7 IMPACT ASSESSMENT

7.1 IMPACT TYPES

The Proposal would involve the construction, operation and eventual decommissioning of PV infrastructure, electricity corridors, tracks and site buildings, as detailed in Table 7-1

Table 7-1 Potential impacts of the Proposal

	Construction and decommissioning	Operation phase
Vegetation	• Clearing and disturbance during construction and installation of the array • Tree clearing required for the transmission cable corridor and possibly along access routes • Risk of noxious and environmental weed introduction and spread	• Microclimate impacts under the PV array (shading, temperature, humidity) • Potential soil erosion under the array from concentrated rainsplash and possible vegetation loss • Weed growth and spread
Fauna	• Clearing of habitat for the transmission cable and access roads (such as tree food sources, tree hollows, rock habitats) – likely to t\be low as existing farm tracks are proposed to be used. • Disturbance to local fauna from noise, light and vibration • Vehicle collision risks to fauna	• Loss of or alteration to grassland habitat for macropods, birds, reptiles and insects due to shading, changed microclimate and reduced productivity • Movement barrier and collision hazard created by perimeter fencing • Habitat avoidance due to presence of infrastructure • Vehicle collision risks to fauna
Riparian and aquatic habitats	• Potential soil erosion and sedimentation • Alteration to local hydrology due to earthworks, site drainage or concentrated runoff • Pollution risks	• Potential soil erosion and sedimentation during the construction and operation phases • Alteration to local hydrology (eg due to panel washing, site drainage or concentrated runoff) • Use of water resources for panel washing • Pollution risks

7.1.1 Direct impacts

Direct impacts are those that directly affect habitat and individuals, usually within the footprint of the Proposal. They include, but are not limited to, clearing and habitat removal.

The Proposal has potential to directly impact biodiversity values at the subject site through:

- Impacts to soils, vegetation and habitats during construction
- Disturbance to local fauna during construction
- Altered productivity and microclimatic conditions under the PV array
- Soil erosion potential under the PV array
- Habitat avoidance behaviour, movement barriers and collision hazards for fauna
- Potential for introduction and spread of weeds

Loss of vegetation and habitats during construction

Estimates of the areas affected by each component of the Proposal are indicated in Table 7-2 and Table 7-3.

Table 7-2 Estimated impact areas of each Proposal component

Component	Quantity	Length (m)	Width (m)	Area (m2)
Site office and facilities	1	20	20	400
Underground electricity transmission (control room to substation)	1	500	0.5	250
Solar panels	360,000	2	1	720,000 (panel surface) 612,000 (ground coverage assuming 30 degree tilt of panels)
Pile driven posts	100,000	0.1	0.1	1,000
Underground cabling (4 circuits)	4	2,500	0.5	5,000
Inverters	140	4.3	2.2	1,324
Pad-mount transformers	70	3	2	420
Internal access tracks	1	18,560	8	148,480
Perimeter tracks	1	12,800	8	102,400
Perimeter fencing	1	12,800	1	12,800
Temporary laydown area	1			15,000
Parking	1			750
Operations and maintenance building (operational stage)	1	12	9	108
Total site area				**200 ha of450 ha**

Table 7-3 Area of impact summary

Total area permanently cleared[1]	Components	% of site area
267,682m^2 (26.8 ha)	Site office and carpark PV array posts Inverter and transformer pads Perimeter and internal tracks Diverted existing road	6%
Total area cleared and rehabilitated	**Components**	**% of site area**
20,000m^2 (2 ha)	Underground cabling Temporary laydown area	0.4%

[1] for the operating life of the solar farm

Groundlayer vegetation

Groundlayer vegetation over an estimated area of around 26.8 hectares would be removed for the operating life of the solar farm. Most of this clearing will result from the establishment of the perimeter and internal access tracks. Note: this figure is based on all tracks and roads requiring an 8m wide clearing zone and this is likely to be an over estimation of the actual clearing required.

These works would affect native dominated pasture (Coolibah – Black Box Woodland derived), exotic dominated pasture and cultivated paddocks, all with generally minimal conservation value. Similar vegetation is locally abundant.

Canopy vegetation and hollow bearing trees

A total of approximately 50 mature trees would be removed to reduce shading of the PV arrays. This would include 27 hollow bearing trees (see Appendix C for a list of hollow bearing trees within the development envelope).

Vegetation clearing guidelines, including hollow-bearing tree removal, should be adopted. Example guidelines are provided in Appendix K.

Disturbance to fauna during construction

Habitat alienation is a potential impact during the construction of infrastructure. Excessive noise and vibration, increased human and vehicle activity and night work (if required) may not directly harm individual animals but it could affect feeding and breeding behaviours resulting in negative impacts on long term population viability. Disturbance impacts can be difficult to directly attribute to population level changes (Hill et al. 1997) however, efforts should be made to minimise this impact as a precautionary approach. Works should be planned to avoid the breeding season of Brown Treecreepers (June to December) particularly around the recorded roosting/breeding site in the central north DE, Grey-crowned Babblers (July to February, breeding begins with spring rains) and Pink Cockatoos (May to December). Works would be preferentially staged between March and June-July. Avoiding works outside of this period will have the benefit of minimising potential disturbance impacts to other threatened species with a lower probability of occurrence on site and more common species that inhabit the area.

Trenching works have the potential to injure or trap native fauna. Trenches are likely to be 0.8m deep and 0.4m wide[6]. Trenches should be backfilled as soon as possible to minimise the chance of fauna becoming trapped. If trenches are left open for any length of time small ramps or ladders should be installed to allow trapped fauna to escape. If left open overnight, trenches should be checked the following morning and trapped fauna should be removed unharmed and released into nearby vegetation.

Construction materials should not be stockpiled on site for extended periods of time as local fauna may take up residence and be injured when the materials are moved. Laydown sites should not be adjacent to high quality habitat for the same reason.

Alteration to microclimate and erosion potential under the solar array

An estimated 220 ha of native EEC derived grass/shrubland in low to moderate condition and exotic dominated pasture and cropland would be use to site the PV array. Vegetation and ground habitats would be affected by altered microclimate beneath the array; with reduced insolation and

[6] Based on indicative trenching information received from Infigen 17 August 2010.

temperature and increased humidity. Wind speeds may also be reduced. If required, regular washing of PV arrays PV array would contribute to an increase in soil moisture under the array.

Changes in rainfall distribution

The vertically projected area under the solar panels is estimated to be 61.2 hectares, or 28% of the total array site. There would be a concentration of rainfall runoff in a strip below the lower edge of the solar panel rows. This would increase rainsplash intensity and soil erosion potential in this area during heavy rainfall events. The erosion risks should be manageable using adequate site preparation, and responsive pasture and stock management. A rainshadow below the solar panel rows would also be created. Soil in this area may be drier than surrounding soil, but this would be offset by reduced evapotranspiration losses due to shading and reduced air movement, variation in the angle of rainfall and lateral movement of soil water from adjacent rain-exposed areas. Shade tolerant ground cover should be established on the cultivated paddocks prior to the installation of the array, and maintained at all times, including during winter and drought periods if possible.

A groundcover management plan should be developed for the site and the proponent should routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required. Any localised erosion that develops under the array (for example, due to concentrated rainsplash) should be promptly treated with techniques such as hardening with gravel or organic mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.

Shading and groundcover management under the array

The total area of permanent shading is estimated to be 30% of the area under the array (18.4 hectares). 70% (42.8 hectares) would be partially shaded depending on the season and time of day.

Shading by the PV arrays will have an impact on the microclimate of 61.2 ha of the development envelope. Reduced insolation may mean lower rates of plant growth and biological productivity. However, this may be offset by increased soil moisture and reduced evaporative demands due to increased humidity and/or reduced temperature resulting in enhanced plant growth (Prinder and Facelli 2004).

In the grazed paddocks existing native and exotic pasture across the site is likely to decline initially due to shading following PV array installation. The vegetation community that would establish under the panels, given no management intervention, is hard to predict as there has been little research into the effects of pasture shading in the central west of NSW. Shade tolerant species already present onsite are the understorey plants of the woodland remnants, including a number of native species (refer to random meander 1, 5, 7, 8, 10 results in Section 4). A study into the effects of tree canopy shade on three Chenopod species in arid Australia showed that some were tolerant of a wide range of light and soil moisture conditions (Prider and Facelli 2004), and it is likely that a native groundcover of some description would survive onsite under the PV arrays.

Soil seedbanks in the arid and semi arid floodplains of Australia have evolved to take advantage of irregular rainfall/flooding events and generally remain viable for extended periods (Capon and Brock 2006). The regenerated native pasture and associated Chenopod shrubs in the western paddock (Area B1) are an indication of the potential for natural recolonisation of cultivated land. This paddock has not been cultivated for the past 10 years (pers comm. B. Morris, property owner, 7th July 2010).

In is anticipated that over time shade tolerant native species present in the soil seed bank would recolonise the areas under the PV arrays. However, it would be necessary to establish fast growing, shade tolerate, perennial species to stabilise the soil and maintain habitat in the interim. While some studies have looked at shade tolerant tropical forage species (for example Stür, 1991), it is recommended that shade tolerant perennial species suitable for the local climate be identified through field trials and these species be established in the cultivated paddocks (Area B3) prior to the installation of infrastructure. By taking this approach the risk of shading effects reducing groundcover under the panels would be minimised. Monitoring the groundcover under the arrays would be an important component of ongoing site management.

