Wollar Solar

Amendment Report

WOLLAR SOLAR FARM

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NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622)

www.nghenvironmental.com.au e: ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
8/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Brisbane
suite 4, level 5, 87 wickham terrace
spring hill qld 4000 (t 07 3129 7633)

Newcastle - Hunter and North Coast
7/11 union st
newcastle west nsw 2302 (t 02 4929 2301)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Bega - ACT and South East NSW
suite 1, 216 carp st (po box 470)
bega nsw 2550 (t 02 6492 8333)

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1 INTRODUCTION

1.1 BACKGROUND

An Environmental Impact Statement (EIS) for the Wollar Solar Farm proposal (NGH Environmental, 2019a) was prepared on behalf of the proponent and was submitted to NSW Department of Planning Infrastructure and Environment (DPIE) in March 2019. The EIS was placed on public exhibition from 10 April 2019 to 7 May 2019.

Key environmental issues investigated in the EIS, based on the requirements of the Secretary's Environmental Assessment Requirements (SEARs), included:

- Biodiversity impacts;
- Aboriginal heritage impacts;
- Land and soil resources;
- Compatibility of the proposal with existing land uses; and
- Hydrology and flooding impacts.

A Submissions Report was lodged in September 2019 addressing community and agency submissions.

1.2 PURPOSE OF THIS DOCUMENT

The purpose of this document is to describe any substantive changes made to the Project since the public exhibition of the EIS and provide an updated environmental assessment, where required, to address these changes.

The change now proposed is an alternative site access option; "Southern Access Option 2".

This Amendment Report details the justification for and impacts of this alternative access route. It considers the requirement for additional mitigation measures, to address the alternative access route.

2 PROPOSED AMENDMENT

The Wollar Solar Farm proposal remains generally as detailed in Section 4 of the EIS (NGH Environmental, 2019). However, one change is proposed; in the event that heavy vehicle access is not feasible during the construction phase using the Northern Access indicated, an alternative access option, referred to as the Southern Access Option 2, would be utilised.

2.1 ACCESS PROPOSED IN THE ENVIRONMENTAL IMPACT STATEMENT

The EIS proposed two access options; a Northern Access and a Southern Access shown in Figure 2-1 below as Northern Access and Southern Access Option 1. The Northern Access was assessed for use by all vehicles, including heavy and oversized vehicles during construction and operation. The Southern Access Option 1 was assessed for use during construction and operation, with vehicle use limited to light vehicles only.

2.2 ACCESS PROPOSED IN THIS AMENDMENT

An alternative access, termed the Southern Access Option 2, is now proposed that would be constructed in the event that Northern Access cannot be used for site access. Southern Access Option 2 is presented in Figure 2-2 (close up). The proposal site access points for each access options is shown in Appendix E in the context of the proposal's environmental constraints.

If required, Southern Access Option 2 would allow heavy vehicle construction access via Barigan Road and the (Maree Road) road reserve. Southern Access Option 2 would only be used if Option 1 could not be used. Approximately 1.8 km of heavy vehicle access for the Northern access would not be developed in this case. The inclusion of this alternative access option would increase the development footprint by up to 2 ha, to a total of approximately 463 hectares.

It should be noted that the development footprint has now been reduced surrounding the current Maree Road alignment to include a 12m corridor. The amended area can be seen in Figure 2-4 as Southern Access Option 1.

2.2.1 Amendment detail and assessment approach

The nature and extent of road upgrades required for Barigan Road and Maree Road have been investigated by Amber traffic consultants in consultation with MWRC in the Addendum Traffic Impact Assessment (TIA) provided in Appendix A. A summary of the upgrades required for Barigan Road and (Maree Road) road reserve is provided below.

Barigan Road

- Road widening including:
    - Widening to achieve a 7 m wide pavement to allow for safe simultaneous two-way traffic movement in areas of Barigan Road where the pavement is less than 7m in width.
    - Widening to accommodate the swept path assessment provided in the Addendum TIA (Appendix A) to allow for safe simultaneous two-way traffic movement at bends and access intersections.
    - Sealing of Barigan Road between Wollar Road and Maree Road

A 12 m wide corridor of Barigan Road has been proposed for impact to provide flexibility for traffic management and engineered designs which will be determined via a competitive tender process, by the Engineering, Procurement and Construction contractor, once appointed and pending approval.

Should Northern Access and Southern Access Option 1 be utilised, the above upgrade requirements would only be needed between the Barigan Road/Wollar Road intersection up to the Northern Access option entry point. In the event that the Northern Access and Southern Access Option 1 are used, heavy vehicles would not be permitted beyond the Northern Access point.

Maree Road (road reserve)

- Full road construction of approximately 1 km to unsealed road standard with a recommended width of 7 m.

In this assessment, the worst case impacts for Maree Road and Barigan Road have been assessed for environmental impacts. Refer to Figure 2-1, Figure 2-2 and Figure 2-3 amended development footprint.

These include all areas where infrastructure / road upgrades may be located. Figure 2-4 shows the close up of all access options.

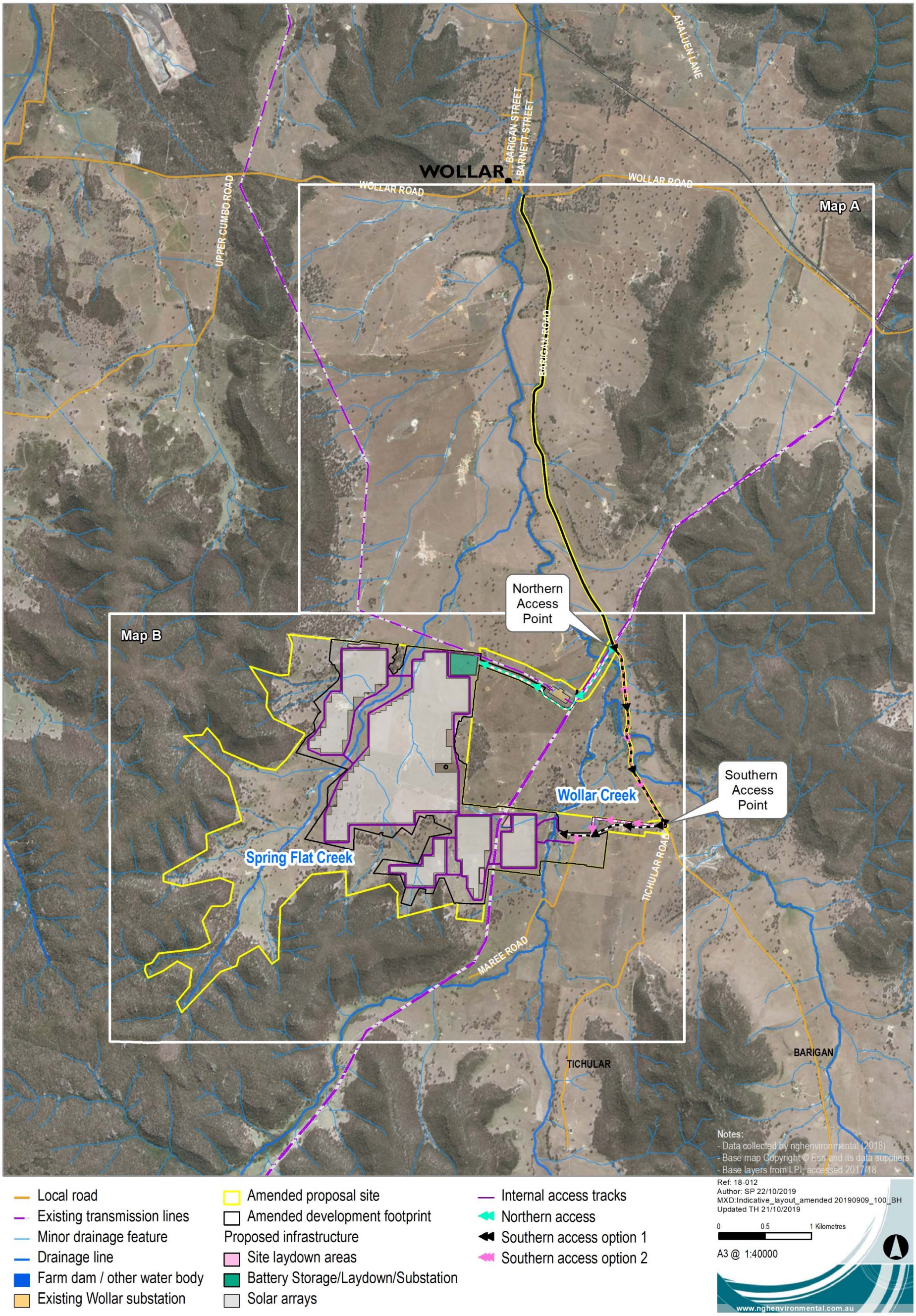


Figure 2-1 Overview of proposed amendment to the development footprint including access options (Northern Access, Southern Access Option 1 as presented in the EIS) and Southern Access Option 2 proposed within this Amendment Report

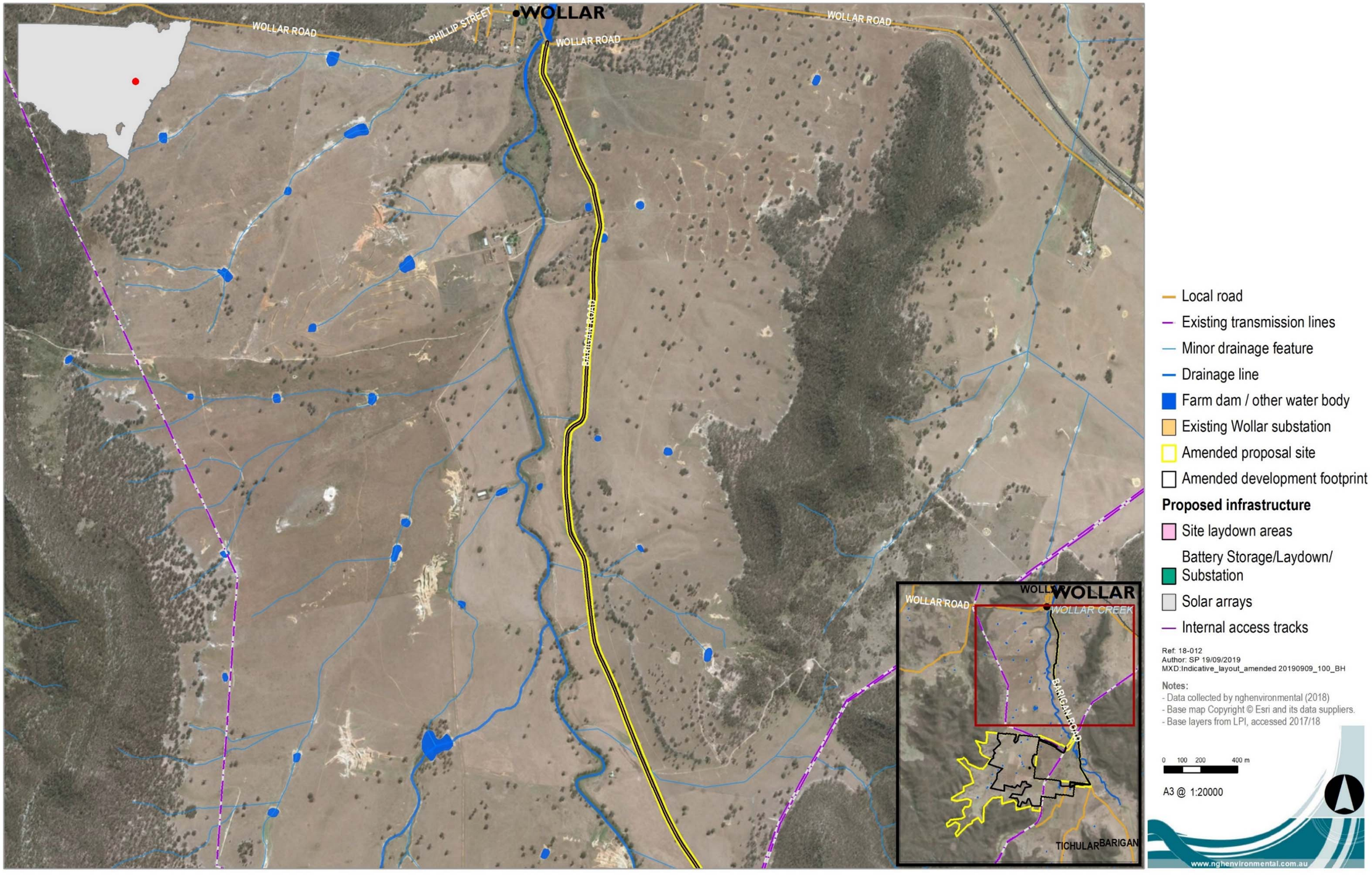


Figure 2-2 Map 1 showing proposed amendment to development footprint to include Barigan Road from its intersection with Wollar Road

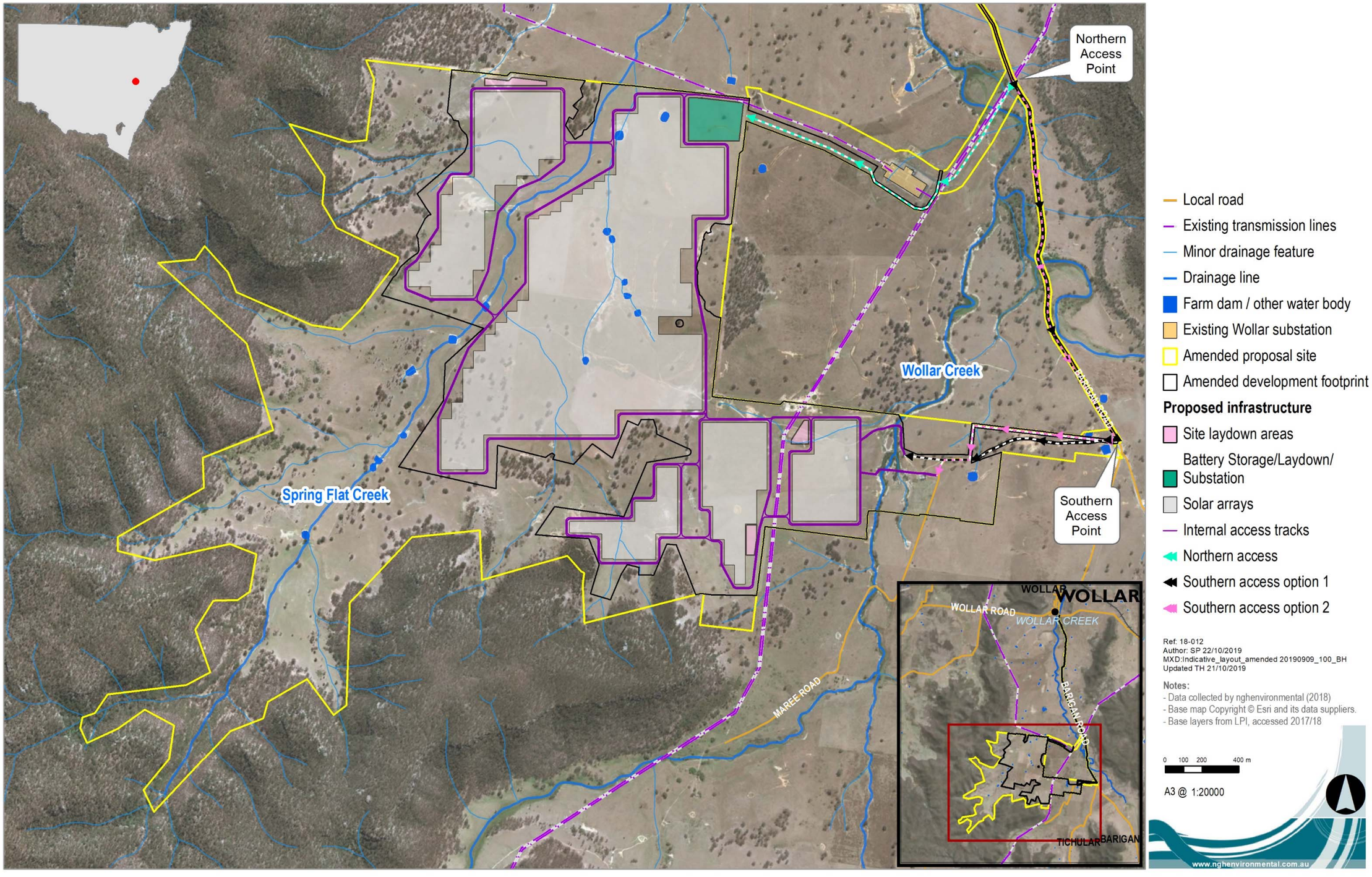


Figure 2-3 Map 2 showing proposed amendment to development footprint including Barigan Road up to the southern access point

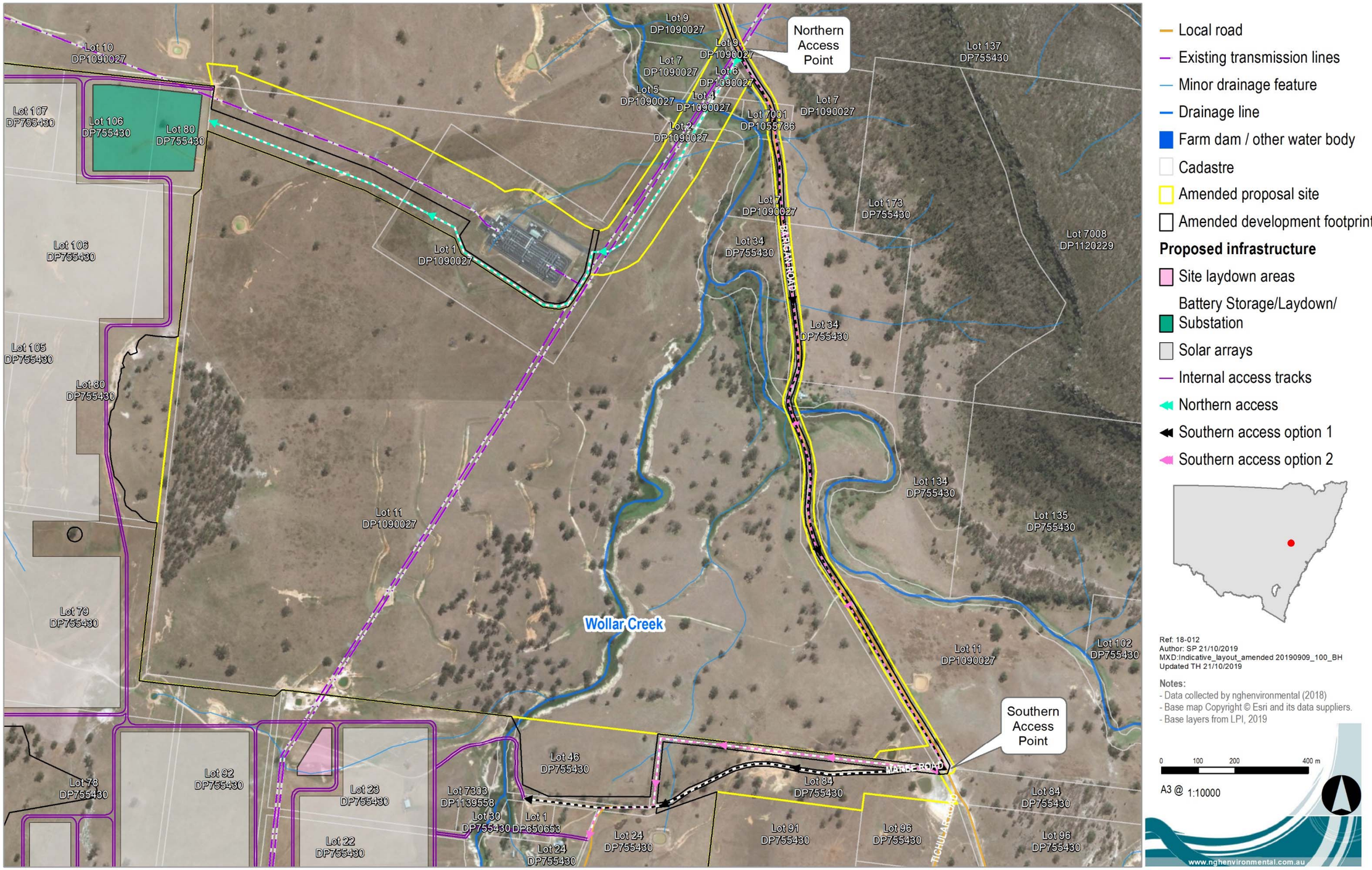


Figure 2-4 Close up perspective of access points including Southern Access Option 2 route within the unformed (Maree Road) road reserve proposed within this Amendment Report.

3 JUSTIFICATION FOR THE AMENDMENT

The Northern Access and Southern Access Option 1 remain the preferred access options. They include proposed upgrades to Barigan Road between Wollar Road and the TransGrid access road within the existing road reserve, as set out in Section 2.2.1. Southern Access Option 2 would only be constructed if land tenure cannot be secured for the Northern Access and Southern Access Option 1.

Southern Access Option 2 is being added to the project description to ensure legal access to the proposal site as the existing access relies on one property owner that is not project involved. While the amended access proposed is not the preferred access route, it will provide the project with required certainty, regarding the ability to access the site.

4 ENGAGEMENT UNDERTAKEN

Consultation regarding this amendment has been undertaken as set out below.

Mid-Western Regional Council (MWRC)

The proponent, traffic (Ontoit) and environmental assessment (NGH Environmental) consultants met (via teleconference) with the MWRC on 11 July 2019. Representatives from MWRC included the Planning and Development Team, Director of Operations and Development Engineer. The agenda of the meeting was:

- Introduction by proponent; why the project requires the second heavy vehicle access.
- Assessment context by NGH Environmental: where the project is up to and how this fits into the assessment and approval process.
- High level road upgrade requirements proposed by Ontoit, sourcing specialist engineering advice.
- Open discussion.

