1.1 Biodiversity

A biodiversity assessment was undertaken by Ecolink and EnviroKey to identify ecological constraints for the project and is detailed in the BDAR provided in Appendix B. This section provides a summary of the BDAR and discusses the potential impacts of the project on biodiversity.

1.1.1 Methodology

The SEARs require that an assessment of the likely biodiversity impacts of the development be conducted, having regard to the BC Act, BC Regulation, Biodiversity Assessment Method (OEH 2017a) and the Threatened Species Assessment Guidelines - Assessment of Significance (DoECC 2007).

The SEARs provide a list of some of the environmental planning instruments, guidelines, policies, and plans that may be relevant to the biodiversity assessment for this development. Other policies and plans relevant to this biodiversity assessment include:

- SEPP No. 44 – Koala Habitat Protection
- Narrandera LEP 2013

The Biodiversity Assessment Method (BAM) comprises three stages that set out the biodiversity assessment requirements and offset practices for major projects (OEH 2017a), which are as follows:

- **Stage 1** – Biodiversity assessment requirements and survey methods that must be undertaken by an applicant to identify, map and describe the native plant community types (PCTs), threatened species and threatened species' habitat on the development site and an offset site.
- **Stage 2** – Impact assessment requirements for demonstrating how any impacts on biodiversity values have been avoided and minimised at the planning, construction and operational phases of the development.

  Stage 2 measures the loss to biodiversity caused by the remaining direct and indirect impacts of the development. The assessments quantify the loss and gain in biodiversity values through the determination of biodiversity credits. The loss of biodiversity values caused by the project is expressed as a biodiversity credit requirement (i.e. the number and type of biodiversity credits that would be required to offset the impact of development).

  Both Stage 1 and Stage 2 are documented in the BDAR provided in Appendix B.
- **Stage 3** – An assessment of the management requirements at a biodiversity stewardship site, where offsets for impacts to biodiversity values can be managed to achieve an improvement of biodiversity values within the state. Stage 3 is typically undertaken after submission of the BDAR.

Assessment area

Preliminary biodiversity assessments undertaken as part of scoping works for the project investigated four properties in the Sandigo area (Ecolink 2017). These assessments provided the applicant with a broad overview of ecological constraints of the properties. As a result of these assessments, the applicant refined the proposed development site to the current property at 174 Mitchells Road, Sandigo. The proposed area of impact has further been refined, on the basis of the preliminary biodiversity assessment, to avoid key ecological values within this property. This approach is consistent with the applicant's commitment to avoid and minimise biodiversity impacts and is in line with purpose of the Biodiversity Offsets Scheme provided in the BC Regulation.

The biodiversity assessment undertaken for the purpose of preparing the BDAR assessed the 231 ha development site as part of a broader survey within a larger 608 ha area that is managed by the

same landholder, extending south of Kywong Faithfull Road. The areas surveyed outside the 231 ha development site will not be impacted by the proposed development. The road reserves of Mitchells Road and Kywong Faithfull Road, as well as the proposed site access along Kywong Boree Creek Road, to the east of the development site, have been included in the assessment.

Desktop assessment

The potential ecological constraints within the development site were identified based on a desktop assessment of the following information sources:

- Department of Environment Protected Matters Search Tool, to identify Matters of National Environmental Significance (MNES) under the EPBC Act
- existing threatened species listings under the BC Act, FM Act and EPBC Act
- existing records of threatened species observations in the development site, as recorded in the Threatened Species Database in the Atlas of NSW Wildlife (OEH 2017b) and BioNet Atlas (OEH 2017c).

Site assessment

A site assessment was undertaken between 27 November and 1 December 2017, by two ecologists from Ecolink under the guidance and supervision of Steven Sass from EnviroKey (Biodiversity Accreditor Assessor BAAS17047). The entire development site was walked and/or driven to assess the location and quality of habitats that were present. Areas adjacent to the development site that contained higher ecological values than the development site were also assessed as reference areas to the pre-impact conditions of the site.