Caution needs to be applied when choosing groundcover species to sow prior to infrastructure installations as sowing a pasture variety that has not been trialled under local conditions may lead to establishment failure or subsequent pasture decline creating management problems post construction. Using a proven pasture mix and ensuring adequate groundcover is of greater importance than the establishment of a native habitat to protect physical environmental values (pers comm. Warwick Badgery, Research Agronomist NSW Department of Primary Industry Orange 9/8/10).

Management of the groundcover under the array would be an important operational activity. Approaches could include the use of cell grazing by sheep or irrigation (pers comm. C. Waters, NSW Department of Primary Industry Research Scientist; pers. comm. A. Southwell, Charles Sturt University Lecturer). It is recommended that consultation be undertaken with a qualified agronomist to inform appropriate groundcover establishment and management under the PV arrays.

Fauna impacts

It is unclear what the impact to soil moisture, soil nitrogen and subsequent vegetation composition from factors such as reduced light and near ground wind levels will be following the installation of the PV arrays. The response of local fauna to these changes is equally hard to predict and will be largely influenced by the vegetation changes that occur. An altered microclimate under the PV arrays due to shading and associated vegetation changes has the potential to affect sensitive fauna e.g. ants and poikilothermic species such as reptiles. Basking opportunities may be reduced however the structure of the PV arrays may provide fauna with a degree of protection from predation, particularly from raptors and foxes. Increased soil moisture may create favourable shelter and foraging habitat for amphibians. As the PV arrays will be located in modified grazing and cropping paddocks with few fauna habitat values (refer to Appendix B, habitat assessments 1, 7, 9) there is little probability of fauna species, particularly threatened species, being impacted by any microclimate and associated vegetation changes that may occur in these areas.

Fauna habitat loss and collision hazards

Increased vehicle movements during construction may lead to collisions with native fauna. Vehicle movements should be restricted during dawn and dusk and speed limits should be enforced. It is unlikely that any threatened species would be put at risk by increased vehicle activity.

The construction of a perimeter fence has the potential to impact native fauna by creating a barrier to movement and by providing a collision risk. Where security concerns permit barbed wire should not be used in the fence construction as it is capable of entangling and killing a range of native fauna (van der Ree 1999). High chainlink fences are a hazard to fast flying parrot species (Pfennigwerth 2008). Superb Parrots were recorded on site and there is some potential for this species to be impacted. Installing

coloured streamers, using shade cloth or coloured wire are examples of measures used to increase the visibility of this type of fence to parrots (Pfennigwerth 2008). The central section of the site where woodland stands link the areas to the north and south of the site is an area where improving the visibility of the fence may be required.

A perimeter fence would provide a barrier to the movement of many large terrestrial fauna species. Species likely to use the subject site for foraging and dispersal would be capable of accessing and utilising the nearby expanses of similar modified grazing land and are unlikely to be greatly affected by the reduction of habitat brought about by fencing the subject site.

For species that will still have access to the habitat within the perimeter fence for example, birds, habitat modification due to microclimate changes and associated invertebrate and vegetation changes may reduce the quality of the foraging habitat. As the land is highly modified and representative of much of the farmland in the district loss of approximately 244 ha of this habitat type is not considered to be significant.

Species with the ability to disperse through open country are likely to utilise the remnant trees on the subject site. If clearing of these trees was required it would not be significant in terms of restricting fauna movement considering the abundance of remnant vegetation surrounding the subject site.

Potential introduction and spread of weeds (general)

The site carries noxious weeds which will require control before and after the proposed works. Best practice hygiene will be required to prevent the movement of weeds around and off the property, and prevent the introduction of any new weeds. Safeguards have been included to ensure weeds are adequately controlled at the site.

With the appropriate implementation of weed controls during and following construction, weed impacts within and off the subject site are not expected to be significant.

The spacing between the PV array rows would be adequate to allow an ATV to access the site for ongoing weed control and pasture renovation, as required.

7.1.2 Indirect impacts

Indirect impacts occur when project related actions affect species, populations or ecological communities in a manner other than direct loss, usually beyond the footprint of the Proposal. Indirect impacts can include loss of individuals through predation by domestic and/or feral animal, deleterious hydrological changes (including increased runoff and raising or lowering the water table), erosion, weed invasion, pollution, trampling, altered fire regimes, habitat fragmentation and disruption of wildlife movement corridors.

Indirect and off-site impacts relevant to the proposal include:

- Fauna habitat avoidance and corridor impacts
- Downstream sedimentation and pollution
- Effects on fire frequency and impact.

Fauna habitat avoidance and corridor impacts

The structure provided by the PV arrays and perimeter fence may deter species such as Grey-crowned Babblers from foraging between the PV arrays, however changes in microclimate may increase soil moisture and invertebrate numbers. Post construction site usage monitoring would be valuable to determine the level of site usage by native fauna.

The central subject site (Area B6) displays structural characteristics, in the form of remnant woodland stands, suitable for fauna dispersal. These stands are degraded due to a history of stock grazing and clearing. Die back symptoms including canopy thinning and death and a lack of canopy species regeneration are feature of these stands that suggest they would be lost in the medium term. Maintaining and enhancing these features via offset plantings and fencing from stock are proposed as offset measures. These actions would benefit biodiversity on site and within the locality.

Downstream sedimentation and pollution

The proposed works have potential to release sediment and pollutants into drainage areas that eventually flow into the Bogan River, located 1.5km to the west of the site. These risks would apply mainly during the construction phase but could also arise due to concentrated rainsplash below the lower edge of the solar panel rows. This can be effectively managed onsite by installation of sediment erosion controls if required.

The panels would be periodically washed as required, using a pressure hose and water truck. Washing is expected to be infrequent, and in response to particular events such as a dust storm. Water for washing would be obtained from existing Council supplies. No detergent would be used for washing the panels. The panel washwater is not expected to result in pollution of local waterways or the groundwater resource.

A continuous vegetated groundcover would need to be maintained under the array to maximise infiltration of panel runoff, reduce sediment pollution risks and reduce dust during the operational phase of the project

Effects on fire frequency and impact

Although there have been isolated cases of sparks from the back of panels, the risk of this causing a grass fire is considered to be low. Vegetation under the array would be kept low by slashing or sheep grazing. Access tracks would be constructed to each inverter and around the perimeter of the farm. This network would serve to contain any fire starting at the array, to protect the array during a wildfire and to provide access for fire suppression during an event. The Proposal is unlikely to significantly affect wildfire frequency in the study area.

Natural wildfires produce noxious gases and temporary habitat changes which would affect local fauna populations over the short-medium term. Any additional releases from a fire-affected PV array are not expected to add significantly to these impacts to fauna. The Suntech modules to be used do not have passed the Underwriters Laboratories standard UL1703 (which includes flammability tests) and are inflammable and do not pose a pollution risk in the event of fire.

7.1.3 Cumulative impacts

Impacts to vegetation at the PV array site would result from the direct effects on microclimate in combination with altered land use patterns, such as grazing. The site would be managed to maintain a dense low groundcover to protect biodiversity values. The cumulative effects of microclimate and land

use changes are not expected to be significant given the current high levels of disturbance at the site. No cumulative fauna impacts are anticipated.

7.2 IMPACT ASSESSMENT

7.2.1 Assessments of Significance

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.

An Assessment of Significance has been completed for the following threatened entities, which were rated as having potential for adverse impact as a consequence of the proposal:

Flora
Red Darling-pea (*Swainsona plagiotropis*)
Slender Darling-pea (*Swainsona murrayana*)
Ecological Communities
Coolibah – Black Box Woodland
Myall Woodland

Fauna	
Australian Bustard	Turquoise Parrot
Barking Owl	White-fronted Chat
Brown Treecreeper	Greater Long-eared Bat (south eastern form)
Bush Stone-curlew	Kultarr
Diamond Firetail	Little Pied Bat
Grey-crowned Babbler	Stripe-faced Dunnart
Pink Cockatoo	Yellow-bellied Sheathtail-bat
Superb Parrot	

The assessments conclude that, with the adoption of the mitigation measures listed in Section 8 and pending follow up spring-summer surveys to confirm the assumptions of the assessment, the Proposal is unlikely to have a significant impact on any of the threatened entities listed above.

The focus of the follow up survey would be to confirm the presence or absence of the following threatened species on the site:

Red Darling-pea (*Swainsona plagiotropis*)

Slender Darling-pea (*Swainsona murrayana*)

Should presence be confirmed, management actions, such as exclusion zones, would be incorporated into the proposal to ensure significant impacts are avoided. The follow-up surveys would be undertaken in the appropriate seasonal window of 2010, prior to the determination of the project.

8 RECOMMENDATIONS AND CONCLUSION

The following measures are required to ensure that biodiversity impacts are adequately managed and to avoid the likelihood of significant impact for any listed entity. They are ordered by project phase.

8.1 INFRASTRUCTURE SITING AND DESIGN

- The PV array, site access tracks and other infrastructure should be sited to avoid:
  - Stands of Woodland across the site
  - Hollow bearing trees
  - Isolated trees, where possible
- Areas of Myall Woodland EEC would be avoided. If infrastructure was to be placed within these areas it would be microsited to avoid and retain Myall individuals particularly in areas of regeneration.
- The denser patches of Coolibah-Black Box Woodland EEC in the central section of the site would be avoided and retained. Infrastructure would be microsited to avoid the need for clearing in this community. No development that would reduce the functionality of these areas as fauna movement corridors should be undertaken.
- Biologically sensitive areas (listed above and on the constraints map) would be clearly identified throughout construction and protected from the direct and indirect impacts of the Proposal. Contractors and staff will be made aware of the significance and sensitivity of these areas.
- Works should be planned to avoid sensitive times for threatened species Late July to early December for Gray-crowned Babblers (Counsilman 1979), June to December for Brown Treecreepers (Schodde and Tidemann, 2007), May to December for Pink cockatoos and September to December for Superb Parrots.