The outcomes of the meeting were as follows:

- Impact assumptions Barigan Road, south of the substation access. Ontoit explained that there were a range of upgrade options available to facilitate Southern Access Option 2 as the primary construction access, if required. NGH Environmental explained that the least impact scenario for Barigan Road had been assessed for environmental impacts. Any increased impacts (such as greater road formation impacts on Barigan Road) would need to be assessed via a Modification Application for the project. The balance between traffic management and engineered solutions will be a matter for the Engineering, Procurement and Construction contractor, once appointed, pending approval.
- Impact assumptions Maree Road. Ontoit explained that this would require construction of a 7m formed road, to facilitate Southern Access Option 2 as the primary construction access. NGH Environmental explained that the worst case impacts for Maree Road had been assessed for environmental impacts. This included heritage and biodiversity field assessments.
- Required road standards. MWRC noted that the 8m formation and 10m formation were required for Beryl Solar Farm, currently under construction, was appropriate for that location and road type. It was agreed that Barigan Road, as a rural no through road (with around six properties on the road), has very much lower local traffic volumes.

- Road safety. MWRC noted that safety concerns for all road users would always be their primary concern.
- Water supply. MWRC noted that water supply was currently limiting road grading activities within the Council area in general. The question was asked did the project have sufficient water to provide for the construction program, given the water requirements for road construction and maintenance. NGH provided some information that will appear in the Submissions Report regarding water requirements and sources. It was agreed that the Southern Access Option 2 would increase the water requirements of the project. Most of this would relate to the 1km of new formation for Maree Road.
- Council assets. MWRC noted that as long as the new formation for Maree Road (approximately 1 km) was built to Council standard and left in a suitable condition, Council is unlikely to have an objection to managing this as a new Council asset.
- Road alignment. Use of the Maree Road reserve (paper road) will include at least one right angle bend. Council noted that the road reserve width should be capable of providing for a geometric pavement design that would accommodate large vehicles. It was noted the existing (paper road) easement is one chain or 20.12 metres wide.
- Public consultation. Council asked if the Amendment Report would be publicly exhibited. It was noted that this is DPIE's decision however given the high level of support and lack of public objections to the project, it may not be exhibited.

Overall, Council were not opposed in principle to the development of the Southern Access Option 2, if this is required to be used as the primary construction access. However, their support would be subject to the issues above being satisfactorily addressed[1].

Following the meeting, Council was provided with the draft Amendment Report outlining the proposed changes to the project in relation to road upgrades and safety measures. As a result, the following occurred:

- Amber was engaged in August 2019 to prepare an Addendum TIA to further address specific Council concerns.
- A representative from Amber undertook a site inspection on 22 August 2019 with Mid – Western Regional Council's Development Engineer. The site inspection included a detailed discussion of Council's concerns and a drive through of the access routed proposed.
- Amber provided Council with a swept path assessment (provided in Appendix A) demonstrating areas within Barigan Road proposed for upgrade on 28 August 2019 and 2 September 2019.
- On 3 September 2019, Amber and Council's Development Engineer met by telephone to confirm in principle endorsement of the proposed widening areas provided in the Addendum TIA (Appendix A).
- A draft Addendum TIA was provided by email to Council's Director Development and Development Engineer welcoming feedback and requesting endorsement of the recommendations made in the Addendum TIA prior to lodging the documents with DPIE.

Following MWRCs review of the draft Addendum TIA and Submissions Report V1, an additional meeting was undertaken on 1 October 2019, those who attended were:

- Julie Robertson (MWRC)

[1] Council staff who attended this meeting provided permission to publish the minutes above and agreed they were an accurate representation of the meeting; email J. Robertson 16/07/2019 4:18 PM.

- David Webster (MWRC)
- Gary Hemsworth (MWRC)
- Mike Willson (Amber traffic consultants)
- Rhyson Li (WSD)
- Bruce Howard (WSD)
- Louiza Romane (NGH)
- Nick Graham – Higgs (NGH)

The meeting included a discussion of the proposed upgrade requirements for Barigan Road including:

Southern Access Option 2 (Barigan Road)

- With reference to the *Unsealed Roads Manual: Guidelines to Good Practice* (2009), it was noted that the proposed peak construction traffic (9 month period) would exceed the average traffic for gravel roads by 31 vehicles. As such, MWRC are of the view that Barigan Road requires a bitumen seal for areas proposed for use by heavy vehicles.
- This issue was noted and will be picked up once WSD have been provided with a cost estimate for MWRC to undertake works required to seal Barigan Road.

Southern Access Option 2 (Maree Road)

- In relation to the construction of a new road within the (Maree Road) road reserve, it was agreed that an unsealed 7 m wide road would be required and that maintenance would be at the cost of the contractor. No further discussion surrounding Maree Road was considered to be required.

4.1 REGISTERED ABORIGINAL LAND HOLDERS

An addendum Aboriginal Cultural Heritage Assessment (ACHA) (NGH Environmental 2019c) was completed for the Southern Access Option 2 (described in the report as 'Eastern expansion area' and 'Barigan Road upgrade').

Consultation with the Aboriginal community was continuous from the initial project and followed the process outlined in OEH's Aboriginal cultural heritage consultation requirements for proponents 2010. BCD was informed about the proposed expansion of the development footprint and subsequent addendum report, prior to the notification to the Registered Aboriginal Parties (RAPs).

The project has ten Aboriginal groups and an individual recorded as Registered Aboriginal Parties. The groups included:

- North West Wiradjuri Company LTD;
- Murong Gialinga Aboriginal & Torres Strait Islander;
- Buudang;
- Wellington Valley Wiradjuri Aboriginal Corporation;
- Gallaggabang Aboriginal Corporation;
- Mudgee LALC;
- Binjang Wellington Wiradjuri Heritage Survey;
- Barraby Cultural Services;
- Yulay Cultural Services; and
- Yurrandaali Cultural Services.

The RAPs were informed of the proposed changes to the development footprint in the area referred to as the Eastern Expansion area in April 2019 and about the proposed Barigan Road upgrade in August 2019.

The methodology for the proposed survey of the Eastern Expansion area and Barigan Road upgrade area was noted to be in line with that proposed during the completion of the original solar farm assessment and would include survey with selected RAPs. The RAPs who participated in the initial ACHA survey were then asked to participate in the additional surveys of the Eastern Expansion area and Barigan Road upgrade area given that these were outside the area assessed in the original Wollar Solar Farm ACHA, presented in the EIS.

The fieldwork covering the Eastern Expansion area was carried out on the 9th of April 2019 by an NGH archaeologist with two representatives from the Aboriginal community. In April 2019, a draft version of the Addendum Aboriginal Cultural Heritage Assessment was forwarded to each registered Aboriginal party inviting comment on the results, the significance assessment and the recommendations. A minimum of 28 days was allowed for responses to the document. Comments included:

- Wellington Valley Wiradjuri Aboriginal Corporation and Gallaggabang Aboriginal Corporation provided a joint response in writing via a letter dated the 22 April 2019. Both groups noted that they agreed with the findings of the report and the recommendations. No further comments were provided.
- Barraby Cultural Services replied via email on the 23 April 2019 that they had received the document however no further comments were provided.
- Report feedback was provided in writing via email from Murong Gialinga Aboriginal & Torres Strait Islander on the 20 May 2019 who did not raise any issues with the report or its recommendations. No further comments were provided.
- Report feedback was provided in writing via email from Paul Brydon on the 22 May 2019 who did not raise any issues with the report or its recommendations. No further comments were provided.
- No feedback was received from the North West Wiradjuri Company LTD, Buudang, Mudgee LALC, Binjang Wellington Wiradjuri Heritage Survey, Yulay Cultural Services and Yurrandaali Cultural Services.

The fieldwork covering the proposed Barigan Road upgrade area was then completed on 29th August 2019 by NGH an archaeologist and three RAP representatives.

In September 2019 the addendum report was then updated to include the results of this survey. A draft version of the Addendum Updated Aboriginal Cultural Heritage Assessment Report for the proposed Eastern Expansion area and the Barigan Road upgrade for the Wollar Solar Farm (Appendix C) was provided to the RAPs, for review and comment. A response period of 28 days was allowed for the receipt of comments.

The addendum ACHAR is included in Appendix C and details the consultation process, including involvement in field assessments of the Southern Access Option 2.

5 AMENDED ASSESSMENT

Due to the incorporation of a new area to the development footprint off Maree Road, additional biodiversity, Aboriginal heritage assessments and traffic impact assessment has been have been provided. The following specialist reports have been provided as appendices to this report:

- Addendum Traffic Impact Assessment (Appendix A) (Amber, 2019). The report is summarised in 5.3. Section 2.2.2 of this report sets out the range of upgrades likely to be required to use this access option as provided within the report.
- Updated Biodiversity Development Assessment Report (Appendix B) (NGH Environmental, 2019b). The BDAR submitted in the EIS has been updated to include the additional impacts of upgrades to Barigan Road and constructing a new road within the Maree Road Reserve. This assumes a worst case impact footprint for Maree Road Reserve. This report is summarised in Section 5.1 below, including consideration of Matters of National Environmental Significance.
- Addendum Aboriginal Cultural Heritage Assessment (Appendix C) (NGH Environmental, 2019c). This addendum addresses the worst case impacts of upgrades to Barigan Road and constructing a new road within the Maree Road Reserve. This report is summarised in Section 5.2 below.
- Noise Technical Note (Appendix D) (Renzo Tonin & Associates, 2019). This Technical Note addressed to potential noise impacts arising from updated traffic movement numbers (provided in the Addendum TIA and Appendix F of the Submissions Report) and upgrades proposed for Barigan Road.

These were considered to be the key impact areas affected by the alternative access route. However, Section 5.3 sets out other environmental aspects relevant to the change.

5.1 BIODIVERSITY

The updated Biodiversity Development Assessment Report (BDAR) was prepared by NGH Environmental (NGH Environmental, 2019b). The revised impact to native vegetation within the development footprint is 367 ha and includes impacts occurring as a result of the upgrade of Barigan Road/Maree Road (Southern Access Option 2).

It should be noted that the development footprint has now been reduced in the area surrounding the current Maree Road alignment to include a 12m corridor. The amended area can be seen in Figure 2-4 as Southern Access Option 1. As such, The native vegetation impacts within the development footprint have reduced by 3 ha.

The objectives of updating the BDAR to reflect the alternative access route include:

1. Update assessment and credit requirement pursuant to the NSW Biodiversity Assessment Methodology (BAM) under the *Biodiversity Conservation Act 2016*.
2. Update assessment in regard to MNES under the EPBC Act.

It is noted that the biodiversity impact assessment for this project is based on the worst case scenario in two ways. All vegetation is considered lost due to shading from the solar panels, when in fact the composition of ground cover species is expected to persist largely unchanged. Secondly, it includes the impacts to access option 1 as well as option 2, but if Southern access option 2 is utilised, no clearing would be required for the option 1 routes above.

The updated BDAR assessment assumes a worst case scenario of works for Barigan Road where the road must be road widened to achieve a 7 m wide pavement but the impacted area will include a width of 12 m. If the pavement is less than 7 m, the road will need to be widened to meet this requirement and thus impact the roadside vegetation. Additionally, widening is required to accommodate the swept paths provided in the Addendum TIA (Appendix A).

The vegetation impact on Maree Road has been altered to facilitate Southern Access Option 2. The road construction required maintains a 7 m width for approximately 1 km with the road alignment including at least one right angle bend. The road alignment is linear following the northern boundary till the right hand bend and re-joins the existing Maree Road.

An additional field assessment was undertaken in September 2019 to include Barigan Road and identify any new impact areas. Vegetation zones have accurately delineated and sufficient plot data are entered into the BAM calculations to reflect the additional area. No additional targeted surveys were considered warranted based on the habitat in the new areas. The impacted native vegetation consists of

- 24.59 ha of structural woodland,
- 342.92 ha of derived grasslands and cultivated low condition areas.
- 340.31 ha of vegetation meets the NSW criteria for Endangered Ecological Communities, most (92%) in degraded condition that does not generate offsets.
- 229.59 ha of vegetation that meets the Commonwealth criteria for Critically Endangered Ecological Communities, most (89%) in degraded condition.
- In addition to the 367 ha of native vegetation areas above, the development footprint also contains 5 paddock trees (assessed under BAM).

The impact areas above include five paddock trees inside the Wollar property and fifty six (56) trees inside Barigan road reserve that contain suitable hollows that may be utilised for various threatened species. The paddock trees (as defined under BAM) will also be removed in addition to the native vegetation above.

The updated offset obligation is shown below. It would be met by securing credits in accordance with one of the mechanisms recognised under the *Biodiversity Conservation Act 2016* (NSW). No changes to the mitigation strategies contained in the BDAR were required to accommodate the inclusion of Southern Access Option 2.

Table 5-1 Biodiversity impact of original proposal compared with amended proposal.

	BDAR submitted with EIS	Updated BDAR included in this report	Net change
Area of native vegetation impacted	370 ha	367 ha	-3 ha
Area that meets the NSW criteria for Endangered Ecological Communities	343 ha	340.92 ha	-2.08 ha
Area that meets the Commonwealth criteria for Critically Endangered Ecological Communities	232 ha	229.59 ha	-2.41 ha
Credit requirement (ecosystem credits)	826	713	- 113
Credit requirement (species credits)	0	544	+ 544

The updated BDAR report is provided in Appendix B.

5.1.1 Matters of National Significance (MNES)

As the Wollar Solar Farm proposal is being assessed via a 'streamlined' Commonwealth assessment (considering Supplementary Secretary General's Requirements, issued for the proposal), this section identifies MNES, with reference to Southern access option 2, sourcing the BDAR.

All of the additional impact area (229.59 ha) qualifies as a TEC under the EPBC Act; White Box – Yellow Box – Blakely's Red Gum Grassy Woodland. It occurs as structural woodland and derived native grassland.

No EPBC listed fauna are considered to have habitat present in this area. Relevant species considered include the Regent honeyeater, Large-eared pied bat and Pink-tailed worm lizard.

The MNES offset calculations have been updated to reflect the inclusion of the Southern Access Option 2 (although it is noted that all three options are included as a worst case to obtain an upper limit offset requirement). The updated project requirement is now 413 ha in total comprised of:

- 205 ha for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland, and
- 208 ha for White Box – Yellow Box – Blakely's Red Gum Grassy Woodland Derived native grassland.

Within the development site, in areas that would not be impacted by the development, around 217 ha of this community is available for protection under an offset agreement. Based on available mapping, though not subject to detailed survey, it is estimated that an additional 258 ha remains within study area, that would not be impacted by the development and may provide suitable direct offsets. If suitable, this exceeds the required amount by 62 ha.

5.2 ABORIGINAL CULTURAL HERITAGE

An Addendum ACHA was undertaken by NGH Environmental to investigate and examine the presence, extent and nature of any Aboriginal heritage sites within the Wollar Solar Farm proposal area. Subsequent to the finalisation of the Wollar Solar Farm ACHA, a 2.3 ha area outside the previous heritage assessment was identified in April 2019 for inclusion in the proposed Wollar Solar Farm development footprint. This area is referred to in this addendum report as the Eastern Expansion area. Following investigation of this area, the eastern expansion area has been refined to 0.8 ha and will be referred to herein as the 'Maree Road reserve construction corridor'. The Eastern Expansion area has been assessed in full, however the impact of the proposal will be limited to the (Maree Road) road reserve construction corridor as indicated.

In addition to this area, a second additional area requiring assessment was identified in August 2019 relating to access. Access to the site during the construction of the solar farm will be via Barigan Road and Maree Road, both of which are unsealed local roads. Due to the increased usage which will occur as a result of this project and the nature of the usage – primarily heavy vehicles – an upgrade to Barigan Road including widening is required to improve safety.

The addendum report documents the ACHA undertaken for the additional 2.3 ha for the proposed Eastern Expansion development footprint (which includes the refined 0.8 ha Maree Road reserve construction corridor) and the additional 8.8 ha for proposed upgrade works to Barigan Road, to investigate the presence of any Aboriginal sites, assess impacts to cultural heritage values, and provide management strategies to mitigate any potential impacts within the additional areas. This addendum report is intended to be read in conjunction with the original Wollar Solar Farm ACHA report (NGH Environmental 2018).

Eastern expansion area

While the survey was impeded by poor visibility, a number of exposures were present that were inspected. However, no surface Aboriginal objects or culturally modified trees were recorded.

Discussions were held in the field with the representatives present to assess the potential for subsurface deposits across the proposed eastern expansion area. Based on the land use history, an appraisal of the landscape, soil, level of disturbance and the results from the field survey, it was concluded that there was negligible potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the proposed eastern expansion area. Consequently, subsurface testing is not considered warranted.

The Aboriginal representative present during the fieldwork noted that if any further development or ground disturbance works were proposed outside the assessed areas, then additional assessment would be required.

Barigan Road upgrade

A single survey transect was undertaken on foot by the NGH archaeologist and three representatives from RAPs from the northern end of the proposed road upgrade area to the intersection with Maree Road. Ground surface visibility was high and four artefacts scatters and three isolated finds were identified, containing a total of 44 artefacts. The two largest artefact scatters, containing the majority of the total assemblage, were located in close proximity to the banks of Wollar Creek. All site identified had been extensively disturbed as a result of previous road construction and maintenance.

A total of nine sites, including four artefact scatters and five isolated finds were identified within the Proposed Barigan Road Upgrade Area. All of these sites will likely be subject to impacts as a result of the proposed upgrade works due to the movement of plant and vehicles within the road reserve and the ground surface disturbance required for the road widening.

The addendum ACHA recommends that:

- The proposed Eastern Expansion of the Wollar Solar Farm development footprint as detailed in this addendum report has negligible potential to impact Aboriginal objects.
- The proposed Eastern Expansion of the Wollar Solar Farm development footprint should now be able to proceed without any additional Aboriginal archaeological investigation.
- The proposed Barigan Road Upgrade as detailed in this addendum report will impact nine artefact sites recorded as part of this assessment.
- **The artefacts identified at NGH Barigan AFT 1, 2, 3 and 4; and NGH Barigan IF 1, 2, 3, 4 and 5, must be salvaged prior to the proposed work commencing and moved to a safe area within the Wollar Solar Farm development footprint. Note that this in addition to artefacts referenced in Recommendation 4 of the Wollar Solar Farm ACHA (NGH 2018) which are to be salvaged prior to construction.**
- **The surface collection and relocation of the artefacts must be undertaken by an archaeologist and representatives of the registered Aboriginal parties. The salvage should be consistent with the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* A new site card must be completed once the artefacts are moved to record their new location on the AHIMS database. Note that RAP comments include a request for the option to test excavate where topsoils are present within the impact zone. This will be determined by the proposed road upgrade design (refer to Section 2.1 Table 2-1 of the addendum ACHA).**
- **It is recommended that the proposed upgrade works be designed to avoid subsurface disturbance further than one metre from the edge of the gravel road on the eastern side of Barigan Road**

between NGH Barigan Rd AFT 3 and NGH Barigan Rd IF3. This relates to the presence of topsoil which is present along the side of the road in this location, which has some potential to contain Aboriginal objects.

- **With reference to the Wollar Solar Farm ACHA (NGH 2018), reburial of artefacts is the preferred option for the management of Aboriginal objects recovered during salvage works. Artefacts recovered from Barigan Road should be reburied within the road reserve and as close to their original location/s as possible. The Aboriginal community requests that a Cultural Smoking Ceremony be accommodated to cleanse the salvaged artefacts and the reburial location.**
- WSD should prepare a Cultural Heritage Management Plan (CHMP) which includes an unexpected finds procedure. Preparation of the CHMP should be undertaken in consultation with the registered Aboriginal parties and be incorporated into the overall management plan for the solar farm.
- In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH, the local police and the registered Aboriginal parties should be notified. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal.

This is consistent with the broader proposal's commitments and strategies to manage Aboriginal heritage impacts. Recommendations in **bold** above will now become part of the proposals commitments and have been included in Section 7.

The addendum ACHA report is provided in Appendix C.

5.3 TRAFFIC, TRANSPORT AND SAFETY

An updated TIA was previously prepared in June 2019 by Ontoit and is provided in Appendix B of the Wollar Solar Farm Submissions Report. Following additional investigation, Amber was engaged to prepare an Addendum TIA in August 2019. The Addendum TIA (Amber, 2019) forms an addendum to the existing updated TIA by Ontoit (2019). For the purpose of the proposed changes within this Amendment Report, the recommendations made relation to the upgrade and construction requirements of Barigan Road and Maree Road in the Addendum TIA (Amber, 2019) superseded those made within the updated TIA (Ontoit, 2019). The Addendum TIA (Amber, 2019) is summarised below and provided in full in Appendix A.

Background

The Unsealed Roads Manual: Guidelines to Good Practice, dated March 2009, notes that the average traffic for gravel roads usually varies between 20 and 200 vehicles per day. The document also notes that roads may warrant paving when maintenance costs increase to unacceptable levels, in wet climates, or when economic or social benefits are evident.

Barigan Road is estimated to currently accommodate 60 vehicle movements per day assuming that each of the six dwellings that have access to the road generate 10 vehicle movements per day. The traffic volumes along Barigan Road would increase to 232 vehicle movements per day during peak construction periods (an increase of 172 vehicle movements generated by construction traffic). Therefore, the traffic volumes would marginally exceed the recommended loading for gravel roads.

Northern access

A swept path assessment (refer Appendix B) has been prepared that shows two AVs are able to pass at the Northern Access assuming Barigan Road has been widened to 7 m. Vehicles exiting the access will be required to wait for vehicles to turn right into the access before proceeding onto Barigan Road. This is considered to be a suitable arrangement given the low traffic volumes expected at the access. Accordingly, the access is currently suitably designed to accommodate two-way heavy and light vehicle movements.

Clear sight distances are provided along Barigan Road in both directions for vehicles exiting the site.

Southern Access Option 1

Southern Access Option 1 will be used for light during construction and operation, and will only be used if an easement agreement is achieved. The access will utilise the current formation of Maree Road, which extends from Barigan Road. The access is located on private land. Should this option require heavy vehicle passage, the existing formation of Maree Road will be widened to 7 m to accommodate two-way vehicle movement and Barigan Road would be upgraded to the same standard as described for Southern Access Option 2 below.

Southern Access Option 2

In the event that easements are unable to be established, Southern Access Option 2 would be the only access utilised during construction and operation for both heavy and light vehicles. The access will utilise Council's (Maree Road) road reserve located at the termination of Barigan Road to access the site. The access will be constructed to have a road width of 7 m to allow for simultaneous two-way traffic movement.

