

### 1.2.3 Potential impacts of the Proposal

Potential impacts to biodiversity during the construction phase of the Proposal relate to site preparation, operation of vehicles and machinery and the installation of infrastructure. This would involve earthworks for tracks, trenches, footing and pylons, associated vegetation clearing and pollution risks from chemicals used onsite and concreting works as well as potential for mobilised sediment.

The operation of PV arrays is generally considered to generate low environmental impact, especially with regard to biodiversity values (Kaygusuz 2009). The components are non-moving, the surface non-reflective and the PV arrays release no emissions. The potential environmental impacts of PV solar farms depend on the size and nature of the project and are frequently site specific (Gekas *et al.* 2002). Biodiversity impacts are likely to be closely tied to the specific biodiversity values of the site and their sensitivity to the installation of infrastructure such as PV array arrays, roads, perimeter fencing and overhead transmission lines. Vehicle access for operation and maintenance will also have minor impacts.

In their summary of potential environmental impacts of PV solar farms, Gekas *et al.* (2002) include the following issues relevant to biodiversity:

- **Environmental benefits** - significant noise or chemical pollutants emission reductions and an increase in soil humidity and plant growing conditions in dry areas
- **Land use and ecosystem impacts** – these depend on specific factors such as topography, the area and the type of the land covered by the system, the distance from areas of natural beauty or sensitive ecosystems and the biodiversity. Impacts are related to construction and transport movements. Projects can ‘reserve’ soils for future uses.
- **Pollution** - emissions into soil and groundwater of poorly stored materials, abnormal plant operations, damaged panels or fire. In the case of Copper Indium Diselenide (CIS) and Cadmium Tellure (CdTe) panels, which include small quantities of toxic substances, there is a potential slight risk that a fire in an array might cause small amounts of these chemicals to be released into the environment (Tsoutsos *et al.* 2005). The photovoltaic PV array (PV array) being considered for this Proposal consists of Suntech 270 Watt Poly-crystalline solar panels. These silicon based panels do not pose a pollution risk in the event of fire<sup>1</sup>.
- **Air pollution** - minor emissions associated with transport of the modules.

Mitigation of biodiversity impacts onsite can be achieved by avoiding ecologically sensitive areas (Gekas *et al.* 2002).

Specific potential biodiversity impacts relevant for the Nyngan Solar Farm project are summarised in Table 1-1.

<sup>1</sup> The Suntech modules to be used do not contain these heavy metals, have passed the Underwriters Laboratories standard UL1703 (which includes flammability tests) and do not pose a pollution risk in the event of fire.

Table 1-1 Potential biodiversity impacts of the Proposal

|                                      | Construction and decommissioning                                                                                                                                                                                                                                                        | Operation phase                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vegetation</b>                    | <ul style="list-style-type: none"> <li>Clearing and disturbance during construction and installation of the array</li> <li>Clearing required for any transmission line corridor</li> <li>Risk of noxious and environmental weed introduction and spread</li> </ul>                      | <ul style="list-style-type: none"> <li>Microclimate impacts under the PV array (shading, temperature, humidity)</li> <li>Potential soil erosion under the array from concentrated rainsplash and possible vegetation loss</li> <li>Shading under the PV array</li> <li>Weed growth and spread</li> </ul>                                                                   |
| <b>Fauna</b>                         | <ul style="list-style-type: none"> <li>Clearing of habitat for the transmission line and access roads (such as tree food sources, tree hollows, fallen timber)</li> <li>Disturbance to local fauna from noise, light and vibration</li> <li>Vehicle collision risks to fauna</li> </ul> | <ul style="list-style-type: none"> <li>Loss of or alteration to grassland/shrubland habitat for fauna due to shading</li> <li>Movement barrier and collision hazard created by perimeter fencing (also potential predator exclusion)</li> <li>Habitat avoidance due to presence of infrastructure</li> <li>Vehicle collision risks to fauna</li> </ul>                     |
| <b>Riparian and aquatic habitats</b> | <ul style="list-style-type: none"> <li>Potential soil erosion and sedimentation</li> <li>Alteration to local hydrology due to earthworks, site drainage or concentrated runoff</li> <li>Pollution risks</li> </ul>                                                                      | <ul style="list-style-type: none"> <li>Potential soil erosion and sedimentation during the construction phase, and possible loss of soil cover resulting from shading or poor establishment of groundcover under the PV arrays</li> <li>Alteration to local hydrology (eg due to module washing, site drainage or concentrated runoff)</li> <li>Pollution risks</li> </ul> |

## 2 ENVIRONMENTAL AND PLANNING CONTEXT

### 2.1 ENVIRONMENTAL CONTEXT

#### 2.1.1 *Interim Biogeographic Regionalisation of Australia (IBRA)*

Bioregions are relatively large areas that share similar characteristics in terms of landscape-scale natural features, environmental processes and ecosystems. There are 17 IBRA bioregions in NSW and each is broken into subregions. Subregions are based on finer scale geophysical and ecological commonalities (DECC 2008a).

The study area falls into the Darling Riverine Plains Bioregion, and the Bogan-Macquarie IBRA subregion. The characteristic landforms of this subregion include floodplains and channels of the Bogan and Macquarie Rivers. Soils are dominated by clays and vegetation by riparian communities, swamps and woodlands.

#### 2.1.2 *Catchment Management Authority and subregions*

Catchment Management Authorities (CMAs) have been established across NSW and are responsible for managing natural resources at the catchment scale. There are 13 CMAs in NSW. Key roles include preparing Catchment Action Plans (CAPs) and managing incentive programs to implement these plans (CMA 2010). There are a number of subregions within each of the CMAs and these are broadly based on an overlay of the CMA and IBRA subregion boundaries (DECCW 2010).

The study area lies within the Central West CMA and close to the boundary between two catchment subregions:

- Bogan-Macquarie
- Canbelego Downs

These subregions have a high level of biodiversity due to the confluence of the diversity of landforms including plains, ranges and waterways. Much of the vegetation has been cleared for agriculture and many of the large native vegetation remnants are held within state tenure, such as state forests, national parks and travelling stock reserves. Some vegetation communities in the subregions are poorly reserved, including Box-Gum Woodland and Myall Woodland communities. Across the two subregions, there are six ecological communities, 7 flora and 51 fauna species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act).

#### 2.1.3 *Important Bird Areas*

The southern portion of the Macquarie Marshes Important Bird Area (IBA) begins 55km east of the site, near the town of Warren, and extends northward. This IBA protects a number of water birds including Australasian Bittern and Sharp-tailed Sandpiper (Birds Australia 2009). The Macquarie Marshes Nature Reserve protects some of this area (the nature reserve is located over 100km north-east of the site).

### 2.1.4 District assessment

The proposed solar farm site is located within the Bogan Local Government Area (LGA) and is zoned 1(a) General Rural under the Local Environmental Plan (LEP). Bogan LGA covers an area of approximately 14,610 square kilometres with an estimated population of 3220 of which, 2500 are in Nyngan (Bogan Shire Council 2010).

The main land use in the area is agriculture, predominantly cropping (largely found to the west of the Bogan River) and grazing of cattle and sheep (Bogan Shire Council 2010). The vegetation and fauna communities in the district have been highly modified by past agricultural activities, including clearing and ploughing. There are pockets of remnant and regrowth vegetation in the district. The Bogan River (a major tributary of the Darling River) and associated riparian vegetation are local environmental features, running north-south approximately 1.3km west of the site.

There are several state conservation areas within the district including Thorndale State Forest (26km west), Miandetta State Forest (26km west) and Quanda Nature Reserve (45km south-west)

### 2.1.5 Locality assessment

A locality-scale review of habitats was conducted with reference to aerial photography and topographic maps and vehicle-based surveys. For the purposes of this report, the locality is defined as the area surrounding the subject site over a radius of 15 kilometres. Most of this area is substantially cleared and modified. Key conservation values in the district include:

- The Bogan River and associated wetlands and floodplains
- Remnant woodland and other native vegetation communities, including roadside corridors
- Records for thirteen threatened fauna species listed under the TSC Act

The riparian zone along the Bogan River is vegetated and would provide habitat, a drought refuge and act as a movement corridor for wildlife. Open woodland remnants, loosely linked through a grazed agricultural matrix by remnant trees, provide connectivity to this riparian woodland from land to the east. Thin remnant woodland strips form linear corridors between cropped paddocks to the west of the river. The subject site lies nestled between several larger woodland patches on the outskirts Nyngan with limited connectivity through the centre portion (in Area 6) via degraded woodland stands isolated by pasture.

## 2.2 SITE DESCRIPTION

The subject site consists of approximately 450 hectares of flat terrain, characteristic of the alluvial floodplains of the Nyngan locality. The site is located 2 kilometres south from the township of Nyngan, between the junction of Tottenham Road and the Mitchell Highway (refer to Figure 1-1 above). The subject site is largely cleared with some small remnant patches of vegetation and scattered trees. It has been highly modified by past agricultural activities including clearing, cultivation and grazing. Understorey vegetation is generally comprised of native grasses and Chenopod shrubs across the bulk of the site, excluding a large paddock in the centre of the site which has been cultivated and sown to crops (grazed at the time of the survey).

Native species diversity ranges from moderate in areas where shrubs are present to low where a few grass species become more dominant. Trees are predominately scattered and sparse across the site.

Woodland patches and larger stands occur within the central subject site (Area 6) and adjacent to the subject site; north, south-east and west. Areas of native vegetation are predominately derived from Black Box/Bimble Box woodland. Vegetation in the east of the subject site (Area B7) is derived from Myall woodland. Weed species were common across the subject site. Two species detected, African Boxthorn and Bathurst Burr, are listed as noxious within the Bogan Shire Council control area.

There is a minor drainage line that runs from north-south through the centre of Area B1. This section of the subject site is likely to remain waterlogged following rain. The majority of the subject site appears to be situated on heavy cracking clay soils associated with the Boggy Cowal Channels and Floodplains Mitchell Landscape. Elevation at the site ranges between approximately 170 metres and 180 metres AHD. Slope is flat to gently undulating.

## 2.3 POLICY AND LEGISLATION

The Proposal is deemed Critical Infrastructure and would be assessed as a Major Project under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Projects approved under Part 3A of the EP&A Act require the approval of the Minister for Planning (via the NSW Department of Planning, or DoP). A requirement of Part 3A projects is to 'improve or maintain' biodiversity values.

Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect threatened species, populations or ecological communities, or their habitats. Although not a legal requirement of a Part 3A development, Assessments of Significance provide a transparent and systematic characterisation of impact for listed entities. Assessments of significance have been completed for 15 threatened species identified as having the potential to be impacted by the Proposal.

The Department of Climate Change & Water (DECCW), who administers the *Threatened Species Conservation Act 1995*, will be consulted by the Department of Planning regarding potential impacts to NSW threatened species. The provisions of *State Environmental Planning Policy 44 Koala Habitat Protection* apply to the Proposal and are discussed further in section 5.4.3.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* provides for an assessment and approvals system for actions that may have a significant impact on 'matters of national environmental significance'. These matters include World Heritage properties, wetlands of international importance and Commonwealth listed threatened species and ecological communities. Proposals which would significantly affect a matter of national environmental significance must be referred to the Commonwealth Environment Minister for approval.