8.1.1 Supplementary surveys

- Supplementary surveys, prior to finalisation of infrastructure layout, are required to confirm the assumptions of this assessment as follows:
  - A supplementary flora survey during spring (early November) would be required to confirm if threatened flora species including Slender Darling-pea and Red Darling-pea inhabit the higher quality derived grass and shrubland on the site. This survey would be undertaken prior to finalisation of infrastructure layout and prior to project determination. The probability of these species occurring is considered low and the surveys would be undertaken to verify the assumptions made in the Assessment of Significance.

8.1.2 Offsetting

An Offset Plan would be finalised prior to any construction impacts, based on the final infrastructure layout and the habitat values that it removes or modifies. The permanent removal of quality flora and fauna habitat is expected to be minimal, as the infrastructure footprint is comparatively small and areas of conservation significance have been mapped to allow infrastructure placement to avoid them. This assessment considers that there is ample ability to offset the minor amount of wooded vegetation removal onsite. Enhancing local connectivity, particularly through the central transmission corridor area, will ensure that this aspect of the proposal provides an net environmental benefit. Native pasture is in varying condition. Offsetting impacts to native pasture would only be undertaken where it is in moderate-good condition and considered to provide quality habitat. Offsite offset areas may be required to achieve this. Surveys and assessments conducted in spring would be used to determine the area and locations of native pasture providing quality habitat.

The biodiversity offset principles developed by DECCW would guide the development of an Offset Plan, namely:

1. Impacts must be avoided first by using prevention and mitigation measures
2. All regulatory requirements must be met
3. Offsets must never reward ongoing poor performance
4. Offsets will complement other government programs
5. Offsets must be underpinned by sound ecological principles
6. Offsets should aim to result in a net improvement in biodiversity over time
7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs
8. Offsets should be agreed prior to the impact occurring
9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated
10. Offsets must be targeted
11. Offsets must be located appropriately
12. Offsets must be supplementary
13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract

- The final infrastructure layout will determine the precise amount of clearing required. At that time, and prior to construction commencing, formal agreements would be sought with the affected involved land owners to secure offsetting for areas of habitat permanently removed by the proposal. It appears that, by locating infrastructure in areas of lesser habitat value, managing offset areas to improve their biodiversity value for the life of the project and, viewed in terms of the wider environmental benefits of establishing renewable energy generation in rural areas, that the proposal can achieve an overall 'maintain or improve biodiversity outcome'.

- Regeneration was evident in both Myall and Black Box Woodland communities. With appropriate management these areas have potential to recover and could be utilised as potential offsets on the site. If the central Black Box stands were fenced and expanded via planting/natural regeneration, habitat and connectivity values through the central area of the site would be increased.

8.2 CONSTRUCTION PHASE

- If the removal of any hollow bearing trees was required this activity would be preceded by a pre clearance check by a qualified ecologist including Anabat survey and stag watching.
- Works will avoid impacts to mature eucalypts wherever possible. Tree protection standards should comply with Australian standard AS4970-2009 Protection of trees on development sites (Standards Australia, 2009). Wherever practicable, excavations and vehicle/machinery movements will occur outside the canopy dripline of large eucalypts.
- Where practical, timber from cleared trees should be relocated into areas of adjacent woodland to provide foraging habitat for Brown Tree creepers, Grey-crowned Babblers and Bush Stone-curlews, rather than removed or burnt.
- Existing farm tracks should be used wherever possible to minimise the number of new roads.
- Where security concerns permit, perimeter fences should not contain barbed wire, particularly the top strands. If a cyclone mesh fence is to be used efforts should be made to increase the visibility to fast flying parrots.
- Activity would be minimised in the area adjacent to the Brown Treecreeper roost/nest site (refer to Figure 5-3) at all times.
- No works would take place within 100m of the Brown Treecreeper roost/nest site (refer to Figure 5-3).
- Where cement is included in cable trench backfill, at least 20 centimetres of cement-free topsoil will be replaced as the top layer in the backfill.
- Where practicable, whole sods will be removed with an excavator where these areas are well-vegetated with dense root systems. Sods will be stored in moist, shaded conditions and replaced following the works. Sod storage time will be minimised and sods will be replaced in a manner that maximises the chances of re-establishment.
- Excavated topsoil, subsoil will be stored separately and replaced in a manner that replicates the original profile as closely as possible.
- Where practicable, grass surfaces and shrubs will be retained or restored on infrequently used vehicle routes.
- Site stabilisation, rehabilitation and revegetation will be undertaken without delay.
- Works will avoid impacts to mature eucalypts wherever possible. Tree protection standards should comply with Australian standard AS4970-2009 Protection of trees on development sites (Standards Australia, 2009). Wherever practicable, excavations and vehicle/machinery movements will occur outside the canopy dripline of large eucalypts.

- As a general rule, disturbed areas will be used preferentially for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable.
- Works will be avoided during, and immediately following heavy rainfall events to protect soils and vegetation at the site.
- A weed management plan would be developed for the site including but not limited to the following outcomes;
    - The control of noxious weeds recorded on the site
    - Preventative measures for the spread or introduction of weeds
    - Monitoring of control and preventative measures and ongoing adaptive management
- Laydown sites for excavated spoil, equipment and construction materials will be weed-free or treated for weeds wherever practicable.
- Sediment control materials should be weed free such as certified weed free hay bales or geotextiles.
- Imported materials such as sand and gravel will be sourced from sites which do not show evidence of noxious weeds or Phytophthora infection.
- If dams are removed during site development works, alternative watering points should be established to compensate for their loss and maintain similar habitat resources for native fauna.
- If used, and where practicable, power poles and overhead powerlines will be bird-safe using flags or marker balls, large wire size and wire and conductor spacing.
- Log habitat removed during the construction phase will be reinstated following the works.
- Trenches should be left open for the least time practical and would be inspected for trapped fauna prior to back filling. Any trench sections left open overnight would be inspected early in the morning and any trapped fauna removed. The use of ramps or ladders to facilitate trapped fauna escape is recommended if trenches are to be left open overnight.

8.3 OPERATIONAL MANAGEMENT

- A shade tolerant perennial groundcover should be established across the cropping and exotic dominated grazing paddocks prior to the installation of the PV arrays.
- A groundcover management plan would be developed that would include regular monitoring of vegetation cover and composition and allow for adaptive management. This would include:
    - Advice from an agronomist in relation to preferred species/varieties, establishment methods of alternative pastures and best practice management.
    - Where information is lacking, trials may be required onsite.

- If localised erosion is detected, effective treatments would be applied without delay, such as hardening with mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.
- The space between the PV array rows should be maintained and kept clear to enable access by vehicles for ongoing weed control, and pasture renovation if required.
- Efforts should be made to minimise disturbance to the existing groundcover during construction. Construction and maintenance vehicles should not access the site when soils are very wet to minimise soil compaction and disturbance.
- Monitoring of fauna site habitat usage pre and post construction is recommended but not considered essential.

8.4 CONCLUSION

The subject site is dominated by areas of native pasture and cultivated paddocks. The site contains examples of two threatened communities, Coolibah-Black Box Woodland and Myall Woodland. 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. Native ground cover vegetation within the western and central sections of the site is likely to be derived from Black Box Woodland. In the eastern paddock areas of Myall Woodland occur. Assessments of significance for these two EECs concluded that a significant impact to the local occurrence of the EEC is unlikely as the result of the Proposal (refer to Appendix A).

Potential habitat for several threatened fauna species is present at the site. While the Proposal will remove 27 hollow bearing trees and may reduce foraging habitat for some species, there is an abundance of hollow bearing trees and open pasture habitats in the surrounding locality. Enhancing the connectivity through the central section of the site via offset plantings and exclusion of stock would have a net benefit for local biodiversity.

Ground layer vegetation over an estimated area of around 26.8 hectares would be removed for the operating life of the solar farm. Most of this clearing will result from the establishment of the perimeter and internal access tracks. Around 2 hectares would be temporarily affected by the Proposal and rehabilitated at the end of the construction period. These impacts would not be significant in light of the condition of the vegetation, the low conservation and habitat values and the local abundance of similar vegetation in the locality.

The operational phase of the project will require careful management of pasture under the PV array to control weeds and maintain good groundcover. This is considered to be readily achievable and biodiversity impacts at the site and off the site are not expected to be significant.

By identifying areas of high biodiversity values early in the planning process and then using this information to develop a sensitive layout design, the Proposal achieves the aim of minimising any impacts to biodiversity. In conjunction with a targeted offset plan, that aims to improve connectivity and habitat values both on site and for the wider locality, the Proposal would maintain or improve biodiversity values. In terms of the significance thresholds identified in the Draft Guidelines for Threatened Species Assessment for Part 3A Applications (DEC/DPI 2005) the project would:

- Be likely to maintain or improve biodiversity values
- Be unlikely to reduce the long-term viability of a local threatened species population or ecological community
- Be unlikely to accelerate the extinction of a species, population or ecological community or place it at risk of extinction
- Not adversely affect critical habitat.

