APPENDIX C: SPECIALIST INVESTIGATIONS

Specialist investigations are appended in the following order:

BIODIVERSITY ASSESSMENT – PART A

BIODIVERSITY ASSESSMENT – PART B

ABORIGINAL CULTURAL HERITAGE ASSESSMENT

PRELIMINARY HAZARD ANALYSIS

HYDROLOGY REPORT (INCLUDING FLOODING)

GLARE AND GLINT

VISUAL IMPACT ASSESSMENT

Part One

Biodiversity Assessment

Jemalong Solar Station

JULY 2015

ngh environmental

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EXECUTIVE SUMMARY

Vast Solar have proposed to construct and operate the Jemalong Solar Station at Jemalong, 35 kms west of Forbes, NSW.

The proposal comprises the construction, operation and eventual decommissioning of a 30MW CSP plant with at least four hours' thermal energy storage.

Key infrastructure components include:

1. Fields of dual-axis tracking mirrors or 'heliostats' that track the sun (collectively called 'solar arrays').
2. Thermal energy receivers, mounted on the top of 30 metre towers, which capture the thermal energy reflected from the heliostats.
3. Large scale thermal energy storage (usually though not universally a component of such projects), which enables the system to generate steam and produce electricity at any time, night or day.
4. Heliostats grouped in 'modules', with each module having its own thermal energy receiver.

A solar tracking system would drive the heliostats to reflect and concentrate solar energy to the receiving towers during daylight hours. This solar flux energy field would reach levels of above 50kW/m^2 with temperatures in excess of 450°C in a downward facing, wedge-shaped zone extending 3-4m from the southern face of the receiver.

The purpose of this Biodiversity Assessment is to describe the biodiversity characteristics of the study area, determine the ecological constraints of the proposal, assess the potential ecological impacts of the proposal, assess the significance of the impact of the proposed activities on species, ecological communities and populations listed under the *Threatened Species Conservation Act 1995* (TSC Act) and *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), and to propose environmental management measures to minimise, mitigate and, if necessary, offset residual impacts.

The assessment has been undertaken in two parts that include:

1. **Part One** – titled 'Biodiversity Assessment, Jemalong Solar Station'
2. **Part Two** - 'Jemalong Solar Station: Potential Impacts on Bird Populations and Recommendations for Bird Hazard Risk Management' (Ambecol 2015)

Part one assesses impacts associated with construction of the Solar Station, and operation impacts on all fauna excluding avifauna that would be associated with the operation of Jemalong Solar Station. Part two is a specialist assessment that focuses on assessment of impact on avifauna presented by the operation of the Solar Station.

One site assessment was undertaken by NGH Environmental field staff; from the 17 to 21 November 2014. A further site assessment was undertaken by Ambecol in February 2015.

Three moderate to good condition native vegetation communities were observed within the study area, including Western Grey Box – Poplar Box – White Cypress Pine open woodland (PCT #82), Poplar Box grassy woodland (PCT #244) and River Red Gum swampy woodland wetland (PCT #249). Western Grey Box – Poplar Box – White Cypress Pine open woodland is listed as an Endangered Ecological Community (EEC) under the TSC Act, however this EEC would not be impacted due to the proposed works. **A total of**

1.83 hectares of moderate to good condition native vegetation is proposed for removal, and a further 59.1 hectares of exotic-dominated vegetation would be impacted.

Flora

No threatened flora species were observed during the field survey, and threatened species evaluations determined that the study area is unlikely to provide important habitat for any of the flora species detected in background searches. Of the 17 exotic flora species observed in the study area, one (African Boxthorn) is declared as a Noxious Weed by the Forbes Shire Council.

Fauna

Five threatened bird species were recorded during field surveys; the Superb Parrot (*Polytelis swainsonii)*, Grey-crowned Babbler *(Pomatostomus temporalis temporalis)*, Spotted Harrier (*Circus assimilis*), Brown Treecreeper (Eastern Sub-species) (*Climacteris picumnus victoriae*) and the Turquoise Parrot (*Neophema pulchella*). One of these species, the Grey-crowned Babbler was not recorded within the proposal site but is considered likely to occur there occasionally. Four threatened microbats are considered to potentially occur in the study area based on possible to probable identifications from Anabat recordings. These are the Little Pied Bat (*Chalinolobus picatus*), Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Inland Forest Bat (*Vespadelus baverstocki*) and Corben's Long-eared Bat (*Nyctophilus corbeni*).

Within the study area, potential habitat exists for threatened aquatic birds, shorebirds and other wading birds, raptors, parrots and cockatoos, woodland birds, grassland and shrubland birds, microbats, and the Koala (*Phascolarctos cinereus*). **Assessments of significance under the TSC Act determined that the proposal is not likely to have a significant impact on any of the state-listed fauna species likely to occur in the study area**

A total of 205 hollow-bearing trees were identified within the proposal site, eight of which are proposed to be cleared due to the proposed transmission line. No hollow-bearing trees will be cleared in the solar station proposal. These eight hollow-bearing trees account for approximately 3.9% of the hollow-bearing trees within the study area.

Due to the minimal amount of woodland and hollow-bearing trees proposed to be cleared and the relative abundance of contiguous habitat within the study area, the clearing and disturbance of 1.83 hectares of moderate-good condition woodland, including eight hollow-bearing trees, is considered a negligible loss and hence is not considered to be a significant impact on any EECs, or threatened flora and fauna occurring or likely to occur within the study area.

1 INTRODUCTION

1.1 BACKGROUND

The assessment of impacts on biodiversity assessment for the Jemalong Solar Station near Forbes has been undertaken in two parts that include;

3. **Part One** – titled 'Biodiversity Assessment, Jemalong Solar Station
4. **Part Two** - 'Jemalong Solar Station: Potential Impacts on Bird Populations and Recommendations for Bird Hazard Risk Management' (Ambecol 2015)

Part one assesses impacts associated with construction of the Solar Station, and operation impacts on all fauna excluding avifauna that would be associated with the operation of Jemalong Solar Station.

Part two is a specialist assessment that focuses on assessment of impact on avifauna presented by the operation of the Solar Station. This approach allows for this component of the assessment to focus on avifauna due to the site been located in an area considered of significance to this group of fauna, as it is an area characterised by the intersection of three NSW bioregions, at a site where between 101 and 150 bird species have been recorded (Ambecol 2015).

The focus of Part 2 is risk to bird populations at the solar station in relation to;

- loss of bird habitat
- collision risks with solar station infrastructure (heliostats, towers and cables)
- solar flux burns and related trauma
- heliostats and reflected light perceived by birds as wetlands
- attraction of birds to bright lights at night
- attraction to insects culls and live swarms; and
- stranding and predation.

The assessment of risk to avifauna has been guided by risks to birds observed at solar stations in the United States, and identified by Kagan et al. (2014) and Erikson eta l. (2014). Part 2 is included as Appendix 1.

1.2 PROJECT DESCRIPTION

The proposed development is a 30 MW concentrated solar thermal (CST) plant with thermal energy storage, made up of approximately 90 modules, with each module consisting of a heliostat field and a 30m high receiving tower. The heliostats would be 2.2 m high, located 30 to 100 m from the receiving tower. A solar tracking system would drive the heliostats to reflect and concentrate solar energy to the receiving towers during daylight hours. This concentrated solar energy is referred to as the Solar Flux. The receiving towers would be lattice structures approximately 30 m high with a 2 m high receiving device mounted at the top. Solar flux would reach levels of above 50kW/m^2 (approximately 50 times the brightness of the sun) with temperatures in excess of 450°C in a downward facing, wedge-shaped zone extending 3-4m from the southern face of the receiver.

A power transmission line connecting the solar station to an existing transmission line on Lachlan Valley Way has also been proposed. This transmission line is approximately 4.5 kilometres in length and 45 metres wide.

1.3 STUDY AREA

The proposal site is located in central NSW, approximately 36 kilometres west south west of Forbes. The proposed works would be undertaken within the Jemalong Station in the Forbes Shire Local Government Area (LGA) (Figures 1-1 to 1-3). Land use in the study area currently includes cropping and grazing. Southern Parts of the proposal site are irrigated. Cleared agricultural land surround the proposal site. These are part of the Jemalong Station.

Within the proposal site there are scattered trees and shrubs. For the purposes of the field survey, the ***proposal site*** is defined as the maximum potential impact of the proposal, which includes the outside boundary of the proposed solar station and a 45 metre wide area running along the proposed transmission line.

The solar plant has been designed around existing remnant tree vegetation so that no clearing will be undertaken within the proposal site due to the construction of the solar plant. The ***study area*** is the area surveyed for the purposes of this assessment. This study area includes the proposal site and a 'buffer' of approximately one kilometre around the proposed solar station and incorporates remnant patches of woodland adjacent to the proposed transmission line.

The ***study locality*** (which relates to the database search area) is defined as the area within a 10 kilometre radius of the proposal site. Note that this is different to the definition of *locality* provided within the Threatened Species Assessment Guidelines: the assessment of significance (DECC 2007a) (see below).

The ***locality*** (as defined within DECC 2007a) is the same meaning as ascribed to local population of a species or local occurrence of an ecological community.

The ***local population*** is the population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions:

- The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area.
- The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area.
- The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time.

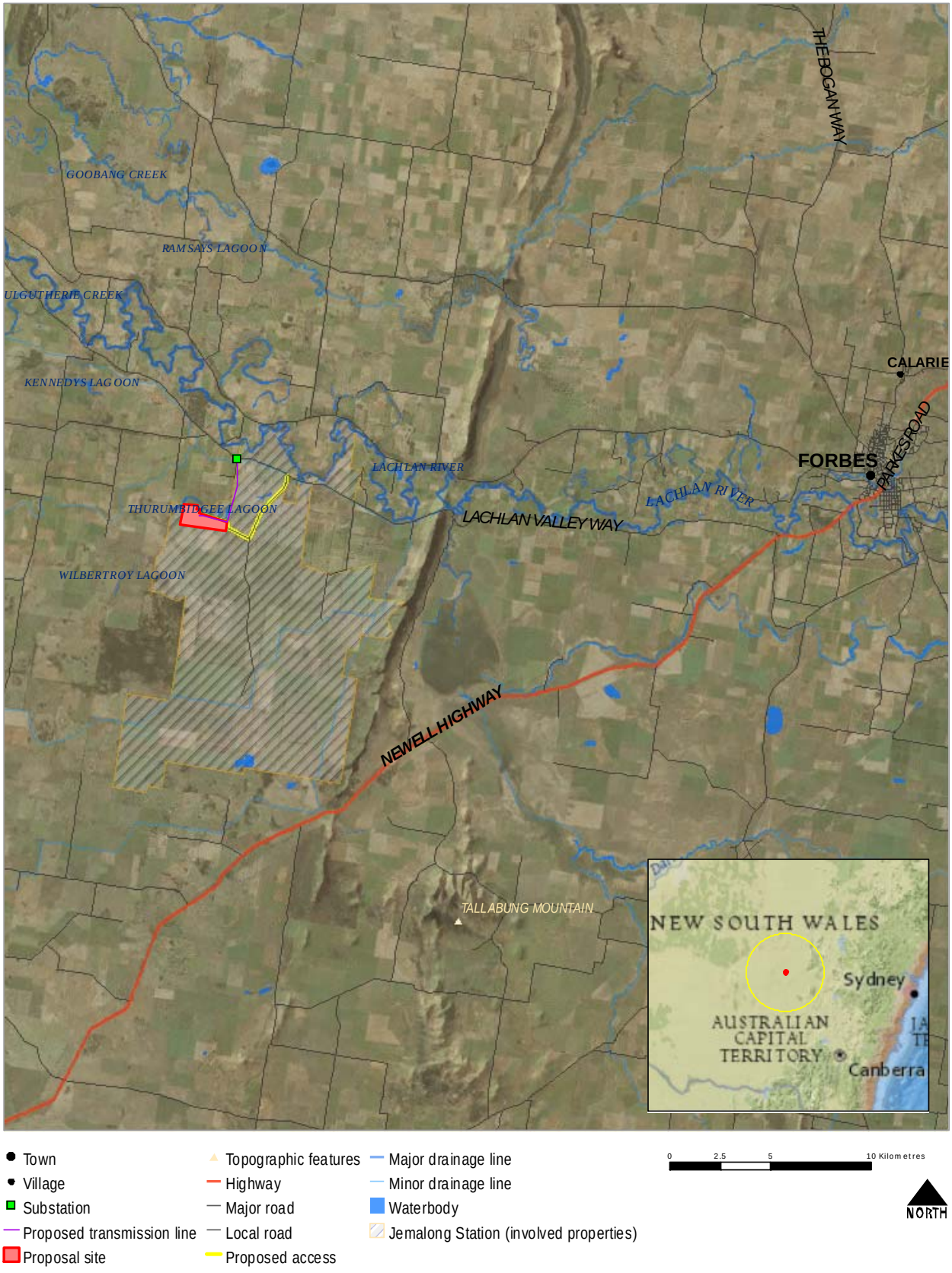

Figure 1-1 The proposal site in the locality.

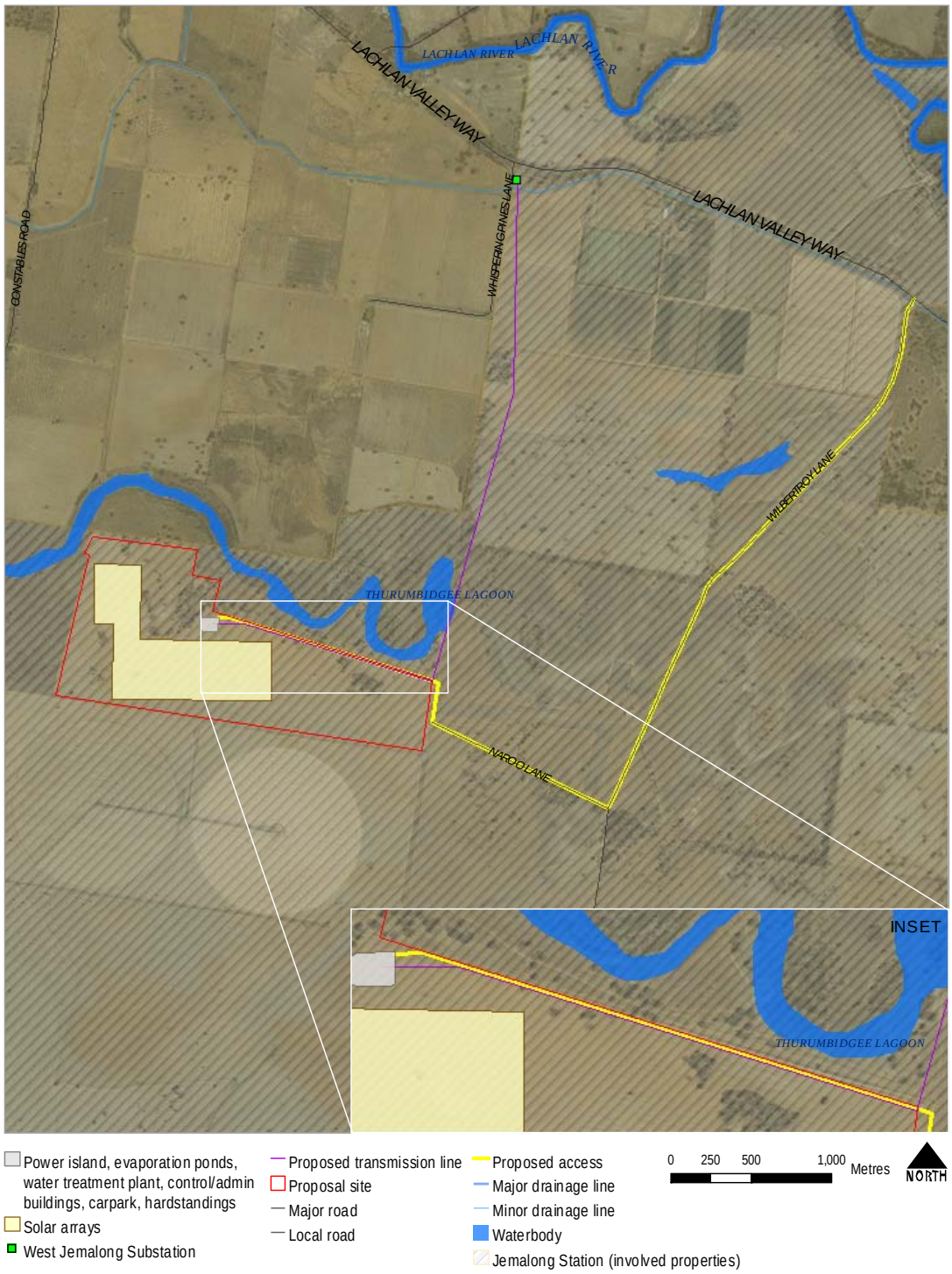

Figure 1-2 Proposal site including solar station and transmission line.