## 3 ASSESSMENT APPROACH AND METHODOLOGY

### 3.1 APPROACH

This Biodiversity Assessment includes:

- A desktop review of research literature, online databases and other sources to determine regional and local biodiversity values and assist field survey planning and design
- Field flora and fauna surveys and habitat assessments
- Analysis and assessment of data to establish conservation values and significance of impacts in relation to environmental legislation
- Development of measures to reduce the risks and identified impacts, focussing on avoidance and mitigation and offsets where impacts are unavoidable

### 3.2 PRELIMINARY ASSESSMENTS

A preliminary constraints map on the findings of the survey was provided to the Proponent early in the proposal planning phase. Based on the biodiversity constraints identified in this map, the development envelope was created with the aim of avoiding areas of high biodiversity value and therefore minimising impacts to biodiversity.

Online database searches of threatened and migratory species were undertaken for the Central West CMA catchment, Canbelego Downs and Bogan-Macquarie sub-catchments using the DECCW threatened species database (as the subject site occurs close to the boundaries of these sub-catchments) and over a 25 kilometre radius using the Commonwealth EPBC Act Protected Matters search tool. Other online resources included the NSW DECCW Wildlife Atlas, the PlantNET database of the Royal Botanical Gardens Herbarium and threatened species databases (DECCW and DEWHA). Topographic maps and air photographs were used to prepare a preliminary stratification for the survey based on topography and interpreted vegetation cover.

Predictive vegetation mapping (DECCW 2010a) was also consulted to identify threatened species and associated habitats for targeting during the survey. The likelihood of identified threatened species to occur within the study area and their potential to be impacted by the Proposal was assessed using a preliminary version of the evaluation included in a.i.1.a.i.Appendix C.

### 3.3 FIELD SURVEY AND MAPPING

#### 3.3.1 Flora

The flora survey was undertaken on 7 & 8 July 2010, using informal transects (random meander after Cropper 1993) and inspection points. In total, 14 random meanders and 18 inspection points were surveyed. The random meanders were up to 30 minutes in duration and each covered up to 1 hectare. A total of 15 person hours was spent on the flora component of the survey. Floristics, structural data, vegetation condition and site physical values were recorded. This approach allows vegetation type and condition to be characterised, while providing the areal coverage required for a project of this scale.

Inspection points were established along a series of random meanders located within relatively homogeneous stratification zones. Inspection points were used to confirm vegetation structure and type and note variations in relative species abundance. The field survey targeted areas of potential habitat for significant or sparsely distributed plant species. The random meander survey sites and general inspection points are indicated on Figure 3-1.

Vegetation condition was rated according to the following four-point scale, focusing on floristic integrity in the groundcover and shrub layers:

|                 |                                                                                                                |
|-----------------|----------------------------------------------------------------------------------------------------------------|
| <b>Exotic</b>   | Groundlayer dominated by exotics, native shrubs and trees sparse or absent                                     |
| <b>Poor</b>     | Understorey dominated by one or two native grass or shrub species, <5 native forbs                             |
| <b>Moderate</b> | Understorey dominated by native grasses or shrubs, 5-11 native forb species present                            |
| <b>Good</b>     | Understorey dominated by native grasses or shrubs with a diversity of forbs (at least 12 native forb species). |

These classes are considered most relevant for vegetation types with a naturally diverse grassy groundcover and shrub layer, such as the woodland and derived grassland observed on the site. The vegetation of the subject site has been classified using the NSW Vegetation Classification and Assessment (NSWVCA) system (Benson *et al.* 2006) which provides the most recent and comprehensive classification for the NSW western plains. A map of the flora survey points in relation to the vegetation type is displayed in Appendix H.

### 3.3.2 Fauna

A fauna survey of the subject site and adjacent areas of remnant vegetation was undertaken from the 7<sup>th</sup> to the 8<sup>th</sup> of July 2010 (winter). Weather during the survey was cool to mild. Details of the climatic conditions experienced during the survey are displayed in Table 3-1.

Table 3-1: Survey conditions<sup>2</sup>

| Date   | Max(°C) | Min (°C) | Rain (mm) | Wind (3pm) | Moon | Cloud |
|--------|---------|----------|-----------|------------|------|-------|
| 7/7/10 | 14      | 5        | 0.0       | SSW @7km/h | half | 7/8   |
| 8/7/10 | 17.7    | 4.5      | 0.0       | SE @7km/h  | half | 3/8   |

### Approach

The focus of the fauna survey was to identify and assess habitat type and quality, including its suitability for threatened species, rather than to detect individual species. This approach is aimed at addressing the problems inherent in surveying for rare and cryptic species, particularly when utilising short duration surveys. Following the precautionary approach, if suitable habitat was found, it has been assumed that the threatened species may also occur unless reliable data demonstrates otherwise.

<sup>2</sup> Weather observation data sourced from the BOM Nyngan weather station located 3 km north of the subject site. Subject site climatic conditions are unlikely to have varied significantly from these figures.

The fauna survey focused on habitat assessment but also included 20 minute bird surveys, call playback, spotlighting, targeted habitat searches for reptiles and opportunistic records of sign and observations. The fauna survey effort is mapped on Figure 3-2.

(a version of this map with the vegetation types found on the subject site is included in Appendix H), and survey methods, target species, and survey effort is summarised in Table 3-2.