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Appendix A ASSESSMENTS OF SIGNIFICANCE

A.1 ASSESSMENTS UNDER THE TSC ACT

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 undertaken for the following two flora species, two ecological communities and 15 fauna species. These entities were identified from the threatened species evaluation (Appendix Appendix C) as having low-moderate or greater potential to be impacted by the Proposal:

Common name	Scientific name	Status
FLORA		
Red Darling-pea	*Swainsona plagiotropis*	V TSC, V EPBC
Slender Darling-pea	*Swainsona murrayana*	V TSC, V EPBC
ECOLOGICAL COMMUNITIES		
Coolibah – Black Box Woodland		EEC TSC
Myall Woodland		EEC TSC
FAUNA		
Australian Bustard	*Ardeotis australis*	E TSC
Bush Stone-curlew	*Burhinus grallarius*	E TSC
Barking Owl	*Ninox connivens*	V TSC
Grey-crowned Babbler	*Pomatostomus temporalis*	V TSC
Brown Treecreeper	*Climacteris picumnus*	V TSC
Diamond Firetail	*Stagonopleura guttata*	V TSC
White-fronted Chat	*Epthianura albifrons*	V TSC
Pink Cockatoo	*Cacatua leadbeateri*	V TSC
Superb Parrot	*Polytelis swainsonii*	V TSC, V EPBC
Turquoise Parrot	*Neophema pulchella*	V TSC
Kultarr	*Antechinomys laniger*	E TSC
Stripe-faced Dunnart	*Sminthopsis macroura*	V TSC
Greater Long-eared Bat	*Nyctophilus timoriensis*	V TSC
Little Pied Bat	*Chalinlobus picatus*	V TSC
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V TSC

V TSC = listed as Vulnerable under Schedule 2 of the *TSC Act 1995.*

E TSC = listed as Endangered under Schedule 1 of the *TSC Act 1995.*

V EPBC = listed as Vulnerable under the Commonwealth *EPBC Act 1999*

EEC TSC = listed as an Endangered Ecological Community under Schedule 1 of the *TSC Act 1995.*

Red Darling-pea (*Swainsona plagiotropis*) and Slender Darling-pea (*Swainsona murrayana*)

Ecological information

These species are generally found in flat grasslands although the Slender Darling-pea can be found in a variety of habitat types including Bladder Saltbush and Black Box communities. The Red Darling-pea and Slender Darling-pea prefer heavy soils ranging from grey, red and brown cracking clays to red-brown earths and loams. Plants have been found in remnant grasslands and grassy woodlands, rail reserves, roadsides and in lightly grazed pastures. Both species flower in spring and dieback after flowering remaining dormant for several months. The winter timing of the survey was not suitable for detecting these species.

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The majority of the native grassland and shrubland present within the subject site has a long history of grazing and or cropping. Grazing sensitive species such as lilies, orchids, tall daisies and pea shrubs were not recorded, although the winter timing of the survey will have made some of these species undetectable. The species are more likely to occur in areas of higher quality habitat at the site and based on a constraints assessment, these areas have been avoided by the Proposal. In view of the degraded condition of the majority of the native pasture to be impacted by the Proposal and the disturbance history, the likelihood of these species being present in these areas is considered low. As such the Proposal is unlikely to have an adverse effect on the life cycle of these species such that a viable population is likely to be placed at risk of extinction. A targeted survey in Spring (early November) would be undertaken prior to determination as a precautionary measure to confirm this assessment and to determine if the Proposal is likely to impact on these species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No populations have been listed for the local area under Part 2 of Schedule 1 of the TSC Act or Part 2 of Schedule 4 of the FM Act.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

   i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

   ii) is likely to substantially and adversely modify the composition of the ecological

community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

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

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

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

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

The Proposal will result in the clearance of up to 26.8 hectares of suitable habitat for this species for the construction of access tracks, cable trenching and the siting of laydown areas and buildings. A further 61.2 hectares will be modified from the installation of the PV array, resulting in alterations to the microclimate of potential habitat for this species. No fragmentation of habitat for these species will occur as a result of the Proposal. The potential habitat for these species within the subject site has a long history of grazing and cropping. In view of the degraded state and disturbance history of the potential habitat that will be impacted by the Proposal, its value is considered low. Considering the degree of modification, the habitat that will be impacted by the Proposal is not considered important to the long-term survival of these species.

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

No areas of critical habitat have been declared for these species.

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

A National Recovery Plan has been prepared for the Red Darling-pea (Tonkinson and Robertson 2010). Specific Objective 3 of the plan, to '*Ensure that all populations and their habitat are protected and managed properly',* is relevant to the Proposal. Due to the unsuitable timing of the winter survey for detecting this species it was not possible to determine whether a population of the Red darling-pea occurs on the site. A follow-up survey in spring would be required to confirm the presence or absence of this species. As discussed in section d) above, the habitat for this species that will be impacted by the Proposal is not considered important to the long-term survival of the species. As such the Proposal is not inconsistent with the objectives or actions of the recovery plan for the Red Darling-pea if the species does not occur on the subject site.

Coolibah-Black Box Woodland

Ecological information

The structure of Coolibah – Black Box Woodland may vary from tall riparian woodlands with a distinctive midstorey to very open grassy woodlands with a sparse midstorey. It is characterised by the dominance of Coolibah (*Eucalyptus coolabah*) and/or Black Box (*E. largiflorens*). The community is found on the grey, self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees. It typically forms a mosaic with other grassland and wetland communities (DECCW 2010).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No populations have been listed for the local area under Part 2 of Schedule 1 of the TSC Act or Part 2 of Schedule 4 of the FM Act.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

The majority of vegetation in the eastern and central sections of the subject site is derived from the Endangered Ecological Community (EEC) Coolibah-Black Box Woodland. Predominately these areas are highly modified due to agricultural disturbance and consist of sparsely distributed Black Box trees with an understorey of native grasses and shrubs. Two small areas of more densely treed woodland occur towards the centre of the site and have a higher diversity of native shrubs and forbs in the understorey. Where a predominately native understorey exists these areas would comprise the EEC in moderate to good condition. Areas under cropping have entirely modified the understorey to consist of planted exotic crops and introduced weeds however, regardless of the understorey composition if Black Box trees are present then these areas would comprise the EEC in poor condition.

The Proposal has the potential to impact upon up to 127 ha of the EEC. The bulk of this is in a highly modified state with no overstorey, due to past and present agricultural activities and the conservation value of these areas is low. Areas that have tree cover have the potential for regeneration if properly managed and a higher conservation value. It is recommended that development in areas of EEC with continuous tree cover in the centre section of the site be managed to avoid the need to remove trees.

This area also provides an important habitat link from north to south across the site. Development would occur in areas of sparse or no tree cover where understorey conservation value is relatively low.

Large areas of the community occur outside of and adjacent to the subject site (over 300 ha) which have not been subjected to the degree of disturbance and modification as those areas within the site, which has included tree clearing and cultivation.

Impacts to vegetation are likely to include:

- Clearing and disturbance during construction and installation of the PV array
- Shading under the PV arrays
- Risk of noxious and environmental weed introduction and spread

Given the occurrence of extensive areas of vegetation of better condition, combined with the fact that the Proposal would be sited within poorer quality areas, would not remove all vegetation, and vegetation and seed bank is likely to be retained (particularly in higher quality areas), it is considered unlikely that the Proposal is likely to significantly impact this community or place the local occurrence of the EEC at risk of extinction.

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

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

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

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

The Proposal would impact upon habitat for Coolibah-Black Box Woodland in the form of direct clearing of this community and the installation of infrastructure that would increase shading. The extent of this impact is discussed in Section c) above. The areas of habitat within the site are already highly modified and fragmented due to grazing pressure, the planting of exotic pastures and crops and the ingress of weeds. The majority of the community within the subject site is in poor condition. The Proposal would not further fragment or isolate habitat for this community. Suitable habitat likely to be removed by the Proposal is in a highly disturbed condition and not considered important habitat. The Proposal would also result in shading of vegetation, and modification to moisture regimes. The combination of shading and shelter from precipitation may result in the creation of bare areas located directly under the panels. However with an appropriate level of livestock and weed management it is anticipated that the majority of the site would retain ground cover of a similar composition that currently exists at the site.

The extent of clearing from construction, combined with impact on the vegetation that would result from operation of the solar farm is not anticipated to impact the long-term survival of this ecological community in the locality.

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

No areas of critical habitat have been declared for this community.

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

No recovery plan has been prepared for this community

Myall Woodland

Ecological information

Myall Woodland varies from low and low open woodland to low sparse woodland or open shrubland. In all cases the dominant or only tree species present is Myall (*Acacia pendula*), also commonly known as Weeping Myall or Boree. The understorey generally consists of an open layer of Chenopod shrubs and an open to continuous ground cover of grasses and herbs. The structure and composition of the community is variable. It typically occurs on red-brown earths and heavy textured grey and brown alluvial clays (DECCW 2010).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No populations have been listed for the local area under Part 2 of Schedule 1 of the TSC Act or Part 2 of Schedule 4 of the FM Act.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Myall Woodland is present at the subject site as a small area in the north of the western section of the site and more extensively in the eastern section. The occurrence in the western section would be avoided by the Proposal and no direct or indirect impacts to the community in this area are anticipated. PV array components are planned to be installed in the eastern section of the subject site where Myall Woodland is present.

Impacts to vegetation are likely to include:

- Clearing and disturbance during construction and installation of the PV array
- Shading under the PV arrays
- Risk of noxious and environmental weed introduction and spread

Larger areas of Myall in an open woodland formation will be avoided and retained by the Proposal. To facilitate the installation of the PV array some Myall trees are likely to be cleared resulting in a direct impact to the EEC. Trees that would be cleared are generally small isolated groups or individuals (<1 hectare). Considering that the larger areas of Myall Woodland (approximately 27 hectares) are to be retained by the Proposal and that impacts would be limited to the removal of a small number of isolated Myall trees, it is considered highly unlikely that the local occurrence of the EEC would be placed at risk of extinction.