The access design and a swept path assessment showing access to the site by an AV is shown within Appendix B of the Addendum TIA (Appendix A). The swept path assessment shows that at the bends within the road reserve only one truck is able to accommodate the carriageway. Accordingly, temporary traffic

management measures such as temporary traffic signals or traffic controllers will be required. It is recommended that these be detailed within the future CTMP.

Conclusion and recommendations

In order to accommodate the traffic volumes generated by the development it is recommended that Barigan Road and/or Maree Road be upgraded based on the designs shown within the road widening and access swept path drawings provided in the Addendum TIA (Appendix A), and that suitable traffic management measures be implemented in key locations.

The designs include upgrade to a width of 7 m to allow two vehicles to pass simultaneously. In some locations the road is proposed to be widened further to accommodate simultaneous two-way truck movement. These locations are shown within the road widening and access swept path drawings provided in the Addendum TIA (Appendix A).

It is noted that the widening required in the location highlighted within Appendix A(5) of the Addendum TIA would be excessive and it is recommended that this section is operated as a one lane road and is controlled by either a temporary traffic signal or traffic controllers. Given the short section of one lane road, and the temporary nature of the construction of the solar farm this is considered to be a suitable arrangement.

It is recommended that water trucks or a light spray seal be used to accommodate the level of traffic generated by the construction traffic and to also act to reduce the dust impact to the nearby dwellings. The increased carriageway width will also allow two trucks to pass.

It is noted that the Updated TIA (Ontoit, 2019) notes that a Road Safety Audit (RSA) will be undertaken in the vicinity of the Wollar Road / Barigan Road intersection in conjunction with RMS, and a structural assessment will be undertaken for the existing Wollar Creek culvert.

Given the expected traffic along Barigan Road during construction, it is concluded that the surface of the road with the inclusion of the proposed upgrades, is suitable to accommodate the future traffic volumes. In addition, the adoption of the above recommendations will assist to mitigate any impact to the road surface and adjacent properties.

Following further consultation with MWRC, the proponent has committed to the following:

- Prior to construction, widening will be undertaken along Barigan Road in accordance with the swept path assessment and access design providing in the Addendum TIA provided in Appendix C of the Submissions Report.
- Prior to construction, sealing of Barigan Road will be undertaken in areas proposed for heavy vehicle use during construction.

5.4 OTHER ENVIRONMENTAL ASPECTS

The following aspects were assessed by desktop assessment, to determine if additional mitigation measures were required to manage the impacts of the Southern Access Option 2. No additional site work was considered to be required for these matters.

Table 5-4 Assessment of the proposed alternative access route.

Environmental aspects	Relevance to Southern Access Option 2
Soils and water quality	And additional 2 km of road upgrade (Barigan Road) and 1 km of road formation (Maree Road) road reserve to facilitate heavy vehicle access would be required for the Southern Access Option 2. This would require additional creek crossings and generate increased dust and erosion potential although, consolidating the access into one Southern Access Option 2, instead of two routes (North access and South Option 1) would result in an overall lesser impact area. It is noted that Southern Access Option 2 would only be used if Option 1 could not be used. Approximately 1.8km of heavy vehicle access for the Northern access would not be developed in this case. In the context of the EIS assessment, the change would be minimal. Existing mitigation measures to manage soil and water impacts are considered sufficient to address these additional impacts.
Land use (including mineral resources)	No additional impacts.
Flooding	Design of additional creek crossings to develop Southern Access Option 2 would need to consider flooding impacts in relation to the two 1st order tributaries of Tichular Creek within the (Maree Road) road reserve and the 4th order Wollar Creek watercourse. The Hydraulic and Hydrological Analysis undertaken for the EIS noted that any new road crossings on watercourses within the proposal area should be in accordance with the Guidelines for Riparian Corridors on Waterfront Land (DPI Water, 2012). Furthermore, vehicular crossings should consist of bed level crossings constructed flush with the bed of the watercourse on 1st (and 2nd) order watercourses to minimise hydraulic impact. Vehicular watercourse crossings for 4th order streams would require a culvert or bridge structure. Existing mitigation measures to manage flooding impacts are considered sufficient to address these additional impacts.
Water use and water quality (surface and ground water)	Additional water use will be required for Maree Road Reserve construction and Barigan Road for road upgrades. Additional water will be required for dust suppression during construction of Maree Road Reserve and use of Barigan Road (least case or worst case). As above, it is noted that Southern Access Option 2 would only be used if Option 1 could not be used. Approximately 1.8 km of heavy vehicle access for the Northern access would not be developed in this case. In the context of the EIS assessment, the increase would be minimal. Existing mitigation measures to manage water use are considered sufficient to address these additional impacts.

<table>
<tr><td>Visual amenity</td><td>Removal of vegetation to develop Southern Access Option 2 will impact the visual amenity. There is one receiver near to Maree Road who is project involved. No visual impacts would result on Barigan Road.
The management measures currently proposed are considered sufficient to address these additional impacts.</td></tr>
<tr><td>Noise and vibration</td><td>A Technical Memo (Renzo Tonin & Associates) has been prepared to address the potential noise impacts due to:
The updated traffic movements noted within the traffic access plan provided in Appendix F of the Submissions Report
The widening and sealing of Barigan Road.
The Technical Note is summarised below and provided in full in Appendix D.
Construction traffic movements
For a conservative assessment, it has been assumed that all the construction traffic will access the site via the southern access option on Maree Road. Therefore, based on the revised estimated traffic movements, the predicted construction traffic noise levels at the nearest affected residences along the proposed route are presented below.

<table>
<tr><th rowspan="2">Receiver</th><th rowspan="2">Road</th><th rowspan="2">Criteria</th><th colspan="3">Truck traffic movements</th><th rowspan="2">Speed (km/h)</th><th rowspan="2">Approx. Distance to Road</th><th rowspan="2">Predicted Noise Level dB(A)</th><th rowspan="2">Exceed?</th></tr>
<tr><th>Light Vehicle</th><th>Medium trucks</th><th>Heavy Trucks</th></tr>
<tr><td>Nearest Residence on Wollar Road, Philip Street and Maitland Street</td><td>Sub-arterial</td><td>$L_{Aeq(15\ hour)}$ 60 dB(A)</td><td>80 /per 15 hours</td><td>40 / per 15 hours</td><td>14 / per 15 hours</td><td>50</td><td>13m</td><td>55</td><td>No</td></tr>
<tr><td>Nearest Residence on Barigan Rd (609 Barigan Road)</td><td>Local</td><td>$L_{Aeq(15\ hour)}$ 55 dB(A)</td><td>8/ per one hour</td><td>4 / per one hour</td><td>2 / per one hour</td><td>50</td><td>25m</td><td>54</td><td>No</td></tr>
</table>

From the above table, it can be seen that predicted road traffic noise level contributions from the vehicle movements associated with the construction works comply with the applicable noise criteria at the nearest affected receivers along Wollar Road, Phillip Street, Maitland Street and Barigan Road. As the construction traffic noise levels are temporary and comply with the RNP criteria set above, it indicates that the traffic noise levels due to the construction works for the solar farm would not adversely affect the existing residences along Wollar Road, Phillip Street, Maitland Street and Barigan Road during construction of the proposed solar farm.</td></tr>
</table>

<table>
<tr><td></td><td>

Traffic noise assessment

Based on the estimated construction traffic movements and proposed widening to Barigan Road, the predicted traffic noise levels for the 'No Build' (ie. existing road) and 'Build' (ie. widened road) scenarios have been predicted and are presented in the table below.

<table>
<tr><th colspan="2">'No Build' Scenario (existing road)</th><th colspan="2">'Build' Scenario (Widened road)</th><th rowspan="2">Difference ('Build' – 'No Build')</th><th rowspan="2">Comply?</th></tr>
<tr><th>Approx. distance to road</th><th>Predicted traffic noise level</th><th>Approx. distance to road</th><th>Predicted traffic noise level</th></tr>
<tr><td>25m</td><td>54dB(A)</td><td>24m</td><td>54dB(A)</td><td>0dB(A)</td><td>Yes</td></tr>
</table>

The results presented in the table above indicate that the widening of Barigan Road will not increase traffic noise levels compared to the existing road. Therefore, compliance with the RNP and NCG have been predicted.

The management measures currently proposed are considered sufficient to address these additional impacts.

</td></tr>
<tr><td>Historic heritage</td><td>No heritage sites within the site. No additional impacts or changes to mitigation strategies.</td></tr>
<tr><td>Socio-economic and community</td><td>Six residences occur within the vicinity of the proposal site and Barigan Road. Construction of upgrades of Barigan Road would result in increased traffic delays for local traffic. The road upgrades, once completed, would be of broader benefit to road users.
In the context of the EIS assessment, the increased impacts would be minimal, however an additional mitigation measure is recommended to ensure community members using Barigan Road to access their residences are informed of any potential delays at an early stage.
Residents at receivers 6, 10, 11, 12 and 13 will be provided with:
• Notification of the proposed works and any road closures well in advance of commencement of the works.
• A mechanism for complaints.</td></tr>
<tr><td>Bushfire</td><td>No additional impacts.</td></tr>
<tr><td>Electric and Magnetic Fields</td><td>No additional impacts.</td></tr>
<tr><td>Climate and air quality</td><td>No additional impacts.</td></tr>
</table>

Resource use and waste generation	No additional impacts.
Hazards	No additional impacts.
Cumulative impacts	No additional impacts.

6 EVALUATION OF MERITS

The Northern and Southern Access Option 1 remain the preferred access options and include proposed upgrades to Barigan Road between Wollar Road and the TransGrid access road within the existing road reserve, as set out in the EIS assessment. Southern Access Option 2 would only be constructed if land tenure cannot be secured for the Northern Access and Southern Access Option 1.

Southern Access Option 2 is being added to the project to ensure legal access to the proposal site, as the existing access relies on one property owner that is not project involved. While the amended access proposed is not the preferred access route, it will provide the project with required certainty, regarding the ability to access the site.

On balance, additional impacts have been assessed as minor in the context of the broader project, manageable in terms of the existing management commitments and justified, to ensure legal access to the site.

7 ENVIRONMENTAL MANAGEMENT CHANGES

The key change is in the updated biodiversity offset requirement to offset a 'worst case' impact area for the project. Refer to Table 5-1.

The following management measures are required to manage the impacts of Southern Access Option 2.

Safeguards and Mitigation Measures	PC/C	O	D
Aboriginal heritage			
• **The artefacts identified at NGH Barigan AFT 1, 2, 3 and 4; and NGH Barigan IF 1, 2, 3, 4 and 5, must be salvaged prior to the proposed work commencing and moved to a safe area within the Wollar Solar Farm development footprint, along with the artefacts referenced in Recommendation 4 of the Wollar Solar Farm ACHA (NGH 2018).**	PC		
• **The surface collection and relocation of the artefacts must be undertaken by an archaeologist and representatives of the registered Aboriginal parties. The salvage should be consistent with Requirement 26 of the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales. A new site card must be completed once the artefacts are moved to record their new location on the AHIMS database.**	PC		
• **With reference to the Wollar Solar Farm ACHA (NGH 2018) the Aboriginal community requests that a Cultural Smoking Ceremony be accommodated to cleanse the salvaged artefacts and the reburial location.**	PC		
Traffic			
• **Prior to construction, widening be undertaken along Barigan Road in accordance with the swept path assessment and access design**	C		

Safeguards and Mitigation Measures	PC/C	O	D
providing in the Addendum TIA provided in Appendix A of the Amendment Report.			
• **Prior to construction, sealing of Barigan Road in areas proposed for heavy vehicle use during construction.**			
• **Maree Road be upgrades based on the designs shown with the Addendum Traffic Impact Assessment (Amber, 2019).**	PC		
Socio-economic and community			
• **Residents at receivers 6, 10, 11, 12 and 13 will be provided with:** o **Notification of the proposed works and any road closures well in advance of commencement of the works.** o **A mechanism for complaints**	PC		

8 REFERENCES

Amber Organisation, 2019, Addendum Traffic Impact Assessment Wollar Solar Farm, prepared for WSD, September 2019.

NGH Environmental, 2019a, Environmental Impact Statement Wollar Solar Farm, prepared for WSD, March 2019.

NGH Environmental, 2019b, Biodiversity Development Assessment Report Wollar Solar Farm, prepared for WSD, June 2019.

NGH Environmental, 2019c, Addendum Aboriginal Cultural Heritage Assessment Report Wollar Solar Farm, prepared for WSD, September 2019.

Ontoit, 2019, Updated Traffic Impact Assessment Wollar Solar Farm, prepared for WSD, June 2019.

APPENDIX A ADDENDUM TRAFFIC IMPACT ASSESSMENT

Amber (2019).

Amber Organisation
www.amber.org.au
+61 432 022 363

Louiza Romane
Environmental Consultant
NGH Consulting
PO Box 470
Bega NSW 2550

Ref: 043
8 October 2019

Issued via email: louiza.r@nghconsulting.com.au

Dear Louiza

Wollar Solar Farm – Traffic Impact Assessment

Amber has been asked to assess the traffic matters of the proposed 290MW solar farm located approximately 7km south of Wollar. Vehicles accessing the site will be required to travel through the township of Wollar via Wollar Road or Ulan-Wollar Road. Vehicles will then use Barigan Road to reach one of the three access locations proposed for the site:

- Northern Access: connects directly with Barigan Road and is currently constructed to connect with the existing substation. This access is the primary access for heavy and light vehicles.
- Southern Access Option 1: utilises Maree Road, which connects with Barigan Road, to access the site. It will be utilised by light and heavy vehicles to access the site.
- Southern Access Option 2: provides a new connection with Barigan Road, just north of Maree Road, and will provide access for heavy vehicles.

It is understood the Northern Access and Southern Access Option 1 require legal access across private land. In the event that easements are unable to be established, Southern Access Option 2 would be the only access utilised during construction and operation for both heavy and light vehicles. If easements are able to be established, the Northern Access would be used for both heavy and light vehicles. Southern Access Option 1 would be used for light and heavy vehicles during construction and light vehicles during operation.

Staff will be located within the nearby regional towns, and primarily within Mudgee and Gulgong. The majority of plant is expected to be delivered from Newcastle and will access the site via Golden Highway, Ulan Road and Ulan-Wollar Road.

A Traffic Impact Assessment has previously been prepared for the solar farm by Ontoit, dated 12 June 2019. The following Traffic Assessment will form an Addendum to the existing report and will undertake a detailed review of the expected traffic generation of the solar farm during key construction phases in order to determine the required road upgrades along key sections of the access route. An assessment of the traffic impacts of the solar farm is provided below.

1. Traffic Assessment

1.1 Traffic Generation

Construction activities would be undertaken during standard daytime construction hours (7:00am to 6:00pm Monday to Friday, and 7:00am to 1:00pm on Saturdays). Any construction outside of these normal working hours would only be undertaken with prior approval from relevant authorities.

The Applicant has advised that the following number of staff will be on-site during the 18-month construction period.

Table 1: Staff On-site Per Construction Month

Month	1	2	3	4	5	6	7	8	9
Staff	26	43	84	80	102	150	180	250	260
Month	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Staff	260	320	320	200	150	80	50	20	5

A maximum of 320 staff will be on-site during peak construction periods. It is understood that 20 shuttle buses will be provided that can accommodate approximately 260 staff (~80% of staff). The remaining staff will access the site using private vehicles. Assuming a vehicle occupancy rate of 2.0 for workers, the site is expected to generate 30 light vehicle movements during each of the peak periods.

Approximately 30 trucks will access the site per day during typical construction periods. The delivery trucks will predominantly be Medium and Heavy Rigid Trucks (MRV and HRV as defined within AS 2890.2:2009). Articulated Vehicles (AV as defined within AS 2890.2:2009) and B-Doubles will occasionally be used to transport larger plant such as the PV panels.

It is anticipated that during peak construction the site could generate up to 72 heavy vehicle and 100 light vehicle movements per day. Table 2 summarises the traffic movements generated during the peak construction period of the solar farm.

Table 2: Traffic Generation During Peak Construction Periods

Vehicle Type	Vehicle Movements per Day
Light Vehicle (car / 4WD)	60
Shuttle Bus	40
MRV/HRV	46
AV/B-Double	26
Total	**172**

Accordingly, the site is expected to generate approximately 172 vehicle movements per day during peak periods.

1.2 Traffic Distribution

Traffic accessing the site will do so via Wollar Road and via Ulan-Wollar Road to/from the west and north, respectively. Vehicles will then be able to utilise Ulan Road to access the wider road network. The following provides a breakdown of the access routes for each of the vehicle classifications outlined within Table 2:

- Light Vehicles: These vehicles will consist of project managers who are provided with their own vehicle and miscellaneous trips made by other contractors. It has been assumed that these trips have been distributed evenly between Wollar Road and Ulan-Wollar Road. This represents staff vehicles located in Mudgee and Gulgong, and trips made to other destinations such as Newcastle or Sydney.

- Shuttle Bus: Staff will be located predominantly within the nearby towns of Mudgee and Gulgong. Shuttles travelling to/from Mudgee will utilise Wollar Road, and shuttles travelling to/from Gulgong will utilise Ulan-Wollar Road to limit the number of vehicle movements along Wollar Road. For the purposes of this assessment it has been assumed that 70% of staff will be based in Mudgee and 30% will be based in Gulgong.

- MRV/HRV: These vehicles will predominantly be water trucks and vehicles transporting materials such as concrete and fencing supplies. These materials will be sourced within the surrounding area and as such, it has been assumed that these vehicles will be evenly distributed between Wollar Road and Ulan-Wollar Road.

- AV/B-Double: All plant will be transported from Newcastle and will utilise Ulan-Wollar Road, unless an alternative route is agreed with Council.

The peak hour for the solar farm will occur at the start and end of the day when staff are transported to/from the site. During the morning peak all vehicle movements will be towards the site and in the evening peak all vehicle movements will be away from the site. It has been assumed that 50% of general light vehicles and all shuttle buses will access/egress the site during the peak hours. The remaining light vehicle and heavy vehicle movements will be distributed throughout the day and will be split evenly between inbound and outbound movements.

1.3 Summary

The site is expected to generate 35 vehicle movements during each of the morning and evening peak hours. These vehicles will be shuttle buses and light vehicles transporting staff to/from the site. Based on the distribution of staff accommodation, the site is expected to generate an increase of 22 and 13 vehicle movements during each of the peak hours on Wollar Road and Ulan-Wollar Road, respectively. This will result in approximately one additional vehicle every 3 minutes on Wollar Road and approximately one additional vehicle every 4 minutes on Ulan-Wollar Road during each peak hour during peak construction times.

A summary of the daily and peak hour traffic volumes for each of the access routes is provided below in Table 3.

Table 3: Traffic Distribution During Peak Construction Periods

Vehicle Type	Vehicle Movements per Day		Vehicle Movements per Peak Hour	
	Wollar Road	Ulan-Wollar Road	Wollar Road	Ulan-Wollar Road
Light Vehicle (car / 4WD)	30	30	8	7
Shuttle Bus	28	12	14	6
MRV/HRV	23	23	0	0
AV/B-Double	0	26	0	0
Total	**81**	**91**	**22**	**13**

Vehicles will also be distributed throughout the day and will generate approximately 9 vehicle movements per hour. Of these vehicle movements, 3 will be light vehicles and 6 will be heavy vehicles. All AV and B-Doubles will utilise Ulan-Wollar Road, whilst the light vehicles and MRV/HRVs will be separated evenly between Wollar Road and Ulan-Wollar Road.

2. Access Route Assessment

2.1 Western Access Route

Vehicles travelling to/from the west will do so via Wollar Road and Ulan Road to reach Mudgee and the wider State Highway network. The Traffic Assessment prepared by Ontoit (Traffic Report) provides a detailed description of Wollar Road, Ulan Road and the crash history along the access route between Wollar and Mudgee. In addition to the comments made within the Traffic Report, the following provides a summary of the key traffic conditions along the western access route:

- Wollar Road is a sealed road which is typically in good condition and provides one lane of traffic in each direction.
- The section of Wollar Road that traverses the Munghorn Gap Nature Reserve has a mountainous nature creating a number of tight bends and in some locations the road condition is poor. This section extends for approximately 4-5km.
- The intersection of Wollar Road with Ulan Road is provided with dedicated right and left turn lanes from Ulan Road.
- Based on the traffic surveys undertaken by Ontoit of the intersection of Wollar Road with Ulan Road, Wollar Road accommodates approximately 40-50 vehicle movements during each of the peak hours. Assuming the peak hour represents approximately 10% of the daily traffic volume, Wollar Road is estimated to currently accommodate 400-500 vehicles per day.
- Ulan Road is an approved AV and B-Double route as outlined within the RMS Heavy Vehicles Map.

The western access route is expected to accommodate 22 light vehicle movements during each of the peak hours and approximately 3 vehicle movements per hour during construction times. The majority of the vehicles will be shuttle bus drivers who know the route well and will not be fatigued such as regular workers. Based on on-site observations, the western route is typically in good condition to accommodate the light vehicles generated during the peak hour and the small number of vehicles generated throughout the day.

Whilst it is noted that there is a section of the route that is in poor condition through the Munghorn Gap Nature Reserve, the western route is still considered appropriate for use by the solar farm for the following reasons:

- All peak hour vehicles will be light vehicles, with some MRV/HRV vehicles utilising the road during the day.
- Skilled shuttle bus drivers will form the majority of vehicle trips. These drivers will know the route well and will not be fatigued such as regular workers. As such, they are expected to be able to traverse the Munghorn Gap Nature Reserve in a safe manner.
- The low level of solar farm traffic that will utilise the western route and the current low level of traffic along the route provides a low congestion environment.

It is understood that a proposal associated with Bylong Coal may result in an increase in traffic along Wollar Road. Further to the above, and even with the increase in traffic volumes generated by the solar farm, there will remain ample road capacity along the western access route. Therefore, it is concluded that the solar farm will still provide ample road capacity along Wollar Road for an increase in traffic movements.

Overall, it is concluded that the use of Wollar Road to access Ulan Road, as outlined above, is acceptable and will not generate any safety or capacity issues. It is recommended that all staff,

including shuttle bus drivers, be made aware of the road conditions within the Munghorn Gap Nature Reserve and this form part of any future Construction Traffic Management Plan which will be prepared prior to construction of the site.