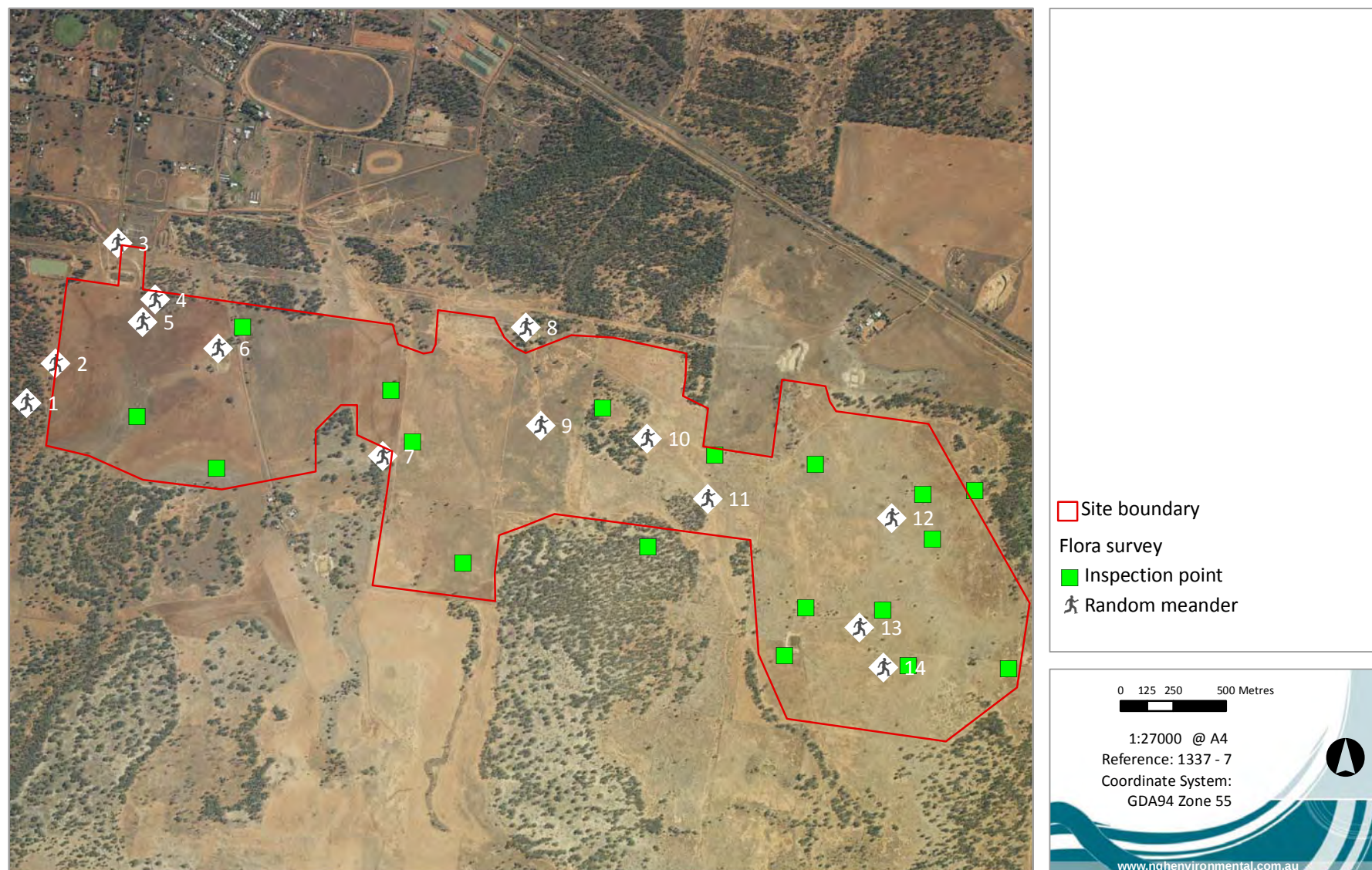


Figure 3-1 Location of flora survey sites

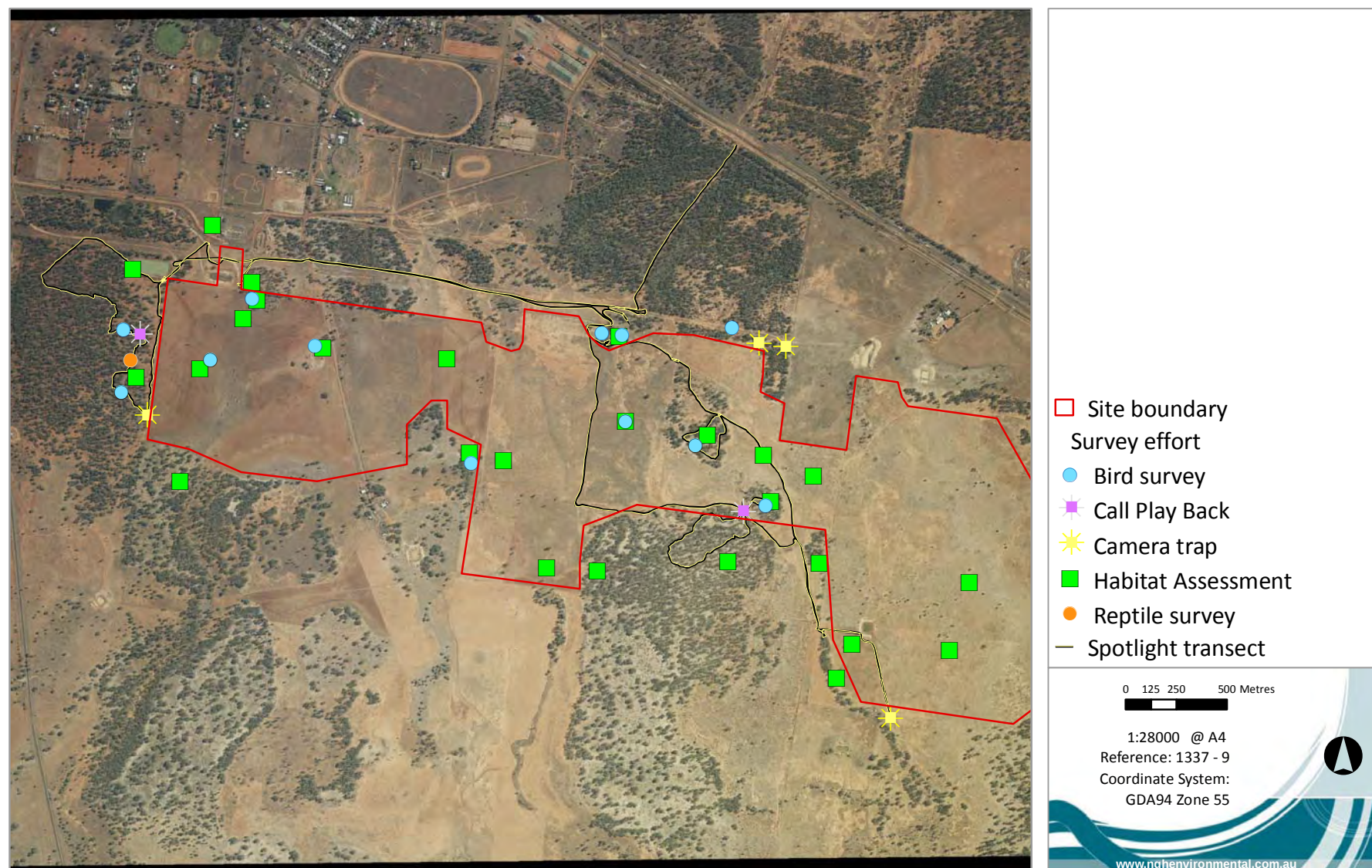


Figure 3-2 Fauna survey effort

Table 3-2 Fauna survey design

| Survey type         | Target                                                                                                            | Design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Survey effort                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Habitat assessment  | Habitat for all species, particularly, threatened species sign and habitat                                        | Habitat assessments recording presence and quality of threatened fauna habitat (for example hollow bearing trees, proximity to water, stands of native grass, fallen timber, watercourses, mistletoe, past and present disturbance) were undertaken across the site. The survey points were originally stratified using aerial photography then adjusted in the field as required following ground truthing to ensure thorough coverage of all habitat types.                                                                           | 26 assessments                                                  |
| Diurnal bird survey | Threatened bird species for example:<br>Superb Parrot<br>Brown Treecreeper<br>Hooded Robin                        | Twenty minute bird surveys were undertaken by one person covering an area of approximately 1 ha on foot. Birds were identified by call or observation (aided by binoculars). Additional opportunistic records were noted while completing other assessments on the site.                                                                                                                                                                                                                                                                | 11 surveys; total of 220 minutes                                |
| Camera traps        | Spot-tailed Quolls<br>Feral predators                                                                             | Infra-red motion detection cameras (scoutguard SG550v) were set on ground bait stations located on existing animal pads (one was set on a fresh feral goat carcass). All (except the goat camera) were baited with honey and sardines.                                                                                                                                                                                                                                                                                                  | 4 camera nights (2 cameras for 2 nights)                        |
| Spotlight           | Arboreal mammals, nocturnal birds, amphibians for example:<br>Squirrel Glider<br>Barking Owl<br>Spot-tailed Quoll | A foot spotlight using a hand-held 12v 50w spotlight was conducted through the remnant Black Box woodland and shrubland in the central section of the subject site and to the south east and west of the subject site. These areas were chosen following habitat evaluations. Spotlighting from a vehicle travelling <5km/hr was carried out through the subject site (the open nature of this country and low, patchy groundcover allowed a large area to be covered by the beam) and the Black Box woodland to the north of the site. | 3 foot transects (3km approx), 2 vehicle transects (8km approx) |

|                               |                                                          |                                                                                                                                                                                                                                                                                                                                                                  |                            |
|-------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Call playback (CPB)           | Barking Owl<br>Masked Owl                                | Surveys broadcasting vocalisations of the Barking Owl and Masked Owl was undertaken. Call playback was carried out after a 5 minute acclimation period. Calls were played for 5 minutes. Listening for responses was carried out for an additional 5 minutes. Ten minutes of spotlighting around the call playback location followed the call play-back session. | 2 surveys; 40 mins         |
| Reptile/amphibian hand search | Common reptile and amphibian species<br>Sloane's Froglet | Three large piles of corrugated iron sheets were searched by hand. Reptiles found were caught and identified.                                                                                                                                                                                                                                                    | 1 survey; 30 minutes       |
| Scat analysis                 | Native mammals                                           | Scats containing hair were collected and sent for analysis. One fox scat was found and analysed.                                                                                                                                                                                                                                                                 | at all times while on site |
| Opportunistic                 | All                                                      | All opportunistic records of fauna or fauna sign were recorded.                                                                                                                                                                                                                                                                                                  | at all times while on site |

### 3.3.3 Mapping

Spatial data obtained during the survey using hand-held GPS Magellan and Garmin GPS units were plotted over aerial imagery (sourced from NSW Department of Lands) using ESRI's ArcGIS software for mapping, planning and presentation. Vegetation and condition boundaries were extrapolated from point and traverse data and notes taken during the general site inspection. All map references are based on the GDA 94 (new) datum.

### 3.3.4 Survey limitations

The short duration and winter timing of the survey was poor in terms of detection for many threatened flora and fauna species.

Some geophytic species, spring or summer flowering annuals and species which are inconspicuous or difficult to identify in their vegetative state will not have been recorded. Where some potential for unrecorded threatened species exists, this possibility is acknowledged and precautions incorporated into the impact assessment and mitigation measures.

At the time of survey, the western areas of the subject site were being grazed by cattle and the central and eastern areas by sheep and goats. This may have affected the recording and identification of some taller species and those being preferentially grazed. Ephemeral species which flower in response to irregular disturbance events such as fire will also have gone unrecorded. The development envelope occupies around 312 ha, requiring extrapolation and generalisation from the flora survey points, using air photo interpretation with some ground-truthing during the survey. Some fine scale errors are possible, but are considered unlikely to alter the broad findings of the study. Areas under cropping within the subject site were considered to consist entirely of exotic agricultural species and were not investigated in any detail.

The winter timing of the survey was unsuitable for the detection of many threatened fauna species, particularly microbats. Habitat assessments (Appendix B) were used as a surrogate for direct detection of threatened species and informed the assessment of whether a species was likely to occur on the subject site. The habitat for threatened species with potential to occur on the subject site is considered identifiable, independent of seasonal factors.

The active and passive surveys undertaken in conjunction with the habitat assessments provide a snapshot of the biodiversity occurring on the site and should not be taken as a comprehensive inventory of species.

## 4 FLORA RESULTS

### 4.1 PRELIMINARY ASSESSMENTS

The Commonwealth Matters of National Environmental Significance search tool indicated two threatened ecological communities and one threatened species listed under the EPBC Act which are likely to occur within a 25 kilometre radius of the subject site (refer Appendix J). The DECCW threatened species database indicates the potential presence of an additional four threatened communities and six threatened species listed under the TSC Act in the Canbelego Downs and Bogan-Macquarie sub-catchments of the Central West CMA catchment.

The evaluation presented in Appendix B concludes that two threatened communities have at least moderate potential to be present in habitat at the subject site, and at least moderate potential to be impacted by the Proposal:

- Coolibah-Black Box Woodland of the Northern Riverine Plains in the Darling Riverine Plains and Brigalow Belt South bioregions (Endangered TSC)
- Myall Woodland in the Darling Riverine Plains; Brigalow Belt; South; Cobar Peneplain; Murray-Darling Depression; Riverina and NSW South western Slopes bioregion (Endangered EPBC & TSC)

The evaluation also concluded that two threatened species have a moderate potential of occurring at the subject site and a moderate potential to be impacted:

- Slender Darling-pea (*Swainsona murrayana*)      Vulnerable (TSC, EPBC)
- Red Darling-pea (*Swainsona plagiotropis*)      Vulnerable (TSC, EPBC).

### 4.2 VEGETATION COMMUNITIES

For the purposes of the field survey and subsequent referral in the report the site was broken up into a number of areas largely based on paddock boundaries. The sections are referred to in the following descriptions and are as presented in Figure 4-1.

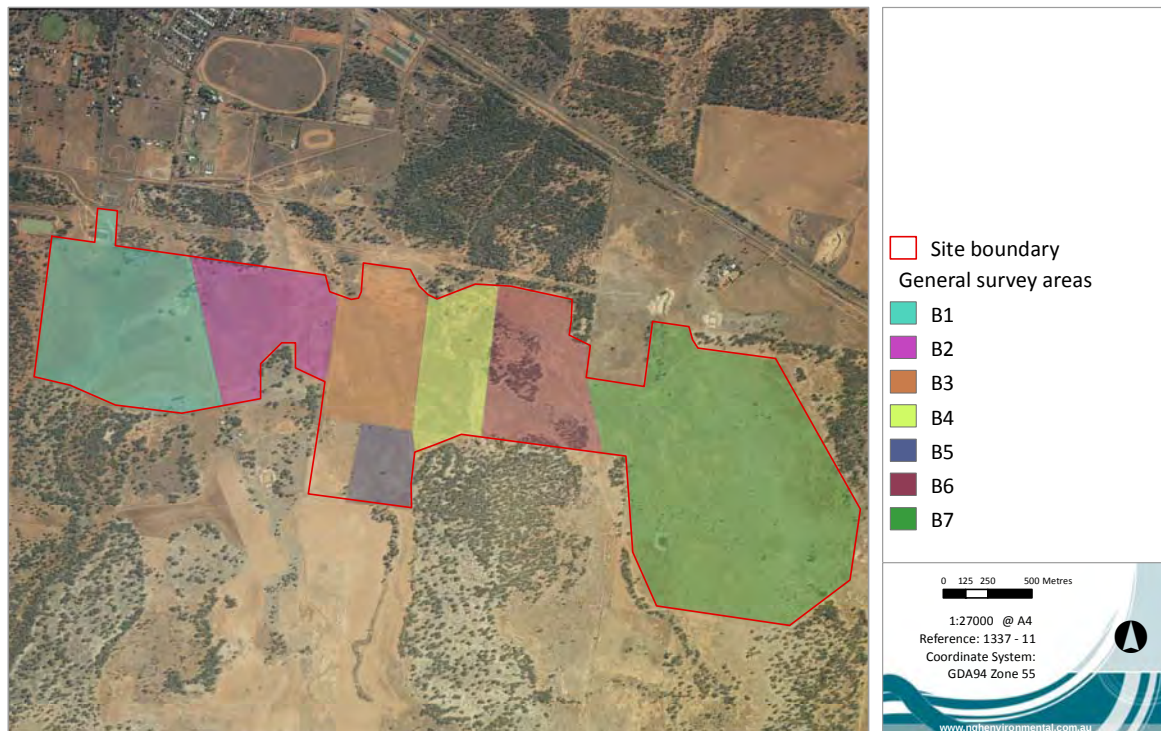


Figure 4-1 Designated survey areas at the Nyngan solar farm site

The subject site has a long history of agricultural disturbance with the majority being regularly cultivated for crops. The western section of the site has not been cultivated for crops for the past 10 years and this has facilitated the re-colonisation of native grass and shrub species. Remnant vegetation adjoining the subject site conforms to Black Box Woodland on Floodplains (ID 37, Benson 2006). Remnant patches of Black Box (*Eucalyptus largiflorens*) trees are scattered across the western (Area B1 and B2) and central sections (Area B4 and B6) of the site. It is likely that the native ground cover vegetation within the western and central sections was derived from this community.