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

Plot surveys

A total of 30 plots were assessed during the site assessment to confirm PCTs in the development site and areas immediately adjacent. Data collected from seven of these plots (as detailed in the BDAR in Appendix B) were used in accordance with the data requirements of the BAM Credit Calculator (used to calculate offsets required) to assess site values within the development site. The remainder of the plots have been used to determine PCT classification and as reference data to determine vegetation quality.

Identifying patches of native vegetation

Although most of the vegetation within the development site is non-native, scattered trees within the paddocks were classified as extant examples of historic PCTs within the landscape. However, these trees meet the definition of a Paddock Tree, as described below, and therefore plot assessments were not required to identify the quality and character of the vegetation. Nonetheless, a polygon of 10 m was created around each tree within the development site, which was conservatively deemed a patch of native vegetation for the purposes of understanding the nature and quality of native vegetation within the development site.

Paddock tree assessment

An assessment of all paddock trees within the development site was undertaken. Under the BAM, these trees meet the definition of a paddock tree because foliage cover for the tree growth form is

not within 25% of the benchmark for the PCT most likely to occur (i.e. PCT 76) across the entire development site.

Threatened species surveys

All threatened species surveys were undertaken from 17 to 19 October, and 27 November to 1 December 2017. Nocturnal surveys could not be undertaken on 27 November due to storms over the development site, so were undertaken from 28 to 30 November. The location of targeted threatened species is shown in Section 10.1 of the BDAR.

1.1.2 Existing conditions

Site condition

The land parcels that comprise the development site are a mixture of grazed and cropped paddocks with houses and supporting infrastructure (e.g. driveways, silos and sheds). Crops within the development site include Wheat *Triticum aestivum*, Barley *Hordeum* spp. and Canola *Brassica napus*. All three of these crops are grown in rotation, interspersed with years in which the paddocks are sowed with Rye-grass *Lolium spp.,* Lucerne *Medicago sativa* subsp. *sativa* or other crops that are nitrogen fixing, return nutrients to the soil, and are also suitable for grazing. In those years, sheep graze the paddocks keeping the biomass low.

Native vegetation is largely absent from the development site, with scattered paddock trees the most obvious remnants of the historic vegetation communities that once covered the area. Despite this, some areas of native vegetation remain around the edges of the site and in the road reserves that adjoin it. Most of this vegetation consists of an overstorey of White Cypress Pine *Callitris columellaris*, Western Grey Box *Eucalyptus microcarpa*, and Buloke *Allocasuarina luehmannii* (in descending order of dominance), over a highly modified and predominantly exotic understorey. The mid-storey is largely absent, and recruitment is limited or excluded by regular grazing, and ongoing soil disturbances from cultivation and cropping.

There are three dams within the development site which generally appear to have been lined with clay and this, in combination with regular grazing by sheep, has resulted in the absence of fringing or aquatic native vegetation. There are no creeks or constructed drains within the development site, only ephemeral waterways as discussed in Section 8.4, and no natural wetlands or swamps were observed during the biodiversity assessment. North of the development site and the Sturt Highway, Sandy Creek, a tributary to the Murrumbidgee River, is located (see Photo 2.3). The vegetation in this area changes from that typical of plains to riparian in nature, with River Red-gums *Eucalyptus camaldulensis* becoming the dominant species, replacing the Grey Box and White Cypress Pine trees. There is not expected to be any impact to this vegetation.

The land-use within the development site is similar to that surrounding it (i.e. cropping and grazing). These surrounding properties generally support very little native vegetation, apart from scattered paddock trees and vegetation within road reserves or fringing the boundaries of the property. Properties to the south and west of the development site are owned by the same landholder and form part of the crop rotation system employed within the development site.

Landscape features

For all analyses of landscape features within the BDAR, a 1.5 km (1,912 ha) assessment circle around the development site was used in accordance with the BAM (OEH 2017a), using GIS layers and aerial imagery.