2.2 Northern Access Route

Vehicles travelling to/from the north will do so via Ulan-Wollar Road and Ulan Road to reach Newcastle, Gulgong, and the wider State Highway network. The Ontoit Traffic Report provides a detailed description of Ulan-Wollar Road along the access route. In addition to the comments made within the Traffic Report, the following provides a summary of the key traffic conditions along the northern access route:

- Ulan-Wollar Road is a sealed road which is in good condition and provides one lane of traffic in each direction. A large proportion of the road has recently or is in the process of being upgraded as part of the Wilpinjong Mine Expansion and is suitable for use by heavy vehicles.
- A school is located along Ulan-Wollar Road, within the Wollar township, which is understood to not currently be in use.
- The intersection of Ulan-Wollar Road with Ulan Road is provided with dedicated right and left turn lanes from Ulan Road.
- Based on traffic surveys outlined within the Wilpinjong Mine Expansion Traffic Report prepared by GTA, Ulan-Wollar Road is expected to accommodate approximately 130 vehicle movements during each of the peak hours north of the mine site access.
- Ulan Road is an approved AV and B-Double route as outlined within the RMS Heavy Vehicles Map.

The northern access route is expected to accommodate 13 light vehicle movements during each of the peak hours and approximately 7 vehicle movements per hour during construction times. The majority of the vehicles during regular construction hours will be larger trucks such as AV and B-Double vehicles. Even with the increase in traffic volumes generated by the solar farm there will remain ample road capacity along the northern access route.

As outlined above, the majority of the northern route has been upgraded as part of the Wilpinjong Mine Expansion and is suitable for use by larger vehicles. South of the upgraded section the road is considered to be in good condition for use by light and heavy vehicles based on on-site observations. Overall, it is concluded that the use of Ulan-Wollar Road to access Ulan Road, as outlined above, is acceptable and will not generate any safety or capacity issues.

2.3 Barigan Road / Maree Road

The *Unsealed Roads Manual: Guidelines to Good Practice*, dated March 2009, notes that the average traffic for gravel roads usually varies between 20 and 200 vehicles per day. The document also notes that roads may warrant paving when maintenance costs increase to unacceptable levels, in wet climates, or when economic or social benefits are evident.

Barigan Road is estimated to currently accommodate 60 vehicle movements per day assuming that each of the six dwellings that have access to the road generate 10 vehicle movements per day. The traffic volumes along Barigan Road would increase to 232 vehicle movements per day during peak construction periods (an increase of 172 vehicle movements generated by construction traffic). Therefore, the traffic volumes would marginally exceed the recommended loading for gravel roads.

In order to accommodate the traffic volumes generated by the development it is recommended that Barigan Road and Maree Road along the access route be upgraded to have a width of 7.0 metres to

allow two vehicles to pass. In some locations the road is proposed to be widened further to accommodate simultaneous two-way truck movement. These locations are shown within Appendix A.

It is noted that the widening required in the location highlighted within Figure 5 would be excessive and it is recommended that this section is operated as a one lane road and is controlled by either a temporary traffic signal or traffic controllers. Given the short section of one lane road, and the temporary nature of the construction of the solar farm this is considered to be a suitable arrangement.

It is recommended that water trucks or a light spray seal be used to accommodate the level of traffic generated by the construction traffic and to also act to reduce the dust impact to the nearby dwellings. The increased carriageway width will also allow two trucks to pass.

Given the expected traffic along Barigan Road during construction, it is concluded that the surface of the road with the inclusion of the proposed upgrades, is suitable to accommodate the future traffic volumes. In addition, the adoption of the above recommendations will assist to mitigate any impact to the road surface and adjacent properties.

2.4 Summary

A Construction Traffic Management Plan (CTMP) will be prepared prior to construction of the site. It is recommended that the following form part of the CTMP to minimise the impact of construction traffic along the unsealed roads:

- All staff, including shuttle bus drivers, be made aware of the road conditions within the Munghorn Gap Nature Reserve.
- Prior to construction, a pre-condition survey of the relevant sections of the existing road network be undertaken, in consultation with Council. During construction the sections of the road network utilised by the proposal are to be monitored and maintained to ensure continued safe use by all road users, and any faults attributed to construction of the solar farm would be rectified. At the end of construction, a post-condition survey would be undertaken to ensure the road network is left in the consistent condition as at the start of construction.
- Water trucks or a light spray seal be used along Barigan Road and Maree Road to accommodate the level of traffic generated by the construction traffic and to also act to reduce the dust impact to the nearby dwellings.
- Neighbours of the solar farm be consulted and notified regarding the timing of major deliveries which may require additional traffic control and disrupt access.
- Barigan Road and Maree Road be upgraded based on the designs shown within Appendix A and B, and that suitable traffic management measures be implemented in key locations.

It is noted that the proposed access routes have been determined in consultation with Council. The distribution of traffic on the road network and the use of the northern route for all vehicles travelling to/from the port has been chosen to remove heavy vehicles from the Munghorn Gap Nature Reserve. Further, the extensive use of shuttle buses will reduce the chance of driver fatigue and the number of vehicles on the road network.

It is also noted that the Ontoit Traffic Report notes that a Road Safety Audit will be undertaken in the vicinity of the Wollar Road / Barigan Road intersection in conjunction with RMS, and a structural assessment will be undertaken for the Wollar Creek culvert.

3. Access Design

3.1 Access Options

Vehicles will use Barigan Road to reach one of the three potential access locations proposed for the site:

- Northern Access: connects directly with Barigan Road and is currently constructed to connect with the existing substation. This access is the primary access for heavy and light vehicles and is currently constructed up to the existing TransGrid substation. It would require construction of an access track between the existing substation and the proposed substation.

- Southern Access Option 1: utilises Maree Road, which connects with Barigan Road, to access the site. It will be utilised by light and heavy vehicles to access the site.

- Southern Access Option 2: provides a new connection with Barigan Road, just north of Maree Road, and will provide access for heavy vehicles.

It is understood the Northern Access and Southern Access Option 1 require legal access across private land. In the event that easements are unable to be established, Southern Access Option 2 would be the only access utilised during construction and operation for both heavy and light vehicles. If easements are able to be established, the Northern Access would be used for both heavy and light vehicles. Southern Access Option 1 would be used for light and heavy vehicles during construction and light vehicles during operation.

3.2 Northern Access

The Northern Access is proposed to be used for heavy and light vehicles during construction. The access will only be used if an easement agreement is achieved. A swept path assessment (refer Appendix B) has been prepared that shows two AVs are able to pass at the Northern Access assuming Barigan Road has been widened to 7.0 metres. Vehicles exiting the access will be required to wait for vehicles to turn right into the access before proceeding onto Barigan Road. This is considered to be a suitable arrangement given the low traffic volumes expected at the access. Accordingly, the access is currently suitably designed to accommodate two-way heavy and light vehicle movements.

Clear sight distances are provided along Barigan Road in both directions for vehicles exiting the site.

3.3 Southern Access Option 1

Southern Access Option 1 will be used for light and heavy vehicles during construction and light vehicles during operation, and will only be used if an easement agreement is achieved. The access will utilise the current formation of Maree Road, which extends from Barigan Road. The access is located on private land and it is understood that the existing formation of Maree Road will be widened to 7.0 metres to accommodate two-way vehicle movement.

3.4 Southern Access Option 2

In the event that easements are unable to be established, Southern Access Option 2 would be the only access utilised during construction and operation for both heavy and light vehicles. The access will utilise Council's road reserve located at the termination of Barigan Road to access the development site. The access will be constructed to have a road width of 7.0 metres to allow for simultaneous two-way traffic movement.

The access design and a swept path assessment showing access to the site by an AV is shown within Appendix B. The swept path assessment shows that at the bends within the road reserve only one truck is able to accommodate the carriageway. Accordingly, temporary traffic management measures

such as temporary traffic signals or traffic controllers will be required. It is recommended that these be detailed within the future CTMP.

Incorporating the above recommendations, the access is able to accommodate the worst-case design vehicle expected to access the site.

4. Conclusions

Amber has assessed the traffic impacts of the solar farm located approximately 7 kilometres south of Wollar, New South Wales. Access to the site is to be provided to/from Barigan Road and Maree Road. The above assessment determined the following:

- The peak construction period of the solar farm is 9 months. The site will generate up to 172 vehicle movements per day during peak construction times, including 72 truck movements;
- The road network is able to accommodate the traffic generated by the development during the construction and operational period;
- In order to mitigate the impacts of the development during construction a CTMP will be prepared which should include the following recommendations:
  - All staff, including shuttle bus drivers, be made aware of the road conditions within the Munghorn Gap Nature Reserve.
  - Prior to construction, a pre-condition survey of the relevant sections of the existing road network be undertaken, in consultation with Council. During construction the sections of the road network utilised by the proposal are to be monitored and maintained to ensure continued safe use by all road users, and any faults attributed to construction of the solar farm would be rectified. At the end of construction, a post-condition survey would be undertaken to ensure the road network is left in the consistent condition as at the start of construction.
  - Water trucks or a light spray seal be used along Barigan Road and Maree Road to accommodate the level of traffic generated by the construction traffic and to also act to reduce the dust impact to the nearby dwellings.
  - Neighbours of the solar farm be consulted and notified regarding the timing of major deliveries which may require additional traffic control and disrupt access.
  - Barigan Road and/or Maree Road be upgraded based on the designs shown within Appendix A and B, and that suitable traffic management measures be implemented in key locations.

Accordingly, based on the assessment and recommendations above, it is considered that the proposed access arrangements for the solar farm are suitable to accommodate the expected construction vehicle types and traffic volumes during the construction and operation phase of the project.

If you have any questions please feel free to contact the undersigned.

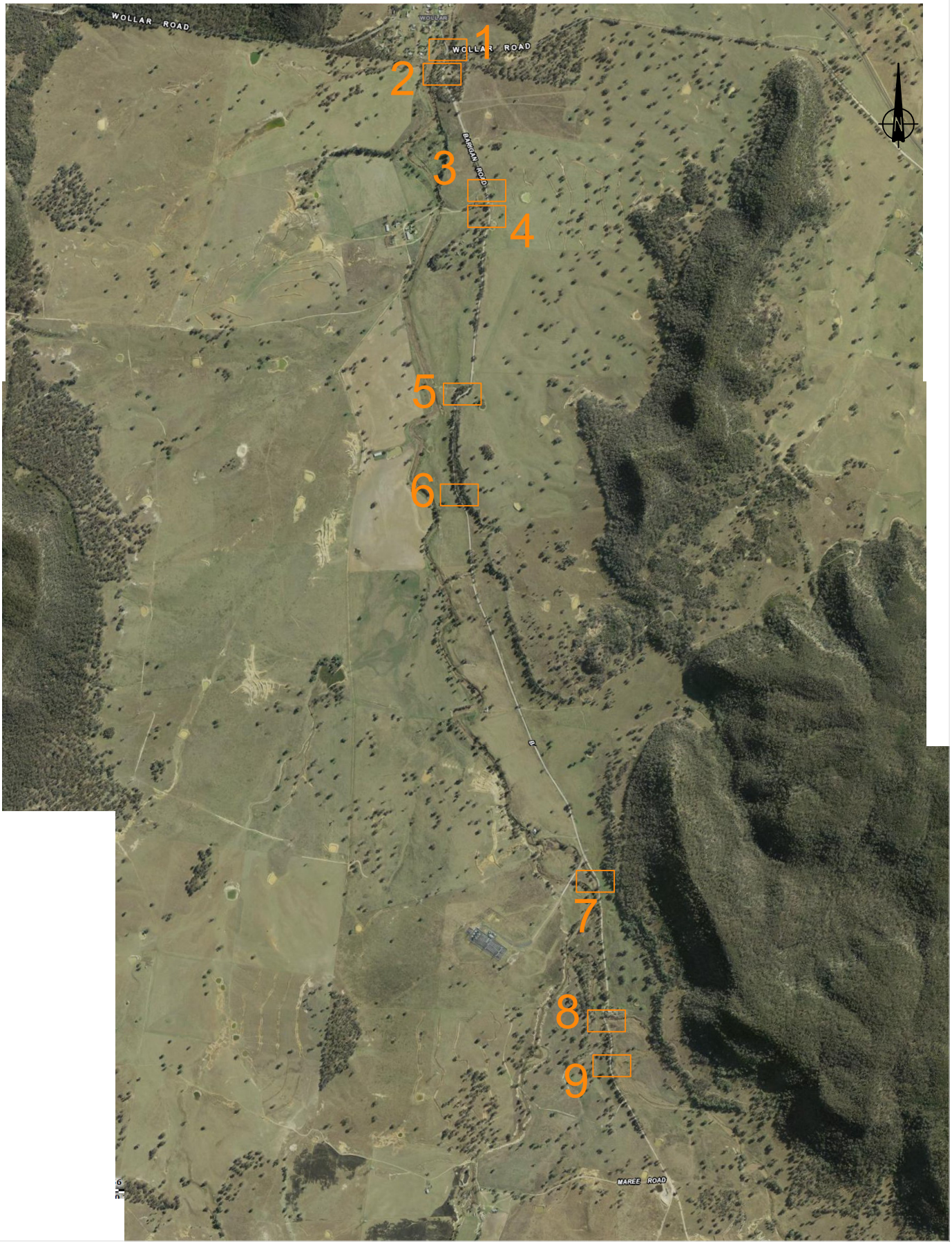
Yours sincerely
Amber Organisation

Michael Willson
Director

Attach: Appendix A – Swept Path Assessment
Appendix B – Access Design

Appendix A

Swept Path Assessment



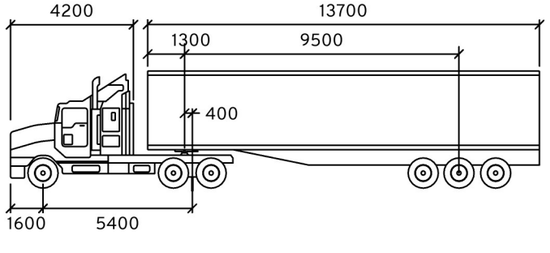
Barigan Road
Swept Path Location Map

Amber A1

Vehicle Envelope

300mm Clearance

AV



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Steering Angle	: 28.3
Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

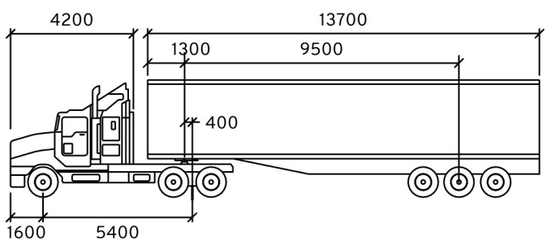
DRAWN: MW
DATE: 03/09/2019
SCALE: 1:600 @ A3
DWG NO: 043-S01A

Amber 1

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

DRAWN: MW
DATE: 03/09/2019
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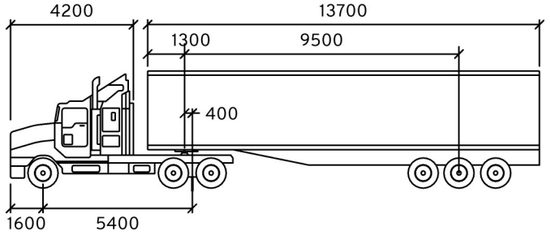
DWG NO: 043-S01A

Amber 2

Vehicle Envelope

300mm Clearance

AV



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Wollar Solar Farm

Road Widening

Swept Paths

DRAWN: MW

DATE: 03/09/2019

SCALE: 1:600 @ A3

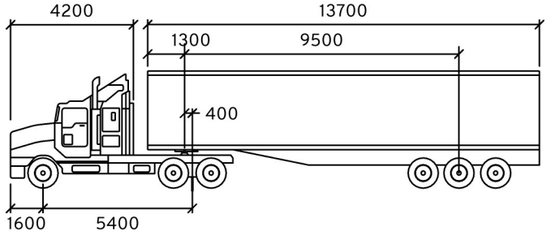
DWG NO: 043-S01A

Amber 3

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

DRAWN: MW
DATE: 03/09/2019
SCALE: 1:600 @ A3
DWG NO: 043-S01A

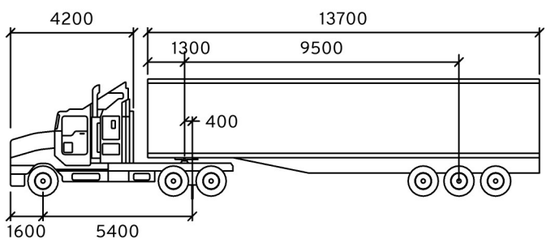
Amber

Provide Traffic Control for One Lane System

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

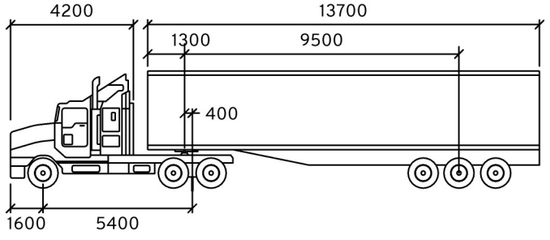
DRAWN: MW
DATE: 03/09/2019
SCALE: 1:1000@ A3
DWG NO: 043-S01A

Amber

Vehicle Envelope

300mm Clearance

AV



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Wollar Solar Farm

Road Widening

Swept Paths

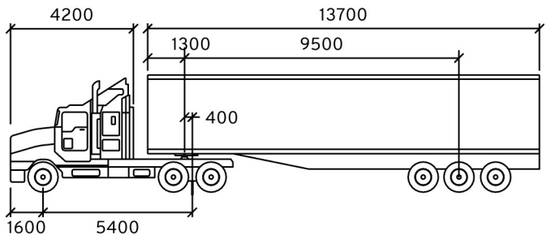
DRAWN: MW
DATE: 03/09/2019
SCALE: 1:750 @ A3
DWG NO: 043-S01A

Amber 6

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

DRAWN: MW

DATE: 03/09/2019

SCALE: 1:1000@ A3

DWG NO: 043-S01A

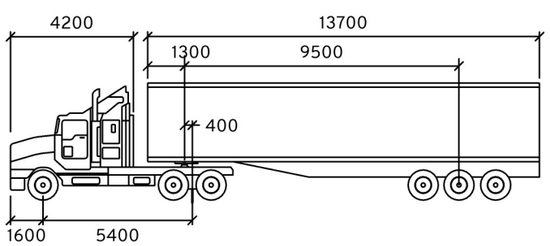
Amber 7

Provide Traffic Control for One Lane System

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

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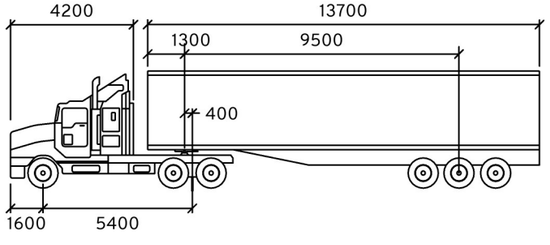
SCALE: 1:1000@ A3
DWG NO: 043-S01C

Amber

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Road Widening

Swept Paths

DRAWN: MW
DATE: 03/09/2019
SCALE: 1:1000@ A3
DWG NO: 043-S01A

Amber 9

Appendix B

Access Design

7000

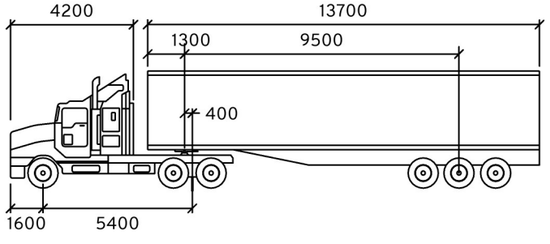
7000

7000

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Northern Access

Swept Paths

DRAWN: MW

DATE: 04/09/2019

SCALE: 1:500 @ A3

DWG NO: 043-S01A

Amber

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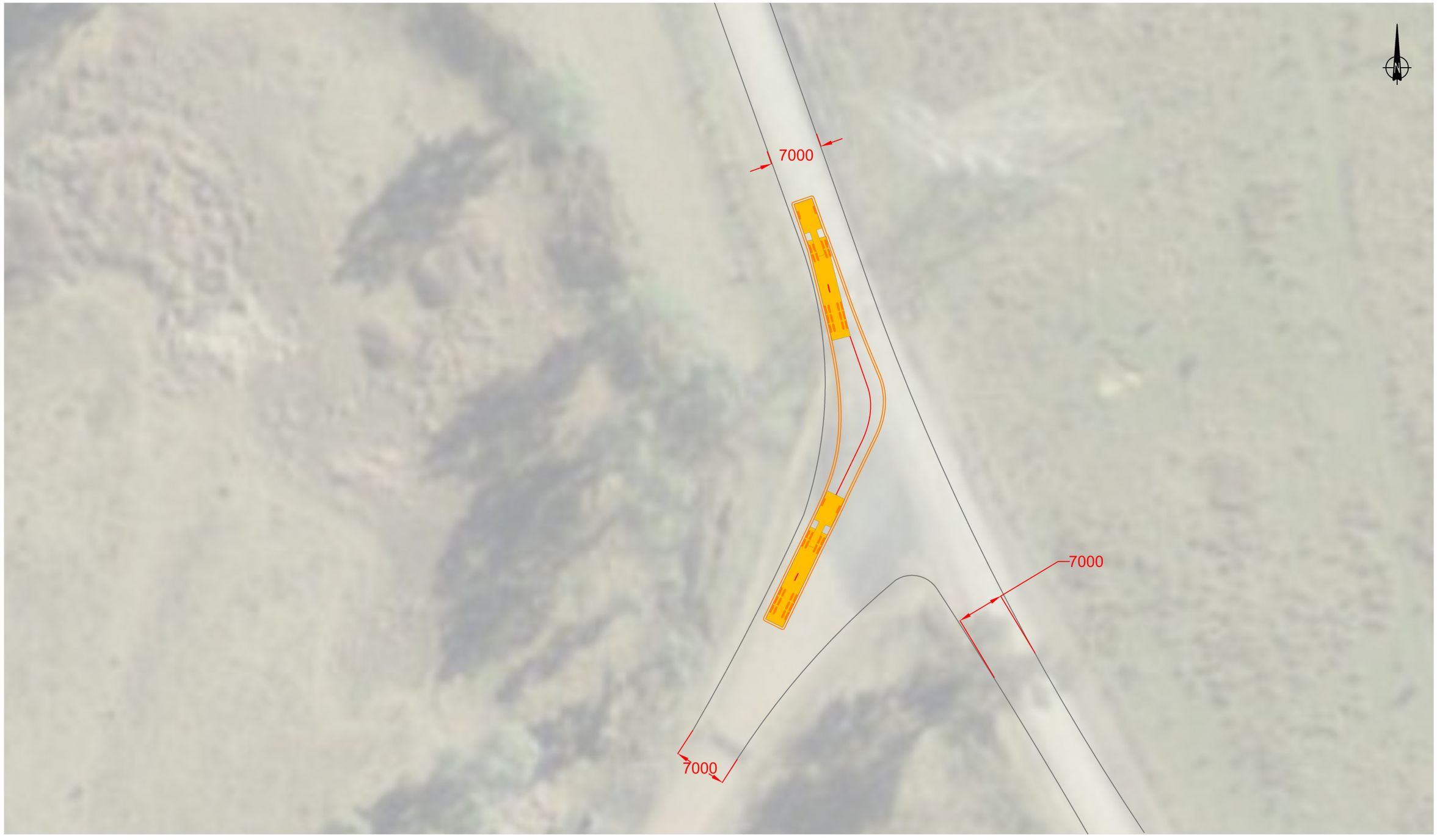