Vegetation to the east of the subject site (Area B7) is dominated by derived native grassland. Sparse to low density Myall (*Acacia pendula*) trees are present and are the only overstorey species in most areas. These areas would conform to Weeping Myall Woodland (ID 27, Benson 2006). A small patch of Myall Woodland also occurs in the far north-west of the site. Due to the high levels of disturbance it is difficult to determine the original extent of the Myall Woodland in this area. As such where Myall trees are dominant it is considered to comprise Myall Woodland. Where Myall is absent in the eastern section of the site the community is considered to comprise a native pasture (grassland).

In summary, five vegetation communities were identified:

- Black Box Woodland
- Myall Woodland
- Black Box Woodland derived grass/shrubland
- Derived Native Grassland
- Exotic dominated pasture/crops

Survey results are summarised in Table 4-1. The full list and general abundance of species recorded during the flora survey is presented in Appendix C. The configuration, distribution and condition of the vegetation communities at the time of the survey is discussed below and displayed in Figure 4-2.

Table 4-1 Random meander survey results summary

| Site | Community and location                                                                    | Dominant species                                                                                                                                                                                        | Condition     | Significance    |
|------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|
| 1    | Black Box Woodland<br>- alluvial clays, dry area off site<br>MGA 517718 6505471           | <i>Eucalyptus largiflorens</i> , <i>Geijera parviflora</i> , <i>Eremophila ?mitchellii</i> , <i>Myoporum montanum</i> , <i>Eremophila maculata</i>                                                      | Moderate-good | High (off site) |
| 2    | Derived grass/shrubland<br>- alluvial clays, wet area<br>MGA 517858 6505854               | <i>Eragrostis parviflora</i> , <i>Chloris truncata</i> , <i>Enteropogon acicularis</i> , <i>Sclerolaena tricuspidis</i> , <i>Sclerolaena birchii</i>                                                    | Poor-moderate | Low-moderate    |
| 3    | Derived grass/shrubland<br>- disturbed area adjacent to sub-station<br>MGA 518149 6506229 | <i>Capparis mitchellii</i> , <i>Eragrostis parviflora</i> , <i>Enteropogon acicularis</i> , <i>Sclerolaena diacantha</i> , <i>*Echium plantagineum</i> , <i>*Trifolium sp</i> , <i>Brachyscome spp.</i> | Poor-moderate | Low             |
| 4    | Myall Woodland<br>- alluvial clays, dry area<br>MGA 518331 6505958                        | <i>Acacia pendula</i> , <i>Eucalyptus largiflorens</i> , <i>Eremophila maculata</i> , <i>Rhagodia spinescens</i> , <i>Einadia polygonoides</i> , <i>Sporobolus caroli</i> , <i>Solanum esuriale</i>     | Moderate      | High            |
| 5    | Black Box Woodland<br>- alluvial clays, dry area<br>MGA 518270 6505850                    | <i>Eucalyptus largiflorens</i> , <i>Eremophila maculata</i> , <i>Rhagodia spinescens</i> , <i>Einadia polygonoides</i> , <i>Eragrostis parviflora</i>                                                   | Moderate      | Moderate        |
| 6    | Derived grass/shrubland<br>- alluvial clays, wet area<br>MGA 518631 6505725               | <i>Eucalyptus largiflorens</i> , <i>*Lycium ferrocissimum</i> , <i>Sclerolaena tricuspidis</i> , <i>Atriplex ?semibaccata</i> , <i>Enteropogon acicularis</i> , <i>*Eragrostis cilianensis</i>          | Poor-moderate | Low-moderate    |
| 7    | Black Box Woodland<br>- alluvial clays, highly disturbed<br>MGA 519410 6505215            | <i>Eucalyptus largiflorens</i> , <i>*Lycium ferrocissimum</i> , <i>Rhagodia spinescens</i> , <i>Atriplex semibaccata</i> ,                                                                              | Poor-moderate | Low-moderate    |
| 8    | Black Box Woodland<br>- alluvial clays, near dam<br>MGA 520090 6505825                    | <i>Eucalyptus largiflorens</i> , <i>Sclerolaena tricuspidis</i> , <i>Chenopodium pumilo</i> <i>Dichondra repens</i> , <i>*Trifolium sp</i> , <i>*Medicago ?arabica</i>                                  | Poor-moderate | Low-moderate    |
| 9    | Exotic dominated pasture<br>- alluvial clays, heavily grazed<br>MGA 520161 6505357        | <i>*Trifolium sp.</i> , <i>*Medicago arabica</i> , <i>Chenopodium pumilo</i> , <i>*Xanthium spinosa</i> , <i>Sclerolaena birchii</i> , <i>Sclerolaena tricuspidis</i>                                   | Poor          | Low             |
| 10   | Black Box Woodland<br>- alluvial clays, intact overstorey<br>MGA 520666 6505298           | <i>Eucalyptus largiflorens</i> , <i>Eucalyptus populnea subsp. bimbil</i> , <i>Sclerolaena bicornis</i> , <i>Brachyscome ciliaris var. ciliaris</i>                                                     | Moderate-good | High            |
| 11   | Black Box Woodland<br>- alluvial clays, intact overstorey<br>MGA 520953 6505011           | <i>Eucalyptus largiflorens</i> , <i>Eucalyptus populnea subsp. bimbil</i> , <i>Sclerolaena bicornis</i> , <i>Sclerolaena tricuspidis</i> .                                                              | Moderate-good | High            |
| 12   | Derived Native Grassland<br>- alluvial clays, dry area<br>MGA 521822 6504925              | <i>Enteropogon acicularis</i> , <i>Chloris truncata</i> , <i>Eragrostis sp.</i> ,                                                                                                                       | Poor-moderate | Low-moderate    |
| 13   | Myall Woodland<br>- alluvial clays, dry area<br>MGA 521674 6504401                        | <i>Acacia pendula</i> , <i>Enteropogon acicularis</i> , <i>Chloris truncata</i> , <i>Eragrostis sp.</i> , <i>Rhagodia spinescens</i> , <i>*Lycium ferrocissimum</i>                                     | Poor-moderate | High            |
| 14   | Myall Woodland<br>- alluvial clays, dry area<br>MGA 521787 6504211                        | <i>Acacia pendula</i> , <i>Enteropogon acicularis</i> , <i>Chloris truncata</i> , <i>Eragrostis sp.</i> , <i>Rhagodia spinescens</i> , <i>*Lycium ferrocissimum</i>                                     | Poor-moderate | High            |

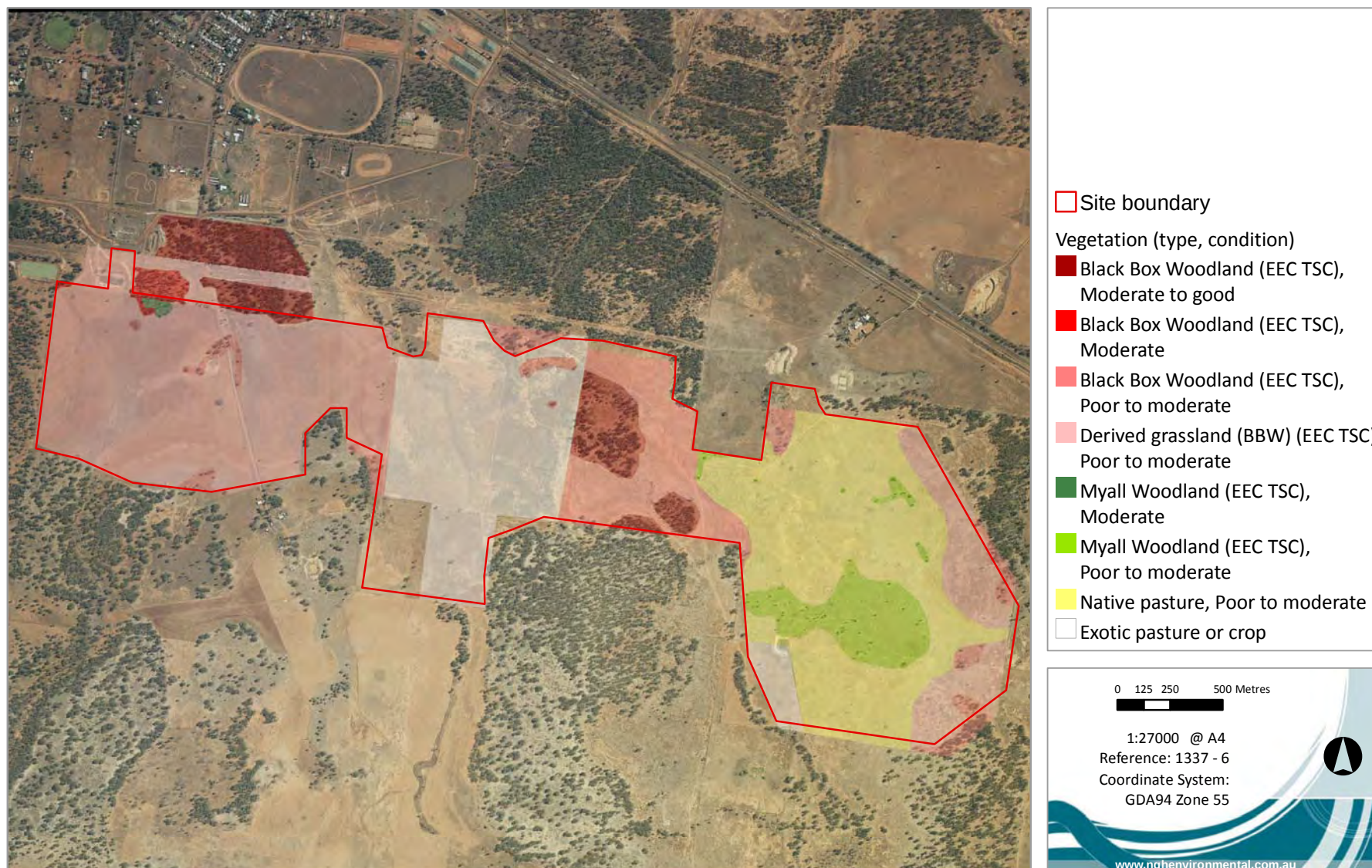


Figure 4-2 Vegetation communities present at the subject site

### Areas under cropping and/or exotic pasture

Area B3 in the eastern section of the site (Figure 4-3) has been entirely planted with exotic agricultural species. Native vegetation is virtually non-existent in this area and all trees have been removed excluding a few isolated Bimble Box (*Eucalyptus populneus subsp. bimbil*) (Figure 4-3). Bimble Box is a component of many vegetation communities and as such, it is difficult to determine what community originally occupied the area. Weeds are prevalent in this area, particularly on the verges of the cropped zone, and include Small-flowered Mallow (*\*Malva parviflora*), Patterson's Curse (*\*Echium plantagineum*), Indian Hedge Mustard (*\*Sisymbrium orientale*) and Peppercress (*\*Lepidium africanum*). Area B3 was being grazed by sheep at the time of the survey.