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

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

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

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

The Proposal would impact upon habitat for Myall Woodland in the form of direct clearing of this community and the installation of infrastructure that would increase shading. Approximately 35 hectares of potential habitat that could be colonised by this community would be affected for the life of the solar farm. No fragmentation of habitat for this community is likely to result from the works. Areas of habitat that will be impacted by the Proposal have been subject to a long history of grazing and disturbance. Native species diversity in these areas is generally low and regeneration of Myall was not evident. Larger areas of Myall Woodland, including areas where regeneration was occurring, will be retained and protected. The habitat that will be impacted by the Proposal is not considered important to the long-term survival of the community in the locality.

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

No areas of critical habitat have been declared for this community

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

No recovery plans have been prepared for this community

Australian Bustard (*Ardeotis australis*) and Bush Stone-curlew (*Burhinus grallarius*)

Ecological information

The Australian Bustard and Bush Stone-curlew differ greatly in size and habit but share the same habitat type and, because of this, they face the same potential impacts from the Proposal.

The Australian Bustard is a very large, heavy-bodied, ground-dwelling bird up to one meter tall with a wingspan of up to 2.3 m. Once found in open country across Australia it has declined greatly in numbers due to predation by introduced foxes, habitat modification by grazing and illegal shooting (DECC, 2005, Schodde and Tidemann, 2007). This species mainly inhabits tussock and hummock grasslands, and also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams (DECC 2005). The diet of the Australian Bustard includes centipedes, insects, lizards, young birds, small rodents, molluscs, leaves, seeds and fruit (Marchant & Higgins 1993). While flocks of up to 1000 were reported last century, this species has declined to be an occasional visitor to far north-western NSW (NPWS 1999).

The Bush Stone-curlew stands about 55 cm tall and is largely nocturnal, being especially active on moonlit nights. This species inhabits open woodlands with a sparse grassy Groundlayer and fallen timber where it forages for insects and small vertebrates, such as frogs, lizards and snakes (DECC 2005). Bush Stone-curlews have suffered a similar fate to the Australian Bustard and are impacted by the same threatening processes of habitat loss / degradation and predation by foxes.

Test of significance
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Neither species was recorded during the survey. There is one recent record of an Australian Bustard 30 km north east of Nyngan and a recent record of a Bush Stone-curlew 30 km south east of the DE. Occasional records for both species occur within 100km of the DE.

Potential foraging habitat may be lost due to the installation of the PV arrays however this habitat is abundant in the district and the likelihood of either species utilising the subject site on anything other than a temporary basis is considered low based on recent records. Breeding of the Australian Bustard is considered highly unlikely within the DE due to the disturbed and exposed nature of the site. While Bush Stone-curlews prefer open areas with sparse low vegetation for nest sites (DEC2006) it is unlikely that an area within the DE would support breeding attempts considering there is a low probability of birds breeding locally (based on recent records), the presence of foxes (implicated in the decline of this species DEC 2006) on site and the abundance of similar open habitat in the district.

Anecdotal evidence suggests that if nests sites and chicks are protected from predators (eg enclosed by predator-proof fencing), breeding success may be enhanced and recruitment may increase, provided that suitable foraging and roosting habitat is available in the vicinity of the nest site (DEC 2006). The perimeter fence of the proposed solar farm may provide a predator free environment for ground nesting birds such as the Bush Stone-curlew should they attempt to breed locally.

Relocating timber from cleared isolated shade trees to the central or adjacent woodland stands would increase the habitat value in these areas for Bush Stone-curlews.

It is unlikely that a viable local population of either species exists at the subject site and if it did the Proposal would be unlikely to impact it such that it would be placed at risk of extinction.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

   i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The project will impact up to 244 ha of pasture/cropping land

ii) The Proposal will not fragment any habitat for these mobile species.

iii) As described in a) above the habitat to be removed is widespread in the district and considered marginal for these species (considering the presence of foxes).

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

No areas of critical habitat have been declared for these species.

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

A recovery plan has been approved for the Bush Stone-curlew (DEC 2006), listing priority actions to secure the future of this species in NSW. The Proposal is not inconsistent with these actions. No

recovery plan has been prepared for Australian Bustard.

Barking Owl (*Ninox connivens)*

Ecological information

The Barking Owl is a moderately large brown hawk-like owl that inhabits a range of habitat types, typically dominated by eucalypts. It usually roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests. Barking Owls have been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses (NPWS, 2003).

Barking Owls nest in large tree hollows with an entrance diameter of 20-46cm. In NSW, egg-laying takes place in August to October. The species is thought to hold permanent well dispersed territories (NPWS 2003).

Barking Owls eat more birds than other large forest owls and also eat many insects in the warmer post-breeding months. However, vertebrates seem to be important in its diet during winter and breeding. Rabbits are frequent prey in rabbit-infested areas where there are few other suitably-sized mammals but where possible, the owl appears to prefer native arboreal mammals such as small gliding possums, caught in the tree canopy (NPWS 2003).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Barking Owls were not detected during the nocturnal surveys (Refer to Section 5.4), however a local population may exist based on recent records of this species in Nyngan.

Potential impacts by the Proposal include loss of marginal foraging habitat and nesting sites. The area to be impacted by the Proposal is unlikely to be significant to a local population of this species in terms of foraging opportunities as the cultivated and grazed paddocks offer little cover/habitat for prey species, similar agricultural land is abundant in the district and foraging in the woodland surrounding the DE is likely to be preferred. Few rabbits were seen during the spotlighting surveys however bird prey species, particularly parrots were abundant in the surrounding woodland.

While 27 hollow bearing trees are to be removed by the Proposal, few contain hollows of a large enough size to be potential Barking Owl nest sites (total of 2 trees with large hollows are to be removed) and no evidence of Barking Owl breeding was observed on site. It is highly unlikely that this loss of potential (marginal) nesting habitat would impact this species as the exposed nature of the trees would make the hollows they contain undesirable to Barking Owls especially when the abundance of hollows in the adjacent woodland and the wooded riparian corridor of the Bogan River are considered as alternatives (17 hollows, from 5 hollow bearing trees were recorded from within a randomly selected 50mx50m plot (a density of over 60 hollows per hectare) in the surrounding Black Box woodland). As a precaution, all hollow bearing trees to be removed will be re

surveyed prior to removal to ensure no Barking Owl nest trees are impacted.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The project will impact up to 244 ha of pasture/cropping land and 27 HBTs

ii) The Proposal will not fragment any habitat for this mobile species.

iii) As described in a) above the habitat to be removed is marginal at best and is unlikely to be significant for this species considering the abundance of better quality habitat in the adjacent woodland.

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

No areas of critical habitat have been declared for these species.

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

A draft recovery plan for the Barking Owl has been prepared by NPWS (NPWS, 2003) with the aim of identifying actions to be taken to ensure the long-term viability of the species in NSW. The Proposal is not inconsistent with the actions listed in this document. The Proposal's activities including the proposed fencing and protection of woodland through the central section of the DE are consistent

with the Specific recommendations for Regional Vegetation Management Plans contained Appendix 1 of the Draft recovery plan.

Grey-crowned Babbler (*Pomatostomus temporalis*)

Ecological information

Grey-crowned Babblers are a social bird found in family groups of two up to 13 (Brown et al. 1983). They are insectivores that forage partly on the ground and partly on the trunks and branches of trees and shrubs. Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. Fallen timber appears to be important in maintaining prey numbers. Family groups build a number of large, domed stick nests in saplings, shrubs or trees, usually 1-6 m above the ground. These nests are used as dormitories for communal roosting at night. An extra nest is built for breeding (DSE 2003).

Grey-crowned Babblers are communal breeders and the size of the family group appears increase the likelihood of fledging young in poor conditions (Blackmore and Heinsohn 2007). Habitat quality and fragmentation are important factors in determining the size of family groups that can be supported and hence reproductive success.

Grey-crowned Babblers show limited dispersal from their parents' territories and most sites occupied by babbler groups are within one kilometre of other groups (Higgins & Peter 2002). Habitat connectivity is therefore important in maintaining a viable local population.

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Two family groups of Grey-crowned Babblers were recorded foraging in the Black Box woodland adjacent to the southern boundary of the development envelope (see Figure 5-3). The roosting (and likely breeding) location of one of these groups was recorded approximately 200m south of the development envelope.

The grazed and cultivated paddocks upon which the PV arrays are to be located support little in the way of leaf litter and are likely to be poor foraging habitat for Grey-crowned Babblers due to lack of prey items and their exposure to predators. Taking the worst case scenario, whereby the entire area to be covered by infrastructure would be lost as foraging habitat for this species, it is unlikely that the resident family would be significantly impacted as the quality of this habitat is poor and key foraging habitat areas are likely to comprise the woodland within each family groups territory.

This species is susceptible to vehicle collision impacts (Schulz 1991) and there is the potential for vehicle caused mortalities to this species during the construction and operation of the solar farm. As it is unlikely that the local family groups spend much time foraging in the DE currently and if speed limits and education of workers are adopted as mitigation measures, the potential for vehicle

collision will be minimised.