Vehicle Envelope

300mm Clearance

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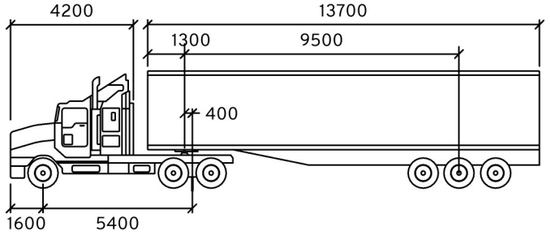

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Articulating Angle	: 70.0

Wollar Solar Farm

Northern Access

Swept Paths

DRAWN: MW
DATE: 04/09/2019
SCALE: 1:500 @ A3
DWG NO: 043-S01A

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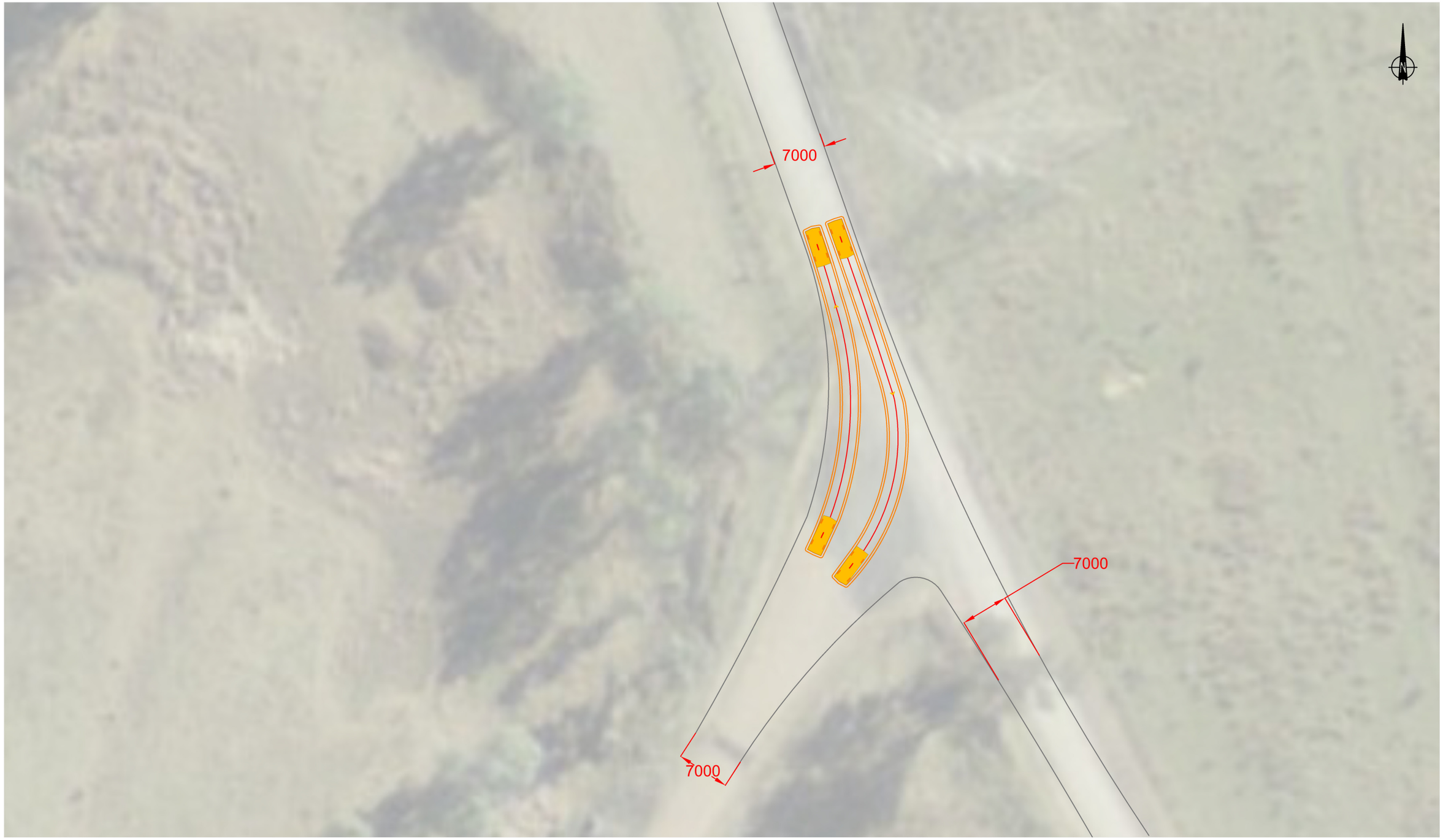

Vehicle Envelope

300mm Clearance

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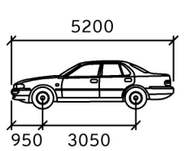

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Wollar Solar Farm

Northern Access

Swept Paths

DRAWN: MW
DATE: 04/09/2019
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7000

R10000

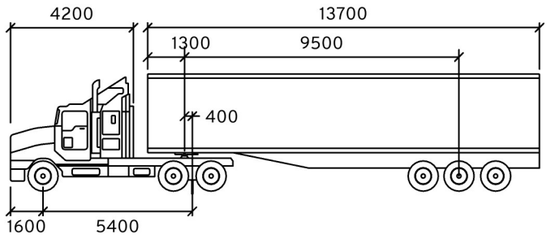
7000

Site Boundry

Vehicle Envelope

300mm Clearance

AV



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Wollar Solar Farm

Southern Access Option 1

Swept Paths

DRAWN: MW
DATE: 05/09/2019
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DWG NO: 043-S01B

Amber B4

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7000

Site Boundry

Vehicle Envelope

300mm Clearance

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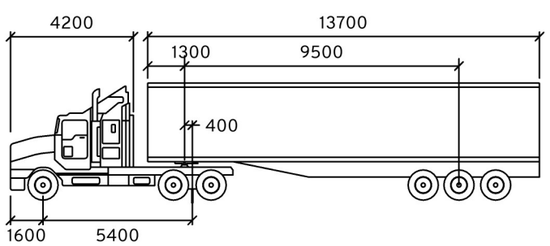

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Articulating Angle	: 70.0

Wollar Solar Farm

Southern Access Option 1

Swept Paths

DRAWN: MW
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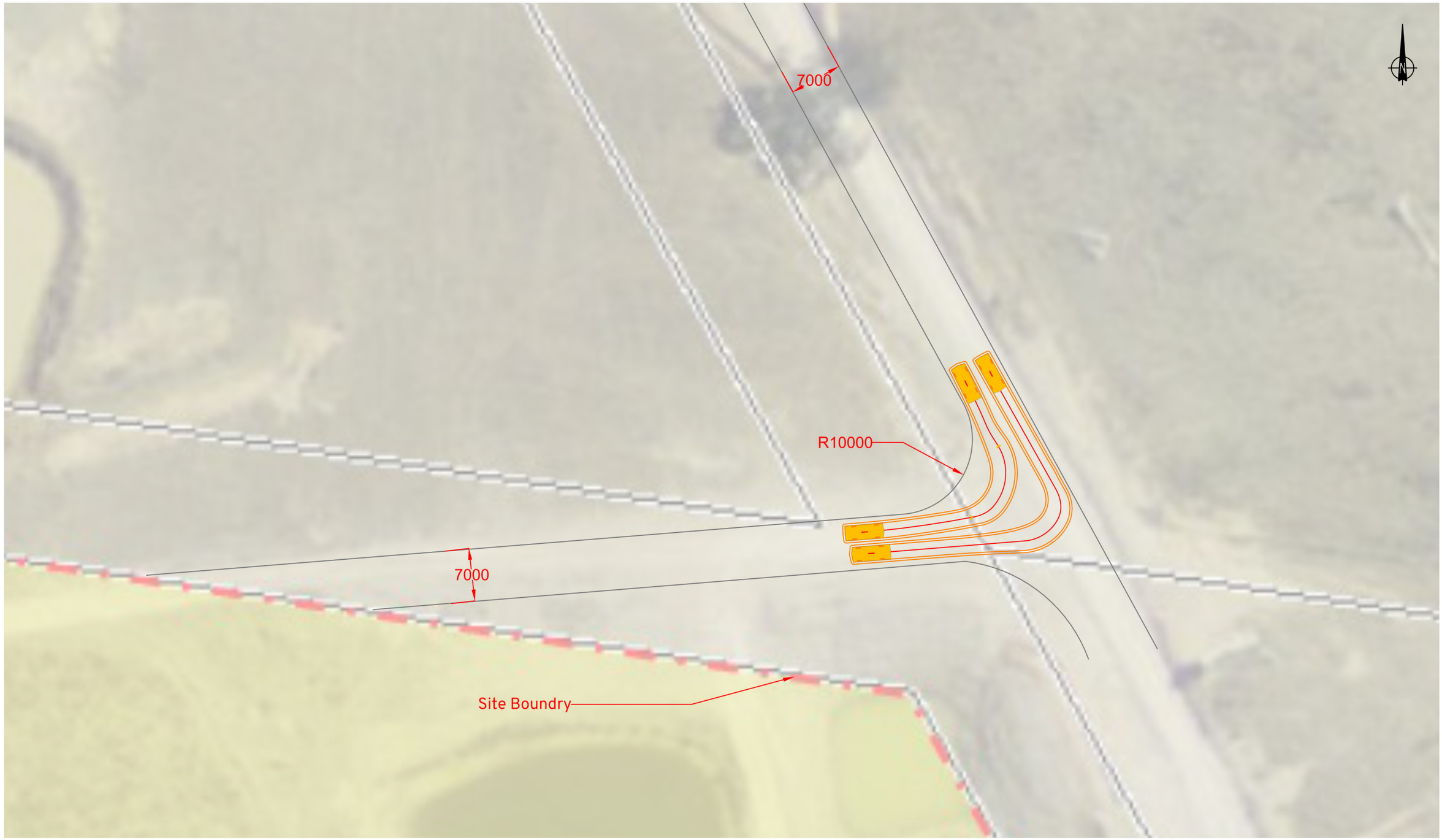
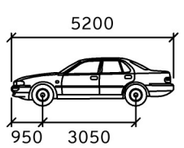


Vehicle Envelope

300mm Clearance

B99



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Wollar Solar Farm

Southern Access Option 1

Swept Paths

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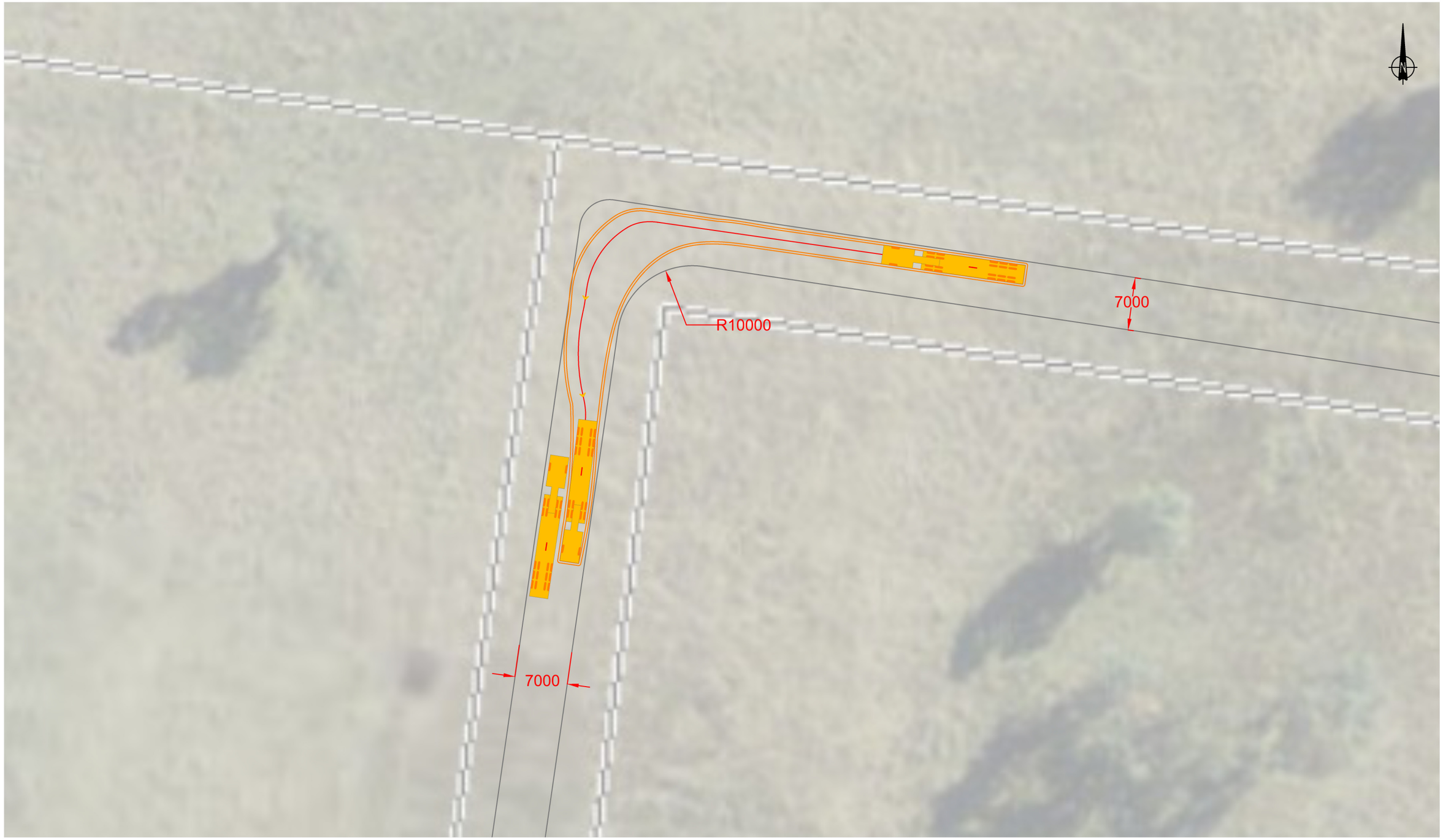

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300mm Clearance

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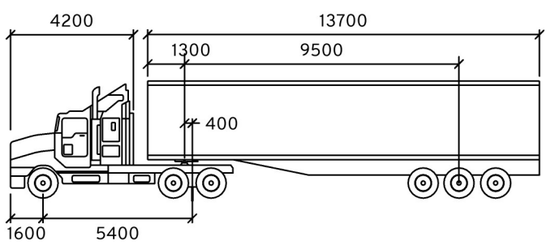

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Articulating Angle	: 70.0

Wollar Solar Farm

Southern Access Option 2

Swept Paths

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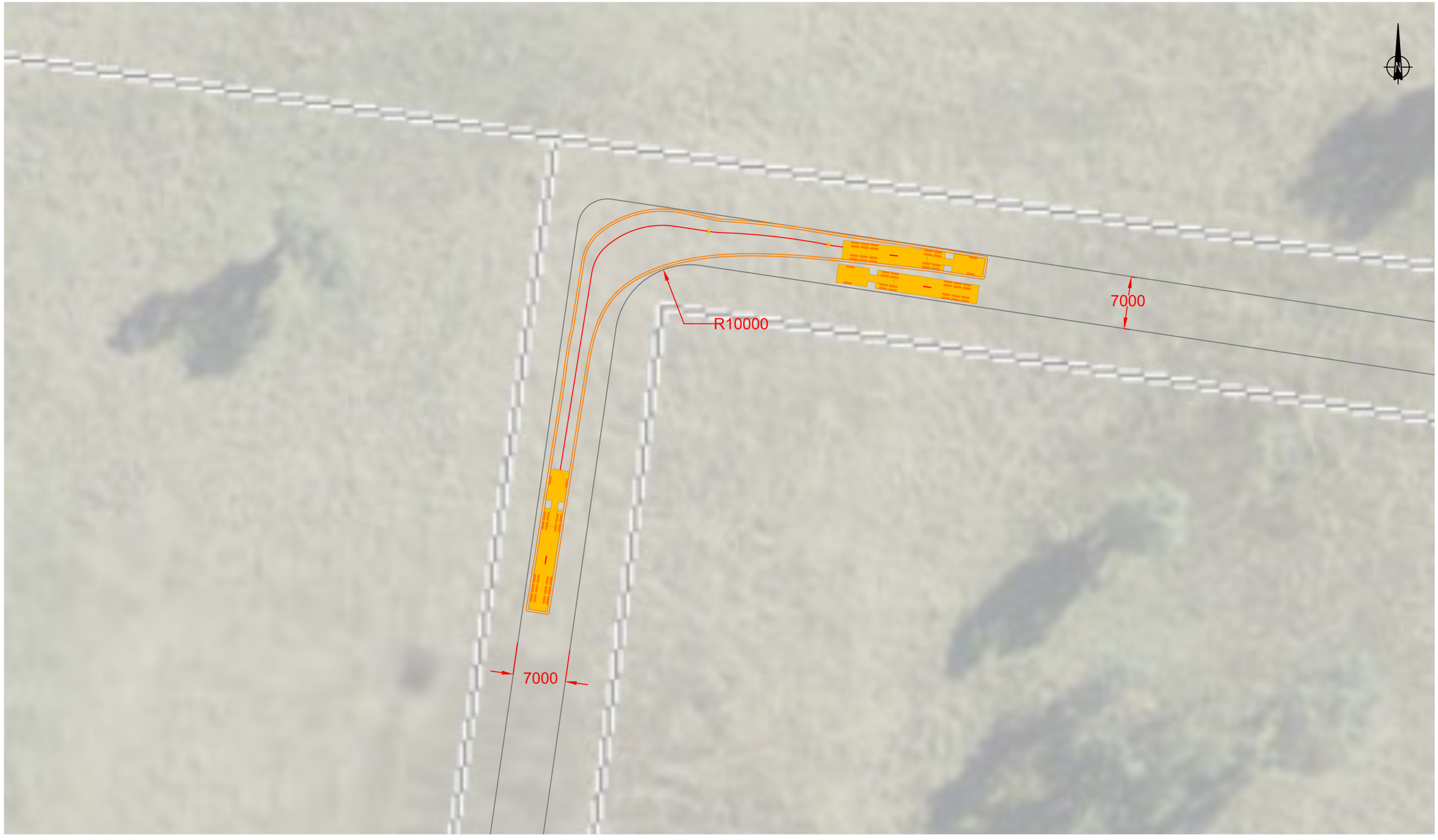

Vehicle Envelope

300mm Clearance

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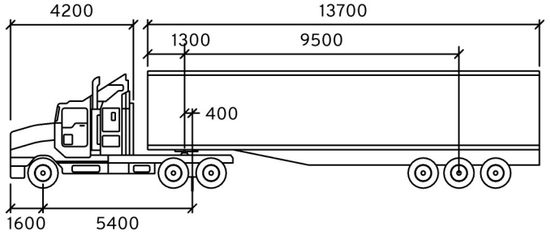

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Wollar Solar Farm

Southern Access Option 2

Swept Paths

DRAWN: MW
DATE: 04/09/2019
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DWG NO: 043-S01A

Amber

B8

Vehicle Envelope

300mm Clearance

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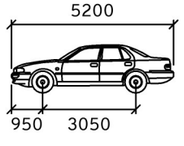

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Wollar Solar Farm

Southern Access Option 3

Swept Paths

DRAWN: MW
DATE: 04/09/2019
SCALE: 1:500 @ A3
DWG NO: 043-S01A

Amber B9

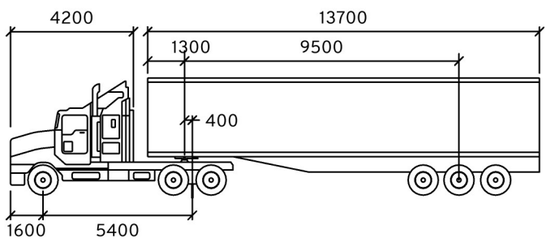
7000

Site Boundry

Vehicle Envelope

300mm Clearance

AV



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Articulating Angle	: 70.0

Wollar Solar Farm

Southern Access Option 2

Swept Paths

DRAWN: MW

DATE: 04/09/2019

SCALE: 1:500 @ A3

DWG NO: 043-S01A

Amber B10

APPENDIX B UPDATED BDAR

NGH 2019

Wollar Solar

Biodiversity Development Assessment Report

WOLLAR SOLAR FARM

OCTOBER 2019

ngh environmental

Document Verification

Project Title: Wollar Solar Farm

Project Number:	18-012
Project File Name	18-012 Wollar BDAR final v2

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Final v1.1	13/12/18	Gillian Young (Accredited BAM Assessor), Zoe Quaas, Mitch Palmer (Accredited BAM Assessor), Deb Frazer.	Dave Maynard (preliminary draft) (Accredited BAM Assessor) Brooke Marshall (Accredited BAM Assessor)	Brooke Marshall
Final v1.2	14/02/19	Brooke Marshall (Accredited BAM Assessor)	Minor changes	Brooke Marshall
Final v2	15/03/19	Gillian Young (Accredited BAM Assessor)	Minor changes	Brooke Marshall
Final v1.4	04/06/19	Mitch Palmer (Accredited BAM Assessor)	Brooke Marshall	Brooke Marshall
Final v2	11/10/19	Michelle Patrick Gillian Young (Accredited BAM Assessor)	Brooke Marshall (Accredited BAM Assessor) Dave Maynard (adjustment of impact areas in calculator) (Accredited BAM Assessor)	Brooke Marshall (Accredited BAM Assessor)
Final v2	18/10/19	Gillian Young (Accredited BAM Assessor)	Minor changes	Brooke Marshall

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622)

www.nghenvironmental.com.au e: ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
8/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Bega - ACT and South East NSW
89-91 auckland st (po box 470)
bega nsw 2550 (t 02 6492 8333)

Newcastle - Hunter and North Coast
2/54 hudson st
newcastle west nsw 2302 (t 02 4929 2301)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Brisbane
suite 4, level 5, 87 wickham terrace
spring hill qld 4000 (t 07 3129 7633)

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BAM	Biodiversity Assessment Methodology
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
BGW	Box Gum Woodland
BOM	Australian Bureau of Meteorology
CEEC	Critically Endangered Ecological Community (CW listing)
DBH	Diameter at Breast Height
DNG	Derived Native Grassland
DPE	(NSW) Department of Planning and Environment
EEC	Endangered Ecological Community (NSW listing)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999* (Cwth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
FM Act	*Fisheries Management Act 1994* (NSW)
GHG	Greenhouse Gases
ha	hectares
HBT	Hollow-bearing Tree
km	kilometres
LRET	Large-scale renewable energy target
m	Metres
MNES	Matters of National environmental significance under the EPBC Act (*c.f.*)
NSW	New South Wales
REAP	Regional Environmental Action Plan (NSW)
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
PV	Photovoltaic
SSD	State Significant Development
SEARS	Secretary's Environmental Assessment Requirements
SAII	Serious and Irreversible Impact
SEPP	State Environmental Planning Policy (NSW)
sp/spp	Species/multiple species
TEC	Threatened Ecological Community (can refer to either CW or NSW listing)

EXECUTIVE SUMMARY

The proposed Wollar Solar Farm is classified as State Significant Development (SSD) under the State and Regional Development State Environmental Planning Policy (SEPP). This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the proposed Wollar Solar Farm (the proposal) according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) and supplementary SEARs issued for the proposal. NGH Environmental has prepared this report on behalf of the proponent, Wollar Solar Development Pty Ltd.