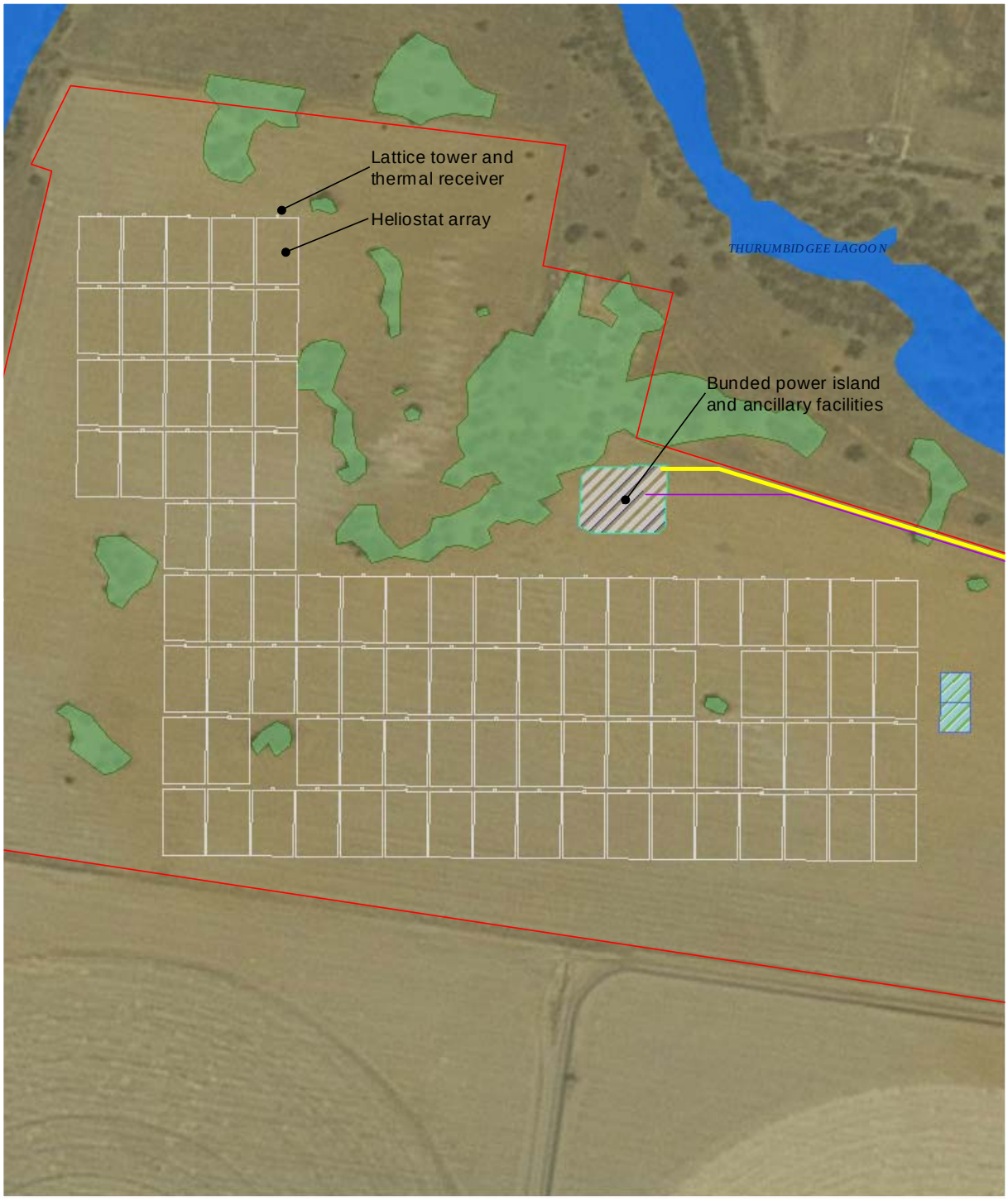

Figure 1-3 Solar station layout including heliostats, receiving towers, access road, storage area and turbine noise hood within the proposal site.

1.4 LEGISLATIVE REQUIREMENTS

1.4.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance. Matters of national environmental significance relevant to biodiversity are:

- Wetlands of international importance.
- Nationally threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.

Significance of impacts is determined in accordance with the *Significance impact guidelines 1.1 – matters of national environmental significance* (Department of Environment, Water, Heritage and the Arts, 2006).

Where a proposal is likely to have a significant impact on a matter of national environmental significance, the proposal is referred to the Commonwealth Environment Minister via the Department of the Environment (DoE). The Minister then determines whether the proposal is a 'controlled action'. If a proposal is declared a controlled action, an assessment of the action is carried out and the Minister makes a decision to approve, approve with conditions, or not approve the proposed action. Further information on the referral and approval process is available at *Assessment and approval process - EPBC Act*.

1.4.2 Native Vegetation Act 2003

The *Native Vegetation Act 2003* regulates the clearing of native vegetation. Clearing is defined as cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning native vegetation including native grasses and herbage.

An authorisation to clear native vegetation is not required for State Significant Development (section 89J EP&A Act).

1.4.3 Noxious Weeds Act 1993

This act aims to prevent the establishment, reduce the risk of spread and minimise the extent of noxious weeds. The *Noxious Weeds Act 1993* (NW Act) guides the management of declared noxious weeds within Local Government Areas (LGAs). The Act distinguishes between five classes of noxious weeds, which are separated based on their distributions and the level of threat that each species poses to the environment, human health, or primary production (Table 1-1). Noxious weeds that are classified as Class 1, 2 or 5 are also considered 'notifiable weeds', which simply means that the Local Control Authority (e.g. Council) must be informed about the presence of the weed on land within 24 hours of becoming aware or suspecting that the weed is on the land. Individual land holders and managers are required under the NW Act to control noxious weeds declared for their area according to their classification. Declared noxious weeds in NSW are plants that have been proclaimed under the NW Act. The legislation requires that these species be controlled or eradicated.

In addition to the NW Act, an effort to gain control of weeds in Australia led to the development of a National Weeds Strategy. The strategy was first developed in 1997 and further refined in 2007 by the

Commonwealth of Australia and issued under the authority of the National Resource Management Ministerial Council. Detailed management procedures have been outlined under the strategy and published for the control of 21 of the 32 recognised Weeds of National Significance (WoNS). WoNS are recognised as having potential to cause a significant impact upon natural values including: threats to human health and safety; threats to pastoral and agricultural industries; threats to water quality and supply; threats to indigenous flora; and threats to biodiversity and cultural values.

Table 1-1: Noxious weed classes and their characteristics as listed under the Noxious Weeds Act 1993.

Noxious Weed Class	Class Characteristics
Class 1 **State Prohibited Weeds**	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
Class 2 **Regionally Prohibited Weeds**	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
Class 3 **Regionally Controlled Weeds**	Plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
Class 4 **Locally Controlled Weeds**	Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
Class 5 **Restricted Plants**	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

1.4.4 NSW Environmental Planning and Assessment Act 1979 (EP&A Act)

Development in NSW is subject to the requirements of the EP&A Act and its associated regulations. Environmental planning instruments prepared under the Act set the framework for development approval in NSW.

The proposal would be assessed under Part 4 of the EP&A Act. The relevant objects of the EP&A Act are:

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 coordination of the orderly and economic use and development of land.

iii. The protection, provision and coordination 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.

vii. Ecologically sustainable development.

The objects of the EP&A Act have been considered throughout this assessment which addresses Secretary's Environmental Assessment Requirements (SEARs), provided by NSW Department of Planning and Environment (DPE) on 26 August 2014.

The recommendations of this assessment have been formulated to avoid impacts where possible, minimise where avoidance is not possible and offset residual impacts to ensure the 'improve or maintain' environmental outcome for the project is met.

1.4.5 NSW National Parks and Wildlife Act 1974 (NP&W Act)

This act aims to conserve nature, habitat, ecosystems, ecosystem processes and biological diversity at the community, species and genetic levels. Under this Act all native fauna is protected, threatened or otherwise. Schedule 13 of the act lists protected plants which shall not be harmed or picked on any land either on or off National Park estate.

With regard to threatened species a person must not:

(a) harm any animal that is of, or is part of, a threatened species, an endangered population or an endangered ecological community, or

(b) use any substance, animal, firearm, explosive, net, trap, hunting device or instrument or means whatever for the purpose of harming any such animal.

1.4.6 NSW Threatened Species Conservation Act 1995 (TSC Act)

This act aims to conserve biological diversity, promote ecologically sustainable development, prevent extinctions and promote recovery of threatened entities, protect critical habitat, assess the impacts of actions on, and encourage the conservation of threatened entities.

Significance of impact

If works are likely to impact on a listed (threatened) species or ecological community, Section 94 of the TSC Act contains seven factors that can be used to determine whether the impact on the entity will be significant or not. Where a significant impact is likely to occur a Species Impact Statement (SIS) must be prepared for projects assessed under Part 4 and Part 5 of the EP&A Act. The content of a SIS is outlined in Sections 110 – 112 of the *Threatened Species Conservation Act 1995* (TSC Act) and includes requesting Director-General's requirements.

Clause 50 requires public authorities to have regard to critical habitat when exercising their functions on land to which a critical habitat declaration applies.

1.4.7 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) encourages the conservation and management of natural vegetation that provides habitat for Koalas. Koalas are listed under the TSC Act as a vulnerable species. The Forbes LGA is subject to this SEPP and cannot approve development in an area affected by the policy without an investigation of core koala habitat. SEPP 44 aims to identify areas of potential and core Koala Habitat. These are described as follows:

- Potential Koala Habitat: areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and

- Core Koala Habitat: an area of land with a resident population of Koalas, evidenced by attributes such as breeding females, and recent and historical records of a population.

This report considers whether any part of the proposal site could be described as potential or core koala habitat under SEPP 44.

1.4.8 Forbes Shire Local Environmental Plan 2013

The study area is zoned as RU1 (Primary Production). The Forbes Local Environmental Plan 2013, lists the objectives for Primary Production:

RU1 (Primary Production) - Objectives of zone

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To provide opportunities for intensive and extensive agriculture in appropriate locations consistent with the environmental capability of the land.

1.5 STUDY AIMS

This component of the Biodiversity Assessment has been prepared by **NGH E**nvironmental on behalf of Vast Solar. It assesses impacts associated with construction of the Solar Plant, and operation impacts on all biodiversity, excluding avifauna, that would be associated with the operation of Jemalong Solar Station.

Part two of the biodiversity assessment is a specialist assessment that focuses on assessment of impact on avifauna presented by the operation of the Solar Station. This part of the biodiversity is included as Appendix 1.

The purpose of this Biodiversity Assessment is to determine the terrestrial biodiversity values of the site and surrounding area and the ecological constraints of the proposal.

The scope and aims of this report are to:

- Determine the biodiversity values of the study area including identifying protected and threatened flora and fauna species, populations and ecological communities and their habitats.
- Identify the ecological constraints of the proposal.
- Identify the potential impacts of the proposed activity on threatened flora and fauna species, populations, ecological communities and critical habitat.
- Address the requirements of the relevant legislation including the EP&A Act, the TSC Act and the EPBC Act.
- Assess the significance of the impact of the proposed activities on species, ecological communities and populations listed under the TSC Act and EPBC Act.

- Propose environmental management measures to minimise, mitigate and if necessary offset residual impacts.

2 METHODOLOGY

2.1 PERSONNEL

Ecologist, Cameron Radford (BSc. Env M. Wildlife Hlth & Pop Mgmt) has over six years' experience as a fauna and flora ecologist working in NSW, South Australia and Queensland. He has experience working in both consultancies and not-for-profit organisations covering all aspects of ecological work including research, assessment and reporting, management and species/ecosystem conservation and restoration. Cameron has led fauna survey teams in semi-arid desert to coastal habitats and has strong experience in fauna and flora surveys and assessments throughout south-eastern Australia. Through his extended experience in environmental assessment and research, Cameron has developed excellent report writing and data analysis skills, as well as strong interpersonal communication skills working with private and public sector stakeholders. Within the NGH Environmental team, Cameron has worked on a range of projects including renewable energy, road infrastructure and water infrastructure.

Brenton von Takach (BScEnv, MConBio) is a botanist and ecologist with NGH Environmental's biodiversity team, and performs flora and fauna assessments for a wide variety of projects. Brenton has been involved with developments ranging from large-scale wind farms and dam upgrades to minor road alterations. He is well-versed in a broad array of monitoring and survey techniques for both flora and fauna, and has conducted surveys in a number of biogeographic regions of NSW. As a result, he is familiar with many of the vegetation types and communities found throughout the state. Brenton's work requires knowledge of and experience in the management of threatened species and ecological communities as well as a solid understanding of legislative requirements at both State and Commonwealth levels. Prior to joining nghenvironmental he worked for the *Australian Wetlands and Rivers Centre* at the University of NSW, conducting survey trips across Australia to undertake vegetation assessments and fauna trapping programs. He has been involved in fauna monitoring programs with OEH and radio tracking fauna for the Australian Wildlife Conservancy. Brenton is a very capable field ecologist with excellent reporting skills.

Nick Graham-Higgs (BSc) is an environmental practitioner with over 30 years of experience, and in 2011 this was formally recognised with the award of Fellowship of the Environment Institute of Australia and New Zealand (FEIANZ). Nick has been a Certified Environmental Practitioner (CEnvP) under the EIANZ's certification scheme, since 2005.

Nick has specialising in environmental management, biodiversity assessment and impact assessment. He has managed and prepared documentation for a wide range of projects, of varying scales and affecting a diverse range of natural and constructed environments. Nick's role includes provision of technical advice and review.

2.2 DATABASE SEARCHES AND LITERATURE REVIEW

Database searches undertaken for the purposes of this assessment included threatened species databases and noxious weed databases as listed in Table 2-1. The results of the database searches are provided in Appendix D. An evaluation of presence of habitat and likelihood of occurrence of threatened flora and fauna species and ecological communities are provided in Appendix E. Likelihood of occurrence criteria include: None (entity does not occur at the site), Unlikely (entity is not likely to occur at the site), Possible (entity could occur and the site may provide suitable conditions), and Present (entity was recorded at the site during field investigations).

Table 2-1 Background searches undertaken

Resource	Target	Search date NGH	Search area
Office of Environment and Heritage (OEH) Wildlife Atlas Data	Threatened flora and fauna and populations	10/11/14	10 km radius of proposal site and within the Lower Slopes CMA Sub-region of the Lachlan CMA
EPBC Act Protected Matters Search	Threatened flora and fauna, endangered populations and ecological communities and migratory species	10/11/14	10 km radius of proposal site
Department of Primary Industries (DPI) Threatened and Protected Species Records Viewer	Threatened fish species	10/11/14	Forbes Shire Council
Department of Primary Industries (DPI) Noxious Weed database	Noxious weeds declared in the relevant LGA.	10/11/14	Forbes Shire Council
Bureau of Meteorology National Atlas of Groundwater Dependant Ecosystems	Vegetation communities that are likely to rely on groundwater.	10/11/14	5 km radius of proposal site.
Broad-scale vegetation mapping of the Lachlan CMA	Threatened ecological communities occurring within the locality of the site.	NA	Lachlan CMA

Literature relevant to this assessment was also reviewed and included:

- OEH Threatened Species Profiles.
- Department of the Environment (DoE) EPBC Act Species Profiles and Threats Database (SPRAT).
- Biobanking Assessment Methodology guidelines (OEH 2014).
- New South Wales Vegetation Classification and Assessment: Part 2 Plant communities in the NSW South-western Slopes Bioregion and update of the NSW Western Plains plant communities (Benson 2008).
- Threatened Species Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC 2004).
- Threatened species assessment guidelines: The assessment of significance (DECC 2007a).
- Ambecol (2015). Jemalong Solar Station: Potential Impacts on Bird Populations and Recommendations for Bird Hazard Risk Management. Ambrose Ecological Services, Sydney.
- Aerial maps.

