscape features:

- within 200 m of water
- within a sand dune system,
- on a ridge top, ridge line or headland,
- within 200 m below or above a cliff face,
- within 20 m of or in a cave, rock shelter, or a cave mouth.

Within the activity area there are several water features, including ephemeral and/or ancestral creek lines and what appears to be several drained creeks / swamps. Closer inspection is required to determine the nature and extent of these features and any intersection with the project area.

The proximity to available water in prehistory renders parts of the activity area more sensitive to the presence of Aboriginal sites than the balance of the surrounding region.

Traditional Owners

Narrandera is located within the traditional lands of the Wiradjuri people. The contemporary Wiradjuri Region covers much of eastern NSW extending from the Murray River in the south to Hay in the west and Nyngan in the north.

The activity area is within the area of interest of the Narrandera Local Aboriginal Land Council (LALC). Other LALC's from the surrounding region may also have interests in the activity area.

Archaeological sites and objects

Narrandera is in the Riverina NSW Bioregion. This bioregion is dominated by the alluvial fans of several major rivers that contribute to the Murray-Darling Basin.

The Murray-Darling Basin contains some of the oldest archaeological sites recorded in Australia, most famously at Lake Mungo in southwestern NSW. The Riverina area is known to be home to

scarred trees, earth mounds, shell middens, human burials and stone artefact scatters. Sites are often located near waterways and other water bodies; however, they can potentially occur anywhere in the landscape. Given the length of time Aboriginal people have lived in the Riverina they would have traversed the activity area regularly. Our ability to identify the remains of this behaviour depends on the visibility of the archaeological record, ground surface conditions, the extent and nature of disturbance that has occurred to the landscape through historical land use (e.g. land clearing) and the nature of past Aboriginal land use.

The following Aboriginal objects may potentially occur within the activity area:

- Aboriginal culturally modified trees (scarred trees)
- earth mounds
- archaeological deposits (sub-surface archaeological sites)
- stone artefacts (either isolated or in clusters).

The presence / absence of these items or places can only be determined through rigorous ground survey of the project area.

Native Title claims

There are no native title claims affecting the project area.

Database search

Relevant databases / registers were searched for heritage sites / values in proximity to the activity area at Sandigo. Of most relevance, an 'extensive' search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken. From that search, it was determined that no Aboriginal sites were known to exist within the activity area. However, searches of heritage databases cannot be assumed to be definitive. Search results indicating no sites are present are usually a reflection of a lack of systemic survey in a given region, rather than a lack of sites existing at any given location.

5.3.2 Preliminary impact assessment and management

The project area has a long history of European land use for agricultural purposes that will have resulted in disturbance to the ground surface. It does not contain any previously recorded Aboriginal objects or places, however, may contain archaeologically sensitive landforms (near ancestral / drained waterways).

If any potential impacts to Aboriginal heritage sites or items are identified during field assessments as part of the EIS, they will be managed in accordance with the NPW Act and consultation with the relevant groups, including the OEH, relevant Registered Aboriginal Parties (RAPs), and council. This could result in a change in the project design to avoid Aboriginal heritage sites.

5.3.3 Need for further assessment

Given that this project is an SSD, identification of cultural values and archaeological assessments will be undertaken to ensure:

- meaningful opportunities for engagement and consultation with traditional owners and/or RAPs for the project are provided
- full compliance with the SEARs
- full compliance with the OEH (2010a) *Aboriginal cultural heritage consultation requirements for proponents*
- full compliance with the OEH (2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

The identification of cultural values and the determination of cultural significance would be consistent with the guidance provided in the *Burra Charter and Indigenous Cultural Heritage Management Practice Note* (Australia ICOMOS 2013). The archaeological assessment would determine the scientific significance of the archaeological places within the project area.

It is expected that an Aboriginal Cultural Heritage Assessment Report (ACHAR) would be prepared as part of the EIS. To comply with the relevant OEH requirements, the objectives of the ACHAR would be to:

- present the project's consultation methodologies and processes as agreed with the RAPs
- ensure that Aboriginal people have the opportunity to participate in and improve the outcomes of the assessment by:
 - providing relevant information about the cultural significance and values of the Aboriginal objects and/or places within the activity area
 - influencing the design of the method to assess cultural and scientific significance of Aboriginal objects and/or places within the activity area
 - actively contributing to the development of cultural heritage management options and recommendations for any objects and/or places within the activity area and the wider project area
 - commenting on draft assessment reports before they are submitted by the proponent to OEH.

5.4 Hydrology and water resources

5.4.1 Existing conditions

The project sites are located within the Murray-Darling Basin, with both the Kywong and Glen Moira sites located approximately:

- 14 km southwest of the Murrumbidgee River
- 0.3 km north and 0.65 km northeast, respectively, of Sandy Creek
- 6 km and 8.5 km southwest, respectively, of Old Man Creek.

The project sites fall within the Murrumbidgee Irrigation Area which is managed by Murrumbidgee Irrigation Limited.

The project sites comprise low-lying land crossed by a number of ephemeral watercourses and containing constructed farm dams. Both sites are gently sloping with an approximately 20 m increase in elevation from north to south at Kywong, and an approximately 19 m increase in elevation from east to southwest at Glen Moira.

The project sites are not located within a flood planning area as designated under the Narrandera LEP. However, due to the presence of farm dams and low-lying areas, localised flooding of paddocks may be an issue.

5.4.2 Preliminary impact assessment and management

Construction and operation of the project is expected to result in only minor ground disturbance, primarily associated with the construction of access roads within the project area. The risk of impacts to water quality or hydrology in dams and waterways from erosion runoff or disturbance of acid sulphate soils (if present) is considered low and manageable. Standard erosion and sediment controls measures such as outlined in Landcom (2004) would be implemented.

The solar farms and associated infrastructure are unlikely to have significant impact on the surface flow of water and will be sited where practical to avoid impacts on watercourses and farm dams. The project is not expected to present a flood hazard.

The risk of groundwater impacts during construction is expected to be low as excavation will not be required to erect the solar panels and trenches for underground cables will be shallow.

Water use during project construction and operation will be minimal and water will be brought to site as required. No impacts on the availability of current surface or groundwater resources used by local landholders are anticipated.

5.4.3 Need for further assessment

Impacts to waterways and hydrology during construction and operation would be assessed as part of the EIS process, and will include an assessment of the potential impacts on:

- surface water and groundwater resources, including nearby watercourses
- adjacent licensed water users and basic landholder rights
- measures proposed to monitor, reduce and mitigate these impacts.

Soil and sediment management measures will be undertaken in accordance with an Erosion and Sediment Management Plan, which will be developed as part of the EIS process.

5.5 Other impacts

Other environmental or social impacts that are considered to be lower risk than those in Sections 5.2 to 5.4 and/or to be readily manageable by implementing standard environmental management and mitigation procedures, are assessed in Table 5.1.

Table 5.1 Assessment of lower priority project impacts and need for further assessment

Existing conditions	Preliminary impact assessment and management	Need for further assessment
Land use compatibility and impacts		
The project area is located within a rural use zone (RU1) and is currently used for agricultural purposes.	<p>There will be temporary loss of agricultural land and production as a result of the project. However the project is unlikely to significantly impact the region's overall agricultural productivity.</p> <p>Construction and operation of the project is expected to result in only minor ground disturbance, primarily associated with access road construction within the site. However, where soils are disturbed, soil erosion and sedimentation issues can result.</p> <p>All above-ground and underground infrastructure would be removed during project decommissioning.</p> <p>Rehabilitation is expected to return the land to its former agricultural capability.</p>	<p>An assessment of the impact of the project on landuse (during construction, operation and after decommissioning) would be undertaken as part of the EIS process.</p> <p>This would include an assessment of the impact of the development on agricultural land and flood prone land, and a soil survey to consider the potential for erosion to occur, and paying particular attention to the compatibility of the development with the existing land uses on the site and adjacent land during operation and after decommissioning, with reference to the zoning provisions applying to the land.</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
Traffic and transport		
<p>The project area is well-serviced by local roads, with the Sturt Highway located adjacent to both sites (to the north of Kywong and east of Glen Moira).</p> <p>The Sturt Highway is classified as a State road by RMS and runs northwest-southeast from Narrandera to Wagga Wagga.</p>	<p>Access to the Glen Moira site during construction and operation is expected to be from the Sturt Highway to the east and Malwa Lane to the northwest (see Figure 1.2).</p> <p>Access to the Kywong site during construction and operation is expected to be from the Sturt Highway to the north and then off Kywong Boree Creek Road to the east (see Figure 1.3).</p> <p>Transport impacts as a result of the proposed project would be largely limited to the construction phase, and may result from factors including: haulage of materials, and movements of workers to and from the site; and movement of trucks, vehicles and construction machinery within the site.</p> <p>It is expected there would be an increase in traffic on the local road network during construction however this would occur during the standard hours of construction and managed in consultation with RMS, local councils and landholders, where relevant, to minimise the risk of adverse impacts.</p> <p>Road upgrades are not expected to be required.</p> <p>Standard traffic management measures would be implemented in accordance with NSW Roads & Maritime Services requirements, such as ensuring vehicle road-worthiness, enforcing speed limits, erecting signage, proper design of site access points, and ensuring access roads within the site are properly engineered.</p>	<p>A transport assessment would be undertaken as part of the EIS process including an assessment of the site access route, site access point and likely transport impacts of the development on the capacity and condition of roads (including on any Crown land), and a description of the measures that would be implemented to mitigate any impacts during construction.</p>
Socio-economic impacts		
<p>The project area is in the Narrandera LGA which had a population of approximately 5,853 (2016 census data).</p> <p>The LGA covers an area of 4,116 km² which is predominantly irrigated agricultural land.</p>	<p>Construction of the project would provide immediate social and economic benefits to the local community. The project would increase local employment opportunities and drive growth in the area, whilst helping NSW to sustainably meet its energy needs.</p> <p>Pressure on local services including accommodation, health services and</p>	<p>The EIS would assess the potential impacts of the project on the local community and include consideration of accommodation and other services for construction workers.</p> <p>Community consultation will be undertaken during and after the EIS preparation stage. Outcomes of the community consultation will be</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
<p>The area's primary income is from agricultural industries such as cropping, cattle and sheep (for wool and meat) production.</p> <p>The main town centre in the LGA is Narrandera.</p>	<p>schools has the potential to increase due to the relocation of construction workers into the area.</p> <p>Communities that host solar farms have benefited from increases in business during construction and operation (Dol 2016).</p>	<p>included in the EIS.</p>
Noise		
<p>Kywong</p> <p>There are two residences occurring within 1 km of the Kywong site (including the landowner's residence).</p> <p>Glen Moira</p> <p>There are four residences (including the landowner's residence and a house leased by the landowner) occurring within 1 km of the Glen Moira site. These residences have the potential to be impacted by noise from project construction.</p>	<p>Impacts from noise would occur mostly during construction of the development due to the presence of vehicles and machinery. Best practice mitigation measures will be implemented to reduce potential noise disturbance e.g. working within standard hours or fitting vehicles with silencing devices, where appropriate.</p> <p>Noise during operation, including any maintenance works, would be minimal, short in duration, and unlikely to disturb surrounding residences.</p> <p>Noise can be managed and minimised through the adoption of standard management practices.</p>	<p>An assessment of construction noise impacts will be undertaken in accordance with the Interim Construction Noise Guidelines (ICNG), and operational noise impacts in accordance with the NSW Industrial Noise Policy, as part of the EIS.</p> <p>Should noise levels be likely to exceed relevant criteria, a noise management plan would be developed.</p>
Air quality and dust		
<p>Existing sources of air pollution in the project area are likely to result from vehicle emissions and dust from agriculture and may increase during the colder months from solid fuel heating and during summer periods if bushfires or dust storms occur in the region.</p>	<p>Construction has the potential to increase dust through movement of traffic on unsealed roads on dry days, vegetation removal and construction activities (such as access road construction). However, dust impacts are unlikely to be significant and standard dust suppression measures can be readily implemented.</p> <p>Impacts to air quality during operation would be negligible and there is the potential to improve existing levels of air quality by maintaining vegetative ground cover beneath the solar panels and other areas of the site.</p>	<p>A Construction Environmental Management Plan (CEMP) would be prepared to manage potential air quality impacts during construction.</p> <p>No specific investigation is required as part of the EIS.</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
Visual amenity		
<p>Kywong</p> <p>The proposed site may have potential to create visual impacts to Lockhart road and Sturt Highway users.</p> <p>There are two residences located within 1 km of the project area.</p> <p>The nearest townships are at Lockhart and Narranderra, located 21 km south and 27 km northwest, respectively. Due to their distance from the site residents of these townships are unlikely to be affected.</p> <p>Glen Moira</p> <p>The proposed site may have potential to create visual impacts to Sturt Highway road users and nearby rural residents.</p> <p>There are approximately four residences located within 1 km of the project area.</p> <p>The nearest townships are at Lockhart and Narranderra, located 28 km southeast and 23 km northwest, respectively. Due to their distance from the site residents of these townships are unlikely to be affected.</p>	<p>The terrain is gently sloping from north to south at Kywong, and east to south-west at Glen Moira. Strategically placed landscape screening from sensitive receptors (i.e. dwellings within close proximity to the solar farm infrastructure) would significantly reduce the visual impact.</p> <p>Solar farms are designed to reflect only 2% of light received (less than from bodies of water) and are generally not considered to be reflective, and therefore potential glint and glare impacts to surrounding areas are considered to be low.</p>	<p>A visual impact assessment would be undertaken as part of the EIS process and would include 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. The assessment report would include a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners.</p> <p>Community consultation (undertaken as part of the EIS process) will focus on visual impact from Sturt highway and neighbouring dwellings, and will inform the visual impact assessment.</p>
Airfields		
<p>The nearest airfields are located in Narranderra, (Narranderra Airport) approximately 33 km to the northwest of Kywong and 29 km northwest of Glen Moira, and Lockhart (Lockhart Airport) approximately 23 km to</p>	<p>It is unlikely that air traffic would be affected from the glint or glare of the solar panels due to their low reflective quality.</p>	<p>Any potential affects to air traffic would be discussed in the visual assessment, prepared as part of the EIS process.</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
the south of Kywong and 31 km south of Glen Moira.		
Historic heritage		
A search of the Australian Heritage Database was undertaken for the Narrandera LGA, which identified 11 listed items. However, none of the items are located within 10 km of the project area.	Due to the disturbance of the area for primary production, it is unlikely there are any unidentified items of historic heritage in the project area.	As part of the EIS process, an assessment of the likely historic heritage impacts of the development will be undertaken.
Electric and magnetic fields		
<p>Kywong</p> <p>Two 132 kV transmission lines pass through the northern and central sections of the site.</p> <p>A 330 kV transmission line crosses the southern part of the site.</p> <p>The site would connect to one or more of these transmission lines by a centrally-constructed substation.</p> <p>Glen Moira</p> <p>A 132 kV transmission line passes through the centre of the site.</p> <p>The site would connect to the transmission line by a switching station.</p>	<p>DC cabling would run from the combiner boxes to the central inverters.</p> <p>AC cabling will carry 33 kV electricity from the inverters to the solar substation.</p> <p>The cabling, inverters and substation would produce some electromagnetic emissions, however these emissions are expected to be below the guideline for public exposure.</p>	<p>The EIS process would include an assessment of potential hazards and risks associated with transmission infrastructure and the substation against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) <i>Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields</i>.</p>
Bushfire hazard		
The project area is largely cleared of vegetation for agricultural purposes and is not considered to be bushfire-prone land, according to the Rural Fire Service Online Tool (search undertaken 23 Oct 2017).	The proposed project is unlikely to be affected by bushfire or pose a significant bushfire risk.	<p>Bushfire response will be part of emergency management planning for the project.</p> <p>No specific investigation is required as part of the EIS.</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
Battery storage hazard		
Not applicable.	Battery storage systems can potentially pose environmental risks due to the hazardous materials they may contain (such as lithium and acids). The components of the battery storage system can also pose a fire risk.	<p>If a battery storage system is to be included in the project, a preliminary risk screening will be undertaken in accordance with <i>SEPP No33 – Hazardous and Offensive Development and Applying SEPP 33</i> (DoP 2011a).</p> <p>If the preliminary risk screening indicates the development is 'potentially hazardous', a Preliminary Hazard Analysis (PHA) will be prepared in accordance with <i>Hazard Industry Planning Advisory Paper No6 – Guidelines for Hazard Analysis</i> (DoP 2011b) and <i>Multi-Level Risk Assessment</i> (DoP 2011c).</p> <p>The results of the preliminary risk screening and, if required, the PHA, will be included in the EIS.</p>
Contamination		
A search of the NSW EPA did not identify any contaminated sites within the Narrandera LGA.	<p>Existing contamination of the project area could be present as a result of past fertiliser, herbicide, pesticide, and other chemical use on the land, and may be uncovered during excavation works at the site.</p> <p>Only very minor quantities of hazardous materials or dangerous goods will be used or stored on site during project construction or operation of the solar panels and grid connection.</p> <p>Storage and management of hazardous materials or dangerous goods is likely to be required if a battery storage facility is constructed and operated at the sites.</p> <p>Hydrocarbons and hazardous materials onsite would be managed in accordance with the CEMP and relevant EPA guidelines.</p>	<p>Risks associated with existing or project-related contamination are generally low.</p> <p>An assessment of contamination risks would be undertaken as part of the EIS process if a battery storage facility is constructed and operated at the sites.</p> <p>If no battery storage is to be constructed and operated, an assessment of contamination risks would not be required as part of the EIS process – provided that any use of hydrocarbons and hazardous materials is subject to standard management practice.</p>
Waste management		
Not applicable.	The majority of waste will be generated during construction. The project will be managed in accordance with the POEO Act (see Section 4.2.14, and will aim to reduce the volume of waste produced, promote re-use and recycling of materials and to avoid storage and	<p>If a battery storage facility is to be constructed and operated at the sites, then the associated handling and disposal of waste would be addressed in the EIS.</p> <p>If a battery storage facility is not to be constructed and operated, then a</p>

Existing conditions	Preliminary impact assessment and management	Need for further assessment
	<p>waste handling methods that may pose risks to environment or health.</p> <p>Waste material generated during construction will be managed in accordance with waste management procedures, which will form part of the CEMP.</p> <p>Waste requiring special handling and disposal may be generated if a battery storage facility is constructed and operated at the sites.</p>	<p>specific assessment of waste management issues would not be required as part of the EIS process – provided that standard waste management practices are implemented as part of site environmental management.</p>

6 Community and stakeholder consultation

6.1 Consultation activities undertaken

6.1.1 Stakeholder identification and initial consultation

ESCO Pacific has identified a range of groups and individuals that are stakeholders in the development of the Sandigo Solar Farms. The stakeholders include regulators who have a decision-making role in project approvals, and groups or individuals who may be directly or indirectly affected by the project. Initial consultation has included formal and informal engagement with the following:

- Narrandera Shire Council
- Department of Planning and Environment
- Landholders within the proposed project area
- Agencies listed in Section 6.1.2 (as part of the preliminary stages of aboriginal cultural heritage consultation)
- TransGrid (including preliminary grid enquiry)

The consultation to date has provided stakeholders with opportunities to contribute to the project development process and raise any concerns. ESCO Pacific continues to expand its stakeholder database as consultation proceeds.