Bioregions, sub-regions and Mitchell landscape regions

The development site and assessment circle occur wholly within the South Western Slopes Bioregion, which lies in the foothills and isolated ranges comprising the lower inland slopes of the Great Dividing Range, extending into western Victoria. The bioregion extends from Albury in the south to Dunedoo in the northeast. Within its boundaries lie the towns of Wagga Wagga, Mudgee, Cootamundra, Narrandera, Parkes, Gundagai and Young. The bioregion also includes parts of the Murray, Murrumbidgee, Lachlan and Macquarie river catchments.

The development site and assessment circle also occur wholly within the Lower Slopes Subregion (NSS02), which comprises of undulating and hilly ranges and isolated peaks set in wide valleys at the apices of the Riverina alluvial fans. Vegetation in this subregion consists of: Dwyer's Gum *Eucalyptus dwyeri* on granite, Red Ironbark *Eucalyptus sideroxylon* on sedimentary rocks; Hill Red Gum *Eucalyptus dealbata*, White Cypress Pine and Red Stringybark *Eucalyptus macrorhyncha* in the ranges; Grey Box woodlands with Yellow Box *Eucalyptus melliodora*, White Cypress Pine and Belah *Casuarina cristata* on lower areas.

Three Mitchell Landscapes occur within the 1.5 km assessment circle: the Lockhart Hills and Footslopes; the Murrumbidgee – Tarcutta Channels and Floodplains; and the Murrumbidgee – Tarcutta Source-bordering Dunes. The development site straddles each of these landscapes, with 87% of the site located in Lockhart Hills and Footslopes which consists of isolated steep rocky ridges and crests with wide foot slopes.

Native vegetation and cleared areas in the landscape

Regional mapping identified 225.55 ha of native vegetation within the assessment circle. Site surveys within the development site, and more broadly from publically accessible areas within the assessment circle, confirmed the location and character of this vegetation. Ten PCTs were identified within the assessment circle with the remainder being cleared land or non-native vegetation that is predominantly used for cropping and grazing (see Figure 1.1). Detailed descriptions of these PCTs are provided in the BDAR (Appendix B). Scattered paddock trees also occur within the assessment circle and are isolated by more than 50 m from the nearest patch of vegetation

Small patches of native vegetation and scattered trees within the development site are discussed in detail below.

Rivers, streams and wetlands

Sandy Creek is located within the assessment circle, approximately 500 m north of the development site. There are no rivers or streams within the development site.

No important local wetlands, national wetlands (i.e. as listed in The Directory of Important Wetlands of Australia (Environment Australia 2001)) or international wetlands (e.g. Ramsar listed) are located in the vicinity of the development site.

Connectivity

Vegetation along the road reserve of Mitchells Road to the south of the development site provides some connectivity to longer habitat corridors associated with riparian vegetation along Sandy Creek, north of the development site, as well as roadside vegetation along Sturt Highway. Strips of vegetation along the eastern boundary of the development site also provide connections to these areas of vegetation. This vegetation will not be directly impacted by the project, as the development site avoids these areas.

Scattered paddock trees on the development site provide stepping stone habitat between larger blocks of native vegetation at Buckinbong and Gillenbah (approximately 16 km west and 24 km northwest of the development site, respectively).