2.3 FIELD SURVEY EFFORT

The field surveys were undertaken by NGH Environmental between the 17 and 21 November 2014. The entire study area was traversed by two terrestrial ecologists, and inspected by car when able. Flora surveys where undertaken using random meanders (after Cropper 1993) and BioMetric Vegetation Plots (as per OEH 2014), and fauna surveys included point bird surveys, reptile searches, spotlight transects, Anabat recordings, hollow-bearing tree assessments and watches and habitat assessments. Furthermore, opportunistic findings were recorded.

Daytime temperatures were hot with limited cloud cover (Table 2-2). Conditions were relatively dry for the duration of the surveys.

Table 2-2 Weather conditions during the field survey.

Date	Temperature min (°C)	Temperature max (°C)	Rain (mm)	Wind speed 9am (km/h)	Moon Phase
17/11/14	8.3	25.7	0	17	Waxing crescent
18/11/14	8.5	28.5	0	11	Waxing crescent
19/11/14	9.2	31.7	0	2	Waxing crescent
20/11/14	10.5	36.0	0	30	Waxing crescent
21/11/14	15.1	35.5	0	22	Waxing crescent

2.3.1 Terrestrial Flora

The aims of the flora surveys were to:

- Determine all vegetation communities present within the study area, their condition and extent.
- Identify potential Endangered Ecological Communities (EECs) within the study area and determine their condition and extent.
- Identify whether threatened flora species are present within the study area, and whether it is likely that any will occur within the existing habitat.
- Determine the local occurrence of EECs.

Five BioMetric vegetation plots were undertaken during the survey period in suitable representative vegetation zones under the Biobanking Assessment Methodology guidelines (OEH 2014). Furthermore, the entire solar station proposal site was traversed in vehicle and on foot, as was the transmission traversed on foot. Traversing surveys were undertaken in the form of informal transects. Approximately 17 person hours was spent inspecting the vegetation of the proposal site and the surrounding landscape, with additional time taken to confirm species identifications and the condition and extent/boundaries of vegetation communities.

A list of all flora species recorded during the surveys along with estimates of their relative abundance in each identified vegetation community is provided in Appendix A.

Random meanders

Formal random meanders (after Cropper 1993) within each vegetation type were undertaken throughout the study area, recording floristic, structural and physical data. This included one random meander within

floodplain woodland outside the proposal site, but within the study area. Dominant tree species, physical structure of the vegetation, and species composition were used to identify vegetation types as particular communities. This method provides comprehensiveness in terms of the number of species and variation within vegetation types, and improves opportunities for detecting significant or sparsely distributed plant species, and assists in validation of boundary of vegetation boundaries.

BioMetric Vegetation Plots

A suitable number of vegetation plots were established in each area/zone of homogenous vegetation type and condition, as defined by the OEH BioBanking Assessment Methodology (Appendix G1). The plots were placed using a stratified approach to ensure that all native vegetation types were adequately surveyed. In total five plots were surveyed within the proposal site. These vegetation plots were undertaken utilising the methodology presented in the relevant documents, such as the BioBanking Assessment Methodology (OEH 2014). Each vegetation plot was assigned to a suitable BioMetric Vegetation Type, as per the OEH database and a suitable Plant Community Type as per the VIS Plant Community Identification Tool (OEH 2015).

Table 2-3 BioMetric Vegetation Plots conducted during the survey by vegetation type.

BioMetric vegetation type	# of plots within proposal site
Western Grey Box – Poplar Box – White Cypress Pine open woodland on red loams mainly of the eastern Cobar Peneplain Bioregion PCT* 82, BVT+ LA152	1
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) PCT 244, BVT LA178	2
River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW PCT 249, BVT LA191	1

*PCT is Plant Community Type, + is Biometric Vegetation Type, LA Lachlan.

Vegetation condition assessment

All vegetation communities in the study area were assigned a vegetation condition as per the OEH Biobanking Assessment Methodology. Under the methodology, native woody vegetation is in low condition if:

- The over-storey per cent foliage is <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type, AND
- <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

Native grassland or herbfield is in low condition if:

- <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

If native vegetation is not in low condition then it is considered to be in moderate to good condition. Hence, for some open woodland communities, treeless native pasture derived from woodland and dominated by native grasses would be classed in 'moderate to good' condition under this categorisation (depending on the overstorey benchmark). Similarly, areas where the groundcover is exotic but suitable overstorey cover is present would also be classed in 'moderate to good condition'.

Native vegetation within the local area

Random meanders were conducted within the study area to assess the vegetation communities within the surrounding local area to determine the extent of vegetation communities throughout the study area, and to assess the contiguous nature of adjoining vegetation types to that of those within the study area. In particular, the area of vegetation in the floodplain to the north of the proposal site and the woodland surrounding the proposal site was assessed.

BioMetric Vegetation Plots were established in each area/zone of homogenous vegetation type and condition within the study area, as defined by the 2014 OEH BioBanking Assessment Methodology (BBAM 2014). The plots were placed using a stratified approach to ensure that all native vegetation types were adequately surveyed. In total, five plots and transects were surveyed within the study area. These vegetation plots were undertaken utilising the methodology presented in BBAM 2014. Each vegetation plot was assigned to a suitable Plant Community Type (PCT) as per the VIS Plant Community Identification Tool (OEH 2011) (see below).

Plant and community nomenclature

Vegetation communities in the study area have been categorised on the basis of their structure and formation using the VIS Plant Community Identification Tool (OEH 2011). The PCT Id Tool classifies vegetation according to the standard NSW operational classification hierarchy used in the NSW Vegetation Information System (VIS), including vegetation formations, vegetation classes and PCTs. The NSW PCT classification was developed in 2011 to establish an unambiguous master community-level classification for use in vegetation mapping programs, BioMetric-based regulatory decisions, and as a standard typology for other planning and data gathering programs. Vegetation names have been correlated in Table 3-1 with their relevant OEH BioMetric Vegetation Type, as per the OEH BioMetric Vegetation Types Database.

Botanical nomenclature follows Harden (1990-2002), with recent name changes provided by the Australian Plant Name Index of the Australian National Herbarium. In the body of this report, flora species are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only. Where a species does not have a generally accepted common name, the scientific name is used throughout the body of the report. Common and scientific names are included in the appendices.

Noxious weeds identified are those declared for the Forbes Shire Council control area under the *Noxious Weeds Act 1993*.

2.3.2 Terrestrial Fauna

The aims of the terrestrial fauna surveys were to:

- Assess the habitat types available and their quality and suitability as threatened species habitat (e.g. trees with abundance of hollows, ground cover, vegetation structure). Surveys in the surrounding study area were also undertaken to assess the relative importance of the habitat in the proposal site to that available in the study area.
- Determine which birds, mammals, bats, and other animals are present within the study area using a variety of nocturnal and diurnal survey techniques. Bird surveys had particular relevance to the proposal based on possible impacts the proposal may cause to birds.

- Collect data on the habitat usage and abundance of threatened fauna observed in the study area, in order to determine the potential impacts of the proposal on these species
- Undertake targeted bird surveys to generate bird species lists for inclusion in the Part 2 Biodiversity Assessment that assesses potential operational impacts on bird populations

Habitat assessment and hollow-bearing tree surveys

An assessment of habitat types available and their quality and suitability as threatened species habitat was conducted across the study area. Factors such as coarse woody debris, leaf litter, vegetation structure, connectivity and disturbance were noted. Five habitat assessments were carried out in total (Appendix G3). These were conducted in remnant woodland, aquatic, open crop and flood plain areas. Length of fallen logs, number of hollows, and the maturity of trees (using tree diameter at breast height as an index of age) were quantified through the use of vegetation plots, which helped to clarify habitat value of each vegetation community in the study area.

A standalone hollow-bearing tree survey was also undertaken, in which every tree within the study area was assessed for the presence, number and size of hollows (Appendix G3). The location of each hollow-bearing tree was recorded using a handheld Garmin GPS device, and the diameter of the tree at breast height, the height of the tree, and the species of tree were noted. Hollows were categorised into small (< 10 cm), medium (10 – 20 cm), and large (> 20 cm).

An assessment of the study area for potential Koala habitat or core Koala habitat was also undertaken, taking into account feed tree (Western Grey Box, Poplar Box, and River Red Gum) densities and incidentally observed evidence of use including presence of scats and scratches. Formal SAT surveys were not undertaken, as these were not within the scope of works of the surveys. Habitat assessment and analysis of historical records was considered sufficient to determine any potential impacts on Koalas.

Incidental sightings of other fauna and their traces (e.g. scats, tracks, scratches) made while present on the site were also recorded, including owl pellets.

Bird surveys

Design for bird survey transects was development in consultation with our specialist ornithologist Dr Stephen Ambrose. Bird surveys were undertaken at 32 sites throughout the study area. In the proposal site, bird point survey sites were approximately 400 metres apart. In the surrounding study area, bird survey sites were located to a distance of approximately 1000 metres away from the proposal site (Appendix G3). Bird survey sites were randomly assigned numbers and either morning, noon or afternoon time periods for survey times. The survey sites were also standardised for timing and location so that any bias for these variables were accounted for. Each bird survey involved a 30 minute point count of bird species detected. For each species identified, abundance counts, behaviour, flight height and direction, the microhabitat, observation type (observed or heard), and whether the bird was within 50 metres, 150 metres or further than 150 metres (counted as opportunistic) from the survey site. Furthermore, bird species were recorded opportunistically throughout the survey period, including the above mentioned details if the bird species was of particular note (such as threatened and aquatic species). This data was later analysed for determination of operational impacts in the Part 2, Biodiversity Assessment (Ambecol 2015).

Microbat surveys

One single Anabat detector was set up to record bats in the study area over three nights. The Anabat detector was placed in varying habitat types to cover the range of microbat species likely to occur in the

study area. Locations are shown in Appendix G3, and were located near likely flyways or foraging spots for microbats. Calls were analysed by fauna specialist Narawan Williams.

Spotlighting

Spotlighting was undertaken over four nights, within the proposal site and immediate surrounds. Spotlighting was carried out by vehicle through spotlight transects, and on foot where feasible (e.g. in larger vegetation patches), by two observers each using 50-watt spotlights. Spotlighting was undertaken on foot or by vehicle for approximately 1 person-hour, preceded by a 10-minute listening period to detect any threatened species that may have been calling. Four spotlighting surveys were conducted over four nights totalling approximately 8 person hours (Appendix G3).

Call playback

Call playback for the Masked Owl and Barking Owl was undertaken on one night in the centre of the proposal site. Call playback was undertaken after spotlighting. Each call was transmitted with a megaphone for five minutes, followed by a listening period of 10 minutes. Ten minutes of spotlighting was then undertaken to determine whether owls had flown into the vicinity without vocalising. This technique is in accordance with the *Threatened Species Survey and Assessment: Guidelines for developments and activities* (DEC 2004), however the 5-8 nights of survey effort proposed under the guidelines was not achievable within the scope of our field work.

Fauna nomenclature

Field guides and standard texts used as a reference are provided in the reference list. The naming of species recorded or known for the region follows the nomenclature present in these texts. The conservation significance of fauna species recorded is made with reference to the EPBC Act and the TSC Act.

2.4 LIMITATIONS

2.4.1 Flora

As all field survey work was undertaken in November, the flora species list reflects plant species detectable during spring when the majority of plant species are detected based on flowering times. There is potential for some grasses and forbs that flower in summer to have gone undetected, however these are likely to be a minority. As such, the list is considered sufficient to indicate the nature of the vegetation communities within the study area, and thus to evaluate the probability of threatened flora species to occur. A precautionary approach has been employed with regard to the presence of threatened species, where suitable habitat exists.

2.4.2 Fauna

The bird surveys were carried out during peak bird activity time (spring), however, some species will only be present during other seasons (such as winter for the Swift Parrot). Furthermore, non-sedentary birds may only be present when food resources are available and bird species with large home ranges may not have been detected during the survey period. However, due to the robustness of the survey effort over time and space, it is likely that all species occurring within the study area were detected.

The calculation of hollow-bearing trees, in particular the size and number of hollows, is as accurate as could be determined from ground level. However, there is potential for some hollows to be present but not visible from ground level, which may result in underestimates of the number of hollows. Where it was deemed likely for hollows to be present but not discernible from ground level, these were noted. The GPS locations for trees are only accurate to within a few metres, which means that all calculations of numbers of trees proposed for removal should be treated as estimates only.

3 EXISTING ENVIRONMENT

3.1 LANDSCAPE CONTEXT

The proposal site is located on a property used for both grazing and cropping that is located south of Lachlan Valley Way and approximately 35 kilometres west of Forbes. The landforms of the locality are an assortment of mountain ranges, dissected plateaus (tablelands), hills and ridges, and plains. As part of the Lower Slopes Sub-region, the study locality is dominated by alluvial soils due to the abundance of flood plains, alluvial plains, and terrace plains (Benson 2008). Wilbertroy State Forest is located approximately 2.5 kilometres to the southwest of the study area. It is a relatively small remnant of woodland, covering an area of 996 hectares. The state forest has been nominated for listing as a National Park under the 'Southwest Cypress Reservation' Bill (DECCW 2010). The state forest has important remnants of riverine woodland of River Red Gum, Grey Box and Belah, being part of the floodplain from Lachlan River to Lake Cowal. The state forest is also important for migrating and nomadic species such as Superb Parrot (*Polytelis swainsonii*), Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolour*) (NRC 2010). Carawandool State Forest is a 1319 hectare forest approximately 15 kilometres to the south-east of the study area.

3.2 LAND USE

According to the Forbes Local Environmental Plan 2013 (LEP), the study area is zoned as Primary Production (RU1). The study area and adjacent landscape is dominated by rural residential properties and agricultural lands used for grazing and crops. The Wilbertroy State Forest that is approximately 2.5 kilometres to the south-west is currently harvested for timber.

3.3 VEGETATION COMMUNITIES AND HABITAT

3.3.1 Vegetation communities

Three native vegetation communities were observed during the surveys. These matched most closely to the following Plant Community Types (PCT) and BioMetric Vegetation Types (BVT) shown in Table 3-1, with equivalent Benson (2008) identification numbers. Vegetation types considered endangered ecological communities (EECs) are under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Additionally, the *Western Grey Box – Poplar Box - White Cypress Pine tall woodland* vegetation community may also be classified as a threatened community listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), depending on whether they meet particular condition requirements (Table 3-2). Within the proposal site, all state EECs that are also listed as Commonwealth EECs (CEECs) met the requirements for Commonwealth EECs, therefore all Commonwealth listed EECs occurring within the study area are also classed as state EECs for the same area. No *Yellow Box tall grassy woodland* was observed within the proposal site.

Table 3-1 Plant Community Types observed in and around the proposal site.

Plant Community Type	Plant Community Type ID number	BioMetric Vegetation Type ID number	Benson (2008) ID number	EEC (Y/N)	Within proposal site	Outside proposal site
Western Grey Box – Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregions.	82	LA 152	82	Yes	Yes	Yes
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt).	244	LA 178	244	No	Yes	Yes
River Red Gum swampy woodland wetland on cowals (lakes) and associated flood channels in central NSW	249	LA 191	249	No	Yes	Yes

The four vegetation communities, of which three are native and one is dominated by introduced species that were identified within the proposal site are described in detail below. One native vegetation community recorded as occurring within the study area was listed as an endangered ecological community (EEC) under the TSC Act.

The distribution of the vegetation communities within the study area is displayed in Appendix H.2. A species list for the study area by vegetation type is provided as **Error! Reference source not found.**.