The proposed Wollar Solar Farm involves the construction, operation and decommissioning of a ground-mounted PV solar array. The subject land is approximately 878 ha and would consist of associated infrastructure occupying around half the area. Approximately 290MW (AC) of renewable energy would be generated and supplied directly to the national electricity grid.

Consideration has been given to avoid and minimise impacts to native vegetation where possible. Site design options have been assessed against key environmental, social and economic criteria. Identifying the final development footprint (463 ha) has been iterative, informed by site surveys and specialist assessments. Mitigation and management measures will be put in place to adequately address direct and indirect impacts associated with the proposal.

Biodiversity impacts have been assessed through comprehensive survey, mapping and assessment completed in accordance with the BAM. Regarding onsite surveys, three targeted survey programs were undertaken to address candidate species. The three candidate species confirmed on site were:

- Large-eared Pied Bat (*Chalinolobolus dwyeri*),
- Large Bentwinged-bat (*Miniopterus orianae oceanensis*) and
- Eastern Cave Bat (*Vespadelus troughtoni*).

Although detected onsite, it was concluded after extensive inspection of rocky scarp habitat that no specialised breeding/roosting/refuge habitat was present inside the development footprint, as such no species credits would be generated for these species.

This updated BDAR (final version 2) now supersedes the previous BDAR provided as part of the Environmental Impact Statement (EIS) proposal (NGH Environmental, 2019a). This updated BDAR reflects a change regarding site access options and potential road upgrades. These changes are required to provide an additional southern access for construction (option 2). All areas and credits now reflect this increase.

The new development footprint is now 463 ha. Of this area, 367 ha comprises native vegetation requiring BAM assessment with impacts to:

- 24.59 ha of structural woodland,
- 342.92 ha of derived grasslands and cultivated low condition areas.
- 340.31 ha of vegetation meets the NSW criteria for Endangered Ecological Communities, most (92%) in degraded condition that does not generate offsets.
- 229.59 ha of vegetation that meets the Commonwealth criteria for Critically Endangered Ecological Communities, most (89%) in degraded condition.
- In addition to the 367 ha of native vegetation areas above, the development footprint also contains 5 paddock trees (assessed under BAM).

The impact areas above include sixty-four hollow-bearing trees (HBTs) that would need to be removed inside the Wollar property and the new Barigan Road access route.

Most of the development footprint (55%) will be used to mount solar panels above the ground. The impacts of shading and diversion of rainfall runoff from the panels themselves on groundcover beneath them is largely

unknown. For the purpose of this BDAR report, the entire development footprint is assumed to be removed however, as the indicative layout shows, substantial peripheral areas are likely to be unimpacted and it is likely that several perennial native species will persist underneath the solar arrays. Certainly, only a minor proportion of the seed bank will be impacted, given the limited excavation proposed. This is therefore a 'worst case' conservative approach. There is currently limited ability to vary this assumption without specific scientific data to justify a lesser impact; such as the results of ground cover monitoring beneath the solar array.

As such, the NSW credit requirement for the 'worst case' impact has been generated as:

- 713 ecosystem credits (5 of these credits generated by paddock tree removal)
- 544 species credits

All species credits are generated by 'assumed presence' of timbered habitat inside the new expanded footprint and also some of the development site for possible disturbances to hollow bearing trees within the Barigan road reserve required for access upgrades, not by targeted surveys. In the absence of targeted surveys in this area, presence has been assumed for and credits generated for:

- Austfeld's Wattle
- Bush Stone-curlew
- Gang-gang Cockatoo
- Large-eared Pied Bat
- *Commersonia procumbens*
- Large-leafed Monotaxis
- Barking Owl
- Powerful Owl
- Squirrel Glider
- Brush-tailed Phascogale
- Koala
- Masked Owl

The retirement of these credits will be carried out in accordance with the NSW Biodiversity Offsets Scheme (BOS).

The project is subject to a Commonwealth 'streamlined assessment[1]', to capture MNES, as well as NSW matters. Regarding MNES, potential impacts on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland – Critically Endangered Ecological Community are considered likely to be significant and warrant offsets. No other Commonwealth entity was assessed to have potential for a significant impact by the project.

In advance of the NSW BOS being endorsed by the Commonwealth (as of 15 March 2019 it is on public exhibition), the Wollar Solar Farm offset strategy retains flexibility. The strategy demonstrates that:

- Securing in perpetuity physical offsets within the subject land are likely to be feasible.
- Similar vegetation occurs in the locality and could also be considered, if required, for physical offsets.

Payment options may also be considered, such as making payments into the NSW Biodiversity Conservation Fund using the offset payments calculator or funding a biodiversity action.

[1] This is not related to the NSW Biodiversity Offset Scheme streamlined assessment, rather it represents concurrent Commonwealth and state assessment of all relevant MNES.

1 INTRODUCTION

The proposed Wollar Solar Farm is classified as State Significant Development (SSD) under the State and Regional Development State Environmental Planning Policy (SEPP). This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the proposed Wollar Solar Farm (the proposal) according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) for the proposal. NGH Environmental has prepared this report on behalf of the proponent, Wollar Solar Development Pty Ltd.

The following terms are used in this document, as required for a BDAR:

Subject land – all lots that would be impacted by the proposal.

Development site – The broader area of land that may be affected by the proposal and to which the BAM is applied. For the purposes of conducting this BDAR, the development site extends 200m out from the development footprint where legal access to land could be obtained. This is mapped on Figure 1-1.

Development footprint – The area of land that is directly impacted on by the proposal. Including, solar array design, perimeter fence, access roads, transmission line footprint and temporary areas used to store construction materials etc. This is mapped on Figure 1-2.

Buffer area – Land extending 1500m out from the development site used to assess native vegetation extent and other landscape features. This is mapped on Figure 3-1.

1.1 THE PROPOSAL

The proposed Wollar Solar Farm involves the construction, operation and decommissioning of a ground-mounted PV solar array. The subject land is approximately 900 ha and would consist of associated infrastructure occupying around half the area (463 ha). Approximately 290MW (AC) of renewable energy would be generated and supplied directly to the national electricity grid. This would provide enough clean, renewable energy for about 104,926 average NSW homes while displacing approximately 515,564 metric tons of carbon dioxide annually.

Key development and infrastructure components would include:

- Approximately 922,432 PV solar panels mounted on either fixed or tracking systems, both of which are considered feasible:
    - Fixed-tilted structures in a north orientation at an angle of 32 degrees or
    - East-west horizontal tracking systems.
- Approximately 58 PCU composed of two inverters, a transformer and associated control equipment to convert DC energy generated by the solar panels to 33kV AC energy.
- Steel mounting frames with driven or screwed pile foundations.
- An onsite 330kV substation containing two transformers and associated switchgear to facilitate connection to the national electricity grid via the existing 330kV transmission line onsite.
- Underground power cabling to connect solar panels, combiner boxes and PCUs.
- Underground auxiliary cabling for power supplies, data services and communications.
- Buildings to accommodate a site office, indoor 33kV switchgear, protection and control facilities, maintenance facilities and staff amenities.
- Internal access tracks for construction and maintenance activities.
- Space for a future energy storage facility with a capacity of up to 30MWh and comprising of lithium ion batteries with inverters.

- Perimeter security fencing up to 2.3m high.
- Native vegetation planting to provide visual screening for specific receivers, if any are required.
- Access upgrades – this is the only project change from the BDAR presented in the EIS and is detailed below for clarity.

Access upgrades

The EIS proposed two access options; a Northern Access and a Southern Access. The Northern Access was assessed for use by all vehicles, including heavy and oversized vehicles during construction and operation. The Southern Access Option 1 was assessed for use during construction and operation, with vehicle use limited to light vehicles only.

An alternative access, termed the Southern Access Option 2, is now proposed that would be constructed if Northern Access cannot be used for site access. If required, Southern Access Option 2 would allow heavy vehicle construction access via Barigan Road and the (Maree Road) road reserve. Southern Access Option 2 would only be used if Option 1 could not be used. Approximately 1.8 km of heavy vehicle access for the Northern access would not be developed in this case.

The inclusion of this alternative access option would increase the development footprint by up to 2 ha, to a total of approximately 463 hectares. These changes are required to provide an additional southern access for construction (option 2). All options are assessed in this BDAR as a conservative approach.

The construction phase of the proposal would take about 12 – 18 months and is anticipated to be operational for 30 years. When the solar farm is no longer viable, all above ground infrastructure, except for the onsite substation, would be removed. Any cabling more than 500mm underground may be left in place as it would not impact future agricultural activities following rehabilitation of the site.

An Environmental Impact Statement (EIS) inclusive of this BDAR was prepared (NGH Environmental, 2019a) on behalf of the proponent and was submitted to NSW Department of Planning and Environment (DPE) which was placed on public exhibition from 10 April 2019 to 7 May 2019. Following submissions resulting for the public exhibition period and from relevant public authorities, and although the proposal remains generally as detailed in the EIS, a change regarding vehicle access has been made (widening of Barigan Road and addition of Open 2, as set out above. Both options are assessed as a 'worst case' assessment approach.

1.2 THE SUBJECT LAND

1.2.1 Site location

The Wollar Solar Farm proposal is within the Mid-Western Regional Local Government Area (LGA). Mudgee is the closest regional centre to Wollar, located approximately 38km south west of the subject land.

Figure 1-1 shows the development site.

Owners of the subject land are outlined in Table 1-1.

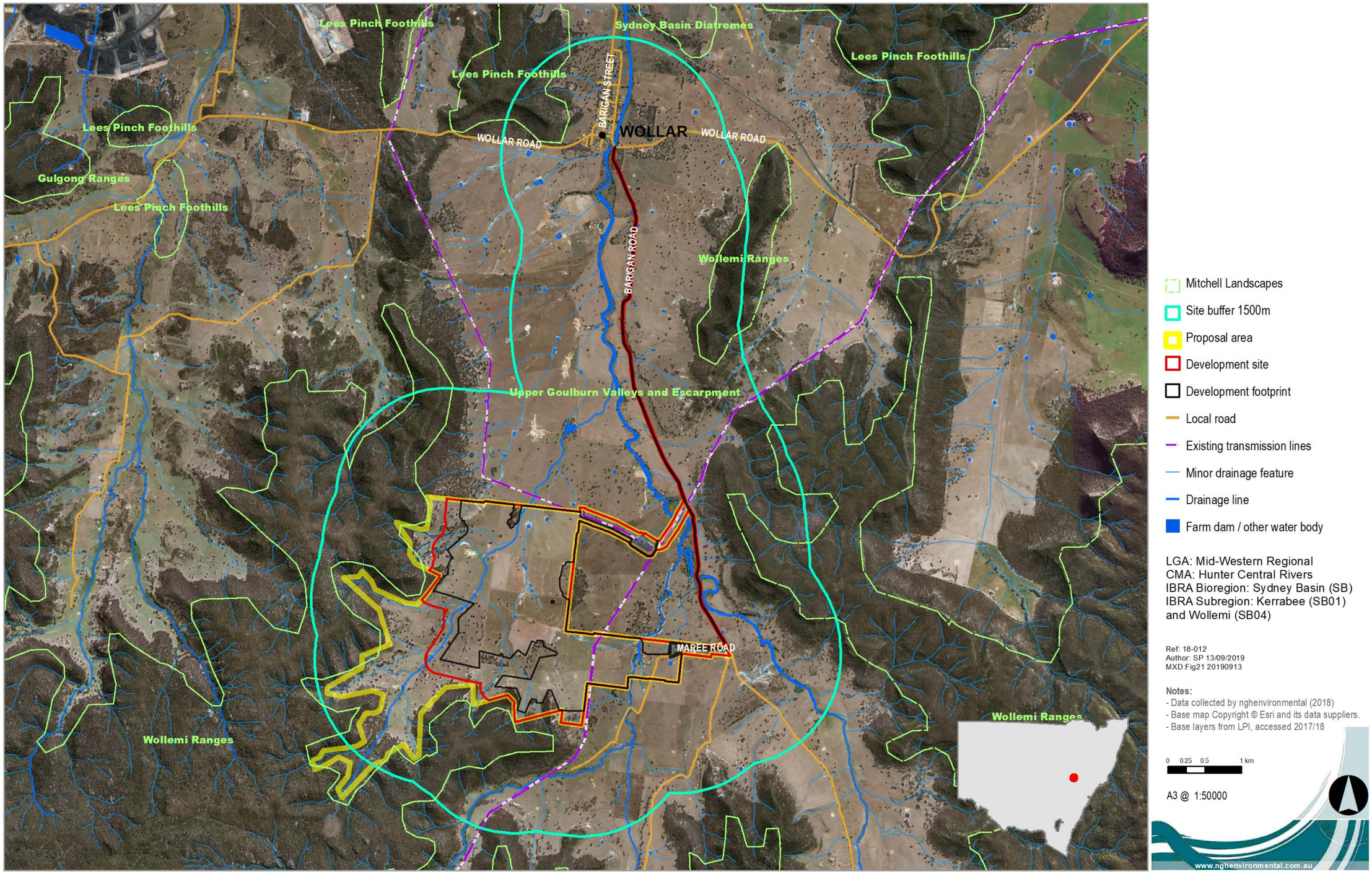


Figure 1-1. Development Site/Subject Land

Table 1-1 Lots associated with potential development of the proposed Wollar Solar Farm

Lots and DP	Owner
Lots 1, 22 - 25, 27, 30, 45, 49-51, 60-63, 69-80, 84, 92, 105-107, 119 and 152-154 of DP 755430 and Lot 1 DP650653	Currently owned by one private landowner
Lots 46 and 84 of DP755430 and Lots 10 and 11 DP1090027	Peabody Australia Pty Ltd.
Lots 1, 2, 4, 6, 8 & 10 DP1090027	TransGrid
Lot 7303 DP1139558	Crown Land
Lot 80 DP755430 and Lot 11 DP1090027	Peabody Australia Pty Ltd.
Road corridor	
Lot 7006, DP1024130	-
Lot 6011, DP1116440	-
Lots 29, 30, 31, 32, 35, 40, 41, 65, 87, 131, 136 DP755455	-
Lots 31, 41 DP755430	-
Lots 6, 7, 9, 11, 34, 7001, DP1090027	-

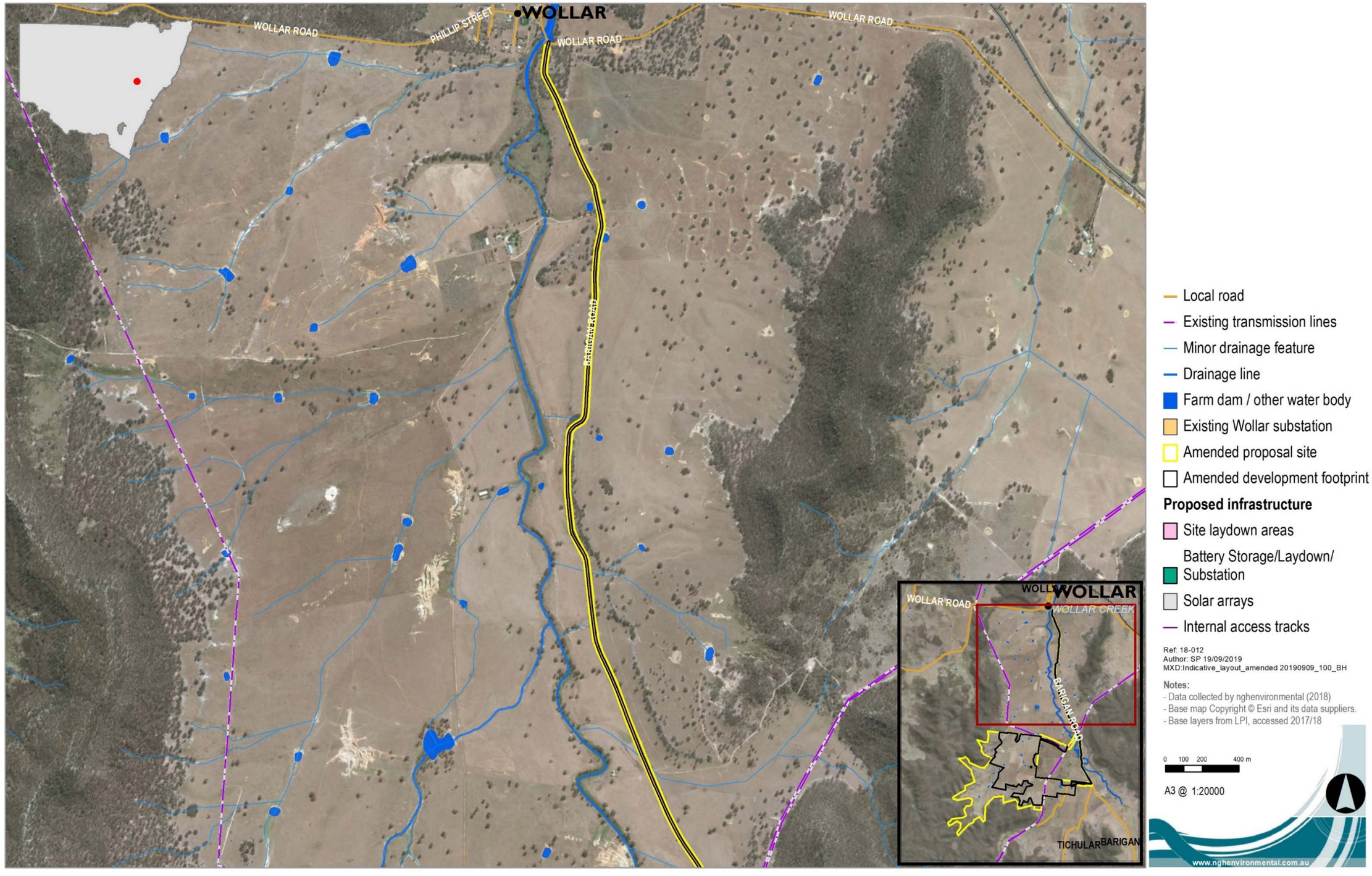
1.2.2 Site description

The Wollar Solar Farm proposal is located on the western side of Barigan Road, approximately 7km south of Wollar Village. The proposal would be located on a property of about 878 ha of freehold land. The development site comprises mostly paddocks within flatter land or foot slopes, which have been cleared for agricultural purposes, and an existing TransGrid 330kV transmission line that crosses the subject land in the north eastern corner.

Key features of the development site include:

- Woodlands and hollow bearing trees of high conservation value.
- Areas of woodland and derived native grassland with high diversity in the groundcover stratum which are classified as Critically Endangered under the EPBC.
- Highly disturbed native vegetation that lacks native understory and forb diversity due to grazing practices (Not critically endangered).
- Fifteen dams.
- Two ephemeral watercourses and approximately eight other tributaries.
- Rocky outcrops

The proposed solar farm would connect to the existing TransGrid 330kV transmission line located to the north eastern corner of the development site. Refer to Figure 1-2 below.