The council has certain obligations under the *Local Government Act 1993* and the EP&A Act to notify owners of land whose enjoyment of that land may be affected by the proposed development.

6.1.2 Aboriginal Cultural Heritage consultation

ESCO Pacific has commenced the aboriginal cultural heritage consultation process, having undertaken the following:

- Submitted a letter to the following agencies, requesting contact details of RAPs, groups or organisations with a cultural interest in the project area:
 - Office of Environment and Heritage (Albury office)
 - Office of the Registrar Aboriginal Land Rights Act 1983
 - Narrandera Local Aboriginal Land Council
 - Griffith Local Aboriginal Land Council
 - Leeton Local Aboriginal Land Council
 - Wagga Wagga Local Aboriginal Land Council
 - National Native Title Tribunal
 - Narrandera Shire Council
 - NTS Corp (formerly NSW Native Title Service Ltd)
 - Murrumbidgee Catchment Management Authority.
- Submitted advertisements in local and regional newspapers to identify RAPs as follows:
 - Narrandera Argus: Tuesday 24th & Tuesday 31st October 2017
 - The Area News: Monday 23rd & Monday 30th October 2017
 - The Daily Advertiser: Monday 23rd & Monday 30th October 2017

- The Riverine Grazier: Wednesday 25th October and Wednesday 1st November 2017
- The Southern Riverina: Wednesday 25th October and Wednesday 1st November 2017
- Established an email address for contact from relevant stakeholders:
cultural.heritage@escopacific.com.au

6.2 Community and Stakeholder Consultation Plan

The EIS process requires project proponents to undertake detailed consultation with affected landowners surrounding the development, RAPs, the local community and local council. ESCO Pacific will prepare a Community and Stakeholder Consultation Plan which sets out the objectives and requirements for consultation with the identified stakeholders. In addition to those listed in Section 6.1 (above) stakeholders will include:

- adjacent landholders
- local community groups
- Aboriginal groups, including RAPs
- Environment Protection Authority
- Department of Primary Industries
- Roads and Maritime Service
- Rural Fire Service

A formal process of consultation will be implemented in support of the EIS process and in accordance with the requirements set out in the SEARs.

7 Proposed environmental assessment requirements

Based on the preliminary environmental assessment for the proposed Sandigo Solar Farms in Section 5, it is considered that the EIS should address the following specific issues:

- **Biodiversity** – including an assessment of the likely biodiversity impacts of the development in accordance with the *Biodiversity Conservation Act 2016*, a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the *Biodiversity Conservation Act 2016*.
- **Aboriginal cultural heritage** – including an assessment of the likely Aboriginal (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community.
- **Hydrology and water resources** – including:
 - an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including nearby watercourses), adjacent licensed water users and basic landholder rights, details of water supply arrangements, and measures proposed to monitor, reduce and mitigate these impacts
 - a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom 2004).
- **Land use compatibility and impacts** – including an assessment of the impact of the development on agricultural land and flood prone land, and a soil survey to consider the potential for erosion to occur, and paying particular attention to the compatibility of the development with the existing land uses on the site and adjacent land during operation and after decommissioning, with reference to the zoning provisions applying to the land.
- **Traffic and transport** – including an assessment of the site access route, site access point and likely transport impacts of the development on the capacity and condition of roads (including on any Crown land), and a description of the measures that would be implemented to mitigate any impacts during construction.
- **Socio-economic** – including an assessment of the likely impacts of the project on the local community and including consideration of accommodation and other services for construction workers.
- **Noise** – including an assessment of construction noise impacts in accordance with the ICNG, and operational noise impacts in accordance with the NSW Industrial Noise Policy. Should noise levels be likely to exceed relevant criteria, a noise management plan would be developed.
- **Visual amenity** – 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.
- **Historic heritage** – including an assessment of the likely historic heritage impacts of the development.

- **Hazards and electromagnetic interference** – including an assessment of the potential hazards and risks associated with bushfires, transmission infrastructure, the battery storage facility (if constructed) and the switching station against the ICNIRP *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields*.

8 Conclusion

This PEA Scoping Report has been prepared in accordance with the requirements of DPE for projects identified as SSDs and therefore requiring an EIS to be prepared under Part 4 of the EP&A Act. The report will support a request to DPE from ESCO Pacific for the SEARs for the EIS.

Potential environmental and social issues associated with the project have been identified and prioritised as either higher priority or lower priority issues. Based on a preliminary assessment of the potential issues, ESCO Pacific has proposed environmental assessment requirements for consideration by DPE.

A key finding of the PEA Scoping Report is the potential for threatened species habitat to be present within remnant vegetation in the project sites. ESCO Pacific proposes managing the potential presence of threatened species habitat during the EIS process by: undertaking targeted surveys where required to determine the presence of threatened species; and by locating the project footprint where practical so as to avoid impacts on important habitat. ESCO Pacific proposes placing a strong primary emphasis on impact avoidance and a strong secondary emphasis on impact minimisation. The company considers that even with the adoption of a conservative approach to avoidance it will have sufficient space within the Kywong and Glen Moira project sites to locate the solar farms.

The project is expected to be a relatively low risk development compared with many SSDs due to the inherently low impact nature of solar farm construction and operation, and the location of the project in an area that has a long history of disturbance from primary production and is distant from areas of high environmental sensitivity. In addition, the project is expected to result in significant benefits to the local community and State of NSW by generating economic activity, and contributing to the transition to cleaner electricity generation and increased energy security through a more diverse energy mix.

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Attachments

Attachment A: Preliminary Biodiversity Assessment, Sandigo Solar Farms, NSW

October 2017

Preliminary Biodiversity Assessment, Sandigo Solar Farms, NSW



Final Report

Prepared for:

Accent Environmental
and ESCO Pacific

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Cover Photograph

A Grey-crowned Babbler *Pomatostomus temporalis*. Listed as Vulnerable on the *Biodiversity Conservation Act 2017* (NSW).

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Executive Summary

ESCO Pacific is in the early stages of planning for the development of a Solar Farm at Sandigo, NSW. Known collectively at the Sandigo Solar Farms, the four sites are identified as Sandigo North, Sandigo South, Kywong and Glen Moira. Ecolink Consulting was engaged by Accent Environmental, on behalf of ESCO to initiate ecological assessments of the proposed site and begin to identify potential ecological constraints to the development. The purpose of the current assessment was to undertake a preliminary assessment of the extent and quality of habitat for flora and fauna species within the project area. This report collates the information from that assessment and a desktop assessment, to make recommendations about the development of the proposed solar farm and ways to minimise and mitigate its impact on the ecology of the proposed sites.

A site assessment was undertaken between 17–19 October 2017 by Principal Ecologists Dr Stuart Cooney and Simon Scott. Only three of the four considered properties was assessed as access to Sandigo South was not granted. The project area includes a mixture of grazed and cropped paddocks with houses and supporting infrastructure. Native vegetation is largely absent, with scattered paddock trees the only remnants of the historic vegetation communities that once covered the project area. Where more intact native vegetation does occur, it is largely restricted to the boundaries of the project areas, although some areas of grassland (RP8 and RP17) persist within the project area. Dominant crops within the project area include Wheat *Triticum aestivum*, Barley *Hordeum* spp. and Canola *Brassica napus*, grown in rotation, interspersed with years in which the paddocks are sowed with Rye-grass *Lolium* spp. and Lucerne *Medicago sativa* subsp. *sativa* for grazing. There are a large number of dams throughout the project area which appeared to have been lined with clay and this, in combination with regular grazing by sheep, has resulted in the absence of fringing or aquatic native vegetation and low ecological values are attributed to them.

Thirty-seven fauna species were recorded during the field assessment, comprising 33 native bird species, two introduced bird species, one native mammal and one introduced mammal. No amphibians or reptiles were observed during the recent assessments, however the assessments were undertaken in Winter, in cold conditions, that make detecting cold-blooded animals difficult. The state significant Grey-crowned Babbler *Pomatostomus temporalis* and White-fronted Chats *Epthianura albifrons*, which are listed as Vulnerable on the *Biodiversity Conservation Act 2017* (NSW) (BC Act), were the only threatened species recorded during the current assessments. All of the other species recorded in the project area are considered common to the Riverina and agricultural landscapes in southern Australia.

The habitat assessment identified five potential habitats for flora and fauna species. Crops accounted for approximately 2,548ha (74% of the project area) and provided very low quality habitat for native flora and fauna. Grazed pasture accounted for approximately 700ha (20% of the project area) and provided low quality habitat for grassland adapted species, including White-fronted Chats, and potentially for Plains-wanderer *Pedionomus torquatus* and Spotted Harrier *Circus assimilis*, which were not recorded during the current assessment, however this type of habitat is widespread within the landscape and unlikely to be important (e.g. breeding habitat) for any species.

Patches of native vegetation comprised approximately 5% of the project area, mostly on the Sandigo North property. This comprised remnant woodlands and derived grasslands, that would once have been woodland. The quality of these patches was generally low; lacking a native understorey or midstorey and with grazing pressure suppressing recruitment. Nonetheless, a range of threatened

species, including Grey-crowned Babblers, which were recorded on site, and other woodland birds that were not recorded during the current assessment, may inhabit the woodlands, while Plains-wanderer, Spotted Harrier, Bush Stone-curlew *Burhinus grallarius* may find habitat in the grasslands. Where access by stock is limited, threatened flora species such as Sandhill Spider-orchids *Caladenia arenaria* and Silky Swainson-pea *Swainsona sericea* in the woodlands, and *Austrostipa wakoolica* in the higher quality grasslands, may persist.

Scattered paddock trees were observed throughout the project area. These trees comprised a mixture of White Cypress Pine *Callitris columellaris*, Western Grey Box *Eucalyptus microcarpa*, Buloke *Allocasuarina luehmannii* or Yellow Box *Eucalyptus melliodora* (in descending order of dominance), over a highly modified and predominantly exotic understorey. Some of these trees are likely to possess hollows. Hollows are generally a limited resource within the landscape, however the disturbed nature of the project area and broader landscape means that it is unlikely that these trees support any threatened species. The scattered paddock trees may provide nesting substrates for raptors, and two raptor nests, one containing a Wedge-tailed Eagle chick *Aquila audax* and one empty, were recorded. Given the timing of the survey it is unlikely that the threatened Little Eagle *Hieraaetus morphnoides* or Square-tailed Kite *Lophoictinia isura* nest within the project area because no nests were observed.

A final habitat—Dams—were also recorded. These dams are of low ecological value and do not provide significant habitat for any threatened species.

The Narrandera Local Environment Plan 2013 covers parts of the study area. The biodiversity section of this plan aims to protect native flora and fauna, as well as ecological processes. RP15a, RP16 and RP17 in the Glen Moira property, as well as RP10, RP 13 and an area of scattered paddock trees in P22, on the Kywong property, are all mapped as areas of ‘terrestrial biodiversity’ to which the Plan applies.

The desktop assessment identified a number of threatened species that have the potential to occur within the project area and the site assessment revealed that up to 15 threatened fauna species and four threatened flora species have the potential to be impacted by the proposed development:

- Grey-crowned Babbler, classified as Vulnerable on the BC Act;
- White-fronted Chat, classified as Vulnerable on the BC Act;
- Plains-wanderer, classified as Critically Endangered on the EPBC Act and Endangered on the BC Act;
- Sandhill Spider-orchid, classified as Endangered on the EPBC Act and Endangered on the BC Act;
- Silky Swainson-pea, classified as Vulnerable on the BC Act;
- *Austrostipa wakoolica*, classified as Endangered on the EPBC Act and Endangered on the BC Act;
- Mossgiel Daisy, classified as Vulnerable on the EPBC Act and Vulnerable on the BC Act;
- Superb Parrot, which is classified as Vulnerable on the EPBC Act and Vulnerable on the BC Act;
- Bush Stone-curlew, classified as Endangered on the BC Act;
- Little Eagle, classified as Vulnerable on the BC Act;
- Spotted Harrier, classified as Vulnerable on the BC Act;
- Major Mitchell’s Cockatoo, classified as Vulnerable on the BC Act;

- Barking Owl, classified as Vulnerable on the BC Act;
- Masked Owl, classified as Vulnerable on the BC Act;
- Scarlet Robin, classified as Vulnerable on the BC Act;
- Hooded Robin, classified as Vulnerable on the BC Act;
- Diamond Firetail, classified as Vulnerable on the BC Act;
- Varied Sittella, classified as Vulnerable on the BC Act; and,
- Dusky Woodswallow, classified as Vulnerable on the BC Act.

Despite this, the Biodiversity Assessment Methodology calculator proposes surveys for a large number of additional species. To ensure that impacts to these species avoided and the burden of species specific targeted surveys are minimised, the retention and protection of the highest value habitat within the project area is recommended. This comprises the remnant patches of native vegetation and the large, paddock trees, especially those with hollows, where possible. In addition to these features, buffers are recommended to protect them from degradation and indirect impacts. If this is done there is unlikely to be a 'significant' impact to any species listed on EPBC Act and a referral would not be required. Offsets are also likely to be required under the NSW based offsetting system if these impacts cannot be avoided.

In this context, and based on the relevant legislation and policies, the following recommendations are made:

- Avoid areas mapped as native vegetation, especially those identified within the Narrandera Local Environment Plan 2013, where possible;
- Retain large paddock trees, particularly those that contain hollows, where possible;
- Where large paddock trees are identified for retention, provide a buffer, based on the tree's Tree Protection Zone;
- Prepare a Construction and Environmental Management Plan that recommends (as a minimum):
 - Avoiding indirect impacts to protected ecological values and their buffer zones. These areas should be fenced with high visibility fencing prior to the start of construction and maintained during the solar farm's operation;
 - Implementing sediment and erosion control prior to and during construction;
 - Only permitting the importation of soils and materials that are certified as weed-free to avoid the introduction of weeds into the project area;
 - Maintaining vehicle hygiene of vehicles entering and leaving the project area to avoid the introduction of new weed or weed pathogens into the project area;
 - Undertaking weed management prior to, during and post-construction; and
 - Undertaking site rehabilitation post-construction, as appropriate.
- If any of the trees are to be removed, particularly those that contain hollows, an ecologist or wildlife handler should be present during their felling to salvage any that contain resident fauna.

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Introduction

ESCO Pacific is undertaking preliminary investigations of four potential solar farm sites in the Riverina region of New South Wales. Known collectively at the Sandigo Solar Farms, the four sites are identified as Sandigo North, Sandigo South, Kywong and Glen Moira (hereafter the project area: Table 1).

Table 1. Land parcels and owners of the prospective Sandigo Solar Farm

Name	Properties	Area
Kywong	Lot 1 on Plan 576714 Lot 33, 35, 55, 108, 109 on Plan 754550 Lot 4 on Plan 607982, Lot 70, 71 on Plan 754559 Lot 1 on Plan 802754	1109 hectares
Glen Moira	Lot 1 on Plan 576714	313 hectares

The purpose of the current assessment was to undertake a preliminary assessment of the extent and quality of habitat for flora and fauna species within the project area. This assessment includes quantification of habitat for common species, but had an emphasis on habitat, particularly limiting habitat¹, for threatened flora and fauna species listed on the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), the *Biodiversity Conservation Act 2017* (NSW) (BC Act) and the *Fisheries Management Act 1994* (NSW) (FM Act). Species listed as Migratory on the EPBC Act were also considered. The location and extent of remnant native vegetation was also recorded because it is understood that ESCO has scope to modify project footprints and will place a high emphasis on avoiding ecological features or areas of high environmental sensitivity.

Methods

Desktop Assessment

The potential ecological constraints within the project area have been identified based on the following information sources:

- Department of Environment Protected Matters Search Tool to identify Matters of National Environmental Significance under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

¹ Limiting habitat is defined as habitat that that limits the growth, abundance, or distribution of an organism or a population of organisms in an ecosystem.

- Existing threatened species listings under the *Biodiversity Conservation Act 2017 (NSW)*, the *Fisheries Management Act 1994 (NSW)* and *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*.
- Existing records of threatened species observations in the project area, as recorded in the Threatened Species Database in the Atlas of NSW Wildlife (NSW Office of Environment and Heritage 2017a) and BioNet Atlas (NSW Office of Environment and Heritage 2017c).