Western Grey Box – Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregions (PCT #82)

This community, in which Western Grey Box (*Eucalyptus microcarpa*) is the most characteristic species, grows on red-brown earths soils in central western NSW mostly in the eastern section of the Cobar Peneplain Bioregion near Nymagee, Tottenham and Boona and extending south. Temperate eucalypt woodlands have been extensively cleared since European colonisation of Australia, with most of the Western Grey Box dominated woodlands currently existing as fragments or degraded remnants in Travelling Stock Routes, cemeteries, along roadsides and railway embankments, small remnants on private property and scattered conservation reserves (Threatened Species Scientific Committee 2010). Approximately 2.9 hectares of this community is found in the proposal site, which occurs in one remnant patch about half way down the north-south proposed transmission line. The community is dominated by Western Grey Box with scattered individuals of White Cypress Pine (*Callitris glaucophylla*), and Poplar Box (*Eucalyptus conica*) (Figure 3-1). The understorey contains a moderately sparse layer of shrubs, mainly consisting of the noxious weed African Boxthorn (*Lycium ferocissimum*) but also containing Narrow-leaved Hopbush (*Dodonaea viscosa* ssp. *angustissima*). A number of the characteristic groundcover and grass species are also present in the study area, including Glycine (*Glycine clandestina*), Corrugated Sida (*Sida corrugate*), Speargrass (*Austrostipa scabra* ssp. *scabra*) and Wallaby Grass (*Rytidosperma* sp.). However, the groundcover is mainly dominated by crop grasses including Ryegrass (*Lolium perenne*) and

Barley Grass (*Hordeum* sp.). As the community has been largely cleared, the vegetation is fairly disturbed and native diversity in the groundcover has been reduced as a result. Despite this, it is still considered to be in moderate to good condition according to the OEH Biometric Vegetation Conditions.

Figure 3-1 An example Inland Grey Box Woodland occurring in the proposed transmission line of the proposal site (outside of direct impact area).

Western Grey Box Woodland in the proposal site is equivalent to ID LA 152 of BioMetric Vegetation Types and 82 of Benson (2008), which is called *Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion* (Table 3-2). It is listed as an EEC under the TSC Act, in which it is named *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*. This community **is not** representative of the CEEC EPBC Act-listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia*. Due to the proposed transmission line design skirting around this patch of Western Grey Box Woodland, no area is likely to be impacted due to the proposal.

Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt) (PCT #244)

This community in which Bimble Box (*Eucalyptus populnear* subsp. *bimbil*) dominates the canopy occurs on alluvial clay-loam soils, mainly confined to the Darling Riverine Plain, western section of the Brigalow Belt South and northern section of the NSW South Western Slopes Bioregions. Approximately 20.7 hectares of this community is found within the proposal site (including the proposed transmission line). The understorey contains a number of shrub species, mainly consisting of the noxious weed African

Boxthorn (*Lycium ferocissimum*) but also containing Acacias (such as *Acacia hakeoides*), Wilga (*Geijera parviflora*) and Saltbush (*Einadia* sp.). A number of the characteristic groundcover and grass species are also present in the study area, including Glycine (*Glycine clandestina*), Corrugated Sida (*Sida corrugate*), Speargrass (*Austrostipa scabra* ssp. *scabra*), Windmill Grass (*Chloris truncate*) and Wallaby Grass (*Rytidosperma* sp.). Like the Western Grey Box community in the proposal site, this community has been largely cleared, the vegetation is fairly disturbed and native diversity in the groundcover has been reduced as a result. Despite this, it is still considered to be in moderate to good condition according to the OEH Biometric Vegetation Conditions.

Poplar Box Woodland in the proposal site is equivalent to ID LA 177 of BioMetric Vegetation Types and 105 of Benson (2008), which is called *Poplar Box grassy woodland on flats mainly in the Cobar Peneplain and Murray-Darling Depression Bioregions* (Table 3-2). This community is not listed a Threatened Ecological Community under NSW state or federal legislation. The majority of this community will not be impacted due to the proposal, however the proposed transmission line will lead to some clearing of this community.

Figure 3-2 Poplar Box Woodland within the proposal site.

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

This community in which River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*) is the dominant canopy species occurs in closed (eg cowals) and open depressions on floodplains and alluvial plains mainly from central west NSW to Victoria. Belah (*Casuarina cristata*) can sometimes be associated in the canopy and was observed within the study area. Approximately 5.6 hectares of this community occurs within the proposal site. This community occurs to the north of the solar station footprint, occurring

along the periodically inundated Thurumbidgee Lagoon and associated depressions, and extends to the east into the proposed transmission line (Appendix G2). Within the study area the understory was relatively bare of vegetation in parts likely due to the periodic flooding of the soil. In the proposed transmission line, the understory mainly consisted of introduced crop species such as ryegrass (*Lolium perenne*) and barley Grass (*Hordeum* sp.). Shrub vegetation was virtually non-existent and native ground cover species were sparse and included Corrugated Sida and Weeping Grass (*Microlaena stipoides*).

Figure 3-3 River Red Gum swampy woodland wetland in the proposal site (proposed transmission line).

Exotic (non-indigenous)

The majority of vegetation within the proposal site is highly modified from its pre-European state and comprises mostly exotic species, but in some areas has a sparse native overstorey. This includes areas of exotic crop and pasture grasses and forbs. This is the dominant vegetation type within the proposal site. In many places this community is too highly modified to determine the pre-European vegetation type, but it is likely that much of the area would have consisted of Poplar Box Woodland in the solar station proposal and either Western Grey Box Woodland or River Red Gum Forest in the proposed transmission line prior to historical clearing. Where the density of the overstorey remains above 25% of the lower value of the over-storey percent foliage cover benchmark for a vegetation type, the vegetation community is considered to be in moderate to good condition, as per the BioBanking Assessment Methodology. Thus areas that have a wholly exotic-dominated understorey but a native-dominated overstorey are still considered part of the native vegetation communities discussed above.

Figure 3-4 Exotic-dominated crop vegetation within the proposal site with Eastern Grey Kangaroo (*Macropus giganteus*) in the foreground.

3.3.2 Conservation status and listed threatened ecological communities

Database searches revealed seven Threatened Ecological Communities (TECs) with potential to occur within a 10 kilometre radius of the proposal site (Appendix C), of which one is present within the proposal site (Appendix D). The conservation status of the vegetation communities present within the study area are listed in Table 3-2, which have been made with reference to Benson (2008) and the listings of threatened ecological communities under the TSC Act and EPBC Act. The proposal site contains one vegetation community that is listed under the TSC Act, including:

- Inland Grey Box – White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South-western Slopes and Riverina Bioregions

The Western Grey Box Woodland **does not** meet the condition requirements of the equivalent listing for EECs and CEECs under the EPBC Act which include:

- Grey Box (*E. macrocarpa*) Grassy Woodlands and Derived Native Grasslands of south-eastern Australia.

No other TECs under the EPBC Act occur within the study area.

Table 3-2 Names and conservation status of native vegetation communities within the proposal site.

Vegetation community	Vegetation formation	Plant Community Type ID	Benson (2008) ID # and name	OEH Biometric Vegetation ID code and Type	Extent in proposal site (ha)	Current total extent (ha) of community in Australia (Benson 2008)	Estimate of pre-European extent remaining (%) (Benson (2008)	Area protected in reserves (ha)	EEC TSC Act?	TSC Act Listing	CEEC EPBC Act?	EPBC Act Listing
Western Grey Box – Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregions.	Grassy Woodlands	82	ID 80: Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	LA152: Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	2.9 ha (TSC-listed) 0 ha (EPBC-listed)	98000 - 180000	12 - 23	280 - 510	Yes	Inland Grey Box Woodland in the Riverina, NSW South-western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	No - None of the state listed Inland Grey Box Woodland within the study area qualifies for commonwealth listed Inland Grey Box Woodland.	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia

3.3.3 Threatened flora species

Database searches for threatened flora species revealed the potential for 16 species to occur within the study area (Appendix C). An assessment of the likelihood of occurrence of all of these species was undertaken and considers the preferred habitat of the species, including vegetation types, soils and species associations, and the current known distributions of the species. This approach provides a risk based assessment for species that may not have been identifiable during the survey. Based on these threatened species evaluations (provided as a table in Appendix D) it was considered unlikely that any threatened flora species occur within the study area and that impacts to any threatened flora species are unlikely. In addition, all areas with the potential to be impacted by the proposal were traversed during the survey, targeting habitat that was more likely to support threatened species. No threatened flora species were detected during any of the surveys.

3.3.4 Weeds and disturbance

The majority of the study area has been subject to some degree of disturbance, mostly associated with agricultural activities such as cropping and livestock. Of the 54 species of plants recorded during the surveys, 17 (31%) were not indigenous to the region. Furthermore, exotic plant cover ranged from 50 – 100% within surveyed vegetation plots (Appendix H). Of these 17 exotic species, one (African Boxthorn *Lycium ferocissimum*) is declared as a Noxious Weed by the Forbes Shire Council. African Boxthorn is listed as a Class 4 Noxious Weed (i.e. it is widely distributed in the region), and is declared as a Weed of National Significance (Table 3-2). Required control actions for these species can be found in the Noxious Weed Declarations listed in Appendix E.

Table 3-3 Noxious weeds detected within the proposal site, where WGBW refers to Western Grey Box Woodland, PBW refers to Poplar Box Woodland, and RRGW refers to River Red Gum Woodland. No noxious species were observed within White Box Woodland.

Species	Abundance				Noxious weed class	Weed of National Significance?
Shrubs	WGBW	PBW	Exotic	RRGW		
African Boxthorn **Lycium ferocissimum*	Present	Common	Present	Uncommon	4	Yes

3.3.5 Groundwater dependent ecosystems

A search of the Bureau of Meteorology's National Atlas of Groundwater Dependent Ecosystems returned a number of groundwater dependent ecosystems within the study area (Figure 3-5). Vegetation communities observed during the surveys that are considered likely to be dependent on groundwater resources includes the River Red Gum swampy woodland wetland and possibly the Poplar Box woodland to some extent. River Red Gum woodlands are usually associated with aquatic systems including rivers, creeks, drainage lines, and floodplains whilst Poplar Box woodland is usually found in lower parts of the landscape and can be found close to floodplain areas. The River Red Gum swampy woodland wetland species would rely on water inundations from time to time, as is provided in the nearby Thurumbidgee Lagoon.

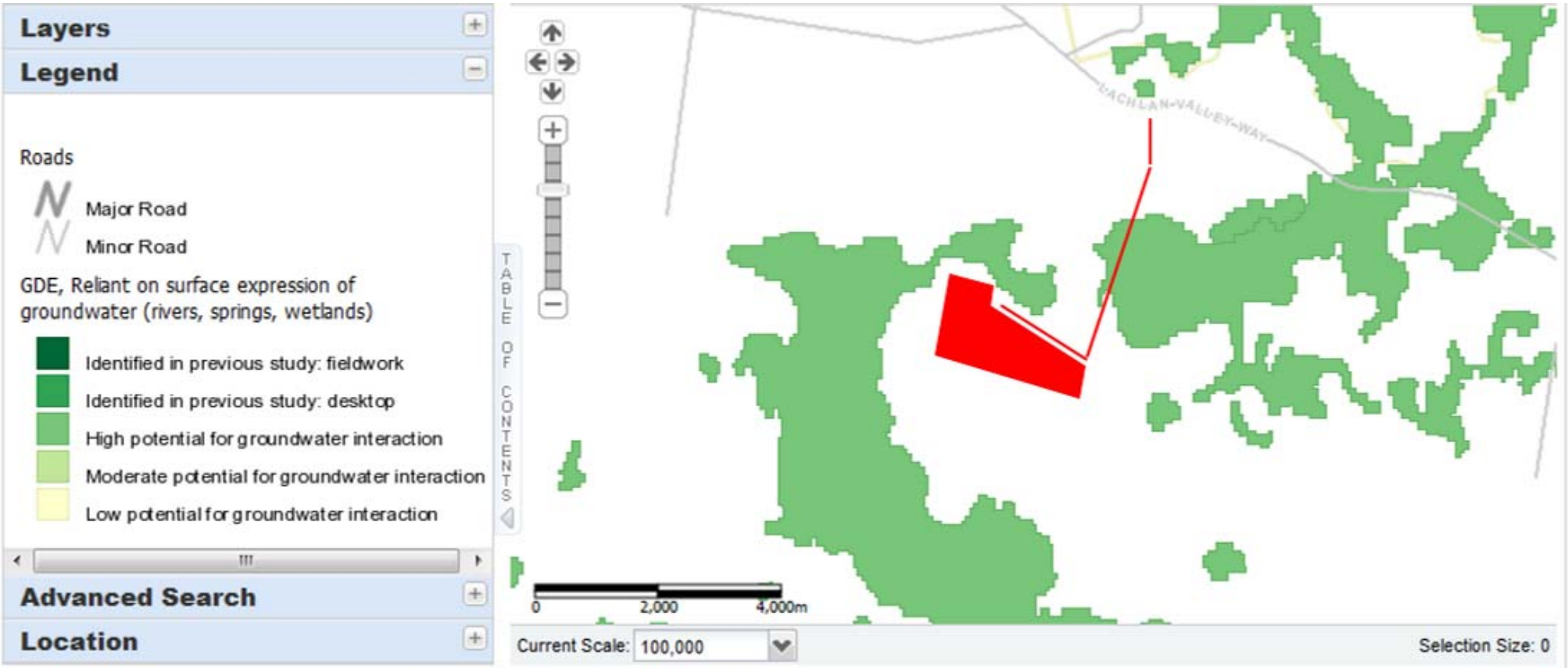

Figure 3-5 Areas with high potential for groundwater interaction (green) in the study area (red). The proposed transmission line runs through an area of high potential for groundwater interaction.

3.4 TERRESTRIAL FAUNA AND FAUNA HABITAT

3.4.1 General

Approximately 84 fauna species were detected during the field survey including 59 bird, three amphibian, 16 bat and six other mammal species. No reptile species were recorded. A complete fauna species list is provided in Appendix B.

The proposal site contains a heterogeneous mix of ecosystem types that vary in their habitat value for fauna. Generally, the proposal site contains a mixture of woodland and open crop land. Patches of remnant woodland occur throughout the proposal site and vary based on elevation and variations in soil moisture. The woodland on dryer soils include Western Grey Box Woodland and Poplar Box Woodland. These woodlands provide nesting, foraging and roosting opportunities for woodland birds and raptors. They may also provide refuge and foraging habitat for reptiles, grazing and refuge habitat for small to large herbivores (including introduced livestock and rabbits and native macropods), and foraging and roosting habitat for arboreal mammals and microbats. These woodlands generally contain the most hollow-bearing trees which are used by woodland birds (especially parrots), owls, arboreal mammals and microbats for roosting and breeding purposes. On lower, moister soils where River Red Gum swampy woodland occurs, similar fauna types are found, however most of the trees in this woodland type are young and hence tree hollows were much less frequent. These woodlands contained a thicker layer of leaf little and logs in which reptiles prefer. These woodlands are also periodically inundated with water and provide habitat for aquatic birds and a valuable drinking resource for all fauna types. The dam to the north-east outside of the proposal site was full during surveys and was providing habitat for the before mentioned fauna types. The open crop lands surrounding these woodland and aquatic habitats were only suitable for grazers such as kangaroos and wallabies, and seed eating foragers including small rodents and some parrots.

Further detail is provided in the following sections on specific fauna groups and habitat elements.

3.4.2 Diurnal birds

The intensive bird survey methods resulted in 59 species being identified during the survey period. Birds were most diverse and abundant in the morning before 10am, however different species were captured throughout the three survey periods and within different habitat types. More abundant species included Galah (*Eolophus roseicapilla*), Australian Magpie (*Cracticus tibicen*), Eastern Rosella (*Platycercus eximius*), common starling (*Sturnus vulgaris*), Australian Raven (*Corvus coronoides*) and Grey Teal (*Anas gracilis*). The Grey Teal was most abundant aquatic species and the other mentioned species are typically abundant for farming environments. Raptors were more abundant from noon to dusk. Of note, large flocks of Yellow-billed Spoonbill (*Platalea flavipes*) were recorded opportunistically in the lagoon area outside the proposal site and parrots (including Blue Bonnet *Northiella haematogaster*, Cockatiel *Nymphicus hollandicus*, Eastern Rosella, Galah, Red-rumped Parrot *Psephotus haematonotus*, Short-billed Corella, Sulphur-crested Cockatoo *Cacatua galerita*, and Superb Parrot *Polytelis swainsonii*) were diverse in woodland habitat. Threatened species under the TSC Act recorded within and around the proposal site included Brown Treecreeper (*Climacteris picumnus*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), Spotted Harrier (*Circus assimilis*) and Superb Parrot. The Superb Parrot is also endangered under the EPBC Act.