As habitat connectivity is an important factor in maintaining viable local Grey-crowned Babbler populations (Watson et al. 2005, DSE 2003) protecting the declining woodland stands in the central portion of the subject site will allow continued dispersal from the large woodland stands to the north and south. Without intervention, it is likely that these stands would continue to decline through impacts of dieback, stock trampling and continued clearing for firewood resulting in increased fragmentation over time.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The project will impact up to 244 ha of pasture/cropping land and up to 50 remanent woodland trees.

ii) Fragmentation is implicated in the decline in this species and the Proposal layout has been designed to not only minimise any potential fragmentation but to increase connectivity between the large woodland patches to the north and south of the site by fencing off the woodland stands in this area so as to allow natural regeneration.

iii) As described in a) above the habitat to be removed is marginal at best and is unlikely to be significant for this species.

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

No areas of critical habitat have been declared for these species.

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

No recovery plans have been prepared for these species

Brown Treecreeper (Climacteris *picumnus*)

Ecological information

Brown Treecreepers inhabit drier forests and woodlands. They appear to rely on relatively undisturbed stands of remnant vegetation and require areas of >200ha to maintain viable populations (Barrett et al. 1994). This species often forages on the ground or on fallen timber as well as the more typical treecreeper foraging habitat of tree trunks and branches (Norske 1979). Brown Treecreepers are reliant on hollows for nesting and roosting. They are sedentary species holding permanent territories and are usually found in pairs or in family groups.

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

One family group of at least four Brown Treecreepers was recorded during the survey. This group was observed entering hollows in the Black Box woodland remnant surrounding a dam in the north of Area B4 and it is likely that roosting and nesting occurs within this stand. One low hollow, where birds were observed entering and exiting, had an accumulation of droppings at the entrance suggesting a history of occupation. There are records of within 10 km to the north and south of the site with the next nearest records >30km away indicating that the woodland around Nyngan may provide a local stronghold for this species.

Potential impacts of the Proposal include disturbance to during construction and habitat alienation following the installation of the PV arrays due to the presence of adjacent infrastructure and associated human activity during maintenance activities. The removal of habitat is unlikely to be significant as the PV arrays will be located in grazed and cultivated paddocks that would not be suitable foraging areas for this species as they lack fallen timber and are likely to be low in invertebrate numbers due to lack of leaf litter, stock impacts and lack of vegetation diversity. The removal of up to 50 isolated paddock trees is unlikely to impact the local population as it is highly unlikely that these trees would be used for foraging and/or roosting/nesting due to the lack of connectivity and the exposed matrix surrounding them.

To minimize the risk of disturbance it is strongly advised that works within 300m of the stand

supporting the recorded roost/nesting site be undertaken outside the recorded breeding season for this species, and that other works within the DE be limited during this time also to reduce the potential to impact other family groups adjacent to the DE. Works should not be undertaken at night within 300m of the woodland stand. A buffer zone of at least 100m from the outer trees in this stand should be applied within which no development should take place. This distance is based on a distance greater than the author's experience of the maximum flight initiation distance (FID) for this species (estimated at 70m). FID is a measure that has been used to establish buffer zones to minimize human disturbance to wildlife (Holmes et al. 1993, Rodger and Smith 1995, Blumstein et al. 2003). The FID can vary depending on the type of disturbance (Geist et al. 2005) and the FID of an approaching human on foot is likely to be less than the FID for heavy machinery and power tools, hence a precautionary buffer distance. The fact that the woodland stand was still in use by the birds following earthworks within 30m of the roost/nest hollows to enlarge the dam (as evidenced by large piles of earth on the edge of the water line) suggests some to disturbance by heavy machinery.

If the mitigation measures detailed in this report are adopted, the Proposal is unlikely to impact the viability of a local Brown Treecreeper population and the increased habitat and connectivity brought about by restoring the woodland patches in the center of the subject site would positively impact this species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

   i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The Proposal will modify up to 244 ha of grazing and croplands. The Proposal will not directly impact habitat for this species other than the removal of up to 50 isolated

trees. It is highly unlikely that these trees would be used for foraging and/or roosting/nesting due to the lack of connectivity and the exposed matrix surrounding them and they would be described as low quality habitat at best.

ii) No habitat for this species would become more isolated or fragmented by the Proposal. The areas to accommodate the PV arrays are unlikely to be used for foraging or dispersal due to their modification by agricultural production and the abundance of adjacent habitat surrounding the site. Mitigation measures including restoring the woodland patches in the central section of the site are likely to increase habitat and connectivity for this species.

iii) The removal of habitat is unlikely to be significant as the PV arrays will be located in grazed and cultivated paddocks that would not be suitable foraging areas for this species as they lack fallen timber and are likely to be low in invertebrate numbers due to lack of leaf litter, stock impacts and lack of vegetation diversity. The removal of up to 50 isolated paddock trees is unlikely to impact the local population as it is highly unlikely that these trees would be used for foraging and/or roosting/nesting due to the lack of connectivity and the exposed matrix surrounding them.

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

No areas of critical habitat have been declared for these species.

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

No recovery plans have been prepared for these species

Diamond Firetail (*Stagonopleura guttata*) and White-fronted Chat (*Epthianura albifrons*)

Ecological information

White-fronted Chats are insectivorous birds that inhabit open fields, heaths, saltmarshes and low shrubland surrounding lakes and swamps. Birds often nest in lose colonies, sometimes only meters apart (Readers Digest, 2007). They forage for invertebrates on the ground with Diptera and Coleoptera being the major components of the diet (Major 1991b). The White-fronted Chat is regarded as resident in many areas, but has been referred to as nomadic in some places. There is no evidence of any migratory movements although flocks of White-fronted Chats have been recorded gathering temporarily in some areas in response to temporary high abundance of food (DECCW 2009, Major 1991b).

Diamond Firetails live in scattered groups of five to 40 birds in the open eucalypt woodlands of South Eastern Australia. They forage exclusively on the ground for seeds and insects. This species is sedentary, though some populations move locally. Diamond Firetail populations appear unable to persist in areas which lack remnants of native vegetation larger than 200ha (NSW Scientific Committee 2001) although they are able to utilise areas around towns and farms (DECCW 2010).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Neither of these species was recorded during the survey. One local Diamond Firetail record exists in the district, 10km north east of Nyngan although the bulk of records for this species occur further to wards the eastern ranges. One record for White-fronted Chats exists 10km north east of Nyngan.

Potential impacts to these species from the Proposal include habitat modification and habitat loss.

White-fronted Chats and Diamond Firetails are capable of foraging in modified farmland. Diamond Firetails have adapted to feed on a range of introduced weed and pasture species (Reid 1994) and foraging habitat is not considered limiting for this species. Both species have a low probability of frequenting the subject based on local records. Breeding habitat would not be impacted by the Proposal and it is unlikely that either species would frequent the DE on anything more than an occasional basis. The presence of a viable local population of either of these species is questionable but, if present, the Proposal would be unlikely to significantly impact the population as the agricultural habitat impacted is common in the district.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

   i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The project will impact up to 244 ha of pasture/cropping land

ii) The Proposal layout has been designed to not only minimise any potential fragmentation but to increase connectivity between the large woodland patches to the north and south of the site by fencing off the woodland stands in this area so as to allow natural regeneration.

iii) As described in a) above the habitat to be removed is considered marginal for these species and would not be limiting for either species based on its common occurrence throughout the district

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

No areas of critical habitat have been declared for these species.

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

No recovery plans have been prepared for these species

Pink Cockatoo (*Cacatua leadbeateri*), Superb Parrot (*Polytelis swainsonii*) and Turquoise Parrot (*Neophema pulchella*)

Ecological information

These three parrot species all require hollows for nesting and can be found in modified agricultural landscapes.

Pink Cockatoos have specific nest site requirements choosing high shallow hollows at least 1km from neighbouring nests (Rowley and Chapman 1991). This species feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of saltbush, wattles and cypress pines (DECCW 2010). Pink Cockatoos are normally found in pairs or small groups, though larger flocks may be found where food is abundant. The decline in native food plants due to agricultural expansion, the illicit bird trade and loss of nesting habitat have been implicated in the decline of this species.

The Superb Parrot occurs in Box-Gum grassy woodland and open forest, and also on the edges of these habitats. This species is long lived with low fecundity and requires tree hollows for nesting (Gibbons and Lindenmayer 2002). Superb Parrots utilise Box-Gum Woodland for foraging and breeding (summer), mostly nesting in dead trees, particularly Blakely's Red Gum (Manning et al., 2006; Webster, 1988). It appears even isolated paddock trees are important nesting habitat for this species (Manning et al. 2006). The breeding distribution for this species stretches from Orange in the north to Wagga Wagga in the south, although birds can be found foraging further north out of the breeding season.

The Superb Parrot forages on the ground or in trees, feeding on lerp, mistletoe berries, eucalypt flowers and grass seed (Higgins, 1996). Like the Superb Parrot, the Turquoise Parrot is endemic to eastern Australia. The species occurs in eucalyptus woodlands and open forests, with a ground cover of grasses and low understorey of shrubs. The species has also been recorded in a variety of other

habitats, including savannah and riparian woodlands and farmland, preferring edges of forest and pasture or other grassland (NPSW, 1999). The Turquoise Parrot feeds on the seeds of grasses, herbaceous plants and shrubs and requires a reliable supply of drinking water (Higgins, 1999). Nests are usually less than two meters above the ground and may be located in hollows of small trees, dead eucalyptus or in holes or stumps, fence posts or even logs lying on the ground (Quinn & Baker-Gabb, 1993)

Threats for both species include: habitat loss (including breeding, foraging and roosting areas), degradation (including overgrazing) of habitat, fragmentation of habitat and loss of hollow bearing trees. Competition from aggressive generalists over foraging and nesting areas may be exacerbated by forest fragmentation and the decline of important habitat features, such as hollows (Higgins 1996; NSW Scientific Committee 2008; Manning et al. 2006).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The Proposal has the potential to impact potential breeding habitat for Pink Cockatoos, Superb Parrots and Turquoise Parrots in the form of the removal of isolated hollow bearing trees. A lesser impact is the loss/modification of foraging habitat.