WOLLAR
WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
WOLLAR ROAD
BARIGAN ROAD
WOLLAR ROAD
WOLLAR
WOLLAR CREEK
BARIGAN ROAD
TICHULAR
BARIGAN
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Existing Wollar substation
Amended proposal site
Amended development footprint
Proposed infrastructure
Site laydown areas
Battery Storage/Laydown/ Substation
Solar arrays
Internal access tracks
Ref: 18-012
Author: SP 19/09/2019
MXD:Indicative_layout_amended 20190909_100_BH
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
0 100 200 400 m
A3 @ 1:20000
www.nghenvironmental.com.au

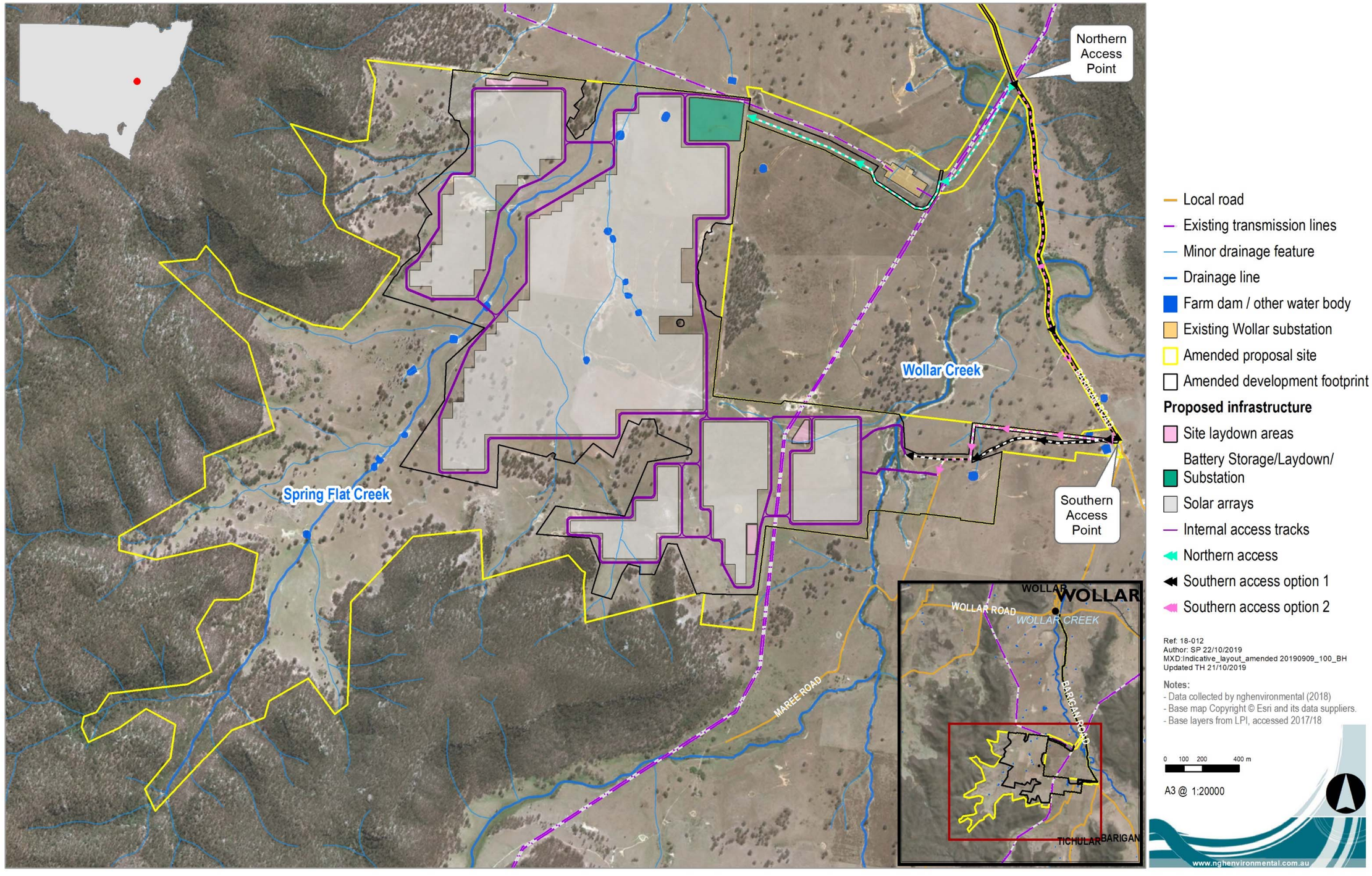


Figure 1-2 Subject land (Barigan Road impacts are now considered to support the Amendment Report; shown over 2 maps)

1.3 STUDY AIMS

This BDAR has been prepared by NGH Environmental on behalf of Wollar Solar Development Pty Ltd.

The aim of this BDAR is to address the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act), as required in the Secretary's Environmental Assessment Requirements (SEARs) and summarised below.

Secretary's Environmental Assessment Requirement	Where addressed
The EIS must address the following specific issues: • **Biodiversity** – including an assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW), a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW).	**Sections 7.1**

No additional or specific threatened species, populations or communities were specified in the SEARs or by the NSW Office of Environment and Heritage (OEH) for consideration.

This BDAR also addresses the assessment requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Provided in Appendix B.

1.4 SOURCES OF INFORMATION USED IN THIS ASSESSMENT

The following information sources were used in this BDAR:

- Proposal layers, construction methodology and concept designs provided by Green Switch.
- Australian Government's Species Profiles and Threats (SPRAT) database http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
- NSW OEH's Threatened Species Profiles http://www.environment.nsw.gov.au/threatenedspeciesapp/
- DPI profiles of threatened species, population, and ecological communities
  Commonwealth Department of Environment and Energy Protected Matters Search Tool Accessed online at http://environment.gov.au/epbc/protected-matters-search-tool
- Clean Energy Council of Australia website accessed online at https://www.cleanenergycouncil.org.au/technologies/geothermal.html
- Wind power Engineering and Development website accessed online at https://www.windpowerengineering.com/projects/guidelines-selecting-sites/
- Australia's IBRA Bioregions and sub-bioregions. Accessed http://environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps
- Department of Environment and Climate Change NSW (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2.
- Lumsden L.F & Micaela J.L (2015). National Recover Plan for Southern Bent-wing Bat. Dept of Land, Water and Planning, Melbourne.
- NSW Government SEED Mapping
- Office of Environment and Heritage (OEH) (2017). Biodiversity Assessment Method.

- NSW OEH's Biodiversity Assessment Method (BAM) calculator (http://www.environment.nsw.gov.au/bbccapp/ui/mynews.aspx).
- NSW Biodiversity Values Map

  https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap
- NSW OEH's BioNet threatened biodiversity database

  Accessed online via login at http://www.bionet.nsw.gov.au/.
- NSW OEH Threatened Species Profiles

  http://www.environment.nsw.gov.au/threatenedSpeciesApp/ and

  www.environment.nsw.gov.au/AtlasApp/UI_Modules/
- OEH BioNet Vegetation Classification Database (OEH 2017)

  Accessed online via login at http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx
- OEH VIS Mapping
- Mitchell, P. 2002 Descriptions for NSW Mitchell Landscapes version 2, NSW National Parks and Wildlife Service, Hurstville.
- NSW Planning portal online https://www.planningportal.nsw.gov.au/find-a-property

1.5 CONSULTATION

Table 1-2 Consultation with relevant departments.

Date	Contact	Reason	Outcome
24/09/18	Shannon Simpson, OEH Ecosystem Assessment Project Officer	To determine areas of mapped 'important areas' for the Swift Parrot and Regent Honeyeater within the solar farm.	'Important areas' for the Swift Parrot do not occur near to the site. The development footprint was refined to ensure no identified 'important areas' for the Regent Honeyeater would be impacted.

2 LANDSCAPE FEATURES

2.1 IBRA BIOREGIONS AND SUBREGIONS

Bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features, and flora and fauna communities. The development site is located within the NSW Sydney Basin Bioregion, in the Kerrabee subregion. The bioregion is characterised by warm summers and no dry season. The geology is characteristic of the Sydney-Bowen Basin, comprised of Carboniferous and Triassic marine volcanic sediments, creating a landscape of elevated plateaued sandstone for the most part of the basin, and sandstone and conglomerate cliff lines of Permian sediments to the south and west.

The dominant IBRA subregion impacted by the proposal is the Kerrabee subregion. This was entered into the BAM Calculator for the proposal.

2.2 NSW LANDSCAPE REGIONS AND AREA

The development site is in the Upper Goulburn Valleys and Escarpment Landscape. This landscape as described by Mitchell, 2002 is distinguished by steep hills and escarpments with rock outcrops on a mix of quartz sandstone, lithic sandstone and conglomerate and shale, making up harsh texture-contrast soils. Woodland in this area generally consists of grey box (*Eucalyptus moluccana*), forest red gum (*Eucalyptus tereticornis*), white box (*Eucalyptus albens*) and yellow box (*Eucalyptus melliodora*).

Upper Goulburn Valleys and Escarpment Landscape was entered into the BAM Calculator for the proposal.

2.3 NATIVE VEGETATION

As determined by GIS mapping from aerial imagery, approximately 2,734 ha of native vegetation comprises 55% of the 4,968ha buffer area 1,500m around the proposal site, including 2,272 ha of woody vegetation and 461 ha of derived grasslands.

The native vegetation in the landscape surrounding the development is considered to be predominantly grassy woodland on the Wollar Valley flats (Figure 2-1) comprising White Box (*Eucalyptus albens*), Blakely's Red gum (*Eucalyptus blakelyi*), Rough-barked Apple (*Angophora floribunda*), Grey Box (*Eucalyptus moluccana*) and Yellow Box (*Eucalyptus melliodora*). Black Cyprus (*Callitris endlicheri*) as well as White Box (*Eucalyptus albens*) dominate the foot slopes and steeper hilly terrain. Areas containing derived native grasslands inside the development footprint were considered Grassy Woodland – Derived Grasslands and included in the native vegetation assessment.

Figure 2-1 Example of native vegetation found within the Development Site

2.4 CLEARED AREAS

Cleared areas in the development site is primarily land where there is evidence of past ploughing/cultivation and where infrastructure is located (i.e. the substation and farm buildings). These areas provide limited foraging habitat for native species. Grass and weed seeds would provide some food for parrots and rodents which in turn would provide foraging habitat for raptors. Introduced species such as foxes and rabbits also occur. Around 168 ha (26%) of cleared areas exists within the development site with photographic examples illustrated within Figure 2-2 Example of cleared areas within the development site below. Cleared areas also include farmhouses, sheds and the substation.

Figure 2-2 Example of cleared areas within the development site

2.5 RIVER AND STREAMS

Spring Flat Creek (Figure 2-3) traverses the middle of the development site in a south-west to north-east direction and discharges into Wollar Creek approximately 2.5km north of the development site. This creek is also a fourth order stream under the Strahler stream classification system (Strahler, 1952). There are eight unnamed tributaries of Spring Flat Creek which traverse throughout the development site. The development site also contains fifteen farm dams; four to the south west, nine to the centre and two to the south east. According to Mid-Western Regional Council online mapping, the development site is not subject to flooding or groundwater vulnerability.

Wollar Creek (Figure 2-4) dissects the western portion of the development site. This creek is a fourth order stream under the Strahler stream classification system (Strahler, 1952).

Figure 2-3 Left: Spring Flat Creek south west of the development site leading into a dam; Right: Spring Flat Creek within north of portion of the development site

Figure 2-4 Left: Wollar Creek directly south of property access track creek crossing, Right; Wollar creek running underneath access track creek crossing to electricity substation.

2.6 WETLANDS

No wetlands occur in or adjacent to the development site. The nearest important wetland listed under the EPBC Act is the Hunter estuary wetlands, which is 150 – 200 km upstream of the locality.

A search of the 1:25000 topographic map reveals no wetlands in or adjacent to the development site.

2.7 CONNECTIVITY FEATURES

There are no significant connectivity features within the development site.

Small patches of treed Box Gum Woodland directly south of the development site provide some minor connectivity value, mainly for highly mobile species such as birds. Tree canopy connectivity is broken by open paddocks devoid of trees, which are mainly used for grazing and cultivation.

The connectivity of native grasslands is more significant for the site. The Wollar Valley has a patchy distribution of both exotic and native pastures. The proposed solar farm is not expected to disrupt connectivity of native grasslands when consideration is given the large area of native grasslands surrounding the development site that exist within Wollar Valley (~8000ha). Also, native groundcover will not be specifically targeted for removal underneath the solar panel arrays.

Spring Flat Creek, although a fourth order watercourse, is largely ephemeral and did not contain much tree cover. There was no observed ponded water at the time of inspection in May 2018. The creek appears to have a wide flat area for distribution of water where much of it would lie underground. The designated 40 metre buffer zone either side of the bank was largely devoid of trees and shrubs and is considered highly degraded (see Figure 2-3).

2.8 AREAS OF GEOLOGICAL SIGNIFICANCE

There are no karsts, caves, crevices or cliffs or other areas of geological significance within the development site. These features do occur in the surrounding vegetated ridgelines but will not be directly or indirectly impacted. There is a distinct band of Narrabeen Sandstone outcropping along the 70-80m contour line south and west of the development site as can be seen in Figure 2-5 below.

Figure 2-5 Sandstone outcropping found adjoining the development site to the south and west.

2.9 AREAS OF OUTSTANDING BIODIVERSITY VALUE

Two areas of Outstanding Biodiversity Value occur within the development site (NSW Biodiversity Values Map); Spring Flat Creek in the centre of the site and Wollar Creek to the south-east (Figure 2-6). The development layout avoids placement of solar panels inside the 40m buffer on either side of Spring Flat Creek. There will be up to two waterway crossings to cross the creek, however. No impacts are required for the use of an existing crossing over Wollar Creek.

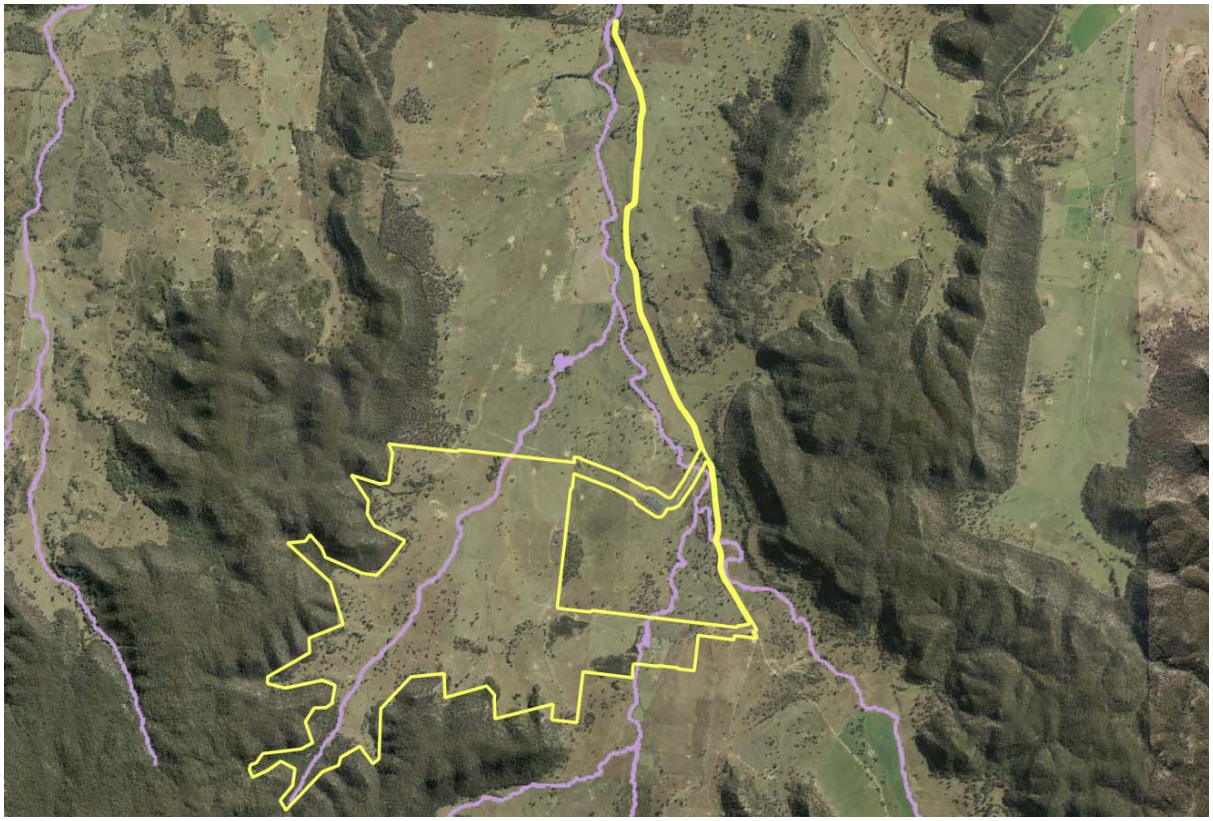


Figure 2-6 Map of biodiversity values (pink) sourced from NSW Government GIS data showing Spring Flat Creek as having biodiversity value, with the proposal site shown in yellow.

For Spring Flat Creek, erosion and waterway protection would be ensured by designing waterway crossings in accordance with the following:

- *Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003).*
- *Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI, 2003).*
- *Guidelines for Watercourse Crossings on Waterfront Land (NSW DPI, 2012).*

2.10 SITE CONTEXT COMPONENTS

Method applied

The proposal conforms to the definition of a *site-based development* under the Biodiversity Assessment Methodology. The site-based development assessment methodology has been used in this BAM assessment.

Percent Native Vegetation Cover

The Percent Native Vegetation Cover within the 1500 m buffer area surrounding the development site prior to the development was calculated to be 74% (See Figure 3-1). This was entered into the BAM calculator for the proposal.

Percent Native Vegetation was calculated by estimating the presence of any native vegetation based on aerial imagery within the 1500m buffer. Unless verified by visual inspection, areas containing grasslands inside the 1500 m buffer were assumed to be non-native grasslands because of existing farming operations in the surrounding landscape and because it could not be verified by site survey. The landscape surrounding the Wollar property contained similar land management practises and it was therefore assumed that groundcover was primarily dominated by native species.

3 NATIVE VEGETATION

3.1 NATIVE VEGETATION EXTENT

Approximately 428.07 ha (66%) of native vegetation occurs within the development site in two main condition states being remnant Box Gum Woodland and derived native grassland (of varying conservation value).

The remaining 222.27 ha (44%) of the development site either contains non-native vegetation or infrastructure (such as Wollar substation, ploughed paddocks with no trees, farmhouses and farm sheds). For areas not containing infrastructure, exotic species such as Lucerne (*Medicago sativa*), Rye Grass (*Lolium perenne*), Wild Oats (*Avena fatua*) and Barley Grass (*Hordeum leporinum*) were observed growing in cultivated paddocks. Other areas were observed to contain freshly ploughed country that did not contain any groundcover (May and August 2018). These areas do not contain native vegetation or provide any threatened species habitat and are not assessed further.

Five paddock trees occur throughout the development site (see Table 3-4 Zones 4 & 7). These trees were assessed using the Paddock Trees module because the vegetation met the following definition:

I. In terms of the groundcover, there was less than 50% cover of indigenous species, and
II. greater than 10% of the area was covered with vegetation (whether dead or alive), and
III. the assessment was made at the time of year suitable for groundcover assessment (Spring), and
IV. foliage cover for the tree growth form group was less than 25% of the benchmark for tree cover for the most likely PCT (See Zone 4 & 7 of Table 3-4).

3.2 PLANT COMMUNITY TYPES (PCTS)

3.2.1 Methods to assess PCTs

Review of existing information

A search was undertaken of OEH Vegetation Information System (VIS) database and NSW SEED mapping to access existing vegetation mapping information within the development footprint. One relevant vegetation map was found covering the Development site.

- *SEED Mapping – Sharing and Enabling Environmental Data (2017).*
    - Central Tablelands Vegetation [API. VIS_ID 4163]

Existing vegetation mapping is largely absent in covering the Wollar Valley. Therefore, PCT classification primarily relied on;

- Species noted during survey in May and August 2018,
- Landscape setting and whether the vegetation was found on a valley floor, foot slope or steeper hilly terrain,
- Geology and observation of soils onsite.

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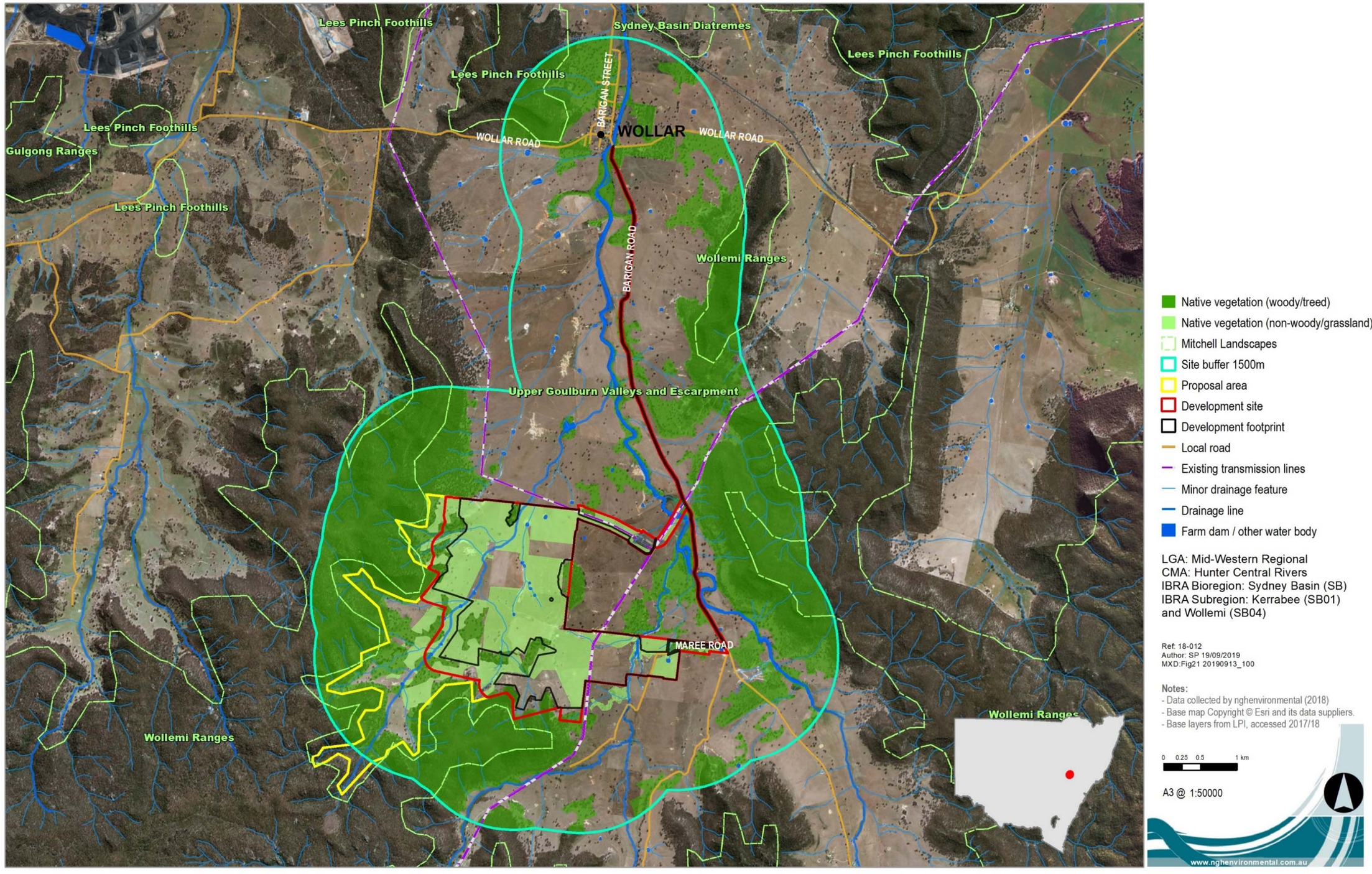

Figure 3-1 Native vegetation extent within the development site

Floristic survey

A preliminary environmental assessment involving field work was conducted within the Wollar property on the 6th and 7th of February 2018. The site was surveyed by a senior ecologist accredited under the BAM. The inspection involved identifying biodiversity constraints and vegetation mapping within the subject land. PCTs were determined based on the presence of diagnostic species via a rapid assessment and recording of dominant species within each stratum. No floristic plots were undertaken.