3.4.3 Reptiles and amphibians

Reptile and amphibian diversity and abundance was low throughout the study area. Only three reptile species were recorded and no amphibians were recorded (although amphibians were not targeted during surveys due to aquatic habitat only occurring outside the proposal site.

Figure 3-6 Ragged Snake-eyed Skink (*Cryptoblepharus pannosus*) foraging within the bark of a tree in the proposal site.

3.4.4 Nocturnal fauna species (excluding bats)

Spotlighting surveys within the study area detected one arboreal mammal (Common Brushtail Possum *Trichosurus vulpecula*), within the River Red Gum woodland area in the north-western area outside the proposal site. Terrestrial fauna identified during the spotlighting surveys included Swamp Wallaby (*Wallabia bicolor*), Red fox (*Vulpes vulpes*) and European rabbit (*Oryctolagus cuniculus*). The red fox and European rabbit are likely to be common throughout the region, as is the Eastern Grey Kangaroo (*Macropus giganteus*) which was recorded opportunistically at dawn and dusk. The feral cat (*Felis catus*) was detected opportunistically during diurnal surveys. Other native nocturnal species detected included the Southern Boobook (*Ninox novaeseelandiae)* and Tawny Frogmouth (*Podargus strigoides)*.

Opportunistic call playback and passive listening for Barking Owls and Masked Owls did not detect either of these species, although habitat evaluation determined that the Barking Owl was likely to occur in the study area.

Figure 3-7 Adult and juvenile Common Brushtail Possum in stag tree with hollows (L) and adult Swamp Wallaby in crop field (R)

3.4.5 Microbats

The threatened species habitat evaluation table (Appendix D), indicated the potential for four threatened microbat species to be utilising the study area; the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Corben's Long-eared Bat (*Nyctophilus corbeni*), Inland Forest Bat (*Vespadelus baverstocki*) and the Little Pied Bat (*Chalinolobus picatus*). The Eastern Bentwing-bat (*Miniopterus orianae (=schreibersii) oceanensis*), which was tentatively identified (but probably due to confusion with *Vespadelus* spp.), is considered unlikely to occur on the site due to the specific nature of the species biology and the very marginal range of this species.

Fifteen species of microbat were identified definitively in the study area, including the Chocolate Wattled Bat (*Chalinolobus morio),* Gould's Wattled Bat (*Chalinolobus gouldii),* Little Pied Bat (*Chalinolobus picatus*), Eastern Freetail-bat (*Mormopterus* sp. 2 = *ridei*), Inland Freetail-bat (*Mormopterus* sp. 3 = *petersi*), Little Forest Bat (*Vespadelus vulturnus),* Large Forest Bat (*Vespadelus darlingtoni*), Long-eared Bat (*Mormopterus* sp.), Western Broad-nosed Bat (*Scotorepens balstoni),* Little Broad-nosed Bat (*Scotorepens greyi*), Inland Forest Bat, Southern Freetail-bat (*Mormopterus* sp. 4), Southern Forest Bat (*Vespadelus regulus*) Yellow-bellied Sheathtail-bat, and the White-striped Freetail Bat (*Tadarida australis).*

The Little Pied Bat, Corben's Long-eared Bat, Yellow-bellied Sheathtail-bat and Inland Forest Bat are all threatened species listed as Vulnerable under the TSC Act. *Nyctophylus* spp. cannot be differentiated through calls alone, therefore *N. corbeni* is assumed to be occurring. It was 'definitely' recorded (as *Nyctophylus* sp.) between three locations 57 times. Six 'Possible' calls of Little Pied Bat were recorded at two locations, one 'probable' call of Yellow-bellied Sheathtail-bat at one location, and 22 'probable' calls of Inland Forest Bat at two locations were also recorded. Corben's Long-eared Bat is also listed as Vulnerable under the EPBC Act.

The calls of a number of species could only be tentatively identified, or were unable to be identified to species level. These include the Little Pied Bat, Eastern Freetail-bat (*Mormopterus* sp. 2 = *ridei*), one or more Long-eared Bats (*Nyctophilus* spp.), Large Forest Bat and the Southern Forest Bat. The difficulty in identification of these species came as a result of either poor quality calls or because calls may overlap in frequency and shape between species in the locality.

3.4.6 Hollows

A total of 205 hollow-bearing trees were recorded within the proposal site (including the proposed transmission line). Approximately eight hollow-bearing trees were recorded within the proposed transmission alignment, and no hollow-bearing trees in the solar station proposal site will be cleared. This estimate does not include remnant patches of Poplar Box Woodland, and scattered trees likely to be retained within the proposal site. The diameter at breast height (DBH) of hollow-bearing trees ranged from 50 centimetres to 150 centimetres, with a mean tree height of approximately 12 metres. The total number of hollows observed in these 205 trees was 532, consisting of 333 small (< 10 cm diameter), 134 medium (10-20 cm diameter), and 65 large (> 20 cm diameter). This represents approximately 2.6 hollows per hollow-bearing tree and demonstrates suitability for a range of species including birds, microbats, and arboreal mammals.

Figure 3-8 Examples of a hollow-bearing trees in the study area including one medium-sized hollow being occupied by a Cockatiel (*Nymphicus hollandicus*).

3.4.7 Threatened species

NSW Wildlife Atlas database searches for threatened species listed on the TSC Act identified 46 bird species, three reptile, two amphibian, and 13 mammal species with the potential to occur within 10 kilometres of the proposal site or known from the LGA (Appendix C). The EPBC Act protected matters search tool revealed six bird, one reptile, two mammal, three fish, and 10 migratory bird species with the potential to occur within 10 kilometres of the proposal site (Appendix C).

The threatened species evaluations in Appendix D concluded there were 38 species with a likelihood of occurring within the proposal site (Table 3-4). Multiple species were considered likely of occurring due to their confirmed presence on site, having broad habitat preferences or home ranges, or simply that the proposal site provides suitable habitat (Table 3-4). Of the bird species, Superb Parrots, Brown Treecreepers, Grey-crowned Babblers and a Spotted Harrier were observed within and outside of the proposal site. All species have been summarised in Table 3-4.

All species with a high potential to be impacted by the proposal are discussed in detail below.

Table 3-4 Summary of threatened, marine and migratory fauna species with the potential to occur within the proposal site.

Species	Status	Atlas Records (10 km)	Closest record	Likelihood of occurrence	Further assessment required?
Magpie Goose	TSC-V	0	Lake Cowal (1994)	Moderate	Yes
Regent Honeyeater	TSC-CE, EPBC-E	0	Lake Cowal (1997)	Moderate	Yes
Fork-tailed Swift	EPBC-Migratory	0	Lake Cowal (1997)	High	Yes
Eastern Great Egret	EPBC-Marine, Migratory	0	Newell Highway 20km SE (2001)	Moderate	Yes
Cattle Egret	EPBC-Marine, Migratory	0	Lake Cowal (1991)	High	Yes
Common Sandpiper	EPBC-Marine, Migratory	0	Lake Cowal (1995)	Moderate	Yes
Sharp-tailed Sandpiper	EPBC-Marine, Migratory	0	Lake Cowal (1995)	Moderate	Yes
Pectoral Sandpiper	EPBC-Marine, Migratory	0	Lake Cowal (1994)	Moderate	Yes
Red-necked Stint	EPBC-Marine, Migratory	0	Lake Cowal (1994)	Moderate	Yes
White-throated Needletail	EPBC-Migratory	0	Lake Cowal (1997)	Moderate	Yes
Rainbow Bee-eater	EPBC-Migratory	0	Lake Cowal (1995)	Moderate	Yes
Glossy Ibis	EPBC-Migratory	0	Lake Cowal (1995)	Moderate	Yes
Common Greenshank	EPBC-Marine, Migratory	0	Lake Cowal (1995)	Moderate	Yes

Species	Status	Atlas Records (10 km)	Closest record	Likelihood of occurrence	Further assessment required?
Marsh Sandpiper	EPBC-Marine, Migratory	0	Lake Cowal (1991)	Moderate	Yes
Australian Bustard	TSC-E	0	Lake Cowal (1997)	Low	Yes
Australasian Bittern	TSC-E, EPBC-E	0	Lake Cowal (1997)	Moderate	Yes
Bush Stone-curlew	TSC-E	0	Private property 30km NW (2008)	Moderate	Yes
Curlew Sandpiper	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Pied Honeyeater	TSC-V	0	Back Yama State Forest 40km NW (1990)	Moderate	Yes
Speckled Warbler	TSC-V	1	Carawandool State Forest 10km SE (2006)	Moderate	Yes
Chestnut Quail-thrush	TSC-V	0	Lake Cowal (1997)	Low	No
Spotted Harrier	TSC-V	0	Proposal site (2014)	Recorded	Yes
Brown Treecreeper	TSC-V	2	Proposal site (2014)	Recorded	Yes
Varied Sittella	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Southern Scrub-robin	TSC-V	0	Lake Cowal (1997)	Low	No
Black-necked Stork	TSC-E	0	Near Tottenham >100km NW (1999)	Low	No
White-fronted Chat	TSC-V	0	Lake Cowal (1995)	Moderate	Yes
Grey Falcon	TSC-E	0	Lake Cowal (1997)	Low	Yes
Black Falcon	TSC-V	0	Lake Cowal (1997)	Low	Yes
Latham's Snipe	EPBC-Marine, Migratory	0	Lake Cowal (1995)	Moderate	Yes
Little Lorikeet	TSC-V	0	Lake Cowal (1997)	Moderate	Yes

Species	Status	Atlas Records (10 km)	Closest record	Likelihood of occurrence	Further assessment required?
Painted Honeyeater	TSC-V	0	South of Carawandool State Forest (2006)	Moderate	Yes
Brolga	TSC-V	1	Lachlan River 5km NW (2002)	High	Yes
White-bellied Sea-eagle	EPBC-Migratory	0	Lake Cowal (1995)	Low	No
Black-breasted Buzzard	TSC-V	0	Lake Cowal (1995)	Low	Yes
Little Eagle	TSC-V	0	Lake Cowal (2004)	High	Yes
Shy Heathwren	TSC-V	0	Lake Cowal (1997)	Low	No
Swift Parrot	TSC-E, EPBC-E	0	Lake Cowal (1997)	Moderate	Yes
Malleefowl	TSC-E, EPBC-V	0	Lake Cowal (1997)	Low	No
Black-tailed Godwit	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Bar-tailed Godwit	EPBC-Migratory	0	Lake Cowal (1997)	Low	No
Major Mitchell's Cockatoo	TSC-V	0	Lake View State Park SW 40km (2006)	Low	Yes
Square-tailed Kite	TSC-V	0	Private land NE 30km	Low	Yes
Hooded Robin	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Black-chinned Honeyeater	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Turquoise Parrot	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Barking Owl	TSC-V	0	Lake Cowal (1997)	Moderate	Yes
Powerful Owl	TSC-V	0	Near Orange >100km E (2005)	Low	No
Blue-billed Duck	TSC-V	0	Gum Swamp, Forbes (2014)	Moderate	Yes
Gilbert's Whistler	TSC-V	0	Lake Cowal (1997)	Low	No

Species	Status	Atlas Records (10 km)	Closest record	Likelihood of occurrence	Further assessment required?
Red-lored Whistler	TSC-E, EPBC-V	0	Round Hill Nature Reserve >100km W (2013)	Low	No
Eastern Osprey	TSC-V, EPBC-Marine, Migratory	0	Lake Cowal (1989)	Low	No
Scarlet Robin	TSC-V	0	Lake Cowal (1997)	Low	Yes
Flame Robin	TSC-V	1	Jemalong (1978)	High	Yes
Superb Parrot	TSC-V EPBC-V	0	Proposal site (2014)	Recorded	Yes
Grey-crowned Babbler	TSC-V	1	Proposal site (2014)	Recorded	Yes
Australian Painted Snipe	TSC-E, EPBC-V	0	Lake Forbes (2007)	Moderate	Yes
Diamond Firetail	TSC-V	1	Lachlan River 10km NE (1978	High	Yes
Freckled Duck	TSC-V	0	West 20km (2008)	Moderate	Yes
Little Pied Bat	TSC-V	0	Proposal site (2014)	Recorded	Yes
Spotted-tailed Quoll	TSC-V, EPBC-E	0	Lake Cowal (1997)	Low	No
Corben's Long-eared Bat	TSC-V EPBC-V	0	Proposal site (2014)	Recorded	Yes
Squirrel Glider	TSC-V	0	Lachlan River NW 10km (1999)	Low	No
Koala	TSC-V EPBC-V	0	NE 50km (2004)	Low	No
Grey-headed Flying-fox	TSC-V, EPBC-V	0	Lake Cowal (1997)	Low	No
Yellow-bellied Sheathtail-bat	TSC-V	0	Proposal site (2014)	Recorded	Yes
Inland Forest Bat	TSC-V	0	Proposal site (2014)	Recorded	Yes

Figure 3-9 Brown Treecreeper was recorded in woodland habitat within the proposal site.

3.5 AQUATIC HABITAT

The habitat evaluations for threatened fish and amphibian species determined that it was unlikely for any of these species to be utilising the available habitat at the proposal site. The large aquatic habitat requirements for the Murray Cod (*Maccullochella peelii*), Silver Perch (*Bidyanus bidyanus*) and Macquarie Perch (*Macquaria australasica*), in conjunction with the periodically inundated nature of the floodplains within the study area, suggest that there is no risk of an impact to these species as a result of the proposal. Similarly, the Booroolong Frog inhabits riffle areas of rocky creeks and rivers, of which none are present within the study area. The periodically inundated floodplains do, however, provide a marginal habitat for Sloane's Froglet, which is known from this habitat type even in disturbed environments (Sloane's Froglet Profile, NSW OEH). Despite this, the lack of records from the locality, the highly degraded habitats, and the marginally suitable habitat only occurring outside the proposal site means that it is unlikely that this species would be occurring within the proposal site.

3.6 CRITICAL HABITAT

Neither the study area nor the surrounding region contain any areas that have been declared as critical habitat under either the TSC Act or EPBC Act.

3.7 WILDLIFE CONNECTIVITY CORRIDORS

The biological species richness of a given habitat area declines with a reduction in the size of that area (MacArthur & Wilson 1967; Drinnan 2005). Thus the removal of vegetation from remnant patches in the landscape will generally reduce the number of species that utilise that remnant patch. Increasing the fragmentation of habitat patches may also have other effects, including declines in biodiversity values as the result of an increase in the ratio of edges to patch size. The value of vegetation within lineal features such as riparian zones, that occur to the north of the study area, is often expressed as a result of its ability to act as a corridor of habitat that connects two habitat patches (Bennett 1990). Such corridors may be used by fauna to traverse generally inhospitable landscapes, allowing for immigration and emigration from populations that may not otherwise occur. This may help to alleviate issues such as inbreeding depression and the effects of demographic stochasticity that can increase the risk of extinction for isolated or small populations. However, it has also been suggested that corridors may also transmit contagious diseases between habitat patches, expose native fauna to predators, exotic and domestic animals and poachers, and produce other negative effects (Simberloff and Cox 1987).

The riparian zone in the study area is generally well-vegetated, as is the fence line running north-south along the western side of the proposed transmission line (also running north-south). Remnant patches within the study area also generally connect to these corridors. The canopy connectivity in these zones is good, however the ground and mid-stratum vegetation connectivity is poor due to mainly exotic flora species occurring there. All three levels of vegetation generally provide good connectivity for fauna species in a typical woodland setting.

The width of the riparian and road/fence corridors within the study area varies, but are generally no wider than 260 metres. Therefore, most of the linkage vegetation is considered ‘edge’ vegetation and not ‘core’ vegetation, however it does connect to Wilbertroy State Forest to the south-west and the riparian zone of the Lachlan River to the north-east (Figure 3-10).