Two pairs of Superb Parrots were observed flying over the central woodland stands from south to north. No Pink Cockatoos or Turquoise Parrots were recorded however numerous records for Pink cockatoos exist in and around Nyngan and Turquoise parrots have been recorded 50km to the west and south of the subject site.

Superb Parrot breeding onsite is unlikely as the core breeding zone for this species lies over 200km to the south of the site (Birds Australia 2009, DEWHA 2010). Pink Cockatoos choose nesting sites in large, shallow, high hollows (Rowley and Chapman 1991) and none of the trees to be removed display hollows with these characteristics. Turquoise Parrots nest in small, low hollows, occasionally in fallen logs. The isolated trees to be removed are unlikely to be chosen for nesting sites if this species breeds in the locality.

In terms of foraging habitat, the loss of up to 244 ha of pasture and cultivated paddocks would not be considered to impact these species due to the abundance of this habitat in the area.

Hollows with signs of parrot nesting (chewing around the entrance) were noted in the southern boundary of Area B2 (refer to Appendix B, habitat assessment 8) however it was not possible to identify the species using these hollows at the time of the survey. These trees would not be cleared by the proposal. The hollow bearing trees to be removed are unlikely to be used as breeding sites for these species and displayed no signs of occupation by any parrot species. Considering the numerous hollows found in the adjacent Black Box woodland (in the vicinity of 60 hollows per ha) and if mitigation measures, such as pre clearance checks and avoidance of works during the breeding season for these species, are undertaken it is unlikely that any of these three species would be negatively impacted by the Proposal.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

iii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) The proposal would impact up to 244ha of native pasture and remove up to 27 hollow bearing trees.

i) The Proposal would not increase habitat fragmentation for these mobile species.

ii) In terms of foraging habitat, the loss of up to 244ha of pasture and cultivated paddocks would not impact these species due to the abundance of this habitat in the area. Up to 27 hollow bearing trees could be removed by the Proposal, however these are unlikely to be used for nesting considering the quality of the hollows and the number of less disturbed alternative hollows in the adjacent woodland.

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

No areas of critical habitat have been declared for these species.

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

No recovery plans have been prepared for these species

Kultarr (*Antechinomys laniger*) and Stripe-faced Dunnart (*Sminthopsis macroura*)

Ecological information

Terrestrial and strictly nocturnal, the Kultarr shelters by day in logs or stumps, beneath saltbush and spinifex tussocks, and in deep cracks in the soil at the base of Acacia and Eremophila trees. It is also found in the burrows of other animals, such as trapdoor spiders and hopping mice, goannas and agamids, but it is not known whether they dig their own burrows in the wild (NPWS 2002). The Kultarr is largely insectivorous, feeding on invertebrates such as spiders, crickets and cockroaches. The species is distributed across arid and semi arid Australia although in NSW most recent sightings come from the region around Cobar.

Habitat of the Kultarr is generally described as sparsely vegetated arid and semiarid plains on stony, sandy and clayey soils. Specific habitat types include gibber plains, open shrubland, mallee woodland, hummock grassland, flood plains, stony areas with sparse ground cover, and acacia shrubland and woodland (particularly Mulga) with sparse groundcover (NPWS 2002). The preferred habitat type of the Kultarr is not known. However, the eastern Australian subspecies appears to prefer sparsely vegetated claypans among Acacia woodland, while the central and Western Australian form prefers stony, granite plains dominated by Acacia, Eremophila and Cassia shrubland (Valente 1995).

Stripe-faced Dunnarts occupy a vast area of central and northern Australia and are found in many habitats in arid regions. They occur in low Chenopod shrublands, in tussock grasslands on clay, sandy or stony soils, in spinnifex grasslands, sparse Acacia shrublands, on open salt lakes and on low, shrubby, rocky ridges. Despite this diversity of potential habitat, the densest populations seem to occur in shrubland and tussock grasslands where grazing stock are sparse or absent (Van Dyke, 2008). During periods of hot weather they shelter in cracks in the soil, in grass tussocks or under rocks and logs (DECC 2005). Like the Kultarr, this species is strictly nocturnal and feeds on invertebrates and occasionally small mammals and lizards. Individuals are able to disperse long distances, with movements of up to 2km per night recorded (Van Dyke, 2008).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

One record of the Stripe-faced Dunnart exists approximately 80km to the north west of the subject site. Numerous records of the Kultarr also exist in this area to the west of the Bogan River and the area around Cobar appears to be a strong hold for the species in NSW. The closest records to the subject site lie 20km to the west.

The long term grazing and cultivation of the subject site has compromised the habitat for both these species. In addition to the direct impacts on native vegetation quality and species composition, stock trampling, particularly by cattle, has the potential to destroy burrows and kill individuals. The subject site did not possess sufficient cover (in the form of logs, burrows, thick undergrowth or cracks) to support either of these species. Populations of both of these species are prone to local extinction following flooding. As the subject site has suffered flooding in the past and the likelihood of recolonisation for either species is low, considering the modification of the site and lack of local records, it is unlikely that either species would be found on the subject site. The removal of up to

26.8ha of pasture and cultivated paddocks would not negatively impact either species, should a viable local population occur.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

v) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

i) Up to 244 ha of native pasture and cultivated paddocks would be potentially modified by the installation of the PV arrays.

ii) The perimeter fence would not restrict movements for these small species and the areas under the PV arrays would not be any less suitable for movement than the existing pasture. No areas of habitat would be fragmented or isolated by the Proposal.

iii) As discussed the modification of the subject site by agricultural practices has removed shelter habitat for these species. Recolonisation of the site by dispersing individuals is unlikely due to the lack of local records and sustained cultivation and grazing by stock. As such the Proposal would not impact any habitat likely to be used by Stripe-faced Dunnarts or Kultarrs.

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

No areas of critical habitat have been declared for these species.

f) whether the action proposed is consistent with the objectives or action of a recovery plan or

threat abatement plan

A recovery plan for the Kultarr has been approved and has the general objectives preventing the continuing decline in population numbers and increase the size of selected representative populations through appropriate management across the range of the species within NSW (NPWS 2002). The Proposal is not inconsistent with these objectives.

Greater Long-eared Bat (*Nyctophilus timoriensis*), Little Pied Bat (*Chalinlobus picatus*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

The Greater Long-eared bat is known to inhabit a wide variety of vegetation types including open woodlands (Churchill2008). This species is a low flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground (DECCW 2010). Greater Long-eared bats roost in tree hollows, under loose bark and in fissures in branches (Churchill 2008).

Little is known about the ecology of Little Pied Bats which are one of the few bats to occur primarily in the arid and semiarid areas of eastern Australia. This species was thought to be a cave and rock-outcrop roosting species but subsequent captures suggest it also uses tree hollows, mine shafts and tunnels, and abandoned buildings (Ayers et al. 1996). The Little Pied Bat has been found in a wide variety of woodland and forest habitats in western NSW and needs ready access to water in a creek and/or tank (Smith et al. 1998).

The Yellow-bellied Sheathtail-bat is found in almost all habitats from woodland to forest to grassland. This species migrates to southern Australia in the summer. It roosts and breeds in hollow trees with colonies of up to 30 individuals recorded (commonly around six) (Churchill 2008). There is speculation that the larger colonies of this species may occur where habitat is limiting as a colony of 29 individuals was found in an isolated paddock tree in cleared grazing land (Rhodes and Hall 1997).

Test of significance

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

No microbat survey was attempted during the fauna survey due to the winter timing of the work, however habitat assessments found suitable habitat roosting habitat for the Greater Long-eared bat, Little Pied Bat and the Yellow-bellied Sheathtail-bat on or adjacent to the site. Little Pied Bats have been recorded within 10km to the south of the subject site and there are three records of Yellow-bellied Sheathtail-bats 15km to the north. There are only three records of Greater Long-eared bats within 100km of the subject site and the closest of these is 50km to the west. The major potential impact to microbats from the Proposal is the loss of hollow bearing trees that provide potential roost sites for these species. Lesser impacts include the removal of a farm dam in Area B1 and the loss of foraging habitat in the form of the isolated shade trees to be removed.

Hollows were common in the Black Box woodland adjacent to the subject site (a randomly selected 50m x 50m plot yielded 5 hollow bearing trees with a combined total of 17 hollows equalling a hollow

density 68 hollows per hectare) and it is therefore unlikely that the removal of 27 isolated hollow bearing shade trees would have a significant impact on local populations of these species due to habitat loss. There is a potential for the mortality of a significant number of microbats should a tree containing a roosting colony be felled. However if a tree removal policy, including pre clearance checks by a qualified ecologist, is adopted the probability of an incident such as this occurring is low.

If the mitigation measures detailed in this report are adopted, and considering the extent of the potential habitat to be removed, the Proposal is unlikely to have any significant impact on local microbats populations.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

vii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or

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

Not applicable.

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

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

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

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

ii) A total of 27 hollow bearing trees would be removed by the Proposal.

iii) The Proposal would not increase habitat fragmentation for these mobile species.

iv) The habitat to be removed, in the form of isolated shade trees is considered marginal for Greater Long-eared bats, Little Pied Bats and the Yellow-bellied Sheathtail-bats especially given the adjacent woodland surrounding the subject site. The removal of the farm dam in Area B1 may reduce foraging quality for local individual bats however alternative water sources exist in the form of a large dam 800m to the west, a farm dam 1km to the southeast and the Bogan River, 2.1km to the west.