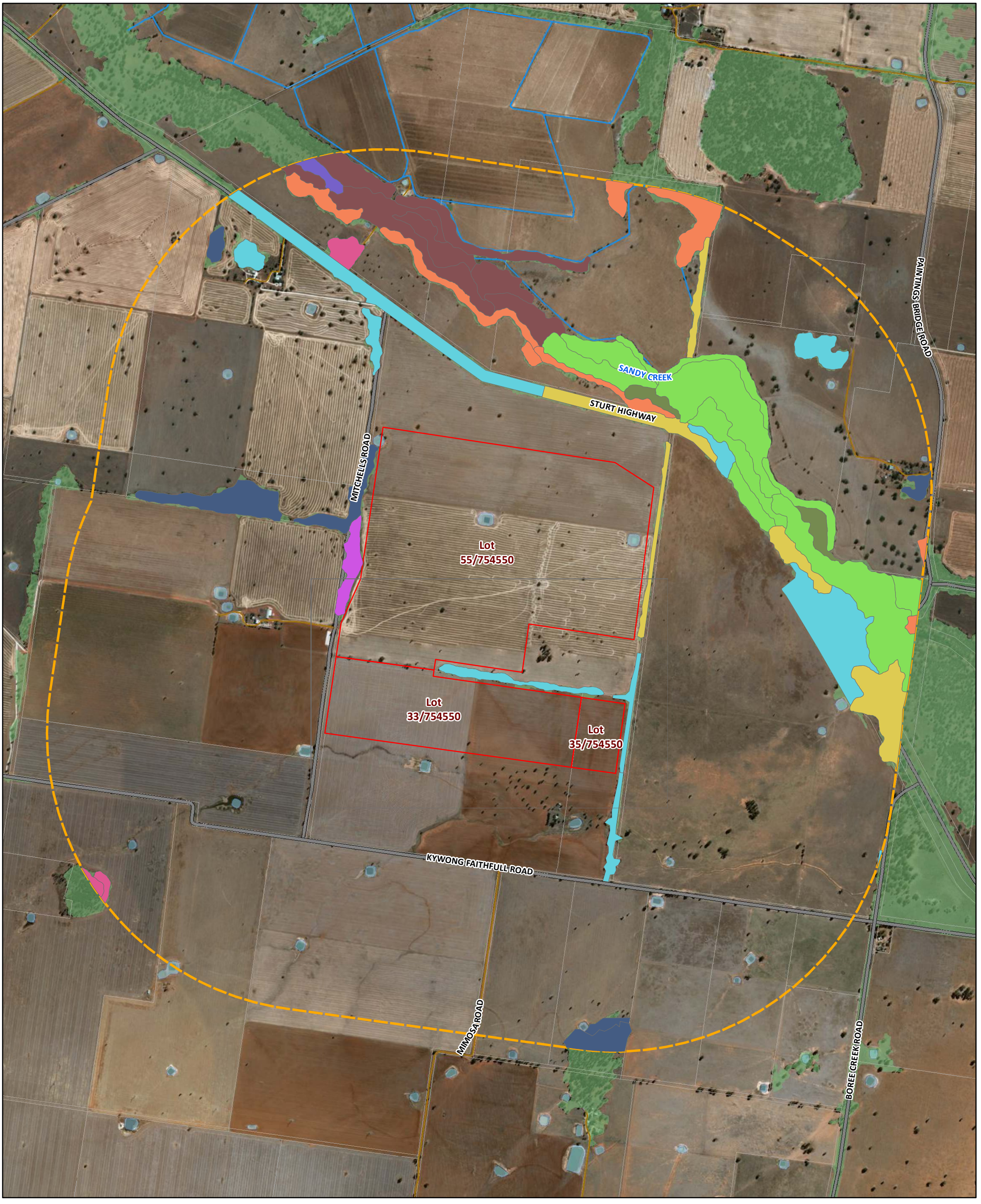

Figure 1.1: Native vegetation within the assessment circle

Legend

- Study Area
- 1500m Study Area Buffer
- Habitat Corridors

PCT Name

- Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina and Murray Darling Depression Bioregions)
- Native grassland complex
- River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion
- River Red Gum herbaceous-grassy very tall open forest on inner floodplains in the lower slopes subregion of the NSW SWS & Riverina Bioregion
- Riverine Western Grey Box grassy woodland of the semi-arid (warm) climate zone
- Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes and Riverina Bioregions
- Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions
- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone
- White Cypress Pine woodland on sandy loams in central NSW wheatbelt
- Yellow Box - River Red Gum tall grassy riverine woodland of NSW South West Slopes and Riverina Bioregions

0 200 400 600 800 Meters

1:17,988

Three threatened fauna species have been identified within the development site and /or immediate vicinity: Superb Parrot *Polytelis swainsonii*; Grey-crowned Babbler *Pomatostomus temporalis temporalis* and White-fronted Chat *Epthianura albifrons*. Each of these three species may use the remnant vegetation to facilitate movement within the landscape for feeding or juvenile dispersal.