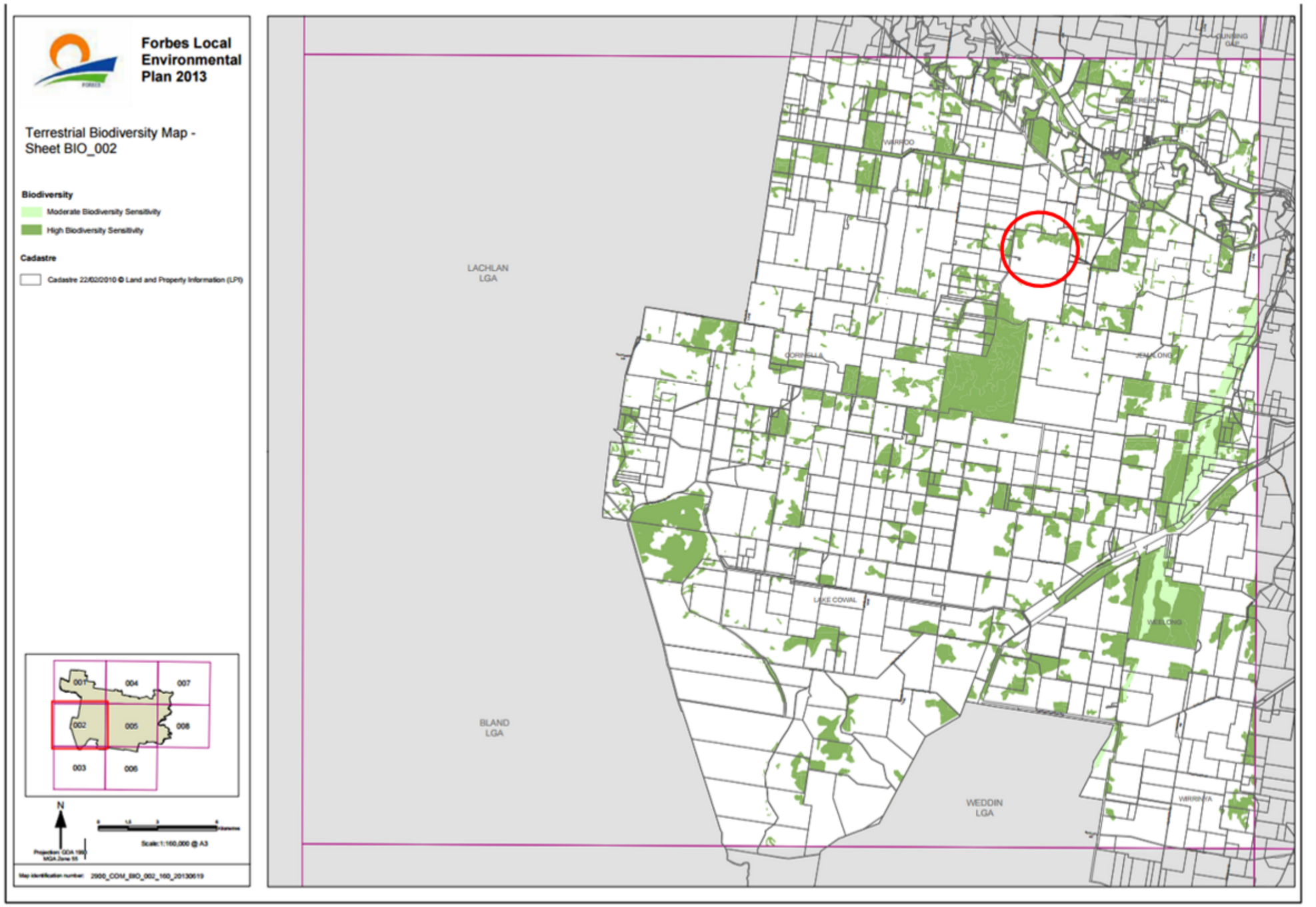

Figure 3-10 High Biodiversity Sensitivity areas (dark green) surrounding the study area (red outline) link the study area to Wilbertroy State Forest to the south-west and the Lachlan River riparian zone the north-east.

Wildlife corridors are generally defined as a link of habitat between two or more larger areas of wildlife habitat. Corridors are critical for the maintenance of ecological processes including allowing for the movement of animals and the continuation of viable populations. Most fauna species in the area are able to traverse this linkage corridor including birds, microbats, arboreal and terrestrial mammals and reptiles. To a lesser degree, they may use it as a 'stepping stone' in between moving to larger tracts of land. Some species, however, will not traverse tracts of cleared land.

The Grey-crowned Babbler is particularly susceptible to clearing and fragmentation, with an apparent reluctance to traverse tracts of cleared land. Isolated small populations are vulnerable to extinction via stochastic events and to loss of genetic viability in the long term (NSW Scientific Committee 2001).

3.8 SEPP 44 – KOALA HABITAT PROTECTION

One primary feed tree was present within the proposal site, River Red Gum. Secondary feed trees present in the proposal site include Inland Grey Box, and Poplar (Bimble) Box (DECC 2008).

River Red Gum was dominant within the River Red Gum swampy woodland wetland community, however only a negligible amount of this community will be cleared due to the proposed works (0.31ha). Bimble Box trees occurring in the Poplar Box grassy woodland are also dominant, however only a negligible amount of this community will be cleared due to the proposed works (1.52ha). No Western Grey Box trees will be removed due to the proposed works.

The Interim Koala Referral Advice for Proponents (DSEWPaC 2012) provides definitions of habitat that is critical to the survival of the Koala. As many patches of woodland (including all Poplar Box, River Red Gum and Inland Grey Box-dominated patches) within and surrounding the proposal site contain primary and secondary food trees that comprise at least 30% (for primary) or 50% (for secondary or primary and secondary combined) of the overstorey trees, these patches are considered to be habitat critical to the survival of the species. The proposal site also contains a number of areas that may aid the dispersal of Koalas between habitat patches. It is noted, however, that there are no koala recordings within 50 kilometres of the study area.

4 POTENTIAL IMPACTS

4.1 FLORA

4.1.1 Loss of Vegetation

Construction

The proposed works for the transmission line (though not within the Vast Solar CST project site itself) would have a direct impact on vegetation communities and fauna habitat within the proposal site as a result of vegetation clearing. The extent and estimated loss of each vegetation community within the proposal site is listed in Table 4-1. Approximately 1.83 hectares of moderate to good condition native vegetation would be permanently removed as a result of the proposed works for the transmission line, which accounts for a small amount of such vegetation in the study area. The two PCT impacted include Poplar Box Woodland and River Red Gum swampy woodland wetland. Neither of these communities are threatened under the TSC Act or EPBC Act. The remainder of vegetation to be impacted is exotic crop species with scattered native grasses and forbs which do not constitute a native PCT. During the design phase, an 'avoid and minimise' approach to loss of native vegetation was adopted. All remnant patches of woodland within the solar station proposal site have been avoided for clearing and most of the remnant woodland along the proposed transmission line was also avoided by designing the transmission line to be constructed around these patches. Only minor areas of woodland could not be avoided for clearing.

One TSC Act listed vegetation community (Inland Grey Box Woodland) was recorded adjacent to the proposed transmission line but would not be impacted by the proposed works.

Due to the Inland Grey Box remnant patch being adjacent to the proposed transmission line and hence will not be cleared due to the proposal, it is considered not necessary to undertake further assessment on the likely impacts to this community type due to the proposal. Recommendations have been made which will ensure this patch is conserved and impacts will be mitigated for (Section 6).

Table 4-1 Estimated loss of communities within the proposal site.

Vegetation Community	Threatened Ecological Community?	BioMetric Vegetation Condition	Extent of Vegetation loss (ha)
Western Grey Box Woodland (TSC)	Yes	Moderate to good	0
Poplar Box Woodland	No	Moderate to good	1.52
River Red Gum swampy woodland wetland	No	Moderate to good	0.31
Exotic	No	N/A	59.1
Native Vegetation			**1.83**
Total Vegetation			**60.93**

Note: While areas have been calculated to two decimal places, they should be treated as estimates only.

Operation

Alteration to microclimate and erosion potential under the heliostats

Vegetation and ground habitats would likely be affected by reduced insolation and temperature and increased humidity underneath the heliostats modules. Wind speeds may also be reduced.

Shading and groundcover management under the Heliostats

In the grazed paddocks existing native and exotic pasture across the site may decline initially due to shading following installation of the heliostats. Areas of exotic pasture are of little importance in terms of biodiversity; however, a reduction in cover may lead to bare ground and susceptibility of the soil to erosion. The selection of a more suitable shade tolerant pasture species for planting would address this issue. Caution needs to be applied when choosing groundcover species to sow prior to infrastructure installation as sowing a pasture variety that has not been trialled under local conditions may lead to establishment failure or subsequent pasture decline creating management problems post construction.

The response of native vegetation to shading is hard to predict as there has been little research into the effects of pasture shading in the central west of NSW. Shade tolerant species are present onsite within the woodland remnants and may benefit from shading. A study into the effects of tree canopy shade on three Chenopod species in arid Australia showed that some were tolerant of a wide range of light and soil moisture conditions (Prider and Facelli 2004). It is likely that a native groundcover would survive onsite under the heliostats in areas where a native groundcover currently exists.

Changes in rainfall distribution

Soil underneath the heliostats would likely receive less rainfall than surrounding soil. However, as these would be moved to a near horizontal angle at night, combined with reduce evapotranspiration losses due to shading and reduced air movement. Lateral movement of surface and subsurface water from adjacent rain-exposed areas would be likely to occur. As such, the net amount of moisture available to vegetation under the heliostats is unlikely to be reduced. Where higher rates are achieved, higher growth rate of groundcover may occur, reducing effects of shading that are discussed above

There could be a concentration of rainfall runoff in a strip below the lower edge of the heliostats. This could increase rain-splash intensity and soil erosion potential in this area during heavy rainfall events. The erosion risks should be manageable using adequate site preparation, and responsive pasture and stock management.

Loss of or alteration to grassland habitat for macropods, birds, reptiles and insects due to shading, changed microclimate and reduced productivity

It is unclear what the impact to soil moisture, soil nitrogen and subsequent vegetation composition from factors such as reduced light and near ground wind levels would be following the installation of the Heliostats. The response of local fauna to these changes is equally hard to predict and would be largely influenced by the vegetation changes that occur. An altered microclimate under the heliostats have the potential to affect sensitive fauna such as ants and poikilothermic species such as reptiles. Basking opportunities may be reduced, although the structure of the heliostats may provide fauna with a degree of protection from predation. Increased soil moisture may create favourable shelter and foraging habitat for amphibians. As the heliostats would be located in modified grazing and cropping paddocks with few fauna habitat values, there is a low probability of fauna species, particularly threatened species, being impacted by any microclimate and associated vegetation changes that may occur in these areas.

Effects on fire frequency

With creation of thermal energy and utilisation of flammable chemicals there is an elevated risk of activities resulting in a grass fire. It is anticipated that to reduce risk of wildfire vegetation under the heliostats would be kept low by slashing or sheep grazing. Access tracks would be constructed through the site and around the perimeter of the station. This network would serve to contain any fire starting at the site, to protect the facility during a wildfire and to provide access for fire suppression during an event. The Proposal is unlikely to significantly affect wildfire frequency in the areas adjacent to the subject site. Fire frequency within the site boundary is already likely to be low given the high levels of modification and low fuel loads.

4.1.2 Weeds

Construction

Spread of African Boxthorn observed on site may occur during vegetation removal and movement of machinery. Appropriate measures would be put in place to ensure this weed is not spread within or out of the proposal site (Section 6). Detailed information on managing this species can be sought from the *Noxious and Environmental Weed Control Handbook* (DPI 2011).

All noxious weeds present within the proposal site would be treated according to the requirements of the NW Act, as well as the recommendations of the Lachlan Valley and Macquarie Valley Weeds Advisory Committees.

4.1.3 Operation

Rehabilitation of disturbed areas and post-construction weed management would limit the establishment and spread of weed species during construction and operation of the proposed road alignment.

4.2 FAUNA

4.2.1 Habitat removal

The abundance of mature trees within the existing proposal site is relatively high. These trees offer important food resources for many fauna species, including birds, bats, and mammals. Mature trees provide more flowers, nectar, fruit and seeds than younger trees, as well as a complex substrate that supplies diverse habitats for invertebrate populations (Recher 1996). Threatened bird species that are more likely to utilise the proposal site for these resources include Superb Parrots, Grey-crowned Babblers, Brown Treecreeper, Little Lorikeets, and Varied Sittellas. Of these, Superb Parrots, Brown Treecreepers and Grey-crowned Babblers were observed within the proposal site. The removal of some mature trees, along with the sparse to moderate shrub layer that is present in some locations, will remove the foraging resources for such fauna species, and also remove the habitat complexity that some species require for shelter and protection. Many common and widespread birds were also observed utilising woodland within the proposal site, and available habitat for these species will likely be reduced as a result of the proposal. However, as only 1.83 hectares of native woodland will be cleared due to the proposal and the majority of woodland within the proposal site will remain intact, these minor impacts

are likely to be negligible to woodland dependent fauna species recorded or likely to occur within the proposal site.

The exotic crop and pasture grasses occurring within the proposal site can be used by native and exotic grazing herbivores, as well as reptiles and invertebrates for refuge and foraging. However, most of this ground cover would remain intact due to the proposed works. Furthermore, this habitat type is abundant throughout the study area, therefore the relative loss of this habitat type due to the proposed works will be negligible.

4.2.2 Loss of Hollow-bearing Trees

205 hollow-bearing trees are located within or are very close to the proposal site. Eight of these trees within the proposed easement for the transmission line will require removal for the proposed works, and another two trees are located on the edge of the proposal and may require removal. 22 hollows were recorded in these eight trees consisting of 13 small hollows, six medium hollows and three large hollows. The loss of these trees represents a proportional reduction of approximately 4% of all hollow-bearing trees and approximately 4% of all hollows observed within the proposal site.

Threatened hollow-dependant fauna species that were either observed in the proposal site or have a high likelihood of utilising the site include the Superb Parrot, Brown Treecreeper, Yellow-bellied Sheathtail-bat, Little Pied Bat, Corben's Long-eared Bat and Inland Forest Bat. Species with a lower likelihood of utilising the proposal site that roost in hollows include the Little Lorikeet (*Glossopsitta pusilla*), Turquoise Parrot (*Neophema pulchella*), Barking Owl (*Ninox conniverns*) and Squirrel Glider (*Petaurus norfolcensis*). Thus there is potential for the loss of hollow-bearing trees to remove roosting and/or breeding habitat for some threatened species. In addition, the loss of these trees has the potential to reduce foraging opportunities for predatory species (such as owls) that rely on hollow-dependant fauna for prey.

When hollow-bearing trees collapse or shed limbs they also provide hollow logs that serve as important foraging substrates and shelter sites (Mac Nally *et al.* 2001). The distribution and abundance of hollow-bearing trees in NSW has been reduced and fragmented by extensive clearing of native vegetation during the past two centuries, primarily for agriculture. Eventual loss of current hollow-bearing trees, and a lack of recruitment of younger trees to replace them, will result in a large decrease in the hollow resource over the wide geographic area covered by agricultural landscapes in the medium term (Saunders *et al.* 2003, Vesk and Mac Nally 2006).

Other native hollow-dependant fauna species detected during the surveys include the Common Brushtail Possum, Chocolate Wattled Bat (*Chalinolobus morio)*, Gould's Wattled Bat (*Chalinolobus gouldii*), Eastern Freetail-bat (*M*. sp. 2), Inland Freetail-bat (*Mormopterus petersi*), Southern Freetail-bat (*Mormopterus* sp. 4), Little Broad-nosed Bat (*Scotorepens greyii*), Western Broad-nosed Bat (*Scotorepens balstoni*), White-striped Freetail-bat (*Tadarida australis*), Large forest Bat (*Vespadelus darlingtoni*), Southern Forest Bat (*Vespadelus regulus*), Little Forest Bat (*Vespadelus vulturnus*), Australian Wood Duck (*Chenonetta jubata*), Blue Bonnet (*Borthiella haematogaster*), Cockatiel (*Nymphicus hollandicus)*, Galah (*Eolophus roseicapillus),* Sulphur-crested Cockatoo (*Cacatua galerita*), Little Corella (*Cacatua sanguinea*), Budgerigar (*Melopsittacus undulates*), Eastern Rosella (*Platycercus eximius*), Blue Bonnet (*Northiella haematogaster*), Laughing Kookaburra (*Dacelo novaeguineae*), Sacred Kingfisher (*Todiramphus sanctus*), Southern Boobook (*Ninox novaeseelandiae*), Spotted Pardalote (*Pardalotus punctatus*), Striated Pardalote (*Pardalotus striatus*) and Red-rumped Parrot (*Psephotus haematonotus).* The loss of up to eight hollow-bearing trees within the proposal site may have a slight impact on populations of these species within the study area, particularly considering the importance of this limited resource and the fragmented nature of

the surrounding landscape. However, with 197 hollow-bearing trees remaining in the proposal site that will not be impacted, this loss of hollow-bearing trees is considered minor. Mitigation and management measures have been proposed which include a staged habitat removal process and the development and implementation of an offset plan.