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

directly or indirectly)

No areas of critical habitat have been declared for these species.

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

No recovery plans have been prepared for these species

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

Three listed Key Threatening Processes are relevant to this Proposal.

1. **Clearing of native vegetation**. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'. Clearing can lead to direct habitat loss, habitat fragmentation and associated genetic impacts, habitat degradation, loss of the leaf litter layer increased habitat for invasive species and off-site impacts such as downstream sedimentation.

   The Proposal would not contribute significantly to the operation of clearing as a threatening process at the local or regional level, since the bulk of the subject site is already cleared of tree cover and given the depauperate condition of the nature pasture that would be affected by the works. The design of the infrastructure layout has been carefully planned to minimize the requirement for clearing any significant vegetation.

2. **Loss of hollow-bearing trees.** In NSW, terrestrial vertebrate species that are reliant on tree hollows for shelter and nests include at least 46 mammals, 85 birds, 32 reptiles and 16 frogs (Gibbons and Lindenmayer 1997, Gibbons and Lindenmayer 2002). Of these, 45 species are listed as threatened. Hollow-nearing trees are in decline for reasons including lack of recruitment and clearing. Trees bearing large hollows in particular are increasingly rare. Generally hollow-bearing trees near riparian habitat are most valuable.

   Hollows were abundant in the woodland adjacent to the subject site. The design of the infrastructure layout has been carefully planned to minimize the requirement for clearing any significant vegetation including hollow bearing trees. Up to 27 hollow bearing trees would be removed by the Proposal, however these trees are of low habitat value due to their isolated locations. Due to the limited number of trees to be removed and considering the abundance of hollows adjacent to the subject site the Proposal would not significantly increase the impact of this threatening process.

3. **Removal of dead wood and dead trees.** The removal of standing or fallen dead wood removes hollows as well as forest floor litter.

   The limited clearing required is not expected to significantly exacerbate this threatening process in the study area. It is recommended that trees cleared by the proposal be laid in the adjacent woodland to provide habitat for Brown Treecreepers, Grey-crowned Babblers and Bush Stone-curlews.

Conclusion

Flora and ecological communities

This assessment concludes that impact to generally poor condition and low conservation value Coolibah – Black Box Woodland EEC and Myall Woodland EEC will occur as a result of the Proposal. This impact would occur in the form of the modification of up to 162 ha of native pasture, 57 ha of cultivated paddocks, the removal of up to 50 isolated remnant trees. The impacts to these EECs would not be significant in the local context, given the poor condition of the vegetation, the limited scale of the impacts and the local abundance of similar vegetation.

The Proposal is not likely to adversely affect the cycle of threatened flora species such that a viable local population is likely to be placed at risk of extinction, subject to the findings of a supplementary spring survey.

Fauna

As discussed in the assessments above the Proposal is unlikely to negatively impact on any threatened fauna species if the mitigation measures detailed in this report are adopted.

A.2 ASSESSMENTS UNDER THE EPBC ACT (COMMONWEALTH)

The following assessments of significance are undertaken according to the Significant Impact Guidelines for Matters of National Environmental Significance listed under the *Environment Protection and Biodiversity Conservation Act 1999*, for the following species with potential to occur (and thereby be impacted).

Common name	Scientific name	Status
FLORA		
Red Darling-pea	*Swainsona plagiotropis*	V TSC, V EPBC
Slender Darling-pea	*Swainsona murrayana*	V TSC, V EPBC
FAUNA		
Superb Parrot	*Polytelis swainsonii*	V TSC, V EPBC

Vulnerable Species Assessment - Red Darling-pea (*Swainsona plagiotropis*) and Slender Darling-pea (*Swainsona murrayana*)

Please refer to the TSC Act assessment for ecological information used herein.

Will the action ...

a) *Lead to a long-term decrease in the size of an important population?*

The Red Darling-pea and Slender Darling-pea were not detected within the subject site however, the winter timing of the survey was not appropriate for detecting these species. A spring survey is required to determine their presence or absence and to accurately determine whether an important population occurs at the site.

b) Reduce the area of occupancy of an important population?

See part a) above.

c) Fragment an existing population into two or more populations?

See part a) above.

d) Adversely affect habitat critical to the survival of a species?

The potential habitat for these species within the subject site has a long history of grazing and cropping. In view of the degraded state and disturbance history of the potential habitat that will be impacted by the Proposal, its value is considered low. The habitat that will be impacted by the Proposal is not considered critical to the survival of these species.

e) Disrupt the breeding cycle of an important population?

See part a) above

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

The Proposal will result in the clearance of 26.8 hectares of suitable habitat for this species for the construction of access tracks, cable trenching and the siting of laydown areas and buildings. A further 61.2 hectares will be modified from the installation of the PV array, resulting in alterations to the microclimate of potential habitat for these species. Large areas of suitable habitat occur outside of the subject site that have not been subject to the same degree of disturbance and modification as the areas within the site. It is unlikely that the Proposal would impact on the availability or quality of habitat such that the species is likely to decline however, this assessment should be confirmed during a follow up survey in spring. If the Red Darling-pea or Slender Darling-pea do occur in areas where the PV array is to be installed, it is possible that the modification of the microclimate may reduce the quality of the habitat for these species such that they decline within the subject site.

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

Minor pasture weeds are common across the site along with the declared noxious weeds, African Boxthorn and Bathurst Burr. The Proposal has the potential to introduce and/or further distribute weeds within the subject site through the movement of vehicles, people and equipment. Mitigation measures have been described in Section 8 of this report to minimise the impacts from invasive species. Given the current level of disturbance and providing the recommendations contained within this report are adhered to, it is unlikely that the Proposal will result in additional harmful invasive species becoming established in the habitat of these species.

h) Introduce disease that may cause the species to decline?

The movement of vehicles, plant, equipment and people on and off the subject site has the potential to introduce disease that may impact upon these species. Mitigation measures have been described in Section 8 of this report to minimise the introduction or spread of weeds. These measures would also reduce the likelihood of introducing or spreading disease. Providing the recommendations contained within this report are adhered to, it is considered unlikely that disease would be introduced which may cause the species to decline.

i) Interfere substantially with the recovery of the species?

The majority of the habitat suitable for this species is in a disturbed and degraded state. The recovery potential of these areas is low and it is unlikely that the species would recolonise these areas with current land management practices. Areas of higher quality habitat would be avoided and protected during the proposed works and recovery of the species would be possible in these areas. Large areas of similar and more suitable habitat occur within the locality. The Proposal is unlikely to interfere with the recovery of the Red Darling-pea or the Slender Darling-pea.

Vulnerable Species Assessment- Superb Parrot (*Polytelis swainsonii*)

Please refer to the TSC Act assessment for ecological information used herein.

Will the action ...

a) *Lead to a long-term decrease in the size of an important population?*

Superb Parrots breeding range extends in a triangle bounded by Molong, Yass and Young and along the Murray and Murrumbidgee Rivers in NSW (see Figure 5-2). In winter the species appears to disperse from the breeding areas and can be found in central northern NSW (DEWHA 2010).

The proposed development has the potential to cause habitat alienation by increasing human activity adjacent to potential breeding sites and potential breeding habitat may be physically removed during construction (a total of 27 hollow bearing trees). However, the hollows to be removed are unlikely to be used by parrots as breeding sites as this species prefer to breed over 200km to the south east in areas of open woodland where Blakely's Red Gum is a major component (Manning et al. 2006). The Proposal would be unlikely to negatively impact this species.

b) Reduce the area of occupancy of an important population?

The proposal is unlikely to reduce the area of occupancy of an important population as the site is outside the core breeding area for this species and foraging and breeding habitat is abundant in the locality.

c) Fragment an existing population into two or more populations?

The Proposal would not fragment any populations of this highly mobile species.

d) Adversely affect habitat critical to the survival of a species?

While isolated hollow bearing trees are important for the viability of Superb Parrot populations (Manning and Lindenmayer 2009) the habitat that will be impacted by the Proposal is unlikely to be utilised by this species as discussed in a) above.

e) Disrupt the breeding cycle of an important population?

See part a) above

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

The Proposal will remove 27 hollow bearing trees and 26.8ha of pasture and cultivated land. As discussed above, this would not be likely to impact this species considering the abundance of this habitat in the locality.

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

The proposal would be unlikely to introduce any invasive species that does not already exist in the locality. The implementation of weed controls as described in Section 8 would minimise the risk of introducing any invasive weeds.

h) Introduce disease that may cause the species to decline?

Psittacine beak and feather disease (BFD) is a potential threat to Superb Parrots, however the development is unlikely to cause an increase in this disease and the main threat lies with disease spread via common parrot species in the local area.

i) Interfere substantially with the recovery of the species?

Given the information presented above and the recommendations given in Section 8, the proposed development is not considered likely to interfere substantially with the recovery of the subject species.

Appendix B HABITAT EVALUATION

HABITAT EVALUATION

A total of 26 habitat evaluations targeting threatened species habitat were undertaken within and adjacent to the subject site. These evaluations included 10 onsite assessments and 16 assessments in habitat surrounding the subject site. Results of these assessments are found below and were used to inform the threatened species evaluation which identifies the threatened species with potential to be impacted by the Proposal. The locations of these assessments are shown in *Figure 9-1 Fauna habitat assessment points.*