Site Assessment

A site assessment was undertaken between 17–19 October 2017 by Principal Ecologists Dr Stuart Cooney and Simon Scott. Three of the four properties comprising the project area were walked and/or driven to assess the location and quality of habitats that were present. Ecolink made contact with Kerry Hopwood on 16 October, 2017 to arrange a suitable access time to assess the Sandigo South site, however permission to undertake the surveys was not granted. This site was therefore not visited, although the desktop assessment, and a cursory “over the fence” assessment from neighbouring properties and road reserves was undertaken and the results presented within this report.

Key parameters of the habitats present within each property (such as the presence/absence of shelter, foraging, nesting resources) were recorded to determine the quality of the habitats present. Areas with the highest likelihood of containing native fauna, including threatened species, were inspected more closely in an attempt to inform the presence of these species based on the habitat quality. Active searches were undertaken underneath debris and leaf litter, and signs, tracks and scats were recorded to confirm the presence of particular species or fauna groups. Incidental observations of all fauna species were recorded throughout the assessment.

A list of dominant flora species was maintained throughout the site assessment. Planted species that were not considered weeds (i.e. naturally spreading), were not recorded. The vegetation communities present within the project area were mapped and broadly quantified. This excluded an assessment of the location, size, species and habitat values of all indigenous “Paddock Trees” located within the project area, which is expected to be undertaken at a later date, when a development plan is further advanced.

Limitations and Qualifications

The following limitations and qualifications apply to this report:

- As with all ecological assessments, a greater survey effort is likely to yield additional flora and fauna records. Where these additional flora and fauna records may alter the recommendations made within this report, (e.g. where additional threatened species may utilise habitats within the project area, or where threatened species may be impacted by the proposed development), further assessment may be recommended, depending on the implications of relevant policies and legislation.
- Access to Sandigo South was not provided by the landowners and was undertaken “over the fence” only;
- The current assessment did not inspect or record details of every paddock tree within the project area, however general notes about the types of trees, their age and health were recorded. A more detailed tree survey is likely to be required when likely impacts are known.

- A detailed vegetation assessment of remnant patches under the Biodiversity Assessment Methodology was not undertaken. A more detailed vegetation survey, using this method, is likely to be required when likely impacts are known.
- It became apparent during the field assessment that some of the external fences did not coincide with cadastral property layer provided used for the mapping in this report. Where this has occurred, and where it was deemed to be relevant to the results of the assessment, vegetation was mapped beyond the external fences of the properties, to ensure that the location of native vegetation, native flora and fauna habitats, or threatened species were captured during the assessment. Therefore, some of the figures presented in tables are approximate based on remote and on-site mapping, including additional areas of native vegetation where it was unclear if fences were situated accurately on title boundaries.
- Grazing by sheep on some paddocks increased the difficulty in identifying some plant species, especially grasses. Some species were unable to be identified to species level because of the lack of fertile material or diagnostic features on the inflorescence.
- Some fauna species may only be recorded during certain times or seasons (e.g. nocturnal mammals and birds, migratory birds, or fauna identified through seasonal breeding calls such as some frog species). The author has made an informed decision about the likely presence of threatened species that may be present, or that may utilise habitats within the project area, based on a detailed desktop assessment, a review of the species' biology, and an understanding of the ecological values of the local area.

Despite these limitations to the assessment, the results gained by both a desktop and a field assessments are adequate to address the purpose of this report.

Results

Project area

The Sandigo Solar Farms are located south of the Sturt Highway, on the outskirts of Narrandera, New South Wales, approximately 70 kilometres north-east of Wagga Wagga (Figure 1). The combined project area is approximately 3450 hectares in size.

The properties that comprise the project area are similar to those surrounding it. These surrounding properties generally support very little native vegetation, apart from scattered paddock trees and vegetation within road reserves, or fringing the boundaries of the property.

Buckingbong State Forest is a large (approximately 12,000 hectares), intact block of remnant Plant Community Type (PCT) 80: Western Grey Box – White Cypress Pine tall woodland that is likely to represent the condition of the project area, prior to its development for agricultural production. Buckingbong State Forest is located on western boundary of the Sandigo North and Sandigo South properties. It is the largest remaining patch of this type of woodland in the NSW Murray Catchment (Herring and McGregor 2008). The Murrumbidgee River is located approximately 10 kilometres north and west of the project area, whereas Sandy Creek, which is a tributary of the Murrumbidgee River, is located nearer to the northern boundary of the Kywong and Glen Moira properties, to the north of the Sturt Highway.

The Narrandera Local Environment Plan 2013 covers parts of the study area. The Narrandera Local Environment Plan 2013 provides regulatory guidance on the future development of the Narrandera Shire. The objective of the section that relates to biodiversity aims to protect native flora and fauna, as well as ecological processes, by encouraging conservation and recovery of native flora and fauna and their habitats. The accompanying map indicates that, in the Glen Moira property, RP15a, RP16 and RP17 are all mapped as areas of ‘terrestrial biodiversity’ to which the Plan applies. On the Kywong property, RP10, RP 13 and an area of scattered paddock trees in P22 are also mapped as areas of ‘terrestrial biodiversity’.

Flora Species

The properties that comprise the project area are a mixture of grazed and cropped paddocks with houses and supporting infrastructure (driveways, silos, sheds) (Table 2; Figure 1; Appendix 1). Crops within the project area include Wheat *Triticum aestivum*, Barley *Hordeum spp.* and Canola *Brassica napus*. All three of these crops (or a limited combination of two of them at some land holdings) are grown in rotation, interspersed with years in which the paddocks are sowed with Rye-grass *Lolium spp.* and Lucerne *Medicago sativa* subsp. *sativa* or other crops that are nitrogen fixing and return nutrients to the soil, and are also suitable for grazing. In these years, sheep graze the paddocks keeping the biomass low. Some paddocks are more permanently planted with Saltbush *Atriplex sp.*, which is used for stock feed at times of low rainfall or biomass.

Native vegetation is largely absent from the project area, with scattered paddock trees the most obvious remnants of the historic vegetation communities that once covered the area. Despite this, some areas of native vegetation remain around the edges of the project area and in the road reserves that adjoin the project area. Most of this vegetation consists of an overstorey of White Cypress Pine *Callitris columellaris*, Western Grey Box *Eucalyptus microcarpa*, Buloke *Allocasuarina luehmannii* or Yellow Box *Eucalyptus melliodora* (in descending order of dominance), over a highly

modified and predominantly exotic understorey. The mid-storey is largely absent, and recruitment is limited or excluded by regular grazing, and ongoing soil disturbances from cultivation and cropping. Higher quality understorey was found in two areas (RP8 – Sandigo North and RP17 – Glen Moira), where there was a greater diversity of native species, including annuals.

Table 2. Land Use within the project area.

Land Use	Kywong	Glen Moira
Crop	1,111.6 66%	262.4 55%
Grazing	504.3 30%	161.7 34%
Planted	9.5 1%	4.6 1%
Roads	10.4 1%	1.7 0%
Native Vegetation	42.9 3%	47.6 10%
Total	1678.6	478.0

These areas generally included an overstorey of the aforementioned species. The midstorey was sparse with only occasional occurrences of Wattles such as Mallee Wattle *Acacia montana* and Varnish Wattle *Acacia verniciflua*. Understorey species generally observed within these areas included Rigid Panic *Walwhalleya proluta*, Rough Spear-grass *Austrostipa scabra* subsp. *falcata*, Supple Spear-grass *Austrostipa densiflora*, Common Wallaby-grass *Rytidosperma caespitosum*, Bristly Wallaby-grass *Rytidosperma setaceum*, Brown-back Wallaby-grass *Rytidosperma duttonianum* and Windmill Grass *Chloris truncata*. It also included saltbushes such as Berry Saltbush *Atriplex semibaccata*, Nodding Saltbush *Einadia nutans* and Ruby Saltbush *Enchylaena tomentosa*.

A list of flora species recorded during the current assessment is provided in Appendix 2.

There are a large number of dams throughout the project area (Figure 1). Generally these dams generally appeared to have been lined with clay and this, in combination with regular grazing by sheep, has resulted in the absence of fringing or aquatic native vegetation (Plate 1). Modelling shows that unnamed creeks would have historically bisected the Sandigo North property, into the Sandigo South and were also present in the Kywong properties. Whilst there remains some evidence of these creeks, this is demonstrated by in different growth rates of the crop that is sowed within them (Plate 2), they do not retain banks, nor retain water (at the time of the assessment). No natural wetlands or swamps were observed during the current assessment.



Plate 1. Typical dam lacking fringing and aquatic vegetation



Plate 2. Changes in height signifying the location of creek lines

Fauna Species

Thirty-seven fauna species were recorded during the field assessments (Appendix 3). This included 33 native bird species, two introduced bird species, one native mammal and one introduced mammal. Most of the species recorded are considered common to the Riverina and agricultural landscapes in southern Australia. Grey-crowned Babblers *Pomatostomus temporalis*, listed as Vulnerable on the *Biodiversity Conservation Act 2017* (NSW), were recorded at Sandigo North, Kywong and the road reserve adjacent to Glen Moira (Figures 1a–c). White-fronted Chats *Epthianura albifrons* were recorded throughout the project area (except for the Glen Moira property) on fences. This species is also listed as Vulnerable on the *Biodiversity Conservation Act 2017* (NSW).

Two large stick nests were observed during the current assessment (Plates 3 and 4; Figure 1a and 1c). The nest on Sandigo North was empty. The nest on Kywong contained a nestling Wedge-tailed Eagle *Aquila audax* (Plate 5). At this same location, a roosting nest of Grey-crowned Babblers was also located (Plate 6). Grey-crowned Babblers usually build a number of nests that are not used for egg-laying, but provide shelter for the family group overnight (Higgins and Peter 2002).

No amphibians or reptiles were observed during the recent assessments. Nonetheless, it is expected that the project area supports a range of amphibians and reptiles, particularly in the higher quality habitats.



Plate 3. Large stick nest on Sandigo North



Plate 4. Wedge-tailed Eagle nest on Kywong



Plate 5. Wedge-tailed Eagle nestling



Plate 6. Grey-crowned Babbler roosting nest

Threatened flora and fauna

A total of 76 threatened flora and fauna species have either been recorded within 10kms of the project area, or a predicted to occur based on the databases consulted for the desktop review (Appendix 4). This comprises 45 birds, nine mammals, two amphibians, one reptile, three fish and 16 plants. Amongst these species, only five birds and one plant have previously been recorded within the vicinity of the project area based on the historical records in the NSW Threatened Species database (NSW Office of Environment and Heritage 2017c). These included two records of Spotted Harrier (both in 2014), one of Brolga (1982), Plains-wanderer (1967), Superb Parrot (1995), Grey-crowned Babbler (2003), and two of a spear-grass *Austrostipa wakoolica* (both in 2000). Grey-crowned Babbler was also observed within the project area during the current assessment.

Twenty-nine species listed as threatened species on the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) have either been recorded within 10kms of the project area, or are predicted to occur based on the databases consulted for the desktop review (Appendix 4). A further eight species are listed as Migratory species under the Act. Of these species, five have a moderate² or greater chance of occurrence within the project area, based on the habitats observed during the site assessment. These species are discussed in greater detail below.

Eighteen species listed as Endangered on the *Biodiversity Conservation Act 2017* (NSW), have either been recorded within 10kms of the project area, or a predicted to occur based on the databases consulted for the desktop review (Appendix 4). A further 45 species are listed as Vulnerable. Some of these species are also listed on the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). Two of these species, Grey-crowned Babblers and White-fronted Chats were observed within the project area, while another 19 species listed on the *Biodiversity Conservation Act 2017* (NSW), have a moderate chance of occupying the project area either regularly or on occasion, when conditions are suitable. These species are discussed in greater detail below. Regent Honeyeaters *Anthochaera phrygia* is the only Critically Endangered species on the *Biodiversity Conservation Act 2017* (NSW), that is predicted to occur.

There are also two fish species, listed as Critically Endangered and Endangered on the *Fisheries Management Act 1994* (NSW), that are predicted to have habitat within or surrounding the project

² See notes to Appendix 4 for the explanation of the likelihood of presence

area, however as there are no natural waterways within the project area, these fish are highly unlikely to occur.

Habitats Recorded

The habitat assessment identified five potential habitats for flora and fauna species:

- Crops;
- Grazed pasture;
- Patches of native vegetation;
- Scattered paddock trees; and,
- Dams.

Crops

The cropped paddocks within the project area comprise approximately 2,548.5 hectares (approximately 78% of the project area) (Figure 1). Crops included a range of species at different stages of their lifecycle or consisted of bare ground in preparation for the seeding and growing season (Plates 7 and 8). All of the crops were advanced at the time of the assessment and due for harvest within the coming month (November).



Plate 7. Wheat crop within the project area



Plate 8. Canola crop within the project area

The crops generally provide very low quality habitat for a range of species including small mammals, reptiles and grassland birds. At the time of the assessment, the crops are likely to provide foraging and dispersal habitat for species such as snakes, lizards, native mice. In these locations birds such as Brown Songlarks *Cincloramphus mathewsi*, Rufous Songlarks *Cincloramphus mathewsi* and Golden-headed Cisticolas *Cisticola exilis* were observed within these paddocks. Seed eating birds, such as Red-rumped Parrots *Psephotus haematonotus* and Zebra Finch *Taeniopygia guttata* were also recorded in these locations. The cropped areas of the project area are unlikely to important provide habitat to any of the threatened species listed in Appendix 4 on a regular basis, with the exception of White-fronted Chats, Plains-wanderer *Pedionomus torquatus* and Spotted Harrier *Circus assimilis*. White-fronted Chats were observed on fences adjoining the cereal crops and are likely to forage within these crops. Plains-wanderer may occur within the project area after the harvest of the cereal crops. The owner of Glen Moira stated that in some years, when the crop is poor he doesn't burn the stubble of the crop after harvest (Geoff Wright, 19 October 2017, pers comm.). In these years, the low vegetation that remains, along with a relatively wide inter-tussock space makes these

stubble paddocks suitable for Plains-wanderer. This species is discussed in greater detail below. Spotted Harriers hunt over grasslands, including crops, for ground dwelling birds, such as quail (Marchant and Higgins 1993). The cropped paddocks are likely to provide abundant habitat for this species as it hunts within its territory. None of the other species listed in Appendix 4 are likely to have limiting habitat within these areas.

Grazed Pasture

Pastured paddocks within the project area account for approximately 700 hectares (20%) of the entire site (Figure 1, although there were no sheep at Sandigo North at the time of the current assessment). These paddocks were grazed by sheep during the current assessment. All of these paddocks are cropped in rotation, so have been regularly ploughed over the last century. The vegetation was dominated by exotic species, including a range of pasture grasses and environmental weeds. The height of the vegetation was generally low (less than 5cm in height) due to grazing pressure (Plates 9 and 10).

Like the crops, the grazed paddocks potentially provide low quality habitat for a range of species including small mammals, reptiles and grassland birds. However, because grazing intensity of these paddocks is so high, there is little exploitable habitat within these areas that would favour dispersal or foraging for most species. Some grassland birds, such as the Rufous and Brown Songlarks previously mentioned, as well as White-fronted Chats and Australasian Pipits *Anthus australis* that were observed during the current assessment may hunt insects within these areas. Despite the presence of scattered paddock trees, sometimes in moderate density, the lack of a native understorey or any sort of midstorey means that these areas could not be described as a woodland, but a better described a derived grasslands of the woodlands that they once supported (and still present in limited extent). These paddocks are also likely to improve in habitat value as they spend a greater amount of time uncropped. During this period, the soil is likely to stabilise and recruitment of native species from nearby source populations is likely to increase.



Plate 9. Grazed paddock, in the Kywong property



Plate 10. Grazed paddock in the Glen Moira property

Of the threatened species listed within Appendix 4, a small number of birds may use these areas on occasion. Plains-wanderer and Spotted Harrier, may both exploit resources within these grasslands on occasions as discussed above. Yellow Wagtails *Motacilla flava* are predicted to occur by the modelling used by the Protected Matters Search Tool (PMST) (Department of the Environment and Energy 2017). This species is very uncommon in southern Australia (Higgins *et al.* 2006), so although

suitable habitat for this species may occur within these areas, it remains highly unlikely that the project area would support this species.

Patches of Native Vegetation

Patches of native vegetation were largely restricted to the boundaries of the project area and the adjacent road reserves. Approximately 5% of the project area (169 hectares) is covered by native vegetation (Table 2), with most of this vegetation occurring on Sandigo North (79.4 hectares: Figure 1a). Sandigo North also supported native vegetation within the project area, near the middle of the property, where a moderately high quality patch of grassland persists (RP8; Plate 11). More native vegetation is located in the south of this property, and this vegetation appeared to continue onto Sandigo South, based on observations from the southern boundary of Sandigo North. Glen Moira has the greatest proportion of native vegetation, with approximately 10% of this property covered by native vegetation. This property also adjoined the highest quality road reserves, within the reserve of the Sturt Highway in the north and Thornleigh Park Road (Figure 1b), which are also identified by the Narrandera Local Environment Plan 2013 as important areas of terrestrial biodiversity.

A range of species were associated with these areas. This included Eastern Grey Kangaroos *Macropus giganteus* that were loafing in the shade provided the trees in these locations. Birds, such as Apostlebirds *Struthidea cinerea*, Weebills *Smicrornis brevirostris*, Yellow-rumped Thornbills *Acanthiza chrysorrhoa* and Eastern Rosellas *Platycercus eximius* were recorded in these areas.