4.2.3 Wildlife Connectivity and Habitat Fragmentation

The biological species richness of an area of habitat declines with a reduction in the size of that habitat (MacArthur & Wilson 1967; Drinnan 2005). Thus the removal of vegetation from remnant patches in the landscape will generally reduce the number of species that utilise that remnant patch. Increasing the fragmentation of habitat patches may also have other effects, including declines in biodiversity values as the result of an increase in the ratio of edges to patch size. The value of vegetation within floodplain and riparian areas, such as in the study area, is high considering how it can be used by wildlife for traversing across the landscape. Such corridors may be used by fauna to move through inhospitable landscapes. This may help to alleviate issues such as inbreeding depression and the effects of local events such as disease or fire that can increase the risk of extinction for isolated or small populations. However, it has also been suggested that corridors may transmit diseases between habitat patches and assist the movement of feral predators (Simberloff and Cox 1987).

The remnants within the proposal site generally have well-vegetated canopies, with patches of moderate to good quality native vegetation as well as patches of low quality non-indigenous or exotic vegetation such as planted exotic trees in crop fields. It is likely that native mammals and birds utilise the existing remnant vegetation to move through the landscape or as a 'stepping stone' from one patch to the next. Wilbertroy State Forest is located approximately three kilometres to the south-west of the proposal site and Carawandool State Forest approximately 10 kilometres to the south-east of the study area. Thurumbidgee Lagoon and the floodplains to the north of the proposal site also likely act a 'stepping stone' for aquatic birds between the Lachlan River and Lake Cowal. However, this lagoon will not be impacted by the proposal. It is likely that these state forests and larger aquatic areas in the local area are more suitable habitat than that of the proposal site for local birds and microbats. It is assumed that these species would preferentially use the habitat areas.

The removal of approximately 1.83 hectares of native vegetation in moderate to good condition from the transmission line easement from proposal site to the West Jemalong Substation would reduce the extent of remnant vegetation in the local landscape to a minor level. This loss of habitat would only cause minor fragmentation between the proposal site and the lagoon/floodplain area directly to the north, and possibly to the north-south remnant vegetation along the proposed transmission line. Species utilising the proposal site as a habitat corridor are likely to already be tolerant of a certain level of fragmentation and are more likely to be highly mobile, wide-ranging species. It is unlikely that connectivity structures would be a suitable mitigation measure due to limited overstorey vegetation in the surrounding landscape, and the suite of species that occur within the study area. .

4.2.4 Koala Habitat

No scratches or scats attributable to Koalas were observed during the field surveys. There are no records of Koalas within 10 kilometres of the proposal site.

One primary feed tree was present within the proposal site being River Red Gum. A couple of secondary feed trees were also present within the proposal site, including Poplar Box, and Inland Grey Box. The most abundant native vegetation community in the proposal site is the Inland Poplar Box Woodland,

which is dominated by Poplar Box. Densities of River Red Gum are high in the study area, however the majority of these trees will not be impacted by the proposal (approximately 0.31 ha).

Most of the moderate to good condition native vegetation present within the study area consists of habitat critical to the survival of the Koala, and some of these patches consist of "potential Koala habitat" as per SEPP 44. Despite this, the fragmented nature of habitat in the locality, the lack of primary feed tree species to be impacted, and the lack of local records of Koala suggest that the proposal site is unlikely to provide habitat that is being or will be utilised by Koalas.

4.2.5 Injury and Mortality

Construction

Clearing of vegetation within the proposal site during construction has the potential to injure fauna due to the disturbance of habitat. Many smaller and more common species such as skinks and frogs are difficult to locate or remove during pre-clearing surveys. It is likely there will be some loss of individuals impacted during construction. There is also the potential for hidden hollows to be present in the forks of large trees, in which bats or birds may occur. Injuries or fatalities to native fauna during the clearing process may arise from such situations. Safeguards and management measures would be put in place during the construction phase to prevent and minimise such impacts, and are discussed in Section 6.

Operation

Risk to fauna associated with Operational impacts relate primarily to birds during operation. Impact to bird population resulting from operation has been assessed in the report titled Part Two Biodiversity Assessment – Jemalong Solar Station: Potential Operational Impacts on Bird Populations and Recommendations for Bird Hazard Risk Management. This assessment is included as Appendix 1.

The main operational impacts resulting from operation of the solar station relate to:

- Collision risks on solar station infrastructure including heliostats, towers, cables and perimeter barbed wire fencing;
- Solar flux burns and related trauma to birds;
- heliostats and reflected light perceived by birds as wetlands;
- attraction of birds to bright lights at night;
- attraction of birds to insects culls and live swarms due to solar flux; and
- stranding and predation of birds

Risk to bats and gliders could result from collision with infrastructure, including heliostats, towers, perimeter fencing and powerlines. This risk is likely to be of a low likelihood. While there may be a low level of mortality following construction, once local populations of gliders and bats become familiar with infrastructure, mortality of individual animals is unlikely. It is recommended that fencing that presents a higher risk of injury or mortality to these species (ie. barbed wire) is not utilised.

The Part Two Biodiversity Assessment assessed specific hazards that included risk to birds associated with High Flux Zones between heliostats and the receiving towers, high temperature zones around the receivers, vertically- and horizontally-orientated heliostats, aggregations of insects that attract insectivorous birds and resident predators that are attracted to aggregations of insectivores and water bodies on and adjacent to the subject site. It identified that the site is also located within a number of

migratory flyways, as well as providing potential habitat and air-space for nomadic species. As such migratory, nomadic and resident birds are likely to fly low through or over the subject site while moving between habitats (woodland, wetlands and grassland) within or outside the site.

An assessment of likely impact associated with operation of the Jemalong Solar Station, has included;

1. a review of studies that have been conducted in the United States of America also suggest that the numbers of bird mortalities and injuries at facilities using solar flux technology is relatively small compared with other anthropomorphic impacts
2. consideration of the diffuse nature of areas where High Flux Zones would be likely to create temperatures that place birds at risk, and
3. the proposed management of the facility (eg. Moving the heliostats to an angle of 20 and 40 degrees downward from the vertical to reduce bird strikes at night).

The assessment has identified that it is unlikely that the Jemalong Solar Station would significantly impact on the status of local populations of bird species, including threatened species and listed migratory species.

Mitigation measures have been developed to assist in reducing impact to bird species.

A number of positive impacts to local fauna are likely to occur once the solar station is in operation. The ground cover vegetation is likely to become more dense and even naturalise, allowing foraging and refuge opportunities for small mammals, birds, reptiles and invertebrates. This highlights the important role solar stations can play in climate protection and biodiversity preservation hand in hand (GREA 2010).

4.3 PESTS AND PATHOGENS

The proposed works have the potential to facilitate the dispersal of pest fauna species such as the feral European Rabbit (*Oryctolagus cuniculus*), European Red Fox (*Vulpes vulpes*), and Feral Cat (*Felis catus*). However, these species are already present within the proposal site and in the locality.

Several pathogens in NSW have the potential to impact on the environment and biodiversity. These may be introduced and spread during the construction of the proposal. Pathogens that have the potential to be introduced and spread during construction activities in NSW include, but are not limited to:

- Phytophthora (*Phytophthora cinnamomi*).
- Myrtle Rust (*Uredo rangelli*).
- Fusarium Wilt/Panama disease (*Fusarium oxysporum*).

Any works where risk of spread is apparent, mitigation measures should be followed to prevent their introduction or spread. Phytophthora is listed as a Key Threatening Processes (KTPs) under both the TSC Act and EPBC Act, and Myrtle Rust is listed under the TSC Act. All of the species listed above are not considered likely to occur at the study area, as they are currently thought to be present only in the coastal or more eastern areas of NSW. Therefore, impacts due to these pathogens are unlikely.

4.4 CHANGED HYDROLOGY

Impacts of changed hydrology on biodiversity include deteriorating water quality, reduced water availability, altered flow regimes in waterways, and the rising of water tables due to clearing of native vegetation and the movement of salts to surface layers of soil and waterways. Vegetation clearing would be of a reduced level. Following construction, ground cover vegetation would be maintained

Thurumbidgee Lagoon and the floodplains surrounding the proposal site was relatively dry at the time of the surveys, and was not offering fauna much in the way of aquatic habitat. However, these floodplains will from time to time. Impacts to aquatic birds due to the proposal are discussed in Appendix A. It is concluded that the proposal will not cause any negative impacts to these aquatic species.

4.5 IMPACT ON RELEVANT KEY THREATENING PROCESSES

Table 4-2 List of key threatening processes and their relevance to the proposal.

Key Threatening Processes (KTPs)		
TSC Act	EPBC Act	Relevance
Clearing of native vegetation	Land clearance	1.83 hectares of moderate to good condition native vegetation would be removed as part of the proposal. This extent does not include state or federally-listed threatened ecological communities. The proposal is thus only minimally likely to contribute to this KTP.
Loss of hollow-bearing trees		Approximately 8 hollow-bearing trees would be removed as a result of the proposed works. An exclusion zone prior to construction would ensure that over-clearing does not occur. Removal of hollow bearing trees would be offset.
Removal of dead wood and dead trees		Approximately three of the eight hollow-bearing trees are dead standing trees which would be impacted by the proposed works. Dead wood is abundant throughout the study area, particularly where eucalypts are present. Works would adhere to mitigation measures in Section 6.
Infection of native plants by *Phytophthora cinnamomi*	Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	The proposed works are not considered likely to exacerbate this KTP, as the pathogen is not known to occur in the region.
Invasion of native plant communities by exotic perennial grasses		A number of exotic perennial grasses (listed in Appendix A) were common across the site, and were already considered dominant in the landscape. Rehabilitation works and regular weed management at the site would help prevent these species from spreading further and may even promote native grass rehabilitation. Recommendations have been made in Section 6 accordingly.
Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)	Competition and land degradation by rabbits	Disturbance to vegetation and soil may attract this species to the study area.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		With adherence to hygiene guidelines (Section 6) it is considered unlikely that the proposal would exacerbate this KTP, particularly as this pathogen is not known to be present in the region.

Key Threatening Processes (KTPs)		
TSC Act	EPBC Act	Relevance
Predation by the European red fox (*Vulpes vulpes*)	Predation by European red fox	Disturbance to native fauna and their habitat may attract this species to the study area or modify its current population density.
Predation by the feral cat (*Felis catus*)	Predation by feral cats	Disturbance to native fauna and their habitat may attract this species to the study area or modify its current population density.

4.6 CUMULATIVE IMPACTS

The clearing of native vegetation, which is a key threatening process at both State and Commonwealth level, is considered a major factor in the loss of biological diversity. At least 61 per cent of the native vegetation in NSW has been cleared or highly modified since European settlement (NSW Scientific Committee 2001e), and the removal of the minimal amount of vegetation for this solar station is contributing to this process. However, the large majority of native woodland in the proposal site has been preserved due to a design aimed at minimizing clearing of native vegetation in the study area. This is most apparent with the preservation of all Western Grey Box Woodland within the proposal site.

The loss of large habitat trees or hollow-bearing trees is a long-term cost of projects such as these, because these features of the environment can take well over 100 years to form (Mackowski 1984; Wormington & Lamb 1999). Loss of hollow bearing trees would offset by development and implementation of an offset management plan.

An assessment of operational impacts on fauna, including bird populations has identified that operational hazards are unlikely to result in a significant impact on the bird populations.

Overall, there are benefits gained by installing a 30 MW solar power facility. For instance, the Jemalong Solar Facility would counteract human-induced climate change, which Foden *et al*. (2013) and Garnett & Franklin (2014) conclude to be one of the most significant global threats to birds today. Erikson *et al*. (2014) state that 1 MW of solar energy offsets between 680 to 1,700 tonnes of CO_2 emissions per year that result from the burning of fossil fuels. Therefore, a 30 MW facility would potentially offset 75,000 tonnes of CO_2 emitted per year.

5 ASSESSMENTS OF SIGNIFICANCE

Assessments of Significance (AoS) have been conducted for 52 species, the results of which are summarised in Table 5-1. AoS completed for impacts to birds due to the operation of the solar station are presented in the Part Two Biodiversity Assessment included as Appendix A. All other AoS are presented in Appendix F. The species requiring AoS are:

- **Aquatic, Wading or Shore Birds** (Magpie Goose (*Anseranas semipalmata*), Australasian Bittern (*Botaurus poiciloptilus*), Curlew Sandpiper (*Calidris ferruginea*), Brolga (*Grus rubicunda*), Blue-billed Duck (*Oxyura australis*), Australian Painted Snipe (*Rostratula australis*) and Freckled Duck (*Stictonetta naevosa*)) (Appendix A).
- **Raptors** (Barking Owl (*Ninox connivens*), Spotted Harrier (*Circus assimilis*), Grey Falcon (*Falco hypoleuco*), Black Falcon (*Falco subniger*), Black-breasted Buzzard (*Hamirostra melanosternon*), Little Eagle (*Hieraaetus morphnoides*) and Square-tailed Kite (*Lophoictinia isura*)) (Appendix A).
- **Parrots** (Turquoise Parrot (*Neophema pulchella*), Superb Parrot (*Polytelis swainsonii*), Little Lorikeet (*Glossopsitta pusilla)*, Swift Parrot (*Lathamus discolour*) and Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)) (Appendix A).
- **Woodland Birds** (Brown Treecreeper (*Climacteris picumnus victoriae),* Varied Sittella (*Daphoenositta chrysoptera*), Hooded Robin (*Melanodryas cucullata*), Regent Honeyeater (*Anthochaera phrygia*), Pied Honeyeater (*Certhionyx variegatus*), Speckled Warbler (*Chthonicola sagittata*), Painted Honeyeater (*Grantiella picta*), Black-chinned Honeyeater (*Melithreptus gularis gularis)*, Scarlet Robin (*Petroica boodang*), Flame Robin (*Petroica phoenicea*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis)* and Diamond Firetail (*Stagonopleura guttata*)) (Appendix A).
- **Grassland or Shrubland Birds (**Australian Bustard (*Ardeotis australis*), Bush Stone-curlew (*Burhinus grallarius*), White-fronted Chat (*Epthianura albifrons*) (Appendix A).
- **Migratory Birds** (Common Sandpiper (*Actitus hypoleucos*), Fork-tailed Swift (*Apus pacificus*), Eastern Great Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*), Sharp-tailed Sandpiper (*Calidris acuminate*), Curlew Sandpiper (*Calidris ferruginea*), Pectoral Sandpiper (*Calidris melanotus*), Red-necked Stint (*Calidris ruficollis*), Latham's Snipe (*Gallinago hardwickii*), White-throated Needletail (*Hirundapus caudacutus*), Black-tailed Godwit (*Limosa limosa*), Rainbow Bee-eater (*Merops ornatus*), Glossy Ibis (*Plagadis falcinellus*), Australian Painted Snipe (*Rostratula australis*), Common Greenshank (*Tringa nebularia*) and Marsh Sandpiper (*Tringa stagnatilis*).
- **Microchiropteran Bats** (Little Pied Bat (*Chalinolobus picatus),* Corben's Long-eared Bat (*Nyctophilus corbeni)*, Inland Forest Bat (*Vespadelus baverstocki*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)).

See Appendix F for the full Assessments of Significance under both the TSC Act and EPBC Act.