Native vegetation within the development site

All areas within the development site are regionally mapped as non-native. Native vegetation within the development site is limited to small patches of remnant vegetation and scattered native trees. An assessment of the benchmarks for four PCTs most likely to have occurred pre-clearing was undertaken, based on their extant proximity to the development site, against the remaining native vegetation observed within the development site.

Of the four PCTs, PCT 76 is the most similar to vegetation present on the development site, based on limited floristic data, soil profile and landform. Eleven native plant species were recorded in the surveys undertaken for the BDAR, including seven species listed as either understorey or overstorey species for PCT 76. The vegetation is located within the floodplain of Sandy Creek, which meets the landform characteristics of this PCT.

PCT 76 is the endangered Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt Bioregions community which is listed under the BC Act, but does not qualify as the nationally significant Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia community. Species identified on the development site as belonging to PCT 76 include Western Grey Box *Eucalyptus macrocarpa* and White Cypress Pine *Callitris glaucophylla* in the upper stratum and Sprawling Bluebell *Wahlenbergia gracilis*, Corrugated Sida *Sida corrugata,* Rough Spear-grass *Austrostipa scabra* subsp. *falcata*, Plains Grass *Austrostipa aristiglumis, and* Windmill Grass *Chloris truncate* in the ground stratum.

To address the SEARs, the potential presence of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes Bioregions was considered. However, it is considered unlikely to occur on the development site based off plot/transect surveys.

The benchmark data for PCT 76 was therefore used to assess the paddock tree data for the development site.

Vegetation zones

Vegetation zones identified within the development site are summarised in Table 1.1 and shown in Figure 1.2. The land use was accurate at the time the assessment. However, all paddocks within the development site are on a five-year cycle of cropping and grazing (year 1: wheat; year 2: barley; year 3 canola; years 4 and 5 grazed by sheep).

Table 1.1 Vegetation zones within the development site

Zone	Name and description	Total area (ha)
1	Cleared Land – dominated by crops of wheat, barley and canola, and exotic pasture grasses such as Perennial Rye-grass and Lucerne; weeds such as Common Sowthistle *Sonchus oleraceus,* Prickly Lettuce *Lactuca serriola* and the high-threat weed African Lovegrass *Eragrostis curvula.* See Photo 1.1.	228.99
2	PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions (low condition). See Photo 1.2.	1.63
	Total	**230.62**

Figure 1.2: Vegetation Zones within the development site, scattered paddock trees and location of Plot surveys

Legend

- Study Area
- Native Vegetation
- Dams

Vegetation Zones

- Zone 1 - Cropped and grazed

- Plot Surveys

Paddock Trees

- Not impacted
- Class 2
- Class 3

0 200 400 600 800 Meters

1:13,261

Photo 1.1 Transects in Zone 1 (looking southwest and northeast)

Photo 1.2 Transects in Zone 2 (looking south and north)

Hollows were recorded in 15 of the remnant trees, and stick nests were recorded in 12 trees (five Corvid, four old roosting nests of a Grey-crowned Babbler and two unidentified small, stick nests). All of the nests were empty at the time of the assessment.

Threatened species potentially present

Approximately 18 (nine fauna and nine flora) threatened species (under the BC Act) were identified by the BAM Calculator as potentially occurring on the development site. Targeted surveys were undertaken for each of these species to identify species presence or potential presence based on habitat. The Superb Parrot was identified in the trees along Mitchells Road during the field survey, immediately adjacent to the development site to the west, however no other fauna was identified. No threatened flora species were identified as occurring or potentially occurring on the development site.