Figure 4-3 Example of areas under cropping at the Nyngan Solar Farm site (Area B3)

### Black Box Woodland and derived grass/shrubland

Black Box is the dominant overstorey species in vegetation surrounding the site and in remnant patches within the site. Bimble Box is also prominent and is often associated with this woodland community. This community has been extensively cleared within the subject site (Figure 4-4). Trees are virtually absent, being restricted to a few isolated patches and native ground cover diversity is generally low, likely due to grazing pressures. Native ground cover in the west of the site is dominated by Weeping Lovegrass (*Eragrostis parviflora*), Curly Windmill Grass (*Enteropogon acicularis*) and Windmill Grass (*Chloris truncata*) with the shrubs Giant Redburr (*Sclerolaena tricuspidis*), Galvanised Burr (*S. Birchii*) and Goathead Burr (*S. bicornis*). These species are associated with Black Box Woodland and given the presence of scattered Black Box trees, it is highly likely that the native ground cover in this area is derived from Black Box Woodland. Exotic pasture species were common in this area and the declared noxious weed, African Boxthorn (*\*Lycium ferrocissimum*) was scattered particularly around trees.

Small stands of Black Box also occur around two dams, one in the east of the site (Area B1) and one in the central north of the site (Area B4) (Figure 4-4). These areas are highly disturbed and the ground cover is predominately exotic.

In the eastern section of the site (Area B6) there are denser stands of Black Box which support a moderate diversity of trees, shrubs and forbs. Bimble Box, Budda (*Eremophila mitchellii*) and Wilga (*Geijera parviflora*) are scattered. Spotted Fuchsia-bush (*Eremophila maculata*), and daisies such as Variable Daisy (*Brachyscome ciliaris* var. *subintegrifolia*) also occur in patches. Grass cover is slightly

more diverse in these areas with native grasses, such as Barbed-wire Grass (*Cymbopogon refractus*) and Small-flowered Wallaby Grass (*Austrodanthonia setacea*) present in small numbers.

Areas of Black Box Woodland and native vegetation derived from this community are considered part of the Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions (Coolibah-Black Box Woodland) Endangered Ecological Community (EEC) listed under the *Threatened Species Conservation Act 1995* (TSC Act).



Figure 4-4 Remnant Black Box patches in Area B1 in the west of the subject site (left) and Area B6 in the east of the subject site (right)

### Myall Woodland

The paddock in the far east of the site (Area B7) supports dense grassland with scattered patches of Myall (*Acacia pendula*) trees (Figure 4-5). This entire area was within the original site boundary and as such included in the original survey. However, the revised site boundary only includes the northern section of this area. Diversity in this area is low being dominated by one or two native grasses and occasional shrubs and forbs. A small patch of Myall Woodland occurs within the subject site in the north of the western section (Figure 4-2, Figure 4-5). This area has also been subject to grazing but exhibits moderate understorey diversity. Diagnostic species include Leaf-less Bluebush (*Maireana aphylla*), Spiny Saltbush (*Rhagodia spinescens*), Ruby Saltbush (*Enchylaena tomentosa*), Quena (*Solanum esuriale*) and the grasses, Weeping Lovegrass (*Eragrostis parviflora*) and Fairy Grass (*Sporobolus caroli*).

The occurrences of this community on the subject site conform to the definition of Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South-western Slopes bioregions (Myall Woodland) EEC listed under the TSC Act. For the purposes of this assessment, the extent is considered as defined by the Scientific Committee's determination for the EEC which includes all areas where Myall trees are present.



Figure 4-5 Myall Woodland to the east of the site (left) and a small patch in the north-west of the site (right)

Table 4-2 shows the high level of depletion and poor conservation status of the woodland vegetation types present and from which the native pastures at the subject site are likely to be derived. Since woodlands frequently coincide with prime farmland, these communities have been heavily impacted by clearing, grazing, cultivation and the introduction of weed and pasture species. The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands.

Applying the general JANIS reservation target of 15% of the original extent for each forest type (JANIS 1997), all of the vegetation types within the study area are under-represented in the conservation reserve system within the Bioregion (refer Table 4-2). Under JANIS criteria, 60% of the remaining stands of vulnerable types and 100% of endangered types should be reserved or otherwise protected.

Table 4-2 Conservation status of vegetation types at the subject site (after Benson 2006)

| Vegetation type                          | Pre-1750 extent (ha) | Extant area (ha)      | Reserved in Bioregion (ha) |
|------------------------------------------|----------------------|-----------------------|----------------------------|
| <b>Black Box Woodland on floodplains</b> |                      |                       |                            |
| Vegetation ID 37                         | 900000 ±30%          | 400000 ±30%           | 11849                      |
| Open Forest, Open Woodland               |                      | (44 % of 1750 extent) | (1.3% of 1750 extent)      |
| Woodland                                 |                      |                       |                            |
| <b>Weeping Myall Open Woodland</b>       |                      |                       |                            |
| Vegetation Group 27                      | 1000000              | 100000 ±30%           | 151                        |
| Open Woodland, Isolated Trees, Woodland  | ±30%                 | (10% of 1750 extent)  | (0.02% of 1750 extent)     |

## 4.3 SPECIES AND COMMUNITIES OF CONSERVATION SIGNIFICANCE

### 4.3.1 Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecosystems which have their species composition and their natural ecological process determined by groundwater (NOW 2002). There are several types of

GDE with six types conventionally recognised in Australia (NWC 2010). Three of these are likely to occur locally:

- Terrestrial vegetation that relies on the availability of shallow groundwater
- River base flow systems where a groundwater discharge provides a baseflow component to the rivers discharge
- Terrestrial fauna, both native and introduced, that rely on groundwater as a source of drinking water

The subject site is located on the floodplain of the Bogan River and supports terrestrial vegetation which may depend on the availability of shallow groundwater associated with the river system. This groundwater is also likely to contribute to the base flow of the Bogan River. The NSW Groundwater Dependent Ecosystem Policy (NOW 2002) sets out objectives and principles for the protection and management of GDEs including the following:

- Ensure the most vulnerable and valuable ecosystems are protected
- Manage groundwater extraction within defined limits thereby providing flow sufficient to sustain ecological processes and maintain biodiversity
- Ensure sufficient groundwater of suitable quality is available to ecosystems when needed
- Ensure the precautionary principle is applied to protect GDEs, particularly the dynamics of flow and availability and the species reliant on these attributes

No groundwater extraction at the subject site is planned as part of the proposal. The installation of the solar array and infrastructure will not affect the net amount of water reaching the surface of the ground during rain or flooding events nor its ability to infiltrate and replenish groundwater systems. As such the proposal is not inconsistent with the objectives and principles of the policy and is unlikely to have an impact on GDEs or other natural systems that depend upon groundwater resources.

#### 4.3.2 *Endangered Ecological Communities*

The survey identified the presence of two threatened communities at the subject site:

- Coolibah-Black Box woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions ('Coolibah-Black Box Woodland')(TSC)
- Myall Woodland in the Darling Riverine Plains; Brigalow Belt; South; Cobar Penneplain; Murray-Darling Depression; Riverina and NSW South western Slopes bioregion ('Myall Woodland') (EPBC & TSC)

#### **Coolibah-Black Box Woodland**

##### **NSW Endangered Ecological Community (EEC)**

The Coolibah-Black Box Woodland EEC listed under the NSW *Threatened Species Conservation Act 1995* includes intact and disturbed areas such as:

- Woodlands which are dominated by Coolibah (*Eucalyptus coolabah*) and/or Black Box (*E. largiflorens*) (with or without native understorey); and
- Grasslands and pastures dominated by native grasses and shrubs that are derived from this community.

Black Box was recorded at the site present as scattered isolated stands within the western and eastern paddocks. Black Box is also dominant in the vegetation surrounding the subject site and it is highly likely that the majority of native vegetation within the subject site is derived from this community. Native species diversity was generally low across the site likely due to impacts from past and present agricultural activities.

The Scientific Committee's determination for this community states that it is found on the grey, self mulching clays of periodically water logged floodplains (DECCW 2010b). Consultation with DECCW (G. German pers. com. 22<sup>nd</sup> July 2010) confirmed that if the community does not occur on this soil type then it does not constitute the EEC. Aerial imagery indicates that this soil type may be present on the site. Without undertaking detailed soil surveys, this assessment concludes that Black Box Woodland EEC occurs within the subject site and has the potential to be impacted by the Proposal.

As the ECC covers a large area, the Proposal would be unlikely to avoid affecting the community. An Assessment of Significance pursuant to the TSC Act has been undertaken (Appendix A). This assessment concluded that a significant impact to the local occurrence of the EEC is unlikely as the result of the Proposal.

## Myall Woodland

### NSW Endangered Ecological Community (EEC)

The Myall Woodland EEC listed under the NSW *Threatened Species Conservation Act 1995* includes intact and disturbed areas where Myall (*Acacia pendula*) is the dominant species. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland depending on site quality and disturbance history (DECCW 2010b).

Myall was present at the subject site as a small isolated patch (approximately 0.5ha) in the north-western section of the site adjacent to the northern boundary and as scattered patches in the eastern section of the site (Figure 4-2). As it was in a woodland formation and Myall was the only tree species in these areas they are considered to comprise the EEC. The area in the western section had a moderate diversity of native shrubs, and grasses in the understorey. Diagnostic understorey species were present (refer to Section 4.2). Areas in the east of the site generally exhibited a much lower diversity in the understorey.

The Proposal is to install parts of the PV array in areas containing Myall Woodland in the east of the site. The majority of Myall will be avoided and retained however, it is likely that a small number of scattered and isolated Myall trees will require removal to facilitate the PV array and as such result in a direct impact to the EEC. An Assessment of Significance pursuant to the TSC Act was undertaken (Appendix A) and concluded that a significant impact to the local occurrence of the EEC is unlikely as the result of the Proposal. The area in the western section of the site will be avoided by the Proposal and will not be impacted.

### Commonwealth Endangered Ecological Community (EEC)

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) sets more stringent criteria for the recognition of the Weeping Myall Woodlands Endangered Ecological Community (EEC) listed under that Act. Under the EPBC Act, Weeping Myall remnants belong to the EEC if:

- The tree canopy is dominated (at least 50% of trees present) by living dead or defoliated Weeping Myall (*Acacia pendula*) trees; and
- The overstorey must have at least 5% tree canopy cover or at least 25 dead or defoliated mature Weeping Myall trees/ha; and
- The area is at least 0.5 ha in size; and
- The patch has either:
  - more than two layers of regeneration of Weeping Myall present; or
  - the tallest layer of living, dead or defoliated Weeping Myall trees is at least 4m tall and of the vegetative cover present, 50% is comprised of native species.