Two broad types of native vegetation were observed: remnant woodlands and derived grasslands

Remnant Woodlands

Most of these remnant patches were grazed, or unfenced, allowing access by stock when they were present. This reduced the recruitment of young plants and effectively removed the mid-storey, which is sparse the in the vegetation communities present within the project area anyway (Plate 12). This was particularly apparent when contrasted with the dense vegetation present within the Buckingbong State Forest, where introduced grazers are largely absent (although a single Feral Goat was observed within the forest). This reduces the value of the patches for a range of species as it allows larger, more dominant birds, such as Noisy Miners *Manorina melanocephala* to drive smaller birds away.



Plate 11. High quality grasslands, showing native grasses and annuals in the Sandigo North property



Plate 12. Patch of native vegetation lacking native understorey in the Glen Moira property

Despite these limitations, the woodland patches of native vegetation did support at least one threatened species. Grey-crowned Babblers were recorded at all three sites that were inspected, or adjacent to them. Other threatened fauna species, such as Diamond Firetail *Stagonopleura guttata*, Dusky Woodswallow *Artamus cyanopterus cyanopterus*, Scarlet *Petroica boodang* and Hooded Robins *Melanodryas cucullata cucullata*, Varied Sittella *Daphoenositta chrysoptera*, Barking Owl *Ninox connivens connivens*, Major Mitchell's Cockatoo *Lophocroa leadbeateri* and Superb Parrot *Polytelis swainsonii* may all find foraging and/or nesting habitat in those patches that retain woodland characteristics, despite the lack of native understorey, particularly those that form corridors with more intact vegetation along roadsides and connecting to Sandy Creek.

Derived Grasslands

Moderately high quality derived grasslands were recorded from Sandigo North (RP8, shown in light blue) and Glen Moira (Patch RP17, shown in pale green), with lower quality derived grasslands recorded elsewhere on these properties (Patches RP 4, 5, 6, and 7). RP17 is also identified by the Narrandera Local Environment Plan 2013 as important areas of terrestrial biodiversity. Sheep were absent from Sandigo North at the time of the assessment, so despite the lack of fences, these recently undisturbed grasslands had developed moderate native species diversity and structure. On the Glen Moira property, the removal of topsoil from a rocky knoll had resulted in it being undisturbed for some period of time, which has resulted in the recolonization of native species, including annuals, to this location. Native grasslands were not recorded on the Kywong property.

In these areas where the overstorey is absent but remnant grasslands persist, birds such as Plains-wanderer, Spotted Harrier, Bush Stone-curlew *Burhinus grallarius* may find habitat. Threatened flora species that may occur within these areas include Sandhill Spider-orchids *Caladenia arenaria* and Silky Swainson-pea *Swainsona sericea* in the woodlands, and *Austrostipa wakoolica* in the higher quality grasslands.

Scattered Paddock Trees

Scattered paddock trees were recorded throughout the project area, within both cropped and grazed paddocks (Figure 1). These trees largely comprised four species, dominated by White Cypress Pine, Buloke, Western Grey Box and Yellow Box. All of these trees were mature specimens with no sign of recruitment observed anywhere in the project area. Some of these trees were dead and dying, although few hollows were observed. The dominance of non-*Eucalyptus* species meant that most of the scattered paddock trees are species that generally do not form hollows and readily as Eucalypts. Despite this, hollows are generally a limited resource within the landscape (Gibbons and Lindenmayer 2002; Gibbons *et al.* 2002; Lindenmayer *et al.* 1994), which makes trees that do support hollows of greater ecological value than trees that do not support hollows. Species likely to use these tree hollows include Common Ringtail Possums *Pseudocheirus peregrinus*, Common Brushtail Possums *Trichosurus vulpecula* and the microbats discussed above, as well as a wide variety of birds, particularly parrots and cockatoos, as well as, potentially, owls.

The trees are isolated within the landscape and the lack of other vegetation strata reduces the quality of the habitat for woodland dependent species (Plates 13 and 14). Nonetheless, the scattered paddock trees are likely to provide habitat to a range of common bird and arboreal mammal species. This is likely to include gregarious bird species such as Noisy Miners, Galahs *Eolophus roseicapilla*, Red-rumped Parrots *Psephotus haematotus* and Eastern Rosellas. Smaller

birds are likely to be restricted to the canopy, such as Striated Pardalotes *Pardalotus striatus* and Weebills. Mammals such as Common Brushtail Possums and Common Ringtail Possums are also likely to forage in the canopy of these trees, whilst micro-bats are likely to use the fissures and flaking bark as diurnal roosting locations, although these species were not observed during the current diurnal assessments. An area of scattered paddock trees on P22 has also been identified by the Narrandera Local Environment Plan 2013 as important areas of terrestrial biodiversity. The trees in this area were denser than in surrounding paddocks, and it was also in this area that one of the flocks of Grey-crowned Babbler were observed.



Plate 13. Scattered paddock tree area in the Kywong property



Plate 14. An example of an isolated, scattered, paddock trees in the Sandigo property

The scattered paddock trees may provide habitat to some of the large, more mobile threatened species listed in Appendix 4, such as Little Eagle *Hieraaetus morphnoides*, and Superb Parrots, as they pass through the project area on occasion, when moving between higher quality habitat. However the trees within the project area do not form a habitat corridor between higher quality habitat, such as occurs within the riparian vegetation associated with Sandy Creek, and, further afield, the Murrumbidgee River, so this is not likely to be a common occurrence. The trees may provide the substrate for nests of threatened birds of prey, such as Little Eagle and Square-tailed Kite *Lophoictinia isura*. Both of these species build stick nests that are relatively large and conspicuous (Marchant and Higgins 1993). Neither of the two nests observed supported these species at a time when nesting would be expected, and it is therefore concluded that these species do not currently nest within the project area. Major Mitchells Cockatoos and Superb Parrots nest in hollows in trees, similar to those within some of the trees within the project area. Major Mitchells Cockatoos are likely rare visitors to the project area, with this species' core range generally further west in more arid habitat. Superb Parrots are more common within the region (and two birds were seen during the current assessment near Narrandera, more than 15 kilometres from the project area and in association with River Red-gum *Eucalyptus camaldulensis*, which is presents higher quality habitat for the species). Nests of both of these species are usually associated with watercourses (Higgins 1999). There is therefore a low likelihood that the trees within the project area are breeding resources for either of these species, although an assessment of hollow bearing trees during the breeding season of these species may be warranted if hollow bearing trees are proposed to be impacted by the proposed development.

Dams

Dams were located throughout the project area, on all four properties (Figure 1a–c). These dams lacked fringing vegetation or aquatic emergent or submerged vegetation. They therefore provided extremely low habitat value for most species (Plates 15 and 16). Nonetheless, some ducks, Australian Wood Duck *Chenonetta jubata*, Pacific Black Duck *Anas superciliosus* and Grey Teal *Anas castanea*, and Australasian Grebes *Tachybaptus novaehollandiae* were recorded from these dams. Other species, such as Crested Pigeons *Ocyphaps lophotes* were also frequently recorded near the dams and Welcome Swallows *Hirundo neoxena* were observed hawking for insects over the waterbodies.



Plate 15. Dam on the Sandigo North property, showing the clay lining contrasting to the surrounding natural soils



Plate 16. Dam on the Kywong property, surrounded by exotic vegetation.

None of the threatened species listed in Appendix 4 are likely to use these dams. Growling Grass Frogs *Litoria raniformis* require a high level of aquatic and fringing vegetation, which was absent from the dams within the project area. This is also true for Australasian Bitterns *Botaurus poiciloptilus*, Brolgas *Grus rubicuada* and the Snipes. The remaining shorebirds require exposed mud-flats that are permeable to invertebrates on which they feed. The clay-lined dams within the project area provide very low quality foraging habitat, and it is very unlikely that any of these species would rely of food resources from these locations.

Discussion

The majority of the project area is highly disturbed and devoid of remnant vegetation. Grazed and cropped paddocks comprise 94% of the project area and these areas are ploughed yearly whilst under crop, and left to pastures for a maximum of three years before being ploughed and set to crops again. In the case of the Kywong property, this has occurred since approximately 1907 (Mark Geppart, pers comm. 18 October 2017). The result of this disturbance is the loss of the vast majority of the native vegetation that once occurred within the project area, and the simplification of the vegetation to be dominated by a small number of exotic species. The simplistic diversity within most of the paddocks has significantly decreased the ecological value of the project area to the majority of species that would have once occurred, and the loss of high quality habitat for all except threatened fauna species (Plains-wanderer, discussed in greater detail below). Some common species of bird have adapted well to this type of disturbed landscape, however most native species will be excluded from the project area because it lacks the important resources that they require to persist within the area.

Within these disturbed areas, large numbers of isolated paddock trees were observed. These trees are likely to provide resources to native species because they are remnants of the native vegetation that once covered the landscape. These trees are also likely to provide foraging habitat for a range of bird and mammal species, as well as invertebrates upon which these animals feed. Some of these trees are likely to possess hollows that are likely to be a valuable and limiting resource in the landscape for a range of bird and arboreal mammal species. A small number of plantations were also observed, comprising Australian native (but not locally indigenous) and exotic species. These areas are likely to provide similar ecological values to some bird and mammals species.

Largely confined to the fringes of the three assessed project areas, native vegetation was recorded in approximately 5% of the project area. These areas of native vegetation were generally narrow and linear. In most instances the understorey was grazed by sheep, reducing the biomass of the understorey, and effectively excluding the mid-storey and recruitment opportunities for the over-storey species (Appendix 1). Despite this, RP10, RP13, and an area of scattered trees in P22 in the Kywong property and RP15a, RP16 and RP17 on the Glen Moira property are identified as areas of 'terrestrial biodiversity' in the Narrandera Local Environment Plan 2013.

There are few records of threatened flora and fauna species within 10kms of the project area and none from within it (Figure 2) (NSW Office of Environment and Heritage 2017c). However the state significant Grey-crowned Babbler was recorded during the recent assessment at all three assessed properties and it is likely that there have been few ecological surveys of the project area in the past. Nonetheless, because of the low quality habitat that dominates the project area and the surrounding landscape, it is unlikely that many threatened species persist within the project area. Despite this, 20 species with a moderate chance of occurring within the project area on at least an occasional basis have been identified. Each of these is discussed below in order of likelihood of occurrence and then potential significance to the project.

Grey-crowned Babbler *Pomatostomus temporalis temporalis*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence³

Confirmed Present

Grey-crowned Babblers were recorded at four locations during the current assessment: on the eastern boundary of the Sandigo North property (Figure 1a); within the road reserve of Thornleigh Park Road, just beyond the western boundary of the Kywong property (Figure 1b); near an abandoned homestead, north of Kywong Road on the Glen Moira property and in a small patch of trees within a grazed paddock near the north-eastern corner of the Glen Moira property (Figure 1c). There is a further, historic record of Grey-crowned Babblers on Greenvale Road, south of the project area (Figure 2) (NSW Office of Environment and Heritage 2017a).

Grey-crowned Babblers occur in woodlands, open forests and farmlands (Pizzey and Knight 2012). They require a sparse ground cover, with logs and leaf litter (Higgins and Peter 2002). The species is a co-operative breeder that retains territories throughout the year, with few movements recorded (Higgins and Peter 2002). A breeding group typically consist of a breeding pair and three to four non-breeding helpers (Higgins and Peter 2002). A roosting nest was observed at the Glen Moira property (Plate 6), and it is likely that other nests occur within the 10 hectare territory that is typical of this species (Higgins and Peter 2002).

Key threatening processes for this species that are applicable to the project area are:

- *“Loss, degradation and fragmentation of woodland habitat on high fertility soils.*
- *Excessive total grazing pressure and loss of coarse woody debris is resulting in degradation and loss of important habitat components.*
- *Infestation of habitat by invasive weeds including exotic perennial grasses. These weeds are very aggressive and form dense grass swards covering inter-tussock spaces preventing access to leaf and stick litter where babblers commonly forage for invertebrates”* (NSW Office of Environment and Heritage 2017g).

Mitigation Measures/Further Action

As this species has been confirmed as being present on site, no further surveys are required. It is recommended that native vegetation is retained where possible, in particular in locations where the species has been recorded, to maintain the territories of these animals and woodland remnants.

If native vegetation is to be impacted, following consultation with regulators, it may be necessary to map home ranges of each of the four groups of Babblers.

³ See notes to Appendix 4 for the explanation of the likelihood of presence

White-fronted Chat *Epthianura albifrons*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence⁴

Confirmed Present

White-fronted Chats were recorded at three locations during the current assessment on the Sandigo North and Kywong properties (Figure 1a-b). Groups of up to eight birds were recorded on fencelines near cropped paddocks.

White-fronted Chats are generally found in association with water and open damp habitats, often near wetlands (Higgins *et al.* 2001). They are regularly encountered in these open habitats on fences and at the top of bushes that emerge from the undergrowth (Pizzey and Knight 2012). Their diet consists of invertebrates, and occasionally seeds (Higgins *et al.* 2001).

Key threatening processes for this species that are applicable to the project area are:

- “Reduction in habitat size and quality.
- Human disturbance (particularly in urban areas) and elevated nest-predation levels.
- Much of their natural habitat is prone to alteration due to modification of river flows and floodplains.
- Prone to predation from snakes and mammals, particularly Feral Cats, European Red Foxes and rodents, as well as birds, particularly ravens” (NSW Office of Environment and Heritage 2017r).

Mitigation Measures/Further Action

As this species has been confirmed as being present on site, no further surveys are required. It is recommended that native vegetation is retained where possible, in particular in locations where the species has been recorded, to maintain the territories of these animals and woodland remnants.

Fork-tailed Swift *Apus pacificus* and White-throated Needletail *Hirundapus caudacutus*

Conservation Status

EPBC Act: Migratory
BC Act: Not listed

Assessment of likelihood of presence

High

⁴ See notes to Appendix 4 for the explanation of the likelihood of presence

Fork-tailed Swifts and White-throated Needletails spend the Austral summer in southern Australia (Higgins 1999) and are likely to pass through the landscape during their migration. Both species are aerial insectivores that are likely to forage above the project area, in advance of low-pressure fronts. There are no records of either of these species within 10kms of the project area (NSW Office of Environment and Heritage 2017a). The project area does not provide important or limiting habitat for either of these species and the development of the project area is unlikely to have any impact on these movements.

Mitigation Measures/Further Action

None recommended

Plains-wanderer *Pedionomus torquatus*

Conservation Status

EPBC Act: Critically Endangered

BC Act: Endangered

Assessment of likelihood of presence

Moderate

Plains-wanderers are small quail-like birds of open plains and grasslands. Habitat for the species includes 'treeless, species-rich, lowland native grasslands with approximately 50% bare ground, 40% herbs and grasses and 10% fallen litter, with grass tussocks spaced around 10-20 cm apart and most vegetation less than 5 cm in height' (Commonwealth of Australia 2016, p. 13). At the time of the current assessment there was very little of this habitat present within the project area, although Paddock RP8 on Sandigo North and Paddock RP17 on Glen Moira, may provide low quality version of this type of grassland. Plains-wanderers are also occasionally found in cereal crops and cereal stubble (Commonwealth of Australia 2016), which the project area, at certain times of the year, provides in abundance. However it is not known if these habitats can support a population of Plains-wanderers, if these birds are moving through this habitat to more suitable habitat, or if they are forced into these conditions because of the loss and lack of habitat within the landscape (Commonwealth of Australia 2016). Critical habitat identified for the Plains-wanderer includes large parts of the Riverina, including near Narrandera, however, neither primary nor secondary habitat for this species is identified within 15kms of the project area (Appendix 5). Furthermore, there has been a 84% decline in the population size of the Plains-wanderer to 2014, with fewer than 1000 birds left in the wild (Commonwealth of Australia 2016). This is due to the modification and loss of habitat, with secondary threats from the size of the population and predation by cats and foxes (Commonwealth of Australia 2016). However, there is one historical records of this species from within 10kms of the project area, located south of the Kywong property, although this was from 1967, prior to the crash in the population of Plains-wanderers (NSW Office of Environment and Heritage 2017a).

There is only a low likelihood that Plains-wanderer persist within the project area, however given the size of the population, should any be found, they would be a significant observation with consequences under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

Mitigation Measures/Further Action

Avoidance of the two relatively higher conservation value remnant grasslands is recommended. If these areas cannot be avoided a nocturnal transect survey in spring and summer, for Plains-wanderers is recommended. Depending on the result of this assessment a referral may be recommended under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) as a potentially significant impact to a Matter of National Environmental Significance.

Sandhill Spider-orchid *Caladenia arenaria*, Mossgiel Daisy *Brachyscome papillosa*, Silky Swainson-pea *Swainsona sericea* and Spear Grass *Austrostipa wakoolica*

Conservation Status

	Sandhill Spider-orchid	Silky Swainson-pea	<i>Austrostipa wakoolica</i>	Mossgiel Daisy
EPBC Act:	Endangered	-	Endangered	Vulnerable
BC Act:	Endangered	Vulnerable	Endangered	Vulnerable

Assessment of likelihood of presence

Moderate

Sandhill Spider-orchid occurs in woodland with sandy soil, especially that dominated by White Cypress Pine (NSW Office of Environment and Heritage 2017l). Silky Swainson-pea is usually found in Box-Gum Woodlands in the Southern Tablelands and South West Slopes, near the project area, however it is also sometimes found in association with Cypress-Pines (NSW Office of Environment and Heritage 2017n). A Spear Grass *Austrostipa wakoolica* grows in a range of habitats on a range of soils, including sandy Cypress Pine woodlands (NSW Office of Environment and Heritage 2017o). While Mossgiel Daisy is predominantly found in Saltbush and Bluebush shrublands, it also occurs in Cypress Pine woodlands (NSW Office of Environment and Heritage 2017k). Each of these habitats are found within the project area. Furthermore, there are two historical records of *Austrostipa wakoolica* from within 10kms of the project area, located north of the Glen Moira property on the Sturt Highway (NSW Office of Environment and Heritage 2017a). Each of these species is threatened by habitat reduction and modification from pastoral development, irrigation and altered flooding regimes, as well as increases in grazing pressure from exotic and native species (NSW Office of Environment and Heritage 2017k; NSW Office of Environment and Heritage 2017l; NSW Office of Environment and Heritage 2017n; NSW Office of Environment and Heritage 2017o).