Surveys for the Sloane's Froglet *Crinia sloanei* were not undertaken as there were no suitable locations for the surveys to be undertaken (as it is associated with periodically inundated areas) and the timing of the biodiversity assessment was outside the recommended survey period to detect this

species. Therefore, in terms of approvals and offsetting, it has been assumed that Sloane's Froglet is present within the development site.

Other species identified as present or potentially present, which were not identified by the BAM Calculator but considered by the preliminary biodiversity assessment (Ecolink 2017) to have potential habitat, were the Grey-crowned Babbler, for which roosting nests were identified on the development site, and White-fronted Chat, for which individuals were observed immediately adjacent to the development site. Targeted surveys of the Plains Wanderer *Pedionomus torquatus* were also undertaken to address the SEARs, but no individuals or core habitat was identified within the development site. Further information on the Plains Wanderer, including a map showing important Plains Wanderer habitat in the region, is provided in the BDAR.

Other species identified as present or potentially present, which were not identified by the BAM Calculator but considered by the preliminary biodiversity assessment (Ecolink 2017) to have potential habitat, were the Grey-crowned Babbler, for which roosting nests were identified on the development site, and White-fronted Chat, for which individuals were observed immediately adjacent to the development site. Targeted surveys for the Plains Wanderer *Pedionomus torquatus* were also undertaken to address the SEARs, but no individuals or core habitat was identified within the development site. Further information on the Plains Wanderer, including a map showing important Plains Wanderer habitat in the region, is provided in the BDAR.

Targeted searches within the development site were undertaken within, and underneath, trees to look for evidence of occupation by Koalas *Phascolarctos cinereus.* No evidence was found and it is concluded that Koalas do not occur within the development site.

The EPBC Act Protected Matters Search Tool identified 29 threatened species, 10 listed migratory species (some of which are also threatened species), four threatened ecological communities and four Wetlands of International Importance (Ramsar wetlands) that are either known, or have the potential to occur, within a 10 km radius of the development site. Of these 39 species, only five have at least a moderate likelihood of occurrence within the development site, with none having been previously recorded within the site, However, one of these species, Superb Parrot, was recorded along Mitchells road adjacent to the development site, as discussed above. Two migratory bird species, Fork-tailed Swift *Apus pacificus* and White-throated Needletail *Hirundapus caudacutus,* are also likely to occur within the boundary of the development site on occasion. However, the development site does not provide important or limiting habitat for these species and is therefore unlikely to have any significant impacts to any of the species identified using the search tool.

1.1.3 Impact assessment

The proposed development of the project may result in both direct and indirect impacts on biodiversity. The direct impacts of the project are expected to comprise:

- removal of 54 paddock trees (PCT 76) within the development site
- removal of up to 15 hollow-bearing trees (included within the 54 trees mentioned above)

The potential indirect impacts of the project on biodiversity may include:

- introduction and spread of weeds due to import of construction vehicles and materials
- potential impact of inappropriate species being used in site rehabilitation and landscaping
- erosion of disturbed areas leading to sedimentation affecting any downgradient habitat
- water quality impacts (e.g. increased turbidity and suspended solids) affecting any downgradient habitat
- short-term disturbance of fauna during construction due to noise generated by vehicles, equipment and construction activities

- possible installation of barbed wire fencing, which could harm birds and bats.

Based on the targeted threatened species surveys for 'candidate threatened species' identified by the BAM calculator, up to four threatened fauna species may be impacted by the proposed development:

- Superb Parrot (also EPBC Act listed)
- Sloane's Froglet (presumed present to expedite the approvals process, despite lack of habitat)
- Grey-crowned Babbler
- White-fronted Chat.

However, none of these species are likely to be significantly impacted as a result of the project, as discussed in Section 1.1.2 above, and therefore a referral to the Environment Minister under the EPBC Act will not be made by the applicant.

The offsets required for potential impacts to paddock trees, classified as historically being a part of the threatened PCT 76 community and the threatened fauna species were calculated in accordance with Section 10 of the BAM and are outlined in Section 1.1.4 below.