Vegetation at the subject site would not meet these criteria and the Commonwealth Weeping Myall Woodlands EEC is therefore not present at the site.

#### 4.3.3 Biometric status

Under the NSW DECCW Biometric guidelines (DECC 2008a), 'red flag' areas are important for biodiversity conservation and cannot easily be replaced. They include:

- Over-cleared vegetation (>70%) in moderate to good condition
- EEC in moderate to good condition
- Threatened species records (where species cannot withstand further loss in the CMA).

Approval to impact red flag areas may be granted provided:

- All reasonable measures have been considered – to avoid adverse impacts on the red flag area or to retain the viability of the red flag area
- The contribution that the development site's impacted biodiversity values make to regional biodiversity values is low
- The development site's biodiversity values are low, or not viable
- If the development impacts on a vegetation type that has 10% or less remaining in the catchment management area, the area of land containing this highly cleared vegetation type is less than 4 ha in size (DECC 2008a).

According to the BioMetric Operations Manual (DECC 2008b) definitions for native vegetation in low condition are:

*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, treeless native pasture derived from an EEC and dominated by native grasses, and trees in woodland formation satisfying the overstorey percent foliage cover over exotic pasture, are considered 'moderate to good' Biometric condition and are red flag areas. However, it should be noted that:

*Only patches of vegetation >0.25ha are assessed separately (as distinct zones) from surrounding vegetation (e.g. a patch of vegetation with benchmark overstorey cover that is <0.25ha is not assessed separately from surrounding vegetation with sparser overstorey cover) (DECC 2008b).*

As such, small isolated patches of Black Box trees (>25% minimum per cent foliage cover) occurring in exotic pasture or crop land that don't meet the minimum patch size would be assessed as per the surrounding vegetation type. In the case of large areas of exotic pasture or crop, these small patches would be considered low condition and therefore, not a red flag area. Areas within native pasture or shrubland would be in moderate to good condition and constitute a red flag area.

#### 4.3.4 Threatened flora species

No threatened species were recorded during the field survey. The evaluation presented in Appendix D concludes that two threatened species have at least a moderate potential to be present in the better quality habitat at the subject site, and at least a moderate potential to be impacted by the Proposal. These species are listed in Table 4-3.

Table 4-3 Threatened flora potentially present at the subject site

| Species                                            | Status                 |
|----------------------------------------------------|------------------------|
| Red Darling-pea ( <i>Swainsona plagiotropis</i> )  | Vulnerable (TSC, EPBC) |
| Slender Darling-pea ( <i>Swainsona murrayana</i> ) | Vulnerable (TSC, EPBC) |

These two threatened species are perennial however, they may not have been conspicuous during the winter period. Despite the seasonal limitation of the survey, the majority of the native pasture of the subject site is considered unlikely to support these grazing-sensitive species. Areas of higher diversity which appear not to have been as intensively cultivated or grazed may support these species. A precautionary survey during spring (early November) would be required to confirm this assessment. Assessments of Significance pursuant to the TSC and EPBC Acts have been conducted for these species and concluded that the species are more likely to occur in better quality habitat at the site which based on the constraints assessment is being avoided by the proposal. As such, a significant impact is considered unlikely, however, the additional survey is still required to confirm this assessment.

#### 4.3.5 Regionally significant species

None of the nationally significant (ROTAP - Rare or Threatened Australian Plants) species listed by Briggs and Leigh (1995) were recorded during the survey. ROTAP species that are not listed under the TSC or EPBC Acts do not present a legislative constraint to the proposal and therefore will not be

specifically targeted during further spring follow-up survey work. However, it is possible that ROTAP species may be incidentally recorded during follow-up survey work and if detected, their avoidance would be recommended.

#### 4.4 DISTURBANCE AND WEEDS

The woodland vegetation has been cleared and thinned at the subject site to provide areas for cropping and pasture. Past clearing and agricultural use have produced a range of direct and indirect impacts to flora habitats, including removal of vegetation, altered microclimate, loss of pollinator and dispersal fauna, altered hydrological regimes and elevated soil nutrients. Evidence of erosion was identified at several dams within the subject site.

Agricultural activities have resulted in the majority of the site being planted with introduced crop species in the past. Currently a large area in the east of the site has been planted and the remainder is being grazed by cattle and sheep. The disturbance has led to the colonisation of a range of other introduced plant species. In areas not utilised for cropping, grazing is likely to have reduced or eliminated palatable native species, such as Kangaroo Grass (*Themeda australis*), terrestrial orchids, wattles and pea shrubs.

Minor pasture weed species were common across the majority of the study area. Two noxious weeds declared for the Bogan Shire Council Area under the *Noxious Weeds Act 1993* were recorded at the subject site. The status and distribution of these weeds at the site are summarised in Table 4-4. All of the recorded noxious weeds are listed as Class 4 weeds, meaning that the growth and spread of these plants must be controlled according to the measures specified in the management plan published by the local control authority (Bogan Shire Council).

Table 4-4 Noxious weeds at the subject site

| Weed species                                     | Status  | Abundance and distribution                                                        |
|--------------------------------------------------|---------|-----------------------------------------------------------------------------------|
| African boxthorn<br>* <i>Lycium ferocissimum</i> | Class 4 | Scattered individuals, particularly near trees in the western section of the site |
| Bathurst burr<br>* <i>Xanthium spinosum</i>      | Class 4 | Isolated individuals widespread across the site                                   |

## 5 FAUNA RESULTS

### 5.1 PRELIMINARY ASSESSMENTS

The Commonwealth EPBC Act Protected Matters search tool indicated five threatened terrestrial fauna species (including one fish) and 11 migratory species listed under the EPBC Act which are likely to occur in the search area (refer Appendix J). The DECCW threatened species database indicates the potential presence of 50 threatened species listed under the TSC Act in the in the Canbelego Downs and Bogan-Macquarie sub-catchments of the Central West CMA catchment.

The Threatened Species Evaluation presented in Appendix B concludes that 20 threatened fauna species have low-moderate potential to use habitat at the subject site. An additional four migratory species listed under the EPBC Act have potential to be present at the site. Of these, 15 threatened species have low-moderate potential to be impacted by the Proposal. These species include birds that forage in grassland and grassy woodland, hollow-dependent birds and microbats and small mammals using shrublands.

### 5.2 SURVEY RESULTS

A total of 64 species, including two amphibians, 51 birds, eight mammals and three reptile species were recorded during the survey. A complete species list (which also notes individuals identified adjacent to the subject site) is included in Appendix F.

Three species listed as Vulnerable under the TSC Act were detected on, or adjacent to, the subject site (refer to Section 5.4). These include:

- Superb Parrot (on subject site)
- Brown Treecreeper (on subject site)
- Grey-crowned Babbler (adjacent to subject site)

General survey areas described in the following sections are the same as those referred to in Section 4 and are displayed in Figure 4-1.

### 5.3 HABITAT RESULTS

#### 5.3.1 *Habitat types*

From the habitat assessments conducted across the subject site (see Appendix B) five major habitat types were identified on the subject site. In order of area occupied these were:

- Native /exotic pasture (with scattered Chenopod shrubs)
- Cultivated crops
- Derived Grassland/Myall Woodland
- Remnant woodland trees/stands
- Aquatic (small dams)

A further two habitat types were recorded adjacent to the subject site

- Black Box Woodland

- Aquatic (Large dam)

These habitat types are summarised in Table 5-1 below and selected habitat features recorded on the subject site are detailed in Figure 5-1. A list of hollow bearing trees and their location within the development envelope can be found in Appendix C.

Table 5-1 Fauna habitat summary

| Habitat type                                                  | Habitat quality | Habitat Assessment Numbers <sup>3</sup> | Location                                                                                                                                                                     | Habitat features                                                                                                                            | Potential threatened species <sup>4</sup>                                                                                                      |
|---------------------------------------------------------------|-----------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Native/exotic pasture(with shrubs)</b>                     | Low-Moderate    | 1, 7,11, 18                             | Predominantly native pasture in the western paddock (Area B1), exotic dominated paddocks in the central north (Area B5) and central east (Area B2) of the subject site       | Few trees (very few hollows), limited foraging and shelter habitat, no cracks, holes or burrows. Some timber piles in Area B1 (to be burnt) | Australian Bustard, Bush Stone-curlew, White-fronted Chat, Stripe-faced Dunnart, Kultarr                                                       |
| <b>Cultivated paddocks</b>                                    | Low             | 9, 12, 14, 20                           | Areas B3, B5 and a small section in the south west of Area B7                                                                                                                | Source of grain for parrots, cultivation, provides limited invertebrate foraging for insectivores and generalists                           | Superb Parrot, Pink Cockatoo, Australian Bustard, Bush Stone-curlew                                                                            |
| <b>Native pasture/Myall Woodland</b>                          | Low- Moderate   | 5, 15, 16                               | The eastern paddock -Area B7, and a small stand in the north of the eastern paddock , Area B1                                                                                | Seed resources and invertebrate foraging area<br>Cover for reptiles (this feature is likely to change with drought or increased grazing)    | Australian Bustard, Bush Stone-curlew,                                                                                                         |
| <b>Black Box/Bimble Box Woodland stands and remnant trees</b> | Moderate        | 2, 3, 4, 8, 10, 13, 17, 19, 21, 22, 25  | Isolated shade trees occur across the site, with the only significant stands occurring in the central area of B6. Larger stands occur adjacent to the subject site boundary. | Numerous hollows, foraging and shelter habitat, some fallen timber                                                                          | Diamond Firetail, Pink Cockatoo, Turquoise Parrot, Yellow-bellied Sheathtail-bat, Greater Long-eared Bat (south eastern form), Little Pied Bat |

<sup>3</sup> Refer to Appendix B.1<sup>4</sup> These are species that have been recorded in high quality examples of the habitat type, many have a very low probability of actually occurring on site

| Habitat type                                                         | Habitat quality | Habitat Assessment Numbers <sup>3</sup> | Location                                                                                                                                                                                                                           | Habitat features                                                                                                                         | Potential threatened species <sup>4</sup> |
|----------------------------------------------------------------------|-----------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| <b>Modified aquatic habitats (dams and ephemeral drainage lines)</b> | Low             | 6, 10, 26                               | Few aquatic habitats were found within subject site. Dams were located in the western paddock Area B1 and the eastern paddock Area B4. Also a larger dam offsite adjacent to the north western corner of the development envelope. | Limited breeding opportunities for amphibians, ephemeral water source for fauna.<br>Cumbungi fringing vegetation, open water, deep water | Australasian Bittern                      |