Mitigation Measures/Further Action

Avoidance of native vegetation and historically uncultivated paddocks within the project area is recommended. If these areas cannot be avoided a spring transect survey for threatened flora species is recommended. Depending on the result of this assessment, if a population of Sandhill Spider-orchid *Austrostipa wakoolica* or Mossgiel Daisy is located, a referral may be recommended under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) as a potentially significant impact to a Matter of National Environmental Significance.

Superb Parrot *Polytelis swainsonii*

Conservation Status

EPBC Act: Vulnerable

BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

The core range of the Superb Parrot is the riparian woodlands and forests of the Murrumbidgee and Murrays Rivers (Higgins 1999). Although they are usually located near water, they disperse into the open woodlands of the surrounding plains (Higgins 1999). They are regularly found in crops, including cereal crops, as well as grazing land where scattered trees persist (Higgins 1999). There is one historical records of this species from within 10kms of the project area, located just beyond the project area near the Sandigo North property (NSW Office of Environment and Heritage 2017a), however they may occur throughout the project area to feed. Despite this, this species may occur and has the potential to nest or feed within trees throughout the project area (NSW Office of Environment and Heritage 2017i). Superb Parrots nest in the hollow spouts of large *Eucalyptus* trees—predominantly River Red-gums, but also Grey Boxes (Higgins 1999). Threats to the species are poorly known, however loss of habitat and persecution by humans are key threats that have been identified (NSW Office of Environment and Heritage 2017p).

Mitigation Measures/Further Action

Once the footprint of the development is known, a spring nest survey is recommended for all hollow bearing scattered trees that may be impacted by the development. Depending on the result of this assessment a referral may be recommended under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) as a potentially significant impact to a Matter of National Environmental Significance. At this stage, this would seem unlikely, however more certainty will follow a spring survey.

Bush Stone-curlew *Burhinus grallarius*

Conservation Status

EPBC Act: Not listed

BC Act: Endangered

Assessment of likelihood of presence

Moderate – Sandigo North and South

Bush Stone-curlews live in open woodlands and forests, including partially cleared farmland, with an open understorey (Marchant and Higgins 1993). They roost and nest on the ground, often near fallen timber, adjacent to more open areas (Marchant and Higgins 1993). At night they feed on invertebrates and small reptiles (Marchant and Higgins 1993). There are no historical records of this species within 10kms of the project area (NSW Office of Environment and Heritage 2017a), however there may be a population of Bush Stone-curlew in Buckingbong State Forest that have the potential to disperse into the neighbouring farmlands at night to forage. Bush Stone-curlews are threatened by predation from cats and foxes, trampling of habitat by cattle and loss of habitat for agricultural and residential development (NSW Office of Environment and Heritage 2017d).

Mitigation Measures/Further Action

Avoid impacts to remnant woodlands.

Little Eagle *Hieraaetus morphnoides* and Spotted Harrier *Circus assimilis*

Conservation Status

EPBC Act: Not listed

BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Both of these birds of prey range over large territories in search of food (Marchant and Higgins 1993). Although the Spotted Harrier favours more open habitat than the Little Eagle, both build large stick nests in large trees. There are no previous records within 10kms of the project area for Little Eagles, but two records of Spotted Harrier from the Sturt Highway, east of the Kywong property (Figure 2). These records are from 2011 and 2014. If these species are present, there is no important or limiting habitat for either of these species that would be impacted by the proposed development, except for the potential for impacts to nesting attempts. The current assessment searched the scattered paddock trees for evidence of nests of these species, however none were found. Little Eagles incubate from approximately August, while Spotted Harriers incubate approximately one month later (Marchant and Higgins 1993), therefore, if any individuals were attempting to nest within the project area, the current surveys should have detected this attempt, despite it not including a direct assessment of every tree within the project area. If neither of these species, nor their nests are observed, there are unlikely to be any significant impacts on either of these species.

Mitigation Measures/Further Action

Once the footprint of the development is known, a spring nest survey is recommended for all scattered trees that may be impacted by the development.

Major Mitchell's Cockatoo *Lophocroa leadbeateri*

Conservation Status

EPBC Act: Not listed

BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Major Mitchell's Cockatoos are large, pink cockatoos of arid and semi-arid regions in Australia. Habitat for this species are dry woodlands, including *Eucalyptus-Callitris-casuarina* assemblages, such as those recorded within, and around, the project area (Higgins 1999). They breed in hollows, usually, in *Eucalyptus* trees, and often close to water (Higgins 1999). Major Mitchell's Cockatoos feed mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and Cypress Pines. There are no historical records of this species within 10kms of the project area (NSW Office of Environment and Heritage 2017a). Despite this, this

species may occur and has the potential to nest or feed within trees within the project area. The key threat to this species is the loss of hollow bearing trees and lack of recruitment of potentially new hollows in the future (NSW Office of Environment and Heritage 2017i).

Mitigation Measures/Further Action

Once the footprint of the development is known, a spring (up to December) nest survey is recommended for all hollow bearing scattered trees that may be impacted by the development.

Barking Owl *Ninox connivens connivens* and Masked Owl *Tyto novaehollandiae novaehollandiae*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Although very few hollow bearing trees were observed during the current assessment, an exhaustive survey of each tree was not undertaken, and tree hollows are likely to be found, particularly in the Eucalypts, within the project area. These trees have the potential to support Barking and Masked Owls as nest sites and diurnal roosts. Barking Owls generally hunt for insects within woodlands (Higgins 1999), limiting the amount of habitat for this species within the project area. Territory size for this species, however is poorly known, with ranges from 30 to 200 hectares (Higgins 1999). It is possible that the project area falls within the territory of a pair of Barking Owls. Similarly, Masked Owls generally occur within forests and woodlands, however they are often located close to cleared areas, such as pasture (rather than crops), grasslands or wetlands (Higgins 1999). Masked Owls predominantly prey upon ground dwelling mammals, such as mice and Antechinus, but they also eat arboreal mammals and birds as well (Higgins 1999). There are no historical records of either of these species within 10kms of the project area (NSW Office of Environment and Heritage 2017a). The key threat to these Owls is the loss of hollow bearing trees and lack of recruitment of potentially new hollows in the future (NSW Office of Environment and Heritage 2017b; NSW Office of Environment and Heritage 2017j).

Mitigation Measures/Further Action

Once the footprint of the development is known, a spring nest survey is recommended for all hollow bearing scattered trees that may be impacted by the development.

Scarlet Robin *Petroica boodang*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Scarlet Robins move from forests and woodland in higher altitudes in summer, to open farmland throughout southern Australia in winter (Higgins and Peter 2002). There are no historic records of Scarlet Robins within 10kms of the project area (NSW Office of Environment and Heritage 2017a). The project area is unlikely to provide limiting habitat for this species, with an abundance of farmland located in the landscape, although the removal of vegetation, albeit not native, may result in a small loss of habitat for the species. Threatening processes for these species are varied, however they largely relate to impacts to natural habitat and predation (NSW Office of Environment and Heritage 2017m). There is unlikely to be a significant impact to this species.

Mitigation Measures/Further Action

None recommended

Hooded Robin *Melanodryas cucullata cucullata*, Diamond Firetail *Stagonopleura guttata* and Varied Sittella *Daphoenositta chrysoptera*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Each of these three birds is a woodland specialist (Pizzey and Knight 2012). Although there are no historical records of these species within 10kms of the project area (NSW Office of Environment and Heritage 2017a), low to moderate quality habitat for these species occurs in the woodland remnant patches of vegetation and the road reserves surrounding the project area. Each of these species are sedentary species, with relatively fixed home ranges (Higgins and Peter 2002; Higgins *et al.* 2006), although Diamond Firetails may disperse in search of food in Autumn (Higgins *et al.* 2006). The key threats to them are the loss of habitat, often at a local level, and modification of habitat through grazing or other agricultural practices (NSW Office of Environment and Heritage 2017e; NSW Office of Environment and Heritage 2017h; NSW Office of Environment and Heritage 2017q). All of them are susceptible to exclusion by Noisy Miners, when the mid-storey and understorey is cleared (NSW Office of Environment and Heritage 2017e; NSW Office of Environment and Heritage 2017h; NSW Office of Environment and Heritage 2017q).

Mitigation Measures/Further Action

Avoid impacts to remnant woodlands.

Dusky Woodswallow *Artamus cyanopterus cyanopterus*

Conservation Status

EPBC Act: Not listed
BC Act: Vulnerable

Assessment of likelihood of presence

Moderate

Dusky Woodswallows are woodland species that forage over open areas, often at very high altitudes (Pizzey and Knight 2012). The species is often found in Cypress Pine woodlands, usually where the understorey is sparse (Higgins *et al.* 2006). From these woodlands, Dusky Woodswallows often feed over open areas adjacent to the woodlands, such as farms (Higgins *et al.* 2006). Threatening processes for this species are varied, however they largely relate to impacts to natural habitat and predation (NSW Office of Environment and Heritage 2017f). There are no previous records of Dusky Woodswallows within 10kms of the project area. Dusky Woodswallows may inhabit the remnant woodlands within and surrounding the project area.

Mitigation Measures/Further Action

Avoid impacts to remnant woodlands.

Summary

The project area has been substantially altered from its natural state. The crops and grazed paddocks comprise approximately 94% of the project area (Figure 1). This has simplified the landscape and reduced its habitat quality for most of the flora and fauna species that would have once occupied the project area. Further, the ongoing disturbance associated with annual crop rotation and grazing by sheep in the fallow years, means that these historical natural values are prevented from re-establishing. Where there are more passive uses of the project area, such as Paddock RP8 on the Sandigo North property, there are signs of some natural value returning in the form of re-emergence of native understorey species.

Whilst there are a number of sources of water within the three inspected properties, these are all artificial dams, lined with clay, lacking aquatic and fringing vegetation and providing only very low quality habitat. These dams were occupied only by highly mobile duck species that are unlikely to rely on them for significant resources.

Despite this, some ecological constraints remain within the project area. The remnant woodlands and derived grasslands that are largely confined to the perimeters of the project area provide low to medium quality habitat for a range of common species. One threatened species was recorded on four occasions in these patches of vegetation, Grey-crowned Babbler, and there is the potential that others occur in smaller numbers, at different times of the year, or in a more cryptic form (such as threatened flora species).

Another ecological constraint within the project area is the presence of scattered paddock trees. These trees are large and some of them are likely to have hollow branches or trunks. The trees are likely to provide foraging and breeding habitat for a variety of species. Hollows are generally scarce in the landscape, which means that those trees with hollows are of greater ecological significance than those without. The species that are likely to nest in these trees are likely to be generally common within the landscape, because the removal of other ecological values in the landscape has reduced the diversity of species that persist near the project area. However many threatened species are hollow dependent, illustrating the impact of the loss of hollow bearing trees within the landscape, so these trees require further assessment.

Recommendations

To remove or minimise impacts to the ecological values within the project area, it is recommended that remnant native vegetation and the scattered paddock trees are avoided as far as practicable. In particular this should include avoidance of RP10, RP13, and an area of scattered trees in P22 in Kywong and RP15a, RP16 and RP17 on Glen Moira which are identified as areas of 'terrestrial biodiversity' in the Narrandera Local Environment Plan 2013.

A tree survey may be required to accurately locate all scattered trees and inform the design of the solar farm if this cannot be undertaken through aerial photography.

The construction and operation of the solar farm is expected to have a relatively low impact, long term, to the remaining ecological values within the project area. Once the solar farm is built, there will be no greater disturbance to the landscape than is currently experienced by the extant flora and fauna as a result of the current farming practices. Therefore, if the highest quality ecological values can be protected within the 5% of the project area that supports them, there is likely to be no significant impact to these values.

In addition to the protection of the ecological values, a buffer is recommended to ensure indirect impacts do not occur during construction or operation of the Solar Farm. The buffer zone for the trees will be based on the size of the tree. This measurement enables the calculation of a tree's 'Tree Protection Zone' (TPZ). The TPZ of a tree is calculated as 12 times its diameter at breast height, but should not be less than 2 metres or greater than 15 metres (Standards Australia 2009). If an area greater than 10% of a tree's Tree Protection Zone is impacted by works, that tree will be considered lost and offset obligations may apply. By avoiding these TPZs the integrity of the tree will be retained and there are unlikely to be any impacts to these trees. Where trees cannot be avoided, it is recommended that trees that possess hollows are retained preferentially over those that do not.

Retained patches of native vegetation are unlikely to require a buffer zone. It would be expected that during construction works they are fenced and machinery and personnel excluded from these areas. Once the farm is established, however, the fence is unlikely to be required and may impede management of the farm.

It is also recommended that a Construction Environmental Management Plan (CEMP) be prepared, as well as the development of management protocols to ensure indirect or inadvertent impacts to areas of ecological value do not occur during the construction and operation of the Solar Farm. These will follow EPA guidelines for sediment control and erosion. The CEMP will also provide induction to construction workers in relation to the protection of these values and provide contingency plans should an EPBC Act threatened species be encountered during works.

Threatened Species Surveys

If the ecological values described above cannot be avoided a range of threatened species surveys are likely to be required. Some of these surveys are required because there is a moderate, or greater, likelihood that a threatened species may be found within the project area (as discussed above), while others are required because it will be a condition of approval imposed by the NSW office of Environment and Heritage due to impacts to native vegetation based on their PCTs (Table 3). These surveys will feed into the Biodiversity Development Assessment Report (BDAR), and each species listed below as being required for survey in Table 3, will require the presentation of the results of the

assessment, or an robust justification for not undertaking those surveys. If some PCTs can be avoided entirely, this list is likely to decrease in numbers.

Whilst there are up to 50 species that require surveys listed in Table 3, there are only six survey types required, many of which can be undertaken concurrently. The survey period for each threatened species survey, if required, is listed in Table 3, while the methods required are described below.

Prior to undertaking any threatened species surveys it is recommended that the NSW Office of Environment and Heritage is consulted on the proposed scope to ensure that surveys are not undertaken unnecessarily and that the proposed methods will satisfy their requirements. Methods will follow the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation (NSW) 2004) with survey effort reflecting the eventual impact of the proposed solar farm footprint (and therefore not provided below). Surveys for Grey-crowned Babbler and White-fronted Chat have not been provided because they are known to occur within the project area.

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Table 3. Survey requirements for threatened flora and fauna species that may occur within the project area.

Threatened Species	Reason for Survey ¹	Survey Type	Survey Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Birds														
Magpie Goose <i>Anseranas semipalmata</i>	PCT 250 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Little Eagle <i>Hieraaetus morphnoides</i>	Likely to occur/PCT 28, 75, 76, 80, 250 Survey Requirement	Bird Survey								✓	✓	✓		
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	PCT 28, 75, 76, 80, 250 Survey Requirement	Bird Survey								✓	✓	✓	✓	✓
Square-tailed Kite <i>Lophoictinia isura</i>	PCT 76, 28 Survey Requirement	Bird Survey	✓									✓	✓	✓
Spotted Harrier <i>Circus assimilis</i>	Likely to occur/PCT 28, 75, 250 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Black-breasted Buzzard <i>Hamirostra melanosternon</i>	PCT 28 Survey Requirement	Bird Survey	✓									✓	✓	✓
Grey Falcon <i>Falco hypoleucos</i>	PCT 28, 76, 80, 250.Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bush Stone-curlew <i>Burhinus grallarius</i>	Likely to occur/BAM Survey Requirement	Transect – Nocturnal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plains Wanderer <i>Pedionomus torquatus</i>	Likely to occur	Transect Nocturnal	✓	✓	✓							✓	✓	✓
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	PCT 75 Survey Requirement	Bird Survey	✓										✓	✓
Major Mitchell’s Cockatoo <i>Lophocroa leadbeateri</i>	Likely to occur/PCT 28, 76, 80, 250 Survey Requirement	Bird Survey/ Tree Survey										✓	✓	✓
Glossy Black-Cockatoo <i>Calyptorhynchus lathami</i>	PCT 75, 76, 80, Survey Requirement	Bird Survey/Tree Survey			✓	✓	✓	✓	✓	✓				
Glossy Black-Cockatoo (Riverina Population)	PCT 75, 76, 80 Survey Requirement	Bird Survey/ Tree Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Turquoise Parrot <i>Neophema pulchella</i>	PCT 75, 76, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Little Lorikeet <i>Glossopsitta pusilla</i>	PCT 75 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Threatened Species	Reason for Survey ¹	Survey Type	Survey Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Swift Parrot <i>Lathamus discolor</i>	PCT 75, 76, 80 Survey Requirement	Bird Survey					✓	✓	✓	✓				
Superb Parrot <i>Polytelis swainsonii</i>	Likely to occur/PCT 28, 75, 76, 80, 250 Survey Requirement	Bird Survey/ Tree Survey									✓	✓	✓	
Barking Owl <i>Ninox connivens connivens</i>	Likely to occur	Nocturnal Tree Survey					✓	✓	✓	✓	✓			
Masked Owl <i>Tyto novaehollandiae novaehollandiae</i>	Likely to occur/PCT 76, 80 Survey Requirement	Nocturnal Tree Survey					✓	✓	✓	✓				
Brown Treecreeper <i>Climacteris picumnus victoriae</i>	PCT 76 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regent Honeyeater <i>Anthochaera phrygia</i>	PCT 75 Survey Requirement	Bird Survey									✓	✓	✓	✓
Painted Honeyeater <i>Grantiella picta</i>	PCT 28, 75, 76, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pied Honeyeater <i>Certhionyx variegatus</i>	PCT 28, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Varied Sittella <i>Daphoenositta chrysoptera</i>	Likely to occur/PCT 28, 75, 76, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Speckled Warbler <i>Chthonicola sagittatus</i>	PCT 75, 76, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hooded Robin <i>Melanodryas cucullata cucullata</i>	Likely to occur/PCT 28, 75, 76, 80 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scarlet Robin <i>Petroica boodang</i>	Likely to occur/PCT 75, 76, 80, 250 Survey Requirement	Bird Survey				✓	✓	✓	✓	✓	✓			
Flame Robin <i>Petroica phoenicea</i>	PCT 76, 80, 250 Survey Requirement	Bird Survey				✓	✓	✓	✓	✓	✓			
Dusky Woodswallow <i>Artamus cyanopterus cyanopterus</i>	Likely to occur/PCT 28, 75, 76, 80, 250 Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diamond Firetail <i>Stagonopleura guttata</i>	Likely to occur/PCT 28, 75, 76, 80, 250. Survey Requirement	Bird Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mammals														