Following the initial site inspection, the client requested additional areas for assessment outside of the original survey area. A desktop assessment was carried out and compared to adjacent areas surveyed to stratify the vegetation within new areas based on landscape morphology such as topography and aspect.

A second survey was conducted from the 22nd to the 24th May 2018 by two ecologists accredited under the BAM and one graduate ecologist. The field work involved carrying out final stratification of vegetation onsite to adequately inspect areas not inspected from the initial site inspection. Collection of vegetation integrity plot data commenced. Six vegetation integrity plots, of 20m by 50m were established in homogenous vegetation zones. Data was collected on the composition, structure and function of the vegetation. The methodology conducted was consistent with the methodology presented in the BAM 2017 by persons trained in the BAM.

The number of plots undertaken did not meet the minimum number of plots required by the BAM. Therefore, further surveys were conducted onsite in October to complete the density of plot survey required for each validated vegetation zone inside the development footprint. A total of thirty-two plots were collected to adequately survey for all eight validated vegetation zones onsite.

3.2.2 PCTs identified on the development site

Three PCTs were identified within the development site:

- White Box – Grey Gum – Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion, White Box - Grey Gum - Kurrajong grassy woodland on northern Capertee Valley, Sydney Basin Bioregion (PCT 1303)
- Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion (PCT 281), and
- White Box - Black Cypress Pine shrubby woodland of the Western Slopes (PCT 1610).

A description of each PCT follows in Table 3-1 to Table 3-3. See Figure 3-2 for mapping of PCTs within the development site.

Table 3-1 Description of PCT 1303 within the development site

PCT name White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion		
Vegetation formation	Grassy Woodlands	
Vegetation class	Western Slopes Grassy Woodlands	
Vegetation type	**PCT ID**	1303
	Common Community Name	White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion

PCT name White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion		
Approximate extent within the development site	Overall, 309.21 ha of PCT 1303. There are four broad condition states; 1) 47.17 ha of 1303_Box Gum Woodland (Zone 1) 2) 133.43 ha of 1303_Derived Native Grassland (Zone 2) 3) 116.16 ha of 1303_Cultivated Low Condition (Zone 3) 4) 12.83 ha of 1303_Exotic (1 paddock tree) (Zone 4)	
Species relied upon for PCT identification	***Species name***	
	Eucalyptus moluccana (observed outside plot)	
	Eucalyptus albens (present within two plots)	
	Bursaria spinosa (observed outside plot)	
	Brachychiton populneus subsp. populneus (present within one plot)	
	Austrostipa scabra (present in three plots)	
Justification of evidence used to identify the PCT	This Box Gum Woodland occurs on lower slopes of the Wollar Valley and is generally associated with a north westerly aspect. It has been subjected to past disturbances caused by land clearing and farming practises. *Eucalyptus albens* was dominant over the landscape with lesser dominant *E. moluccana*. Groundcover species diversity was high with the most prevalent groundcover species being *Bothriochloa macra*. This PCT, although not known to occur in Kerrabee Subregion is the best PCT match based on site observations, plot data, landscape setting and soils. PCT 1303 occurs within Capertee Valley which occurs on Narrabeen Sandstone geology of which Wollar Valley has very similar traits. A shortlist of other PCTs revealed; PCT 483 - This PCT contains the best floristic match however, landscape position and distribution of Wollar Valley did not match with descriptions for this PCT. Wollar Valley does not contain black earths or chocolate soils derived from Basalt. Wollar Valley contains sandy alluvium derived from Narabeen Sandstone geology which is more closely related to PCT 1303 (similar landscape to Capertee Valley). PCT 496 - Equal floristic matches but weak distribution. PCT 266 - *Eucalyptus moluccana* absent in the upper stratum which was observed to be associated within the zone (although not captured in plots).	
TEC Status	This vegetation forms part of the listed EEC: White Box Yellow Box Blakely's Red Gum Woodland listed under the BC Act.	

PCT name White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	
Estimate of percent cleared	90%
Examples	 VI Plot 1  VI Plot 4

Table 3-2 Description of PCT 281 inside the development site.

PCT name: Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion		
Vegetation formation	**Grassy Woodlands**	
Vegetation class	Coastal Valley Grassy Woodlands	
Vegetation type	**PCT ID**	281
	Common Community Name	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion
Approximate extent within the development site	Overall, 225.52 ha of PCT 281. There are three broad condition states; 1) 50.80 ha of 281_Box Gum Woodland (Zone 5) 2) 143.18 ha of 281_Derived Native Grassland (Zone 6) 3) 31.64 ha of 281_Exotic (4 Paddock trees) (Zone 7)	
Species relied upon for PCT identification	***Species name***	
	Eucalyptus blakelyi (2 plots)	
	Eucalyptus albens (one plot)	
	Angophora floribunda (outside plot)	
	Eucalyptus melliodora (outside plot)	
	Microlaena stipoides (2 plots)	
	Bothriochloa macra (one plot)	
Justification of evidence used to identify the PCT	This Box Gum Woodland occurs on the Wollar Valley and is generally associated with Spring Flat Creek. It has been subjected to past disturbances caused by land clearing and farming practises. *Angophora floribunda* was dominant over the landscape with equal numbers of *Eucalyptus blakelyi* and lesser dominant *Eucalyptus melliodora*. Groundcover species diversity was high with the most prevalent groundcover species being *Microlaena stipoides* and *Bothriochloa macra*. This PCT is known to occur in Kerrabee Subregion and was the best PCT match based on site observations and comparison to plot data. A shortlist of other PCTs revealed; PCT 618 - *White Box x Grey Box - red gum - Rough-barked Apple grassy woodland on rich soils on hills in the upper Hunter Valley*	

PCT name: Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
	- Strong floristic match but *Eucalyptus blakelyi* was not present in the upper stratum. PCT 85 - *River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion* - Strong floristic match but PCT not found inside Kerrabee subregion. PCT 266 - White Box grassy woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion - Strong floristic match but no *Angophora floribunda*, the key dominant species in the upper stratum for this vegetation zone.
TEC Status	This vegetation forms part of the listed EEC: White Box Yellow Box Blakely's Red Gum Woodland.
Estimate of percent cleared	94%
Examples	 VI Plot 2

PCT name: Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	
	 VI Plot 5

Table 3-3 Description of PCT 1610 in the development site

PCT name White Box - Black Cypress Pine shrubby woodland of the Western Slopes		
Vegetation formation	**Dry Sclerophyll Forest**	
Vegetation class	Western Slopes Dry Sclerophyll Forests	
Vegetation type	**PCT ID**	1610
	Common Community Name	White Box - Black Cypress Pine shrubby woodland of the Western Slopes
Approximate extent within the development site	Overall, 61 ha of PCT 1610. There were two broad condition states within the development site; 1) 12.37 ha of 1610_Forested (Zone 8) 2) 41.65 ha of 1610_Degraded (Zone 9)	
Species relied upon for PCT identification	***Species name***	
	Eucalyptus albens (observed outside plot)	
	Callitris endlicheri (observed outside plot)	

PCT name White Box - Black Cypress Pine shrubby woodland of the Western Slopes	
	Calotis lappulacea (inside one plot)
	Vittadinia cuneata (inside one plot)
	Cassinia arcuata
Justification of evidence used to identify the PCT	This PCT occurs on the steeper foothills of the Wollar Valley above a distinct sandstone escarpment. The lower parts of this PCT have been subjected to past land clearing and farming practises. *Eucalyptus albens* was the dominant tree with disturbed areas being dominated by thick regeneration of *Callitris endlicheri* and *Acacia ixiophylla*. Groundcover species diversity was high with the prevalence of *Calotis lappulacea*, *Vittadinia cuneata* and *Bothricholoa macra*, *Themeda australis* and Austros*tipa sp*. This PCT is known to occur in Kerrabee Subregion and was the best PCT match based on site observations during field survey. A shortlist of other PCTs revealed; • PCT 281 - *Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion* -The upper stratum species did not contain *Callitris endlicheri* which was a dominant species within disturbed parts of this vegetation zone. • PCT 412 - *White Box - Black Cypress Pine shrubby hill woodland in the east Pilliga - Mendooran - Gulgong regions, mainly Brigalow Belt South Bioregion.* - Incorrect distribution of this PCT. It was not found within Sydney Basin Bioregion. • PCT 434 - W*hite Box grass shrub hill woodland on clay to loam soils on volcanic and sedimentary hills in the southern Brigalow Belt South Bioregion* - PCT not distributed within Kerrabee Subregion.
TEC Status	Not associated with a TEC.
Estimate of percent cleared	40%

PCT name White Box - Black Cypress Pine shrubby woodland of the Western Slopes	
Examples	 PCT 1610_Forest  PCT 1610_Degraded

3.3 VEGETATION INTEGRITY ASSESSMENT

3.3.1 Vegetation zones and survey effort

The random meander, overview inspection and detailed floristic plots have been used to assist in the delineation of vegetation zones. Three PCTs were identified in the development site. Each of the PCTs were further stratified into additional zones on the basis of their condition or other environmental variables. All three PCTs were further stratified and this was on the basis of presence/absence of trees and noticeable differences in groundcover composition, especially the abundance of native species. All vegetation zones including photos of each are shown in Table 3-1 to Table 3-3 and mapped in Figure 3-2.

The number of plots undertaken meets the minimum number of plots required by the BAM for vegetation zones 1-7. A total of thirty-two plots were collected to adequately survey for all nine validated vegetation zones onsite.

Representative plots were undertaken within 'exotic/paddock tree' areas to confirm that the vegetation integrity score was less than 15 and did not require offsetting.

3.3.2 Paddock trees

Five paddock trees occur inside the development site within 'Exotic groundcover' within Zone 4 & 7 (see Table 3-4 below). Tree species included White Box (*Eucalyptus albens*) which was assigned to PCT 1303. Remaining species included Rough-barked Apple (*Angophora floribunda*), Blakley's Red Gum (*Eucalyptus blakelyi*) and Yellow-box (*E. melliodora*) which were assigned to PCT 281. As none of the paddock trees had hollows, most of the threatened candidate species identified by the BAM Calculator are not considered to utilise these trees. The only exception would be the Little Eagle where there is evidence of these birds utilising paddock trees as potential nesting areas. Where targeted fauna surveys were required for the BAM Calculations, paddock trees were also included in surveys for inspection of raptor nests. More details are included under Section 4 and 5.

All paddock trees were mapped in the field using a handheld GIS Tablet. Trees were identified to genus and species. The Diameter at Breast Height (DBH) of the tree was assessed and assigned a paddock tree class relevant to the large tree benchmark. The Large tree benchmark for PCTs 1303 and 281 is 50cm DBH. The trees were visually assessed from the ground to determine whether any hollows were present. The paddock trees occurring in the development site are shown within zones 4 and 7 in Table 3-4 below.

Vegetation zones

- Zone 5: PCT 281: Good condition
- Zone 6: PCT 281: Derived
- Zone 8: PCT1610: Good
- Zone 9: PCT 1610: Cleared low condition
- Development site
- Development footprint
- Local road
- Existing transmission
- Minor drainage feature
- Drainage line
- Farm dam / other water

Ref: 18-012
Author: SP 13/09/2019
MXD:vegetation_condition_paddock_trees 20190912

Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18

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www.nghenvironmental.com.au

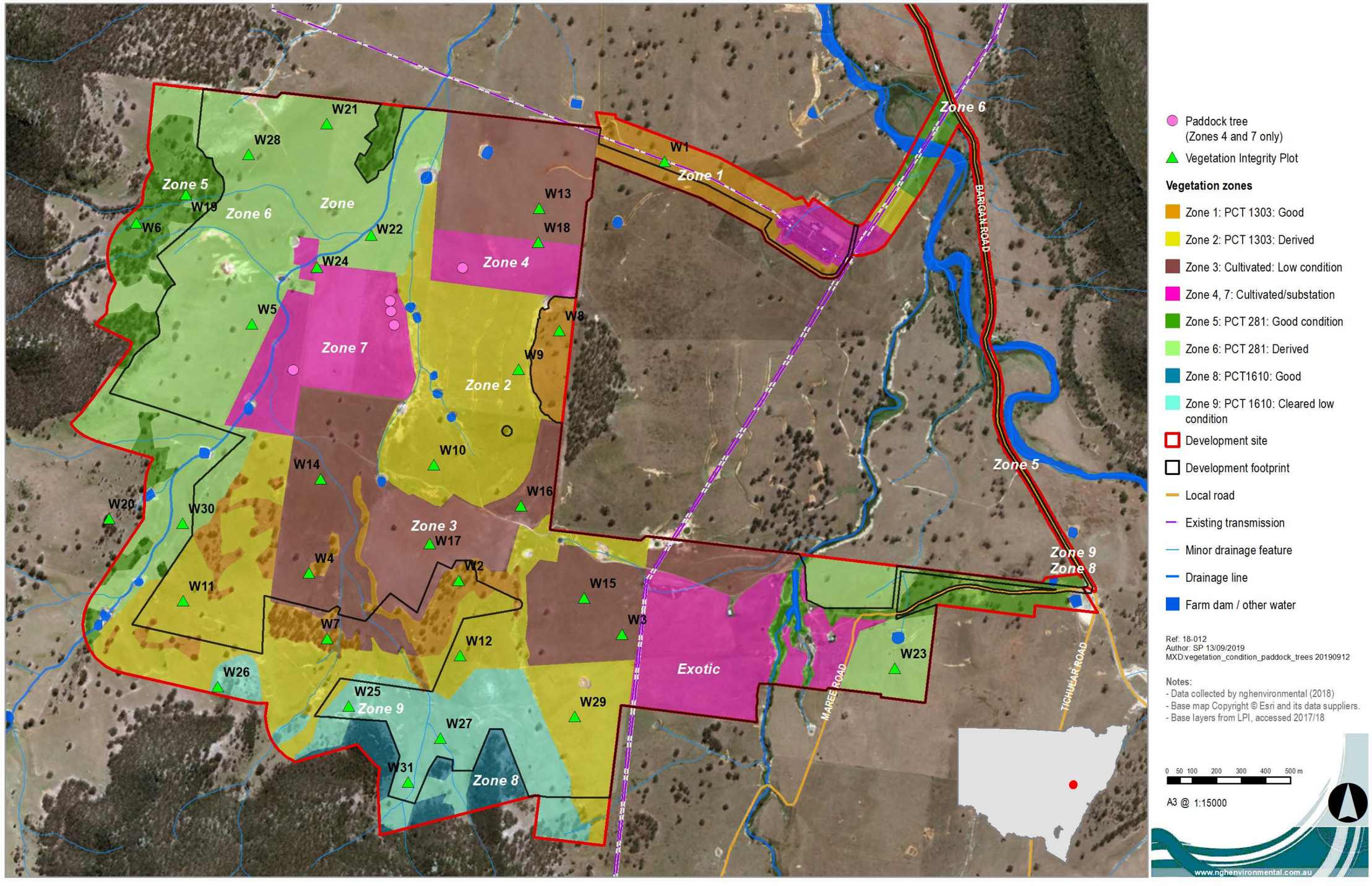


Figure 3-2 Vegetation zones, PCTs and representative Vegetation Integrity plots for development site (shown over 2 maps)

Table 3-4 Vegetation zones within the development footprint (impact area)

Zone ID	PCT ID	Condition	Zone area (ha)	Survey effort (Number of plots)	Patch size (ha)	Examples
1	1303	**Box Gum Woodland** PCT containing tree cover (although sparse in some sections) and with diverse mix of native and exotic groundcovers. Considered to be in moderate condition. This woodland is a TEC under EPBC and BC Act.	16.46	3 plots required (4 plots collected on site includes W1, W2, W7, W8)	101	
2	1303	**Derived Native Grassland** PCT lacking most trees and with a mix of native and exotic groundcovers. Considered to be in moderate to low condition. This zone is still classified as a TEC under the EPBC and BC Act.	102.30	6 plots required (6 collected including W4, W9, W10, W11, W12, W29)	101	

Zone ID	PCT ID	Condition	Zone area (ha)	Survey effort (Number of plots)	Patch size (ha)	Examples
3	1303	**Cultivated Low Condition** This vegetation zone has been cultivated in the past and Red Grass (*Bothriochloa macra*) now colonises this zone. High threat weed Saffron (Carthamus lanatus) also dominated this area. This zone is degraded in diversity but still classified as TEC under the BC Act, because it achieves a vegetation integrity score greater than 15.	110.72	6 Plots required (6 collected including plots W3, W13, W14, W15, W16, W17).	101	
4	1303	**Exotic Ground Cover – 1 Paddock tree** This zone comprised of 1 mature non-hollow bearing White Box tree (Eucalyptus albens) existing within cultivated land containing exotic groundcover (photos illustrates the paddock tree). The overall canopy cover for this vegetation zone was less than 25% of the lower benchmark for PCT 1303. This tree was classified as class 3. This vegetation zone is not classified as TEC. This paddock tree is classified as a class 3 tree and assessed accordingly with use of the paddock tree tool. The trees are not seen to provide habitat for any species credit species generated within BAM assessment.	12.83	One Plot (W18) carried out to confirm groundcover species composition dominated by exotics (>80%) and lack of native groundcover.	NA	

Zone ID	PCT ID	Condition	Zone area (ha)	Survey effort (Number of plots)	Patch size (ha)	Examples
5	281	**Box Gum Woodland** PCT containing tree cover of Rough-barked Apple (*Angophora floribunda*) (although sparse in some sections) and with diverse mix of native and exotic groundcovers. Considered to be in moderate condition. This woodland is a TEC under EPBC and BC Act.	7.99	3 Plots required. (3 collected including W6, W19 and W20)	101	
6	281	**Derived Native Grassland** PCT lacking most trees and with a mix of native and exotic groundcovers. Considered to be in moderate to low condition. This zone is still classified as a TEC under EBPC and BC Act.	102.83	6 Plots required. (6 collected including W5, W21, W22, W23, W28 and W30)	101	

Zone ID	PCT ID	Condition	Zone area (ha)	Survey effort (Number of plots)	Patch size (ha)	Examples
7	281	**Exotic Groundcover – 4 paddock trees** This zone comprised of 4 mature non-hollow bearing paddock trees (2 x Eucalyptus melliodora, 1 x E. blakelyi, 1 x Angophora floribunda) existing within cultivated land containing exotic groundcover. The overall canopy cover for this vegetation zone was less than 25% of the lower benchmark for PCT 281. These paddock trees are classified as class 3 trees and assessed accordingly with use of the paddock tree tool. The trees are not seen to provide habitat for any species credit species generated within BAM assessment. Photo illustrates the two Yellow-Box gums assessed as paddock trees.	31.64	One Plot (W24) carried out to confirm groundcover species composition dominated by exotics (>80%) and lack of native groundcover.	NA	
8	1610	**Good** This vegetation zone is not a TEC under EPBC or BC Act. This zone is within the recently upgraded development footprint alongside Barigan Rd only but not the Wollar property itself.	0.14	NA	NA	

Zone ID	PCT ID	Condition	Zone area (ha)	Survey effort (Number of plots)	Patch size (ha)	Examples
9	1610	**Degraded** PCT subjected to past clearing and is now is regenerating thickly with Black Cyprus Pine (*Callitris endlicheri*) and Sticky-leaved Wattle (*Acacia ixiophylla*). This vegetation zone is not a TEC under EPBC or BC Act.	27.07	4 collected including W25, W27, W31 and W32.	101	

Table 3-5 Paddock trees within the development site

ID	Easting	Northing	Species	Common Name	DBH (cm)	DBH above benchmark (50cm)	Paddock Tree Class	Hollows Present	Impacted by proposal	Vegetation Zone/PCT
1	776316	6410068	*E. albens*	White Box	82	Yes	3	no	Yes	4/1303
2	776042	6409984	*E. blakelyi*	Blakely's Red Gum	72	Yes	3	no	Yes	7/281
3	776015	6400957	*E. melliodora*	Yellow Box	70	Yes	3	no	Yes	7/281
4	776024	6409856	*E. melliodora*	Yellow Box	95	Yes	3	no	Yes	7/281
5	775585	6409691	*A. floribunda*	Rough-barked Apple	76	Yes	3	no	Yes	7/281

3.3.3 Vegetation integrity assessment results

The results of the plot field data can be found in Appendix A.

The plot data from the vegetation integrity survey plots were entered into the BAM calculator. The results of the vegetation integrity assessment are provided in Table 3-5.

Table 3-6 Data used in BAM Calculator for this BDAR assessment based on current development proposal

Vegetation Zone	Plot collected during May 18	Plots collected during Oct 18	Number of plots required by BAM	Approach taken BAM calculator (BAM C)
Veg zone 1 1303_BoxGumWL	2	2	3	4 plots entered.
Veg zone 2 1303_DerivedNativeGL	1	5	6	All plots entered into BAM C
Veg Zone 3 1303_Cultivated Low	1	5	6	All plots entered into BAM C
Veg Zone 4 1303 Exotic (Paddock trees)	0	1	NA	Paddock tree data entered into BAM C. One plot confirmed exotic groundcover
Veg Zone 5 281 BoxGumWL	1	2	3	All plots entered into BAM C
Veg Zone 6 281 DerivedNativeGL	1