1.1.4 Management and mitigation

The applicant has sought to reduce impacts on biodiversity values within the development site by avoiding and minimising the removal of native vegetation and disturbance of fauna habitat. The development site has been selected in part due to its high level of disturbance from a long history of primary production and its distance from areas of high environmental sensitivity. However, to mitigate residual impacts after initial avoidance and minimisation has been implemented, a number of management measures are proposed.

Site Selection and Planning

Site access for construction and operation will be from the south via Kywong Boree Creek Road, Kywong Faithfull Road, and then north along Mitchells Road, where the road reserve is of low ecological value, to minimise vegetation removal and the risk of impacts to threatened fauna species.

Offsetting strategy

Approximately 41.25 ecosystem credit offsets are required for the removal of 54 paddock trees (up to 1.63 ha of PCT 76), including 15 hollow bearing trees. This offset will be provided in Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions and be sourced from PCT's 76, 80, 81, 82, 101, 110, 237, and/or 248. The offset site must be in the Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee or Nymagee bioregions, or any IBRA subregion that is within 100 km of the outer edge of the impacted site.

Offsets will be in place prior to the commencement of construction.

Construction

No direct impacts are expected to occur as a result of the construction phase other than the removal of scattered paddock trees described in Section 1.1.3 above.

Mitigation measures to avoid and minimise impacts will be outlined in the CEMP and include:

- Unless otherwise agreed by the Responsible Authority, the removal of hollow-bearing trees will not be undertaken during the late winter to spring period to avoid the main breeding period for hollow-dependent fauna, such as owls and possums.

- Pre-clearance surveys will be undertaken to ensure that nests and hollows identified in paddock trees are inactive.
- Where an active hollow is identified, a licenced wildlife salvage team will be on-site during vegetation removal to catch and relocate (if appropriate) any wildlife encountered in vegetation or hollow-bearing trees.
- Demarcation and exclusion fencing will be installed around trees and vegetation to be retained in, or directly adjacent to (within the radius of an applicable tree protection zone (TPZ)), the development site, as follows:
  - TPZs will be clearly defined
  - the radius of the TPZ will be calculated for each tree by multiplying its diameter at breast height (DBH) by 12 (i.e. TPZ = DBH x 12) in accordance with the Australian Standard – Protection of trees on development sites AS 4970-2009 (Standards Australia 2009)
  - the TPZ will not be less than 2 m or greater than 15 m, except where crown protection is required (Standards Australia Committee 2009)
  - appropriate signage such as 'No Go Zone' or 'Environmental Protection Area' will be installed around retained trees and vegetation
  - the location of any 'No Go Zones' will be identified in site inductions
  - fencing will comprise star pickets with high visibility bunting.
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas or areas proposed for clearing, and not in areas of retained native vegetation.
- Where practical, all paddock and hollow-bearing trees to be removed will be placed in areas of retained vegetation to provide additional fauna habitat.
- Where appropriate, native vegetation cleared from the development site will be mulched for re-use on the site, to stabilise bare ground.
- Sediment and erosion control measures will be implemented prior to construction works commencing, to protect drainage channels and any downgradient habitat as outlined in Section 8.5.3.
- Standard noise controls will be implemented during construction as outlined in Section 8.7 to minimise disturbance to fauna.
- Barbed wire for site fencing will be avoided, where possible.
- Boundary fences and laydown areas will be located in cleared areas.
- The site rehabilitation plan will be prepared and implemented to progressively rehabilitate disturbed areas.
- Following construction, revegetation of areas of the development site with groundcover plant species compatible with the existing native species composition will be undertaken.
- A Weed and Pest Management Plan (WPMP) will be prepared prior to construction, as outlined in Section 8.5.3.

Operation

The impacts arising from the operation of the project are expected to be negligible due to the inherently low impact nature of solar farm operation.

Decommissioning

Where relevant, the mitigation measures listed as part of the construction phase of the project will be implemented during the decommissioning phase. In addition to this, in areas where cropping is

not to occur, revegetation with groundcover plant species compatible with the existing native species composition will occur.