Threatened Species	Reason for Survey ¹	Survey Type	Survey Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eastern Pygmy Possum <i>Cercartetus nanus</i>	BAM Survey Requirement	Nocturnal Tree Survey	✓	✓	✓							✓	✓	✓
Squirrel Glider <i>Petaurus norfolcensis</i>	BAM Survey Requirement	Nocturnal Tree Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Koala <i>Phascolarctos cinereus</i>	PCT 75, 76, 80 Survey Requirement	Tree Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	BAM Survey Requirement	Nocturnal Survey										✓	✓	✓
Little Pied Bat <i>Chalinolobus picatus</i>	PCT 76, 28 Survey Requirement	Anabat Bat Detection	✓	✓	✓							✓	✓	✓
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i>	PCT 28, 75, 76, 80 Survey Requirement	Anabat Bat Detection	✓	✓	✓							✓	✓	✓
Amphibians														
Sloane's Froglet <i>Crinia sloanei</i>	BAM Survey Requirement	Amphibian Survey							✓	✓				
Reptiles														
Pink-tailed Legless Lizard <i>Aprasia parapulchella</i>	PCT 250 Survey Requirement	Tile Grids									✓	✓	✓	
Flora														
Spike Rush <i>Eleocharis obicis</i>	BAM Survey Requirement	Transect – Flora	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mossgiel Daisy <i>Brachyscome papillosa</i>	Likely to occur/BAM Survey Requirement	Transect – Flora									✓	✓	✓	
Oaklands Diuris <i>Diuris</i> sp. (Oaklands, D.L. Jones 5380)	BAM Survey Requirement	Transect – Flora											✓	
Pine Donkey Orchid <i>Diuris tricolor</i>	BAM Survey Requirement	Transect – Flora									✓	✓		
Sand-hill Spider-orchid <i>Caladenia arenaria</i>	Likely to occur/BAM Survey Requirement	Transect – Flora								✓	✓	✓		
Silky Swainson Pea <i>Swainsona sericea</i>	Likely to occur/ BAM Survey Requirement	Transect – Flora	✓	✓							✓	✓	✓	✓
Slender Darling Pea <i>Swainsona murrayana</i>	BAM Survey Requirement	Transect – Flora	✓	✓							✓	✓	✓	✓

Threatened Species	Reason for Survey ¹	Survey Type	Survey Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Small Purple-pea <i>Swainsona recta</i>	BAM Survey Requirement	Transect – Flora									✓	✓	✓	
Spear Grass <i>Austrostipa metatoris</i>	BAM Survey Requirement	Transect – Flora	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Spear Grass <i>Austrostipa wakoolica</i>	Likely to occur/BAM Survey Requirement	Transect – Flora									✓	✓	✓	✓
Spiny Peppercress <i>Lepidium aschersonii</i>	BAM Survey Requirement	Transect – Flora	✓	✓	✓	✓	✓				✓	✓	✓	✓
Winged Peppercress <i>Lepidium monoplacoides</i>	BAM Survey Requirement	Transect – Flora	✓	✓									✓	✓

Table notes:

¹ BAM Survey Requirements are for 'Candidate Threatened Species (Species credits)' and impacts to these species are likely to require offsets specific to these species. PCT Survey Requirements are for 'Predicted Threatened Species (Ecosystems credits)' and impacts to these species are likely to result in general offsets.

Transect Surveys

Two types of transect surveys are recommended—flora and nocturnal transects.

Flora surveys will involve walking transects in all areas of suitable habitat, searching for threatened flora species. Transects will be walked at no greater than 5 metre intervals and the tracks recorded with a GPS. Key considerations of these surveys will be the detectability of various species (i.e. survey season listed in Appendix 6), however all species within the surveyable window can be surveyed concurrently. Other descriptive data about the transect will be collected to describe the characteristics of the vegetation and landform in which the survey is being conducted.

Nocturnal transects are identical, except that they are undertaken at night and are designed to detect nocturnal, ground dwelling animals, in this case birds. A 12v 100W spotlight (or equivalent) is used, by foot or from a slow-moving vehicle in first gear, to flush birds.

Bird Surveys

Area searches for birds will be undertaken at dawn and dusk, with all observed birds (seen or heard) recorded. Three searches will take place in an area of 2ha for a period of 60 minutes to achieve a 90% detection rate of birds (Department of Environment and Conservation (NSW) 2004). This will be replicated as necessary in suitable habitat.

Tree Surveys

Like the transect surveys, the tree surveys will be undertaken both diurnally and nocturnally to detect the presence of different species.

Diurnal tree surveys will involve targeted searches of impacted trees, as well as other trees for signs of nesting activities by birds. Nests may be large stick nests, as built by birds-of-prey, or in the hollow branches and trunks of trees, as built by parrots and cockatoos. Evidence of birds attending nests, nestlings seen or heard from nests, or adult building nests will be recorded to confirm the presence of these species within the project area. These searches will also be used for arboreal mammals, such as the Koala *Phascolarctos cinereus*.

Nocturnal tree surveys are identical, however a spotlight is used to aid observations of nocturnal birds and mammals. The nocturnal surveys will also include call playback of owl calls, of target Owl species, as well as Bush Stone-curlew (if relevant). A period of quiet listening will follow call playback before the call of a different species is started. The nocturnal surveys will take place on mild (>14°C) and calm nights.

Amphibian Surveys

An amphibian survey may be required for Sloane's Froglet *Crinia sloanei*. This will involve a combination of call playback surveys and nocturnal searches in suitable habitat after rain (Department of Environment and Climate Change 2009). A minimum of one 200-metre transect per water body or inundated area, repeated on a minimum of two separate nights is required (Department of Environment and Climate Change 2009).

These surveys are highly unlikely as natural waterbodies do not exist within the project area.

Reptile Surveys

Tile grid trapping is the recommended approach to surveying Legless Lizards. However it is also an effective tool to detect the presence of other reptiles and small mammals. Tile grids (layout of 50 roofing tiles at 5x10m spacings per grid) will be placed on site in winter (during the targeted flora surveys) to allow tiles to be embedded into the ground before surveys from September until December. Details of climatic conditions will be recorded at survey times including weather conditions, ambient temperature, temperature under the tile, temperature at surface of the tile, relative humidity, relative humidity under the tile, and soil temperature. Optimal time for checking is when weather is fine but preferably with >50% cloud cover. Air temperature should be in low 20s and ground temperature high 20s to low 30s (°C).

Anabat Bat Surveys

The Anabat system (Titley Electronics) is the most widely used system in Australia to detect the echolocation calls of bats. Anabat Bat Detectors will be deployed in areas identified on site as flyways, areas of high activity and that target species of interest and left for periods of up to two weeks to recorded bat calls. Surveys will be undertaken during the warmer months of the year, i.e. October to April, on nights with mild weather, no rain and little wind; nights with strong winds will be avoided as they are likely to trigger the Anabats to make false recordings.

Conclusion

The majority of the project area provides only low quality habitat to most native species that historically existed within it. However some ecological values remain, including remnant vegetation and scattered paddock trees and area identified by the Narrandera Local Environment Plan 2013 as important areas of terrestrial biodiversity. Those trees that possess hollows are likely to provide important breeding habitat for a range of common birds and arboreal mammals species. Targeted surveys for a range of species, as described above, are likely to be required to determine the presence of these species within the project area, however sensitive design of the solar farm layout and the implementation of the mitigation measures described above, is likely to be sufficient to ensure that any residual impacts to these species are minimal.

With the implementation of buffer zones around these sites of ecological significance and 'important areas of terrestrial biodiversity' and the implementation of a CEMP, there are unlikely to be any significant impacts to any conservation dependent or listed migratory species. On this basis, the proposed construction and operation of the Sandigo Solar Farm is unlikely to be considered a 'controlled action' under the EPBC Act and a referral would not be recommended.

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Figures



Figure 1b. Results of the current assessment.

Glen Moira
Sandigo Solar Farms, NSW

Legend

Study Area

Land Use

Planted Vegetation/Infrastructure

Road/Driveway/Track

Sheep Grazing

Barley Crop

Wheat Crop

Native Vegetation (PCT Classification)

250 - Derived Tussock Grassland

28/80 - White Cypress Pine Open Woodland/Western Grey Box - White Cypress Pine Tall Woodland

76 - Western Grey Box Tall Grassy Woodland

80 - Western Grey Box - White Cypress Pine Tall Woodland

Scattered Trees

Exotic/Planted trees among Indigenous Paddock Trees

Indigenous trees among planted vegetation

Transmission Lines

132kV

66kV

Dams

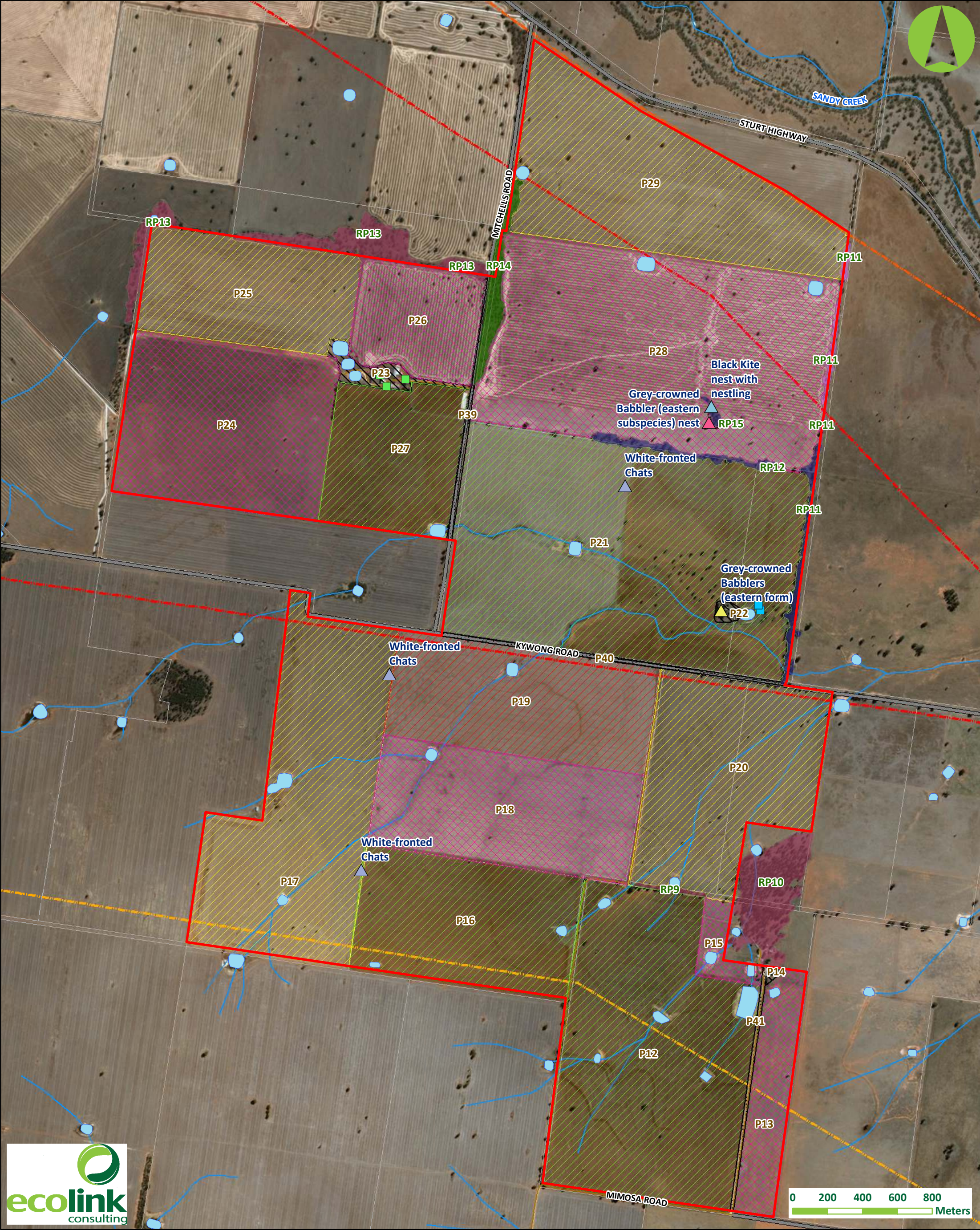


Figure 1c. Results of the current assessment.

Kywong
Sandigo Solar Farms, NSW

Study Area

Land Use

- Planted Vegetation/Infrastructure
- Road/Driveway/Track
- Sheep Grazing
- Barley Crop

- Canola Crop
- Wheat Crop

Native Vegetation (PCT Classification)

- 237 - Riverine Western Grey Box Grassy Woodland

- 28/80 - White Cypress Pine Open Woodland/Western Grey Box - White Cypress Pine Tall Woodland
- 76 - Western Grey Box Tall Grassy Woodland
- 80 - Western Grey Box - White Cypress Pine Tall Woodland

Scattered Trees

- Exotic/Planted trees among Indigenous Paddock Trees
- Indigenous

Transmi... Lines

- 330kV

132kV

66kV

Dams

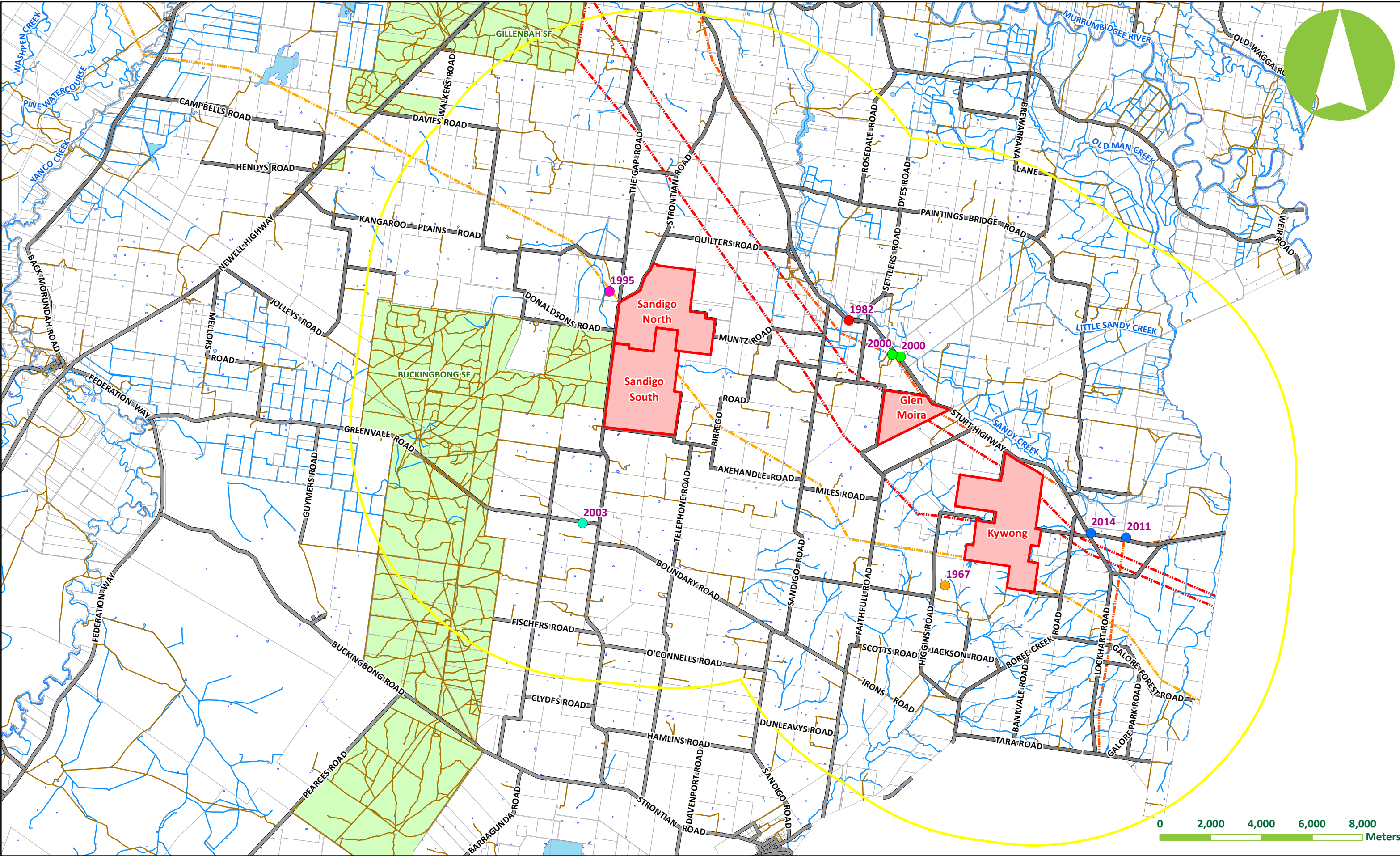


Figure 2. Historical records of threatened Flora and Fauna within 10kms of the study area.

Sandigo Solar Farms, NSW

Legend

Study Area

10km Study Area Buffer

Common Name

A spear-grass

Brolga

Grey-crowned Babbler (eastern subspecies)

Plains-wanderer

Spotted Harrier

Superb Parrot

Transmission Lines

330kV

132kV

66kV

33kV

State Forests

Appendix 1. Land use within the project area at the time of the field assessment

Zone Number	Current Land Use	Dominant Flora
Sandigo North		
P1	Sheep grazing	Rye Grass, Capeweed, Barley Grass
P2	Plantation along driveway	Non-indigenous Gums over Rye Grass, Capeweed, Barley Grass
P3	Wheat crop	Wheat
P4	Small plantation	Non-indigenous Gums over Rye Grass, Barley Grass
RP1		White Cypress Pine, Grey Box
RP2		White Cypress Pine, Grey Box
P5	Canola crop	Canola
RP3		Rye, Wild Oats
P6	Canola crop	Canola
P7	Canola crop	Canola
RP4		
P8	Canola crop	Canola
RP5		
RP6		
RP7		
P9	Shelterbelt	Planted species include non-indigenous Paperbarks, Gums and Saltbush
P10	Wheat crop	Wheat
P11	Saltbush plantation	Saltbush
RP8		
Kywong		
P12	Wheat crop	Wheat
P13	Sheep grazing	
P14	Plantation around dwelling and sheds	Peppercorns and Yellow Gums, with Barley Grass dominant in the understorey
P15	Sheep grazing	
P16	Wheat crop	Wheat
P17	Canola crop	Canola
P18	Sheep grazing	Bromes, Wild Oats, Barley, Rye
P19	Barley crop	Barley
P20	Canola crop	Canola
RP9		Grey Box over exotic understorey
RP10		White Cypress Pine, Buloke, Grey Box over predominantly exotic understorey but also contained Wallaby-grass, Spear-grass and Windmill Grass
RP11		Grey Box and White Cypress Pine over 50% cover of exotic Barley and Rye and 50% cover is indigenous Wallaby-grass, Spear-grass and Windmill Grass, and Saltbushes
P21	Wheat crop	Wheat
P22	Plantation around disused dwelling	Plantation of Red Ironbark and Peppercorns over and understorey of Barley and Rye

Zone Number	Current Land Use	Dominant Flora
RP12		White Cypress Pine and Grey Box over predominantly exotic understorey but also contained Wallaby-grass, Spear-grass and Windmill Grass
P23	Plantation area, shed and silos	Plantation of Peppercorns and non-indigenous Paperbarks. Some White Cypress Pine
P24	Sheep grazing	Rye Grass, Capeweed
P25	Canola crop	Canola
RP13		White Cypress Pine and Grey Box over predominantly exotic understorey but also contained Wallaby-grass, Spear-grass and Windmill Grass
P26	Sheep grazing	Bromes, Wild Oats, Barley, Rye
P27	Wheat crop	Wheat
P28	Sheep grazing	
RP14		Grey Box and White Cypress Pine over 50% cover of exotic Barley and Rye and 50% cover is indigenous Wallaby-grass, Spear-grass and Windmill Grass, and Saltbushes
P29	Canola crop	Canola
RP15		Grey Box over Barley Grass understorey
Glen Moira		
P30	Plantation around the dwelling	2x Kurrajong Trees, Grey Box and Peppercorns over exotic understorey dominated by Barley Grass, Squirrel-tail Fescue, Rye
P31	Wheat crop	Wheat
P32	Barley crop	Barley
P33	Wheat crop	Wheat
P34	Barley crop	Barley
P35	Sheep grazing	Lucerne, Barley
P36	Sheep grazing	Lucerne, Barley
RP16		Grey Box, White Cypress Pine over exotic understorey of Barley Grass
P37	Wheat crop	Wheat
RP17	Nil	Wallaby-grass, Windmill Grass, Spear-grass
RP18		Grey Box and White Cypress Pine over 50% cover of exotic Barley and Rye and 50% cover is indigenous Wallaby-grass, Spear-grass and Windmill Grass, and Saltbushes
RP19		Grey Box, White Cypress Pine and Buloke over an exotic understorey dominated by Barley Grass

Table notes:

See also Figures 1a–c

Appendix 2. Flora species recorded during the current assessment

Scientific Name	Common Name	Conservation Status *
<i>Acacia montana</i>	Mallee Wattle	
<i>Acacia verniciflua</i> s.l.	Varnish Wattle	
<i>Aira elegantissima</i>	Delicate Hair-grass	I
<i>Aira</i> spp.	Hair Grass	I
<i>Allocasuarina luehmannii</i>	Buloke	
<i>Alternanthera denticulata</i> s.l.	Lesser Joyweed	
<i>Amyema miquelii</i>	Box Mistletoe	
<i>Anthosachne scabra</i> s.l.	Common Wheat-grass	
<i>Arctotheca calendula</i>	Cape weed	I
<i>Atriplex semibaccata</i>	Berry Saltbush	
<i>Austrostipa aristiglumis</i>	Plump Spear-grass	
<i>Austrostipa densiflora</i>	Dense Spear-grass	
<i>Austrostipa elegantissima</i>	Feather Spear-grass	
<i>Austrostipa scabra</i> subsp. <i>falcata</i>	Rough Spear-grass	
<i>Avena fatua</i>	Wild Oat	I
<i>Brachyscome ciliaris</i>	Variable Daisy	
<i>Brachyscome paludicola</i>	Woodland Swamp-daisy	
<i>Brasicus napus</i>	Canola	I
<i>Bromus catharticus</i>	Prairie Grass	I
<i>Bromus diandrus</i>	Great Brome	I
<i>Bromus hordeaceus</i>	Soft Brome	I
<i>Bromus rubens</i>	Red Brome	I
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria	
<i>Callitris columellaris</i>	White Cypress Pine	
<i>Centaurium tenuiflorum</i>	Slender Centaury	I
<i>Centipeda cunninghamii</i>	Common Sneezeweed	
<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>	Small-leaf Goosefoot	
<i>Chloris truncate</i>	Windmill Grass	
<i>Chrysocephalum apiculatum</i> s.l.	Common Everlasting	
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting	
<i>Cirsium vulgare</i>	Spear Thistle	I
<i>Convolvulus erubescens</i> s.l.	Pink Bindweed	
<i>Cotula australis</i>	Common Cotula	
<i>Craspedia glauca</i> s.l.	Common Billy-buttons	
<i>Dichondra repens</i>	Kidney-weed	
<i>Echium plantagineum</i>	Paterson's Curse	I
<i>Einadia hastata</i>	Saloop	
<i>Einadia nutans</i>	Nodding Saltbush	
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush	
<i>Enteropogon acicularis</i>	Spider Grass	
<i>Epilobium</i> spp.	Willow Herb	
<i>Eragrostis curvula</i>	African Love-grass	I

Scientific Name	Common Name	Conservation Status *
<i>Erodium botrys</i>	Big Heron's-bill	I
<i>Erodium cicutarium</i>	Common Heron's-bill	I
<i>Eucalyptus camaldulensis</i>	River Red-gum	
<i>Eucalyptus melliodora</i>	Yellow Box	
<i>Eucalyptus microcarpa</i>	Grey Box	
<i>Hordeum leporinum</i>	Barley-grass	I
<i>Hordeum</i> spp.	Barley Grass	I
<i>Juncus amabilis</i>	Hollow Rush	
<i>Juncus flavidus</i>	Gold Rush	
<i>Juncus</i> spp.	Rush	
<i>Juncus subsecundus</i>	Finger Rush	
<i>Lachnagrostis filiformis</i> s.l.	Common Blown-grass	
<i>Lepidium africanum</i>	Common Peppercross	I
<i>Leptorhynchos squamatus</i>	Scaly Buttons	
<i>Lolium perenne</i>	Perennial Rye-grass	I
<i>Lolium rigidum</i>	Wimmera Rye-grass	I
<i>Lythrum hyssopifolia</i>	Small Loosestrife	
<i>Maireana enchylaenoides</i>	Wingless Bluebush	
<i>Malva parviflora</i>	Small-flower Mallow	I
<i>Marrubium vulgare</i>	Horehound	I
<i>Medicago polymorpha</i>	Burr Medic	I
<i>Medicago sativa</i> subsp. <i>sativa</i>	Lucerne	I
<i>Oxalis perennans</i>	Grassland Wood-sorrel	
<i>Paspalum dilatatum</i>	Paspalum	I
<i>Paspalum distichum</i>	Water Couch	I
<i>Persicaria prostrata</i>	Creeping Knotweed	
<i>Polygonum aviculare</i> s.l.	Prostrate Knotweed	I
<i>Romulea rosea</i>	Onion Grass	I
<i>Rumex brownie</i>	Slender Dock	
<i>Rumex crispus</i>	Curled Dock	I
<i>Rytidosperma caespitosum</i>	Common Wallaby-grass	
<i>Rytidosperma duttonianum</i>	Brown-back Wallaby-grass	
<i>Rytidosperma setaceum</i>	Bristly Wallaby-grass	
<i>Schinus molle</i>	Pepper Tree	I
<i>Sclerolaena muricata</i> var. <i>villosa</i>	Grey Roly-poly	
<i>Silybum marianum</i>	Variegated Thistle	I
<i>Sonchus asper</i> s.l.	Rough Sow-thistle	I
<i>Sonchus oleraceus</i>	Common Sow-thistle	I
<i>Trifolium angustifolium</i> var. <i>angustifolium</i>	Narrow-leaf Clover	I
<i>Trifolium subterraneum</i>	Subterranean Clover	I
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy	
<i>Vulpia bromoides</i>	Squirrel-tail Fescue	I
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	

Scientific Name	Common Name	Conservation Status *
<i>Wahlenbergia</i> spp.	Bluebell	
<i>Walwhalleya proluta</i>	Rigid Panic	

Table notes:

* Conservation Status:

I: Introduced

Appendix 3. Fauna species recorded during the current assessment

Order	Common Name	Scientific Name	Conservation Status	Sandigo North	Kywo ng	Glen Moira
Birds	Australasian Grebe	<i>Tachybaptus novaehalloandiae</i>		✓		✓
	Australian Wood Duck	<i>Chenonetta jubata</i>		✓	✓	
	Grey Teal	<i>Anas gracilis</i>		✓		
	Pacific Black Duck	<i>Anas superciliosa</i>		✓		
	Wedge-tailed Eagle	<i>Aquila audax</i>			✓	
	Crested Pigeon	<i>Ocyphaps lophotes</i>		✓		✓
	Eastern Rosella	<i>Platycercus eximius</i>		✓	✓	
	Red-rumped Parrot	<i>Psephotus haematonotus</i>		✓	✓	✓
	Galah	<i>Eolophus roseicapillus</i>		✓	✓	✓
	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>			✓	
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>			✓	
	Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>			✓	
	Striated Pardalote	<i>Pardalotus striatus</i>		✓		
	Weebill	<i>Smicronis brevirostris</i>		✓		
	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>			✓	✓
	Noisy Miner	<i>Manorina melanocephala</i>		✓	✓	✓
	White-fronted Chat	<i>Epthianura albifrons</i>	V	✓	✓	
	Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	V	✓	✓	
	Magpie-lark	<i>Grallina cyanoleuca</i>		✓	✓	✓
	White-winged Triller	<i>Lalage sueurii</i>			✓	
	Willie Wagtail	<i>Rhipidura leucophrys</i>			✓	
	White-browed Woodswallow	<i>Artamus superciliosus</i>			✓	
	Australian Magpie	<i>Cracticus tibicen</i>		✓	✓	
	Pied Butcherbird	<i>Cracticus nigrogularis</i>		✓		
	Australian Raven	<i>Corvus coronoides</i>		✓	✓	✓
	Australasian Pipit	<i>Anthus novaeseelandiae</i>		✓	✓	
	Welcome Swallow	<i>Hirundo neoxena</i>		✓	✓	✓
	Rufous Songlark	<i>Cincloramphus mathewsi</i>			✓	
	Brown Songlark	<i>Cincloramphus cruralis</i>			✓	
	Golden-headed Cisticola	<i>Cisticola exilis</i>			✓	
	Apostlebird	<i>Struthidea cinerea</i>			✓	✓
	White-winged Chough	<i>Corcorax melanorhamphos</i>				✓
	Common Starling	<i>Sturnus vulgaris</i>	I	✓	✓	✓
	House Sparrow	<i>Passer domesticus</i>	I		✓	
	Zebra Finch	<i>Taeniopygia guttata</i>			✓	
Mammals	Eastern Grey Kangaroo	<i>Macropus giganteus</i>		✓	✓	✓
	Rabbit	<i>Oryctolagus cuniculus</i>	I	✓	✓	✓

Table notes:

* Conservation Status:

I: Introduced

V: Vulnerable

Taxonomy after International Ornithological Congress World Bird List v7.2 (Gill and Donsker 2017).

Appendix 4: Threatened fauna and flora species that have previously been recorded within, or 10kms of the project area, or that has habitat that may occur within the vicinity of the project area.

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
Birds									
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable	– Endangered BC Act	Mallee, acacia, paperbark and other scrubs as well as open eucalypt woodlands or coastal heaths on sandy or gravelly soils.	NPR	No	Unlikely	– Likely to occur (PMST)	N/A
Magpie Goose	<i>Anseranas semipalmata</i>	-	– Vulnerable BC Act	Large seasonal wetlands and well-vegetated dams, wet, grasslands	NPR	No	Unlikely	– BAM predicted species	N/A
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Endangered	– Endangered BC Act	Reed beds, dense vegetation of freshwater swamps and creeks	NPR	No	Unlikely	– Likely to occur (PMST)	N/A
Little Eagle	<i>Hieraetus morphnoides</i>	-	– Vulnerable BC Act	Plains, foothills, open forests, woodlands	NPR	Yes – foraging habitat throughout, potential nesting habitat in largest paddock trees	Moderate	– Known to occur on NSW TSD – BAM Predicted species	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	-	– Vulnerable BC Act	Oceanic / coastal and larger inland waterways.	NPR	No	Low	– Known to occur on NSW TSD – BAM Predicted species	N/A
Square-tailed Kite	<i>Lophoictinia isura</i>	-	– Vulnerable BC Act	Heathlands, woodlands, forests	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A
Spotted Harrier	<i>Circus assimilis</i>	-	– Vulnerable BC Act	Open plains and grasslands	2014 (2)	Yes – foraging habitat throughout	Moderate	– Bionet Previous Record – Known to occur on NSW TSD	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>		– Vulnerable BC Act	Grasslands, gibber, sandhills of northern and central Australia	NPR	No	Unlikely	– BAM predicted species	N/A
Grey Falcon	<i>Falco hypoleucos</i>	-	– Endangered BC Act	Lightly treed inland plains, gibber deserts, pastoral lands	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A
Brolga	<i>Grus rubicuada</i>	-	– Vulnerable BC Act	Well vegetated wetlands, wet pastures, rice-fields, stubble, ploughed fields and grasslands near water	1982 (1)	No	Low	– Bionet previous record	N/A
Bush Stone-curlew	<i>Burhinus grallarius</i>	-	– Endangered BC Act	Open woodland, dry watercourses with fallen timbers, leaf litter, sparse grasslands, timber remnants along roadsides	NPR	Yes – May disperse from daytime roosts in Buckingbong State Forest to surrounding pastures on Sandigo North and South at night	Moderate	– Known to occur on NSW TSD – BAM Predicted species	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
Australian Painted-Snipe	<i>Rostratula australis</i>	Endangered	– Endangered BC Act	Lowlands on shallow freshwater swamps with emergent vegetation, and flooded salt marshes	NPR	No	Unlikely	– May to occur (PMST)	N/A
Eastern Curlew	<i>Numenius madagascariensis</i>	Critically Endangered Migratory		Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	NPR	No	Unlikely	– May occur (PMST)	N/A
Common Sandpiper	<i>Actitis hypoleucos</i>	Migratory		Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	NPR	No	Unlikely	– May occur (PMST)	N/A
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Migratory		Wetlands, estuaries, tidal mudflats, mangroves, shallow	NPR	No	Unlikely	– May occur (PMST)	N/A