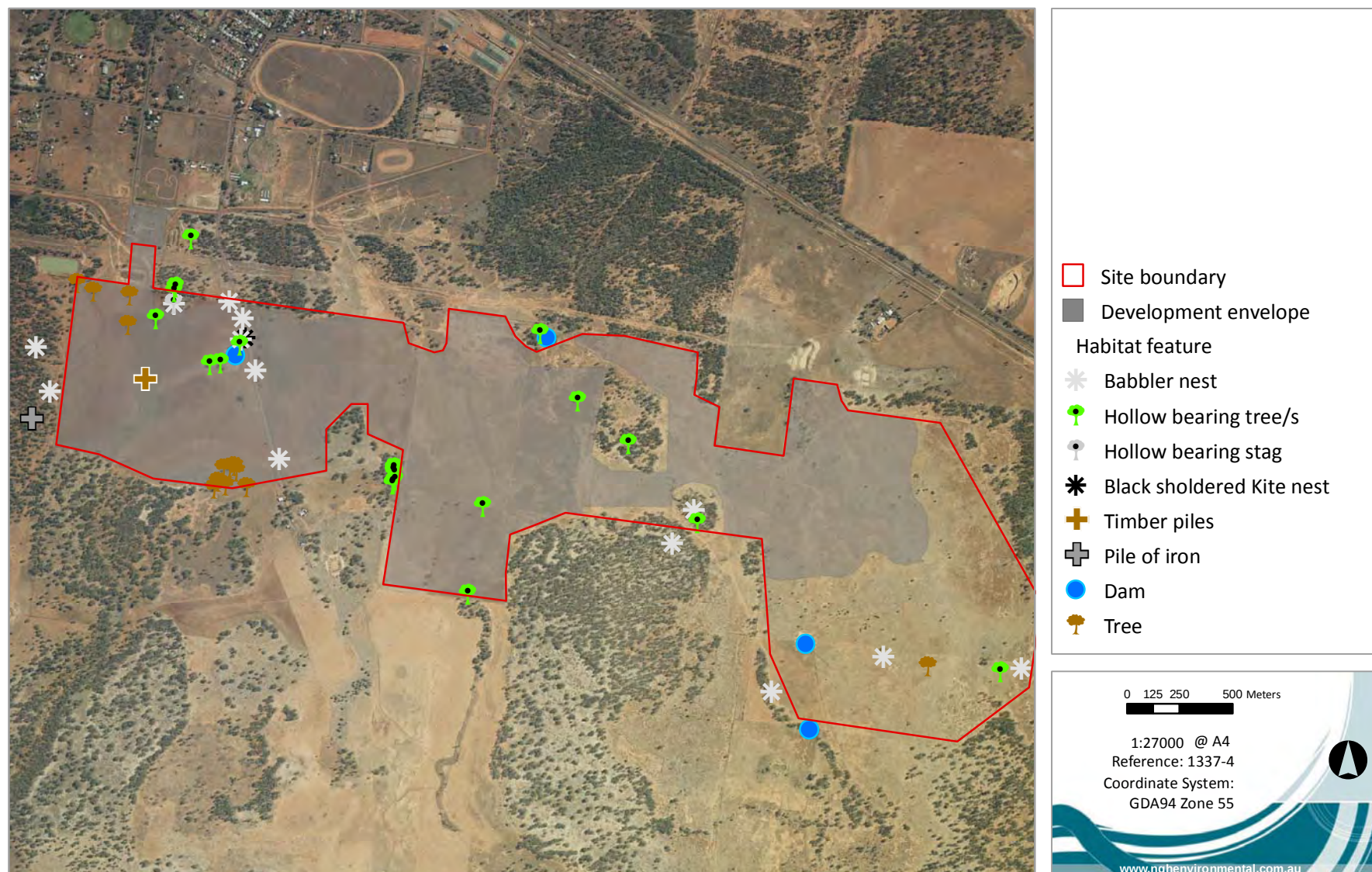


Figure 5-1 Fauna habitat features and development envelope at the subject site

## 5.4 SPECIES OF CONSERVATION SIGNIFICANCE

### 5.4.1 Threatened species

Three threatened fauna species were recorded during the survey (mapped on Figure 5-3 and discussed below).

- **Brown Treecreepers** were recorded in a remnant Black Box stand within the central northern boundary of the subject site. A family of five birds was observed and two roost trees were located. A Brown Treecreeper, possibly one of the birds observed offsite, was heard in the largest remnant Black Box stand towards the centre of the central section of the site. It is likely that this remnant provides important foraging resources and enables movement for this and other species between the larger areas of native vegetation to the north and south of the subject site.
- Two pairs of **Superb Parrots** were seen flying over the centre of the site. The site is likely to be used for foraging for this species but breeding is unlikely as the core Superb Parrot breeding zone lies over 200km to the south of the site (see Figure 5-2) (Birds Australia 2009, DEWHA 2010, Manning and Lindenmayer, 2009).
- Two family groups of **Grey-crowned Babblers** were recorded in the adjacent woodland south of the subject site. One of these groups had a roost tree located within 150m of the site boundary and would be likely to forage within the woodland stands in the central area of the site from time to time. Competition for woodland habitat is likely to exist between Grey-crowned Babblers and local Chestnut-crowned Babblers. Family groups of Chestnut-crowned Babblers, numbering up to 18 individuals, were recorded in four locations within and adjacent to the subject site. Babbler nests were recorded across the site however, it is likely that the bulk of these were disused based on the exposed position of the nests and lack of birds foraging in the area. These nests, often in isolated trees, are likely to have belonged to Chestnut-crowned Babblers which were recorded in more exposed and modified habitat than the Grey-crowned Babblers in the area.

Based on the Threatened Species Evaluation undertaken in Appendix D, the site represents potential habitat for 15 threatened fauna species with at least a low-moderate potential to be impacted by the proposed development. Assessments of Significance have been undertaken for these species (provided in full, Appendix A).

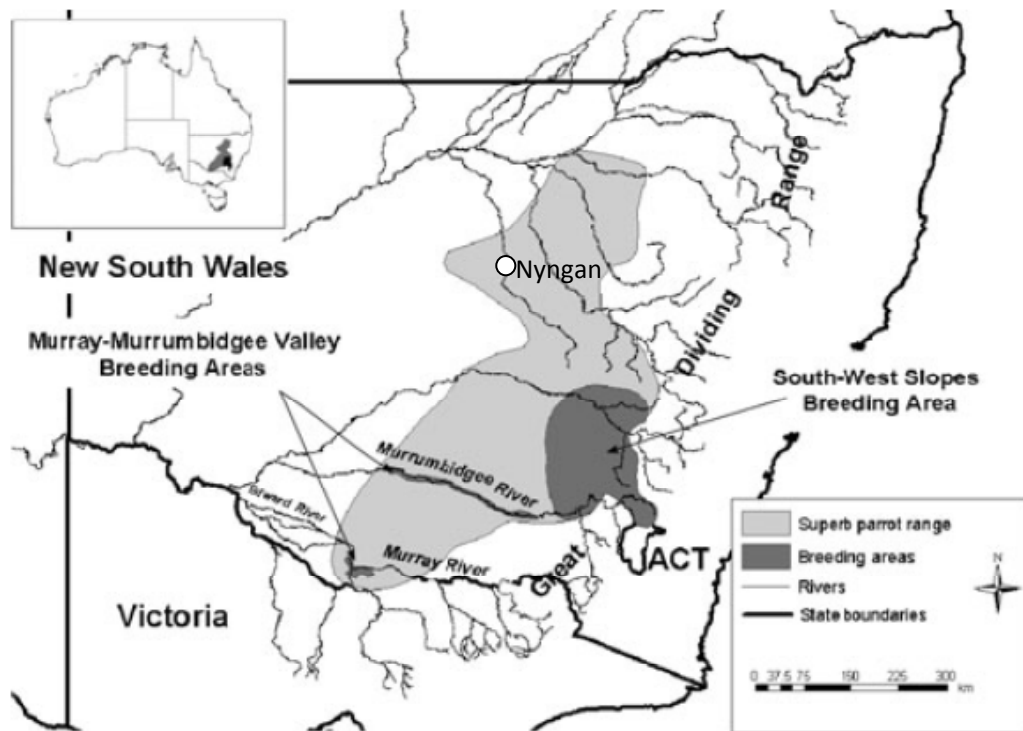


Figure 5-2 Approximate range and key breeding areas of the Superb Parrot (adapted from Manning and Lindenmayer 2009)

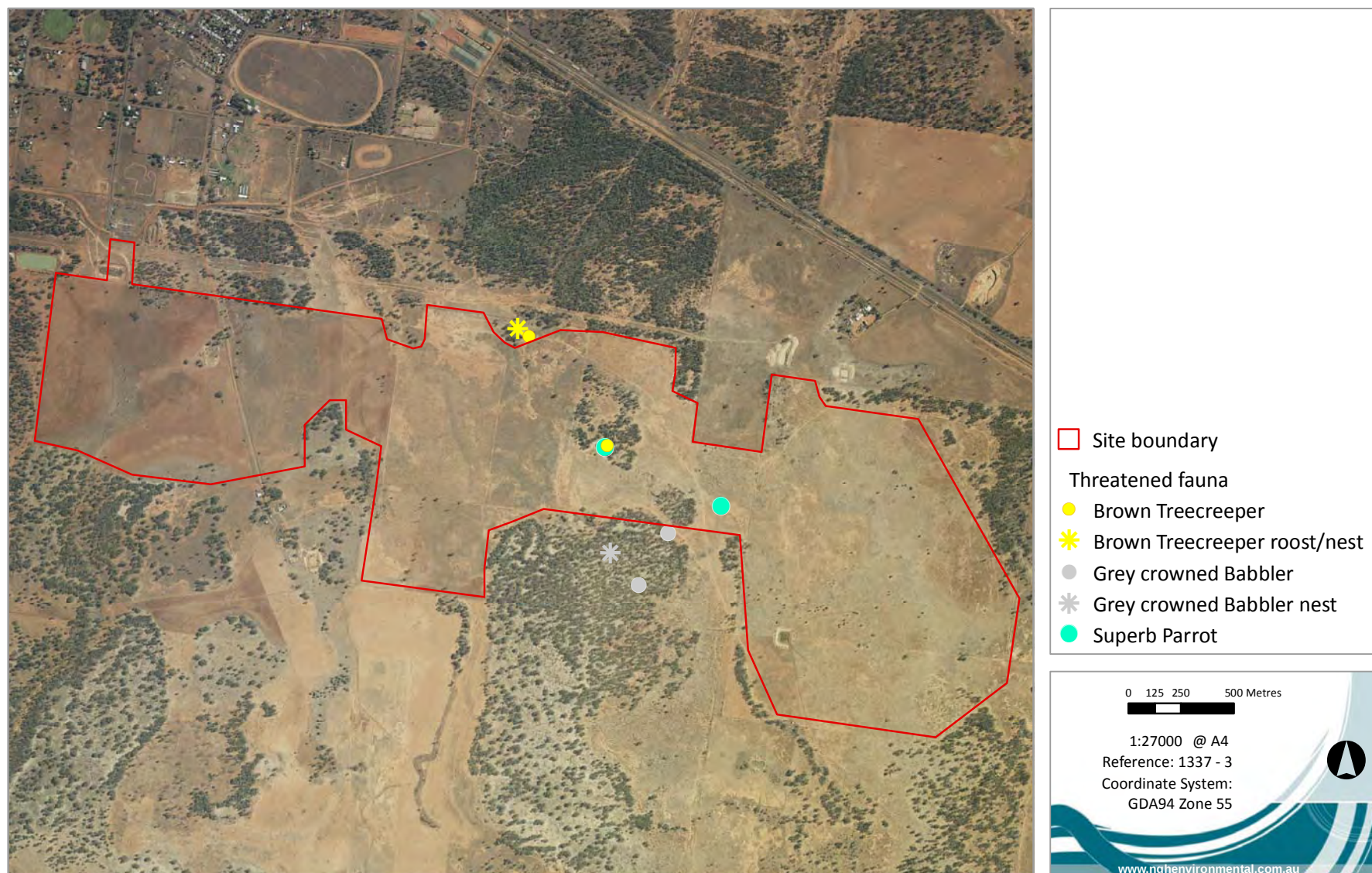


Figure 5-3 Threatened fauna survey results

### 5.4.2 Migratory species

No migratory species listed under the EPBC Act were recorded during the survey, however species such as the White-throated Needletail, Cattle Egret and Rainbow Bee-eater are likely to be occasional visitors to the site. The Proposal would not significantly impact foraging or breeding habitat for any migratory species given the characteristics of the agricultural habitat to be impacted and the extent of this habitat in the district.