Table 5-1 Summary of Assessments of significance

TSC Act significance assessments								
Threatened species, or communities	**Significance assessment question[1]**							**Likely significant impact?**
	a	**b**	**c**	**d**	**e**	**f**	**g**	**No**
Australian Bustard	N	X	X	N	X	Y	N	**No**
Bush Stone-curlew	N	X	X	N	X	Y	N	**No**

Barking Owl	N	X	X	N	X	Y	Y	**No**
Magpie Goose	N	X	X	N	X	Y	N	**No**
Australasian Bittern	N	X	X	N	X	Y	N	**No**
Curlew Sandpiper	N	X	X	N	X	Y	N	**No**
White-fronted Chat	N	X	X	N	X	Y	N	**No**
Brolga	N	X	X	N	X	Y	N	**No**
Blue-billed Duck	N	X	X	N	X	Y	N	**No**
Australian Painted Snipe	N	X	X	N	X	Y	N	**No**
Freckled Duck	N	X	X	N	X	Y	N	**No**
Spotted Harrier	N	X	X	N	X	N	N	**No**
Grey Falcon	N	X	X	N	X	Y	N	**No**
Black Falcon	N	X	X	N	X	Y	N	**No**
Black-breasted Buzzard	N	X	X	N	X	Y	N	**No**
Little Eagle	N	X	X	N	X	Y	N	**No**
Square-tailed Kite	N	X	X	N	X	Y	N	**No**
Swift Parrot	N	X	X	N	X	Y	Y	**No**
Turquoise Parrot	N	X	X	N	X	Y	N	**No**
Superb Parrot	N	X	X	N	X	Y	N	**No**
Little Lorikeet	N	X	X	N	X	Y	N	**No**
Major Mitchell's Cockatoo	N	X	X	N	X	Y	N	**No**
Brown Treecreeper	N	X	X	N	X	Y	N	**No**
Varied Sittella	N	X	X	N	X	Y	N	**No**
Hooded Robin	N	X	X	N	X	Y	N	**No**
Regent Honeyeater	N	X	X	N	X	Y	N	**No**
Pied Honeyeater	N	X	X	N	X	Y	N	**No**
Speckled Warbler	N	X	X	N	X	Y	N	**No**
Painted Honeyeater	N	X	X	N	X	Y	N	**No**
Black-chinned Honeyeater	N	X	X	N	X	Y	N	**No**
Scarlet Robin	N	X	X	N	X	Y	N	**No**
Flame Robin	N	X	X	N	X	Y	N	**No**
Grey-crowned Babbler	N	X	X	N	X	Y	N	**No**
Diamond Firetail	N	X	X	N	X	Y	N	**No**
Little Pied Bat	N	X	X	N	X	Y	N	**No**
Corben's Long-eared Bat	N	X	X	N	X	Y	N	**No**
Inland Forest Bat	N	X	X	N	X	Y	N	**No**
Yellow-bellied Sheathtail-	N	X	X	N	X	Y	N	**No**

bat								

EPBC Act assessments		
Threatened species, or communities	**Cause a long-term decrease in the size of a population[2] or important population?[3]**	**Referral to Environment Minister?**
Superb Parrot	No	No
Swift Parrot	No	No
Regent Honeyeater	No	No
Australasian Bittern	No	No
Australian Painted Snipe	No	No
Corben's Long-eared Bat	No	No
EPBC Act migratory assessments		
Migratory species	**Likely significant impact?**	
Common Sandpiper	No	
Fork-tailed Swift	No	
Eastern Great Egret	No	
Cattle Egret	No	
Sharp-tailed Sandpiper	No	
Curlew Sandpiper	No	
Pectoral Sandpiper	No	
Red-necked Stint	No	
Latham's Snipe	No	
White-throated Needletail	No	
Black-tailed Godwit	No	
Rainbow Bee-eater	No	
Glossy Ibis	No	
Australian Painted Snipe	No	
Common Greenshank	No	
Marsh Sandpiper	No	

Notes: Y = Yes (negative impact), N = No (no impact or positive impact), X = not applicable, ? = unknown impact.

1. Significance Assessment Questions as set out in the *Threatened Species Conservation Act 1995/ Environmental Planning and Assessment Act 1979.*
   a in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
   b in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
   c in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
      (i) is likely to have an adverse effect on the extent of the ecological community such that its local

occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

d in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

e whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

f whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

g whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

2. Population of a species as determined by the *Environment Protection and Biodiversity Conservation Act 1999*, is one that for an endangered species:
   a a geographically distinct regional population, or collection of local populations, or
   b a population, or collection of local populations, that occurs within a particular bioregion.

3. Important Population as determined by the *Environment Protection and Biodiversity Conservation Act 1999*, is one that for a vulnerable species:
   a is likely to be key source populations either for breeding or dispersal
   b is likely to be necessary for maintaining genetic diversity
   c is at or near the limit of the species range.

6 MANAGING POTENTIAL IMPACTS UPON BIODIVERSITY

6.1 AVOID AND MINIMISE

Measures to avoid and minimise impacts associated with the proposed works include:

- Clearzone reductions in areas where vegetation is of conservation significance. Discussions with regarding the presence of endangered ecological communities and hollow-bearing trees have resulted in a proposed transmission line design that avoids clearing of remnant patches of woodland, however some trees on edges may still be cleared due to the proposal. The remnant patches of Poplar Box Woodland within the proposal site will not be cleared as a result of the proposal.
- The proposal site has been designed to avoid clearing of hollow-bearing trees as much as possible. Only eight hollow-bearing trees of a possible 205 in the study area will be cleared.
- Design of the solar station has included the rotation of the heliostats angled 20 and 40 degrees downward from the vertical during night-time to avoid reflections that may cause aquatic birds to land on them nocturnally mistaking them for a 'lake'.
- Design of the solar station has ensured the solar heat flux range around the receiving towers is minimal, meaning birds are unlikely to be impacted due to solar heat flux.

6.2 SAFEGUARDS AND MANAGEMENT MEASURES

The proposal would follow a number of environmental safeguards to assist with minimising the impacts on biodiversity during construction and operation of the solar station. See Appendix A for bird hazard management and survey and assessment of bird impacts.

Table 6-1 Safeguards and management measures designed to minimise impacts on biodiversity.

Impact	Environmental safeguards	Responsibility	Timing
Clearing and prevention of over-clearing	• A CEMP would be prepared including an erosion sediment control plan, vegetation management measures, a revegetation and weed management program, fauna management measures, and Work Methods Statements for all works within 10 m of the waterways occurring adjacent to the proposal site. All site workers should be inducted and made aware of the conservation issues and associated CEMP for the site. • Prior to the commencement of work, the clearing limit needs to be clearly demarcated and implemented. The delineation of such a boundary may include the use of temporary fencing, flagging tape, parawebbing or similar. • Pre-clearing surveys would be carried out by an ecologist and would include targeted surveys for nesting Superb Parrots, Grey-crowned Babblers,	Contractor	Pre-construction Construction

Impact	Environmental safeguards	Responsibility	Timing
	Brown Treecreepers and general tree hollow inspections where possible. They would include targeted searches for arboreal fauna and inspections of vegetation for other fauna occupancy. Habitat trees would be clearly marked with flagging tape. If active nests are found during clearing works, or hollows are being used by nesting birds or arboreal mammals, an ecologist or local wildlife carer should be contacted to remove the eggs, chicks or juvenile mammals to be hand-raised. • Trees would be removed in such a way as not to cause damage to surrounding vegetation. Root systems of trees and shrubs to be removed should be retained in-ground to ensure surrounding ground layer vegetation is undisturbed and to prevent soil erosion. • Where possible, trees to be removed would be mulched on-site and re-used to stabilise disturbed areas. • Where trees are to be retained, an adequate protection zone (TPZ) would be provided around each tree for the duration of construction. Details for calculating TPZs are provided within *Australian Standard 4970-2009 – Protection of trees on development sites*. • If work cannot avoid encroaching into the TPZ, it would not impinge on the structural root zones (SRZ) of trees to be retained. Details for calculating the SRZs are provided within *Australian Standard 4970-2009 – Protection of trees on development sites*. • An unexpected threatened species finds procedure would be developed before clearing is begun.		
Loss of hollow-bearing trees	• Staged habitat removal for the removal of hollow-bearing trees would be undertaken where non-habitat vegetation would be cleared initially following a pre-clearing inspection by a qualified ecologist. Habitat trees would be disturbed by 'knocking' at this time and cleared at least 24 hours after. • Clearing of hollow-bearing trees would not take place between September and February, where possible. If clearing during this period cannot be avoided, an ecologist would be present on site to check all hollows for animals. If a hollow is being used by a threatened species (e.g. Superb Parrot), an exclusion barrier of appropriate distance (e.g. 30 metres from the base of the tree) would be installed to prevent disturbance. If a hollow is being used by a species not listed under the TSC Act or EPBC Act, any animals	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	present will be caught and either released into appropriate alternative habitat or taken to a wildlife carer. • An offset Management Plan would be developed and implemented to offset the loss of native vegetation, including hollow-bearing trees.		
Damage to native vegetation outside of impact zone	• Stockpile and compound sites would be located using the following criteria: o Within the proposal site. o At least 40 metres away from the nearest waterway. o In areas of low ecological conservation significance (i.e. previously disturbed land). o On relatively level ground. o Outside the 1 in 10 year Average Recurrence Interval (ARI) floodplain.	Contractor	Construction
Introduction and spread of noxious weeds and pathogens	A Weed Management Plan would be developed for the sites to prevent/minimise the spread of weeds in and between sites. This would include: • Declared noxious weeds would be managed according to the requirements stipulated by the *Noxious Weeds Act 1993* during and post construction • Develop protocol for weed hygiene in relation to plant, machinery and importation and management of fill • All pesticides would be used in accordance with the requirements on the label. Any person undertaking pesticide (including herbicide) application would be trained to do so and have the proper certificate of completion/competency or statement of attainment issued by a registered training organisation. • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated and reported.	Contractor	Construction
Disturbance to fallen timber, dead wood and bush rock	• Any fallen timber, dead wood and bush rock (if present) encountered on site would be left in situ or relocated to a suitable place nearby. Rock would be removed with suitable machinery so as not to damage the underlying rock or result in excessive soil disturbance.	Contractor	Construction
Injury and entrapment to fauna due to barbed wire fence construction	• Microbats and birds may be injured through collisions with barbed wire on the perimeter fencing of the solar station. In order to help these impacts due to the perimeter fence, use of barbed wire would be avoided.	Vast Solar, contractor	Construction
Feral animal management	• Implement feral animal management program, including species such as rabbits, rodents and starlings to reduce risk of attracting raptors.	Vast Solar	Operation

Impact	Environmental safeguards	Responsibility	Timing
Bird Management	Develop and implement an Adaptive Bird Hazard Management Plan to monitor and manage bird hazards during operation. The plan would include triggers to implement management actions, in response to unacceptable levels of impact or predictions of unacceptable impacts. It would include a set of feasible management actions that could be promptly implemented. A range of potential management actions are provided in Section 5.1 of Part 2 of the Biodiversity assessment and include: o Application of deterrents to dissuade use by birds of the site or sections of towers where monitoring identifies an unacceptable risk to target species o Restrictions on lambing near the site which could attract raptors o Tilting heliostats downwards at an angle from the vertical at night (between 20 and 40 degrees downward) to avoid their appearance as 'water bodies' o Use of reflective power line marking balls on transmission lines Actions would be monitored and adapted to ensure their effectiveness. The program would operate until such time as risks are demonstrated to be low.	Vast Solar	Post-construction

6.3 OFFSETTING

An Offset Plan would be prepared. The objective of offsetting would be to ensure that an overall 'maintain or improve' outcome is met for the project; where impacts cannot be avoided, or sufficiently minimised, the residual impact would be offset in perpetuity.

An Offset Strategy would be prepared prior to commencement of construction. An Offset Plan would then be required to demonstrate the *actual* amount of native vegetation impacted was offset. This plan would therefore be implemented after construction but prior to the operation of the solar plant. Prior to finalising the Offset Site boundaries, the proponent would validate the actual areas impacted by construction to ensure that the actual, not estimated, impacted area is offset. Loss of native vegetation is expected to be minimal in the project site itself, as the Vast Solar modular CST design is such that remnant vegetation can be preserved across the area of the solar array (the largest part of the development). There is expected to be minimal loss of vegetation (approximately 1.83 ha), including approximately eight hollow-bearing trees, in the easement for the transmission line.

The Offset Plan would also set out appropriate management actions specific to the selected offset site. The outcomes of the management actions would be monitored. Monitoring results would be reported

every 2 years for the duration of the project (up to 30 years) to demonstrate that a 'maintain or improve' outcome has been met.

7 CONCLUSION

The assessment has identified that it is unlikely that the Jemalong Solar Station would significantly impact on the status of local populations of bird species, including threatened species and listed migratory species.

Three moderate to good condition native vegetation communities were identified within the study area, including Western Grey Box Woodland, Poplar Box Woodland and Forest Red Gum Swampy Woodland. One of these communities is listed as an EEC under the TSC Act. A total area of 1.83 hectares of woodland is proposed for removal of which none of this is Western Grey Box Woodland. The remainder of vegetation to be cleared is low condition, exotic-dominated vegetation. No threatened flora species were observed during the field survey, and threatened species evaluations determined that the study area is unlikely to provide important habitat for any of the flora species detected in background searches.

Four threatened fauna species were confidently identified in the proposal site during the field surveys; the Superb Parrot (TSC-V, EPBC-V), Grey-crowned Babbler (TSC-V), Spotted Harrier (TSC-V) and Brown Treecreeper (TSC-V). A number of other threatened bird species are likely to use the proposal site on occasion. Four threatened microbats, the Little Pied Bat (TSC-V), Corben's Long-eared Bat (TSC-V, EPBC-V), the Inland Forest Bat (TSC-V) and the Yellow-bellied Sheathtail-bat (TSC-V) were detected on the proposal site with varying degree of confidence. All four species are considered likely to utilise the proposal site. Assessments of significance under the TSC Act and EPBC Act determined that the proposal is not likely to have a significant impact on any of the fauna species that may utilise the proposal site. Loss of 1.83 hectares of moderate to good condition native vegetation, including up to eight hollow-bearing trees, is a minimal impact of the proposal that has the potential to impact on native flora and fauna within the study area. Mitigation and management measures have been recommended in order to prevent further loss and to minimise disturbance. They include the establishment of exclusion zones, staged habitat removal for hollow-bearing trees, erosion control, prevention of fauna fatalities and injuries during operation and the prevention of weed establishment and spread. Furthermore, development and implementation of an Offset Development has been recommended in order to compensate for the loss of both native vegetation and hollow-bearing trees within the proposal site.

Operational risk to bird populations has been assessed in Part Two of the Biodiversity Assessment (Appendix A). This assessed specific hazards that included risk to birds associated with High Flux Zones between heliostats and the receiving towers, high temperature zones around the receivers, vertically- and horizontally-orientated heliostats, aggregations of insects that attract insectivorous birds and resident predators that are attracted to aggregations of insectivores and water bodies on and adjacent to the subject site.

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9 GLOSSARY

AoS	Assessment of Significance
BOM	Australian Bureau of Meteorology
Cwth	Commonwealth
DECCW	Refer to OEH
DoE	Department of the Environment (formerly SEWPaC)
DP&I	NSW Department of Planning and Infrastructure
EEC	Endangered ecological community – as defined under relevant law applying to the proposal
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
FM Act	*Fisheries Management Act 1994* (NSW)
ha	hectares
IGBW	Inland Grey Box Woodland
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007* (NSW)
km	kilometres
LEP	Local Environment Plan
m	Metres
NES	Matters of National environmental significance under the EPBC Act
Noxious Weeds Act	*Noxious Weeds Act 1993* (NSW)
NPW Act	*National Parks And Wildlife Act 1974* (NSW)
NSW	New South Wales
NV Act	*Native Vegetation Act 2003* (NSW)
OEH	NSW Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water (DECCW).
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy (NSW)
SEWPaC	Refer to DoE
SIS	Species Impact Statement
SISD	Safe Intersection Sight Distance
sp./spp.	Singular species / plural species
SRZ	Structural root zone
TPZ	Tree protection zone
TSC Act	*Threatened Species Conservation Act 1995* (NSW)