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
Pectoral Sandpiper	<i>Calidris melanotos</i>	Migratory		river margins, coastal or inland Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	NPR	No	Unlikely	– May occur (PMST)	N/A
Curlew Sandpiper	<i>Calidris ferruginea</i>	Critically Endangered Migratory	– Endangered BC Act	Estuaries, tidal mudflats, mangroves, shallow river margins, coastal or inland	NPR	No	Unlikely	– May occur (PMST)	N/A
Latham's Snipe	<i>Gallinago hardwickii</i>	Migratory		Wet grasslands, open and wooded swamps	NPR	No	Unlikely	– May occur (PMST)	N/A
Plains-wanderer	<i>Pedionomus torquatus</i>	Critically Endangered	– Endangered BC Act	Sparse, treeless, lightly grazed native grasslands/herbfields with bare ground, old cereal crops, low shrubland	1967 (1)	Yes – potential habitat during fallow years of crop rotation system after paddock are grazed for up to three years. In stubble after harvest.	Moderate	– Bionet previous record – Likely to occur (PMST)	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	-	– Vulnerable BC Act	Wetter forests and woodlands, timbered watercourses	NPR	No	Unlikely	– BAM predicted species	N/A
Major Mitchell's Cockatoo	<i>Lophocroa leadbeateri</i>	-	– Vulnerable BC Act	Near water on timbered watercourses, saltbush, mulga and other acacias in arid parts of Australia	NPR	Yes – potential nesting habitat in hollow bearing trees	Moderate	– Known to occur on NSW TSD – BAM Predicted species	Avoid hollow bearing trees where possible
Glossy Black-Cockatoo (Riverina population)	<i>Calyptorhynchus lathami</i>	-	– Endangered BC Act	The Riverina population is largely restricted to hills and low ridges where suitable stands of its food plant, Drooping She-Oak <i>Allocasuarina verticillata</i>	NPR	No – no Drooping She-Oak present	Unlikely	– BAM Predicted species	N/A
Turquoise Parrot	<i>Neophema pulchella</i>	-	– Vulnerable BC Act	Open grassy woodland, often with dead trees near permanent water. Forests, coastal heaths, and disturbed areas near woodlands	NPR	No	Unlikely	– BAM predicted species	N/A
Little Lorikeet	<i>Glossopsitta pusilla</i>	-	– Vulnerable BC Act	Forests, woodland, large trees in open country	NPR	No	Low	– BAM predicted species	N/A
Swift Parrot	<i>Lathamus discolor</i>	Endangered	– Endangered BC Act	Winter migrant from Tasmania. Generally prefers Box-Ironbark forests and woodlands inland of the Great Dividing Range during winter	NPR	No	Low	– May occur (PMST) – BAM Predicted species	N/A
Superb Parrot	<i>Polytelis swainsonii</i>	Vulnerable	– Vulnerable BC Act	Woodlands near rivers, also gardens and pastures in core range of NSW Riverina	1995 (1)	Yes – may occur in road reserves and woodlands on margins of properties when passing between areas of higher quality habitat	Moderate	– Bionet previous record – Known to occur on NSW TSD – Breeding known in area (PMST) – BAM Predicted species	Avoid hollow bearing trees where possible
Barking Owl	<i>Ninox connivens connivens</i>	-	– Vulnerable BC Act	Forest and woodland.	NPR	Yes – May disperse from daytime roosts in Buckingbong State Forest to surrounding pastures on Sandigo North and South at night	Moderate	– Known to occur on NSW TSD	
Masked Owl	<i>Tyto novaehollandiae novaehollandiae</i>	-	– Vulnerable BC Act	Forests, open woodlands, farmlands with large trees, adjacent to cleared country, partly forested coastal plains, timbered	NPR	Yes – may inhabit hollow bearing trees within the project area	Moderate	– Known to occur on NSW TSD – BAM Predicted	N/A

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
				watercourses, paperbark woodlands, caves.				species	
Fork-tailed Swift	<i>Apus pacificus</i>	Migratory		Aerial insectivore that rarely lands to perch, often sleeping on the wing	NPR	Yes – only in airspace above project area, is highly unlikely to land within project area	High	– Likely to occur (PMST)	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
White-throated Needletail	<i>Hirundapus caudacutus</i>	Migratory		Aerial insectivore that rarely lands to perch, often sleeping on the wing	NPR	Yes – only in airspace above project area, is highly unlikely to land within project area	High	– May occur (PMST)	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
Brown Treecreeper	<i>Climacteris picumnus victoriae</i>	-	– Vulnerable BC Act	Dry woodland; forest clearings, eucalypts along streams.	NPR	No	Low	– BAM predicted species	N/A
Regent Honeyeater	<i>Anthochaera phrygia</i>	Endangered	– Critically Endangered BC Act	Depends on nectar and insects from Box-Ironbark Eucalypt forests. Only breeding habitat lies in Northeast Victoria and central coast of NSW	NPR	No	Unlikely	– BAM predicted species	N/A
Painted Honeyeater	<i>Grantiella picta</i>	Vulnerable	– Vulnerable BC Act	Open box-ironbark forests and woodlands, particularly where trees are infested with mistletoe	NPR	No – Mistletoe not recorded during current assessment	Unlikely	– Known to occur on NSW TSD – Likely to occur (PMST) – BAM Predicted species	N/A
Pied Honeyeater	<i>Certhionyx variegatus</i>	-	– Vulnerable BC Act	Arid scrublands, mulga, mallee-spinifex, eucalypt woodlands	NPR	No	Unlikely	– Known to occur on NSW TSD – BAM Predicted species	N/A
White-fronted Chat	<i>Epthianura albifrons</i>	-	– Vulnerable BC Act	Open areas, including fencelines, heath, samphire saltmarshes	Current assessment;	Yes – was observed in road reserves and woodlands on margins of properties	Present	– BAM predicted species	N/A
Speckled Warbler	<i>Chthonicola sagittatus</i>	-	– Vulnerable BC Act	Drier woodlands with tussocks, branches and rocks.	NPR	No	Unlikely	– BAM predicted species	N/A
Varied Sittella	<i>Daphoenositta chrysoptera</i>	-	– Vulnerable BC Act	Open eucalypt woodlands/forests, mallee	NPR	Yes – may occur in road reserves and woodlands on margins of properties when passing between areas of higher quality habitat	Moderate	– Known to occur on NSW TSD – BAM Predicted species	Avoid highest quality remnant vegetation in road reserves and where habitat corridors exist
Grey-crowned Babbler	<i>Pomatostomus temporalis temporalis</i>	-	– Vulnerable BC Act	Open forest, woodlands, scrublands	Current assessment; 2003 (1)	Yes – was observed in road reserves and woodlands on margins of properties	Present	– Bionet previous record – Known to occur on NSW TSD – BAM Predicted species	Avoid highest quality remnant vegetation in road reserves, property margins and where habitat corridors exist
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Migratory		Heavily vegetated gullies in forests, taller woodlands	NPR	No	Low	– May occur (PMST)	Avoid highest quality remnant vegetation in road reserves, property margins and where habitat corridors exist
Hooded Robin	<i>Melanodryas cucullata cucullata</i>	-	– Vulnerable BC Act	Lightly timbered woodland, mainly dominated by acacia and/or eucalypts	NPR	Yes – may occur in road reserves and woodlands on margins of properties when passing between areas of higher quality habitat	Moderate	– Known to occur on NSW TSD – BAM Predicted species	None recommended, project area unlikely to support a significant proportion of limited habitat for this species

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
Scarlet Robin	<i>Petroica boodang</i>	-	– Vulnerable BC Act	Forests, woodlands, scrubs, more open habitats in winter	NPR	Yes – may occur during winter months	Moderate	– Known to occur on NSW TSD – BAM Predicted species	None recommended, project area unlikely to support a significant proportion of limited habitat for this species
Flame Robin	<i>Petroica phoenicea</i>	-	– Vulnerable BC Act	Forests, woodlands, watercourses, more open habitats in winter	NPR	No – west of current distribution	Low	– BAM predicted species	N/A
Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	-	– Vulnerable BC Act	Open forests, woodlands, timbered paddocks	NPR	Yes – may occur in road reserves, woodlands and adjacent paddocks when passing between areas of higher quality habitat	Moderate	– Known to occur on NSW TSD – BAM Predicted species	Avoid highest quality remnant vegetation in road reserves and where habitat corridors exist
Diamond Firetail	<i>Stagonopleura guttata</i>	-	– Vulnerable BC Act	Open grassy woodland, heath and farmland or grassland with scattered trees	NPR	Yes – may occur in road reserves and woodlands on margins of properties when passing between areas of higher quality habitat	Moderate	– Known to occur on NSW TSD – BAM Predicted species	Avoid highest quality remnant vegetation in road reserves, property margins and where habitat corridors exist
Yellow Wagtail	<i>Motacilla flava</i>	Migratory		Short grass and bare ground, swamp margins, saltmarshes	NPR	No	Unlikely	– May occur (PMST)	N/A
Mammals									
Spotted-tailed Quoll	<i>Dasyurus maculatus maculatus</i>	Vulnerable	– Endangered BC Act	Forests including large intact areas of vegetation for foraging.	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A
Striped-faced Dunnart	<i>Sminthopsis macroura</i>	-	– Vulnerable BC Act	Native dry grasslands and low dry shrublands, often along drainage lines where food and shelter resources tend to be better	NPR	No	Low	– Predicted to occur on NSW TSD	N/A
Eastern Pygmy Possum	<i>Cercartetus nanus</i>	-	– Vulnerable BC Act	Broad range of habitats, preferring woodlands and heaths	NPR	No	Low	– BAM Predicted species	N/A
Squirrel Glider	<i>Petaurus norfolcensis</i>	-	– Vulnerable BC Act	Dry sclerophyll forest and woodland, with dense mid-storey, usually on inland slopes and nearby riverine corridors	NPR	No	Low	– BAM Predicted species	N/A
Koala	<i>Phascolarctos cinereus</i>	Vulnerable	– Vulnerable BC Act	Forests and woodlands	NPR	No – May occur in Buckingbong State Forest, but unlikely to move to small patches of woodland within the project area	Low	– Known to occur on NSW TSD – Known to occur (PMST) – BAM Predicted species	N/A
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Vulnerable	– Vulnerable BC Act	Roost sites commonly occur in gullies, in vegetation with dense canopy cover and close to water	NPR	No	Unlikely	– May occur (PMST) – BAM Predicted species	N/A
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>	-	– Vulnerable BC Act	Most environments from deserts to wet forests	NPR	No extensive stands of habitat, although bats may roost within hollows of paddock trees	Low	– Known to occur on NSW TSD – BAM Predicted species	Avoid hollow bearing trees where possible
Little Pied Bat	<i>Chalinolobus picatus</i>	-	– Vulnerable BC Act	Dry sclerophyll forest, woodland and scrub, north of Murray River	NPR	No extensive stands of habitat, although bats may roost within hollows of paddock trees	Low	– Known to occur on NSW TSD	Avoid hollow bearing trees where possible
Corben's Long-eared	<i>Nyctophilus corbeni</i>	Vulnerable	– Vulnerable	Dry woodland and shrubland in	NPR	No	Unlikely	– Known to occur	N/A

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
Bat			BC Act	arid areas				on NSW TSD – May occur (PMST)	
Frogs									
Growling Grass Frog	<i>Litoria raniformis</i>	Vulnerable	– Endangered BC Act	Permanent lakes, swamps, dams and lagoons	NPR	No	Unlikely	– Likely to occur (PMST)	N/A
Sloanes Froglet	<i>Crinia sloanei</i>	-	– Vulnerable BC Act	It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats	NPR	No	Unlikely	– BAM Predicted species	N/A
Reptiles									
Pink-tailed Worm-lizard	<i>Aprasia parapulchella</i>	Vulnerable	– Vulnerable BC Act	Favours areas with native grasses and partially buried rock. Shelters beneath rocks and in tunnels	NPR	No	Unlikely	– May occur (PMST) – BAM Predicted species	N/A
Fish									
Murray Cod	<i>Maccullochella peelii peelii</i>	Vulnerable	-	Small clear, rocky, upland streams with riffle and pool structure on the upper western slopes of the Great Dividing Range to large, meandering, slow-flowing, often silty rivers in the alluvial lowland reaches of the Murray-Darling Basin	NPR	No	Low	– May occur (PMST)	N/A
Flathead Galaxias	<i>Galaxias rostratus</i>	Critically Endangered	– Critically Endangered FM Act	Billabongs, lakes, swamps and rivers, with a preference for still or slow flowing waters	NPR	No	Unlikely	– May occur (PMST)	N/A
Macquarie Perch	<i>Macquaria australasica</i>	Endangered	– Endangered FM Act	Deep, rocky holes with considerable cover and flowing water over unsilted cobble and gravel substrate	NPR	No	Unlikely	– May occur (PMST)	N/A
Plants									
Austral Pillwort	<i>Pilularia novae-hollandiae</i>	-	– Endangered BC Act	Shallow swamps and waterways, often among grasses and sedges	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A
Lanky Buttons	<i>Leptorhynchus orientalis</i>	-	– Endangered BC Act	Grows in woodland or grassland, sometimes on the margins of swamps.	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A
Mossgiel Daisy	<i>Brachyscome papillosa</i>	Vulnerable	– Vulnerable BC Act	Recorded primarily in clay soils on Saltbush and Bluebush plains, but also in grassland and in Inland Grey Box - Cypress Pine woodland.	NPR	Yes – may occur in woodlands with less disturbed understorey, in roadside reserves	Low	– BAM Predicted species	Avoid highest quality remnant woodlands in road reserves
Mueller Daisy	<i>Brachyscome muelleroides</i>	Vulnerable	– Vulnerable BC Act	Seasonally wet depressions	NPR	No	Unlikely	– Likely to occur (PMST)	N/A
Pine Donkey Orchid	<i>Diuris tricolor</i>	-	– Vulnerable BC Act	Grows in sclerophyll forest among grass, often with native Cypress Pine. It is found in sandy soils, either on flats or small rises.	NPR	No – only open woodlands present, not forests	Low	– BAM Predicted species	N/A
Oaklands Diuris	<i>Diuris</i> sp. (Oaklands, D.L. Jones 5380)	-	– Vulnerable BC Act	Grows in White Cypress Pine Woodland, either among dense	NPR	No	Unlikely	– BAM Predicted species	N/A

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
				grasses in flat areas with associated eucalypts, or amongst sparse grasses and forbs on low sandhills. Only known from locations south of project area					
Sandhill Spider-orchid	<i>Caladenia arenaria</i>	Endangered	– Endangered BC Act	Occurs in woodland with sandy soil, especially that dominated by White Cypress Pine	NPR	Yes – in higher quality woodlands and derived grasslands such as RP8	Low	– May occur (PMST) – BAM Predicted species	Avoid highest quality remnant grasslands
Silky Swainson-pea	<i>Swainsona sericea</i>	-	– Vulnerable BC Act	Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines <i>Callitris</i> spp.	NPR	Yes – may occur in woodlands with less disturbed understorey, in roadside reserves	Low	– Known to occur on NSW TSD – BAM Predicted species	Avoid highest quality remnant woodlands in road reserves
Slender Darling Pea	<i>Swainsona murrayana</i>	Vulnerable	– Vulnerable BC Act	Heavy soils, especially depressions, Bladder Saltbush herbland, Black Box woodland and grassland communities	NPR	No	Unlikely	– Known to occur on NSW TSD – Likely to occur (PMST) – BAM Predicted species	N/A
Small Purple-pea	<i>Swainsona recta</i>	Endangered	– Endangered BC Act	Woodlands with a grassy understorey	NPR	No	Unlikely	– BAM predicted species	N/A
A spear-grass	<i>Austrostipa metatoris</i>	Vulnerable	– Vulnerable BC Act	Grows in sandy areas of the Murray Valley; habitats include sandhills, sandridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils.	NPR	No	Unlikely	– BAM predicted species	N/A
Spike Rush	<i>Eleocharis obicis</i>	Vulnerable	– Vulnerable BC Act	Grows in ephemerally wet situations such as roadside mitre drains and depressions, usually in low-lying grasslands	NPR	No	Unlikely	– BAM predicted species	N/A
A spear-grass	<i>Austrostipa wakoolica</i>	Endangered	– Endangered BC Act	Floodplains of the Murray River tributaries, in open woodland, edges of lignum swamps; creek banks; Cypress Pine forests	2000 (2)	Yes – may occur in higher quality, less disturbed grasslands such as RP8 and RP17	Moderate	– Bionet previous record – Known to occur on NSW TSD – Known to occur (PMST) – BAM Predicted species	Avoid highest quality remnant grasslands
Spiny Peppercress	<i>Lepidium aschersonii</i>	-	– Vulnerable BC Act	Found on ridges of gilgai clays dominated by Brigalow <i>Acacia harpophylla</i> , Belah <i>Casuarina cristata</i> , Buloke <i>Allocasuarina luehmanii</i> and Grey Box <i>Eucalyptus microcarpa</i> , often the understorey is dominated by exotic species.	NPR	No	Unlikely	– Known to occur on NSW TSD	N/A

Common Name	Species Name	National Conservation Status	NSW Conservation Status *	Habitat Preferences	Most Recent Record (no of records)	Habitat Present on Site	Likelihood of Presence**	Source ***	Recommended Mitigation
Turnip Copperburr	<i>Sclerolaena napiformis</i>	Endangered	– – Endangered BC Act	Remnant grassland habitats on clay-loam soils	NPR	No	Unlikely	– May occur (PMST)	N/A
Winged Peppergrass	<i>Lepidium monoplacoides</i>	Endangered	– – Endangered BC Act	Mallee scrub in semi-arid areas	NPR	No	Unlikely	– Predicted to occur on NSW TSD – BAM Predicted species	N/A

Table notes

* NSW Conservation Status Abbreviations:

BC Act: *Biodiversity Conservation Act 2017*FM Act: *Fisheries Management Act 1994*

** Likelihood of Presence Definitions:

Unlikely: Site does not contain habitat and/or it is outside the species' known, current distribution.

Low: Site contains some marginal habitat, but the species was not observed and has not been recently recorded in previous surveys in the area.

Moderate: Site contains preferred habitat that may support a population of the species. However, other factors, such as fragmentation, disturbance or predators may be impacting any local population.

High: Site contains the preferred habitat which is likely to support the species.

Present: Preferred habitat is present on the site, and the species was observed on the site, or recently recorded at the site.

*** Source abbreviations:

TSD: NSW Threatened Species Database

PMST: Protected Matters Search Tool

BAM: Biodiversity Assessment Method

PCT: Plant Community Types

NPR – No previous record, modelled presence only under the EPBC Protected Matters Search Tool results.

N/A – Not applicable

Appendix 5 – Narrandera Region Plains-wanderer Priority Habitat Map

Plains-wanderer habitat in Narrandera LGA