### 5.4.3 SEPP 44 Koala Habitat

NSW State Environmental Planning Policy 44 – Koala Habitat Protection 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.

Using these definitions, the site would not be considered potential Koala Habitat as Bimble Box (listed in Schedule 2 of SEPP 44) constitutes >15% of the total number of trees on site.

The recovery plan for the Koala (*Phascolarctos cinereus*) (DECC 2008) lists both Black Box and Bimble Box as secondary feed tree species for Koalas in the Western slopes and plains Koala management area. Using the methodology of Phillips (2000) described in DECC (2008) the site would constitute Secondary Habitat Class B as primary food trees are absent and the habitat is comprised of secondary feed species only.

As the site is extensively cleared and is surrounded by woodland it is unlikely that Koalas would utilise areas within the development envelope. The nearest records of Koalas (two) to the subject site are historic records from around Warren 70km to the east. Considering the lack of local records, low quality of habitat within the subject site and dispersal and foraging opportunities adjacent to the subject site the Proposal is considered very unlikely to impact a local Koala population.

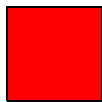
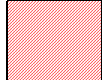
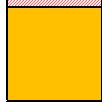
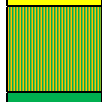
## 6 BIODIVERSITY CONSTRAINTS ANALYSIS

### 6.1 METHODS

#### 6.1.1 Approach and methods

An environmental constraint, for the purposes of the analysis, is an environmental condition that reduces the capability of a site to accommodate the specific development proposed. The identification and mapping of biodiversity constraints provides a visual guide to the significance of potential impacts to biodiversity values in different parts of the site. It is a tool to aid the transparent planning and design of the solar farm project, and provides a wider local context for the impact assessment. Refer to Appendix H for a map of the biodiversity constraints identified on site overlaid with the final development envelope.

Biodiversity values at the site have been identified in Table 6-1, against the assessed degree of constraint imposed on the development.

|                                                                                     |                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | High constraint – direct and indirect impacts need to be avoided in these areas                                                                                                      |
|   | High constraint with the potential for microsining infrastructure with input from an ecologist – there is potential to carefully manage a small amount of direct and indirect impact |
|  | Further survey is needed to accurately determine the level of constraint                                                                                                             |
|  | Moderate constraint – direct and indirect impacts can be managed in these areas with relatively standard mitigation strategies                                                       |
|  | Further survey is needed to accurately determine the level of constraint, however the constraint is predicted to be low                                                              |
|  | Low constraint – the most appropriate areas to develop, direct and indirect impacts can be managed in these areas with relatively standard mitigation strategies                     |

Biodiversity values associated with higher constraint levels are generally more significant and difficult to replace or offset. The avoidance or mitigation of impacts to these features was considered in the planning stage of this project.

### 6.2 DEFINITION AND MAPPING OF CONSTRAINT CLASSES

Key biodiversity features which constrain development of the proposed Nyngan Solar Farm are indicated in Table 6-1, with corresponding constraint levels. The identified constraint levels are specific to the types of impacts expected to be required to construct the solar farm<sup>5</sup>. The constraint classes are mapped on Figure 6-1.

<sup>5</sup> Based on information supplied by Infigen as of 23 July, 2010.

Table 6-1 Biodiversity features and constraint levels at the proposed Nyngan Solar Farm site.

| Biodiversity feature                                                                                                                                                                                                                                                      | Location description                                                        | Area            | Constraint level                                                                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------|
| Remnant Bimble Box and Black Box stands <ul style="list-style-type: none"> <li>Nesting, roosting and foraging resource for threatened birds</li> <li>Potential threatened microbat roost sites</li> <li>EEC</li> <li>Fauna movement corridors</li> </ul>                  | Western and central sections of the subject site and east of the substation | B1, B4, B6      | High                                                                                                |
| Myall Woodland <ul style="list-style-type: none"> <li>Myall Woodland EEC</li> <li>Potential habitat for Bush Stone-curlew</li> </ul>                                                                                                                                      | Eastern section of the subject site                                         | B7              | High                                                                                                |
| Hollow bearing Bimble Box and Black Box Remnant trees <ul style="list-style-type: none"> <li>Coolibah-Black Box Woodland EEC</li> <li>Nesting resource for threatened parrots</li> <li>Roost habitat for threatened microbats</li> </ul>                                  | Scattered across the site as shade trees                                    | B1, B5          | Further survey required in the form of pre clearance survey (Potential moderate to high constraint) |
| Bimble Box and Black Box Remnant trees (non hollow bearing) <ul style="list-style-type: none"> <li>Coolibah-Black Box Woodland EEC</li> <li>General foraging resource for many species</li> <li>Provide structure to facilitate fauna movement across the site</li> </ul> | Scattered across the site as shade trees                                    | All of the site | Moderate                                                                                            |
| Native pasture (moderate diversity): <ul style="list-style-type: none"> <li>Derived from Coolibah-Black Box Woodland</li> <li>Potential (limited) threatened species foraging resource</li> <li>Potential threatened flora habitat</li> </ul>                             | Central and western areas of the subject site                               | B1, B2, B4, B6  | Moderate                                                                                            |
| Native pasture (moderate diversity): <ul style="list-style-type: none"> <li>Potential threatened flora habitat</li> <li>Potential threatened fauna habitat</li> </ul>                                                                                                     | Eastern section of the subject site                                         | B7              | Further survey required (Potential low constraint)                                                  |
| Small dam/flood mitigation pond <ul style="list-style-type: none"> <li>Reeds provide limited cover for threatened species (low probability) pre clearance check advised</li> </ul>                                                                                        | Between site and substation                                                 |                 | Further survey required (Potential low constraint)                                                  |
| Cropped paddocks <ul style="list-style-type: none"> <li>Potential (limited) threatened species foraging resource</li> </ul>                                                                                                                                               | Central paddock and small section of eastern paddock                        | B3, B7 south    | Low                                                                                                 |

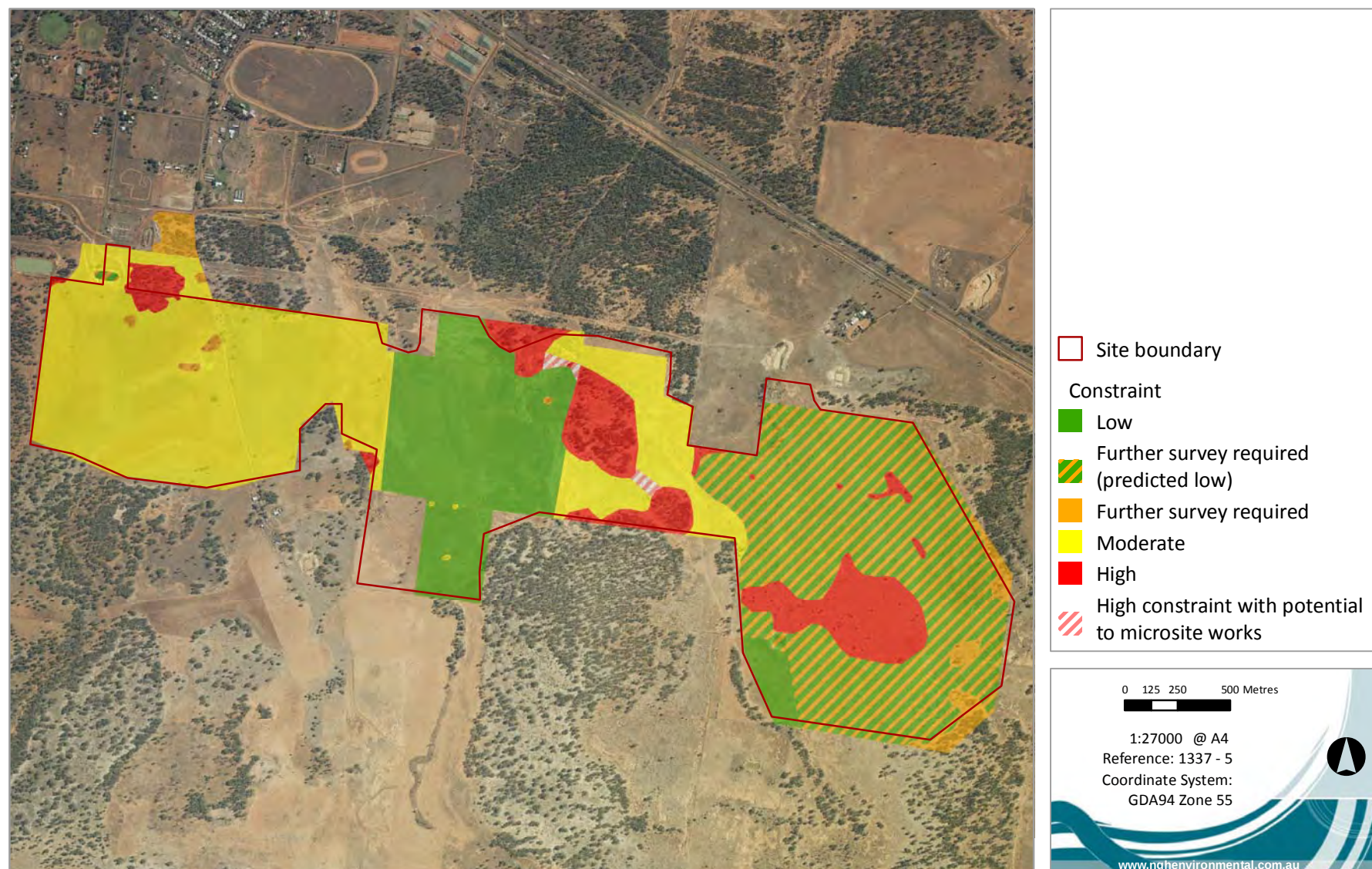


Figure 6-1 Biodiversity constraint classes at the proposed Nyngan Solar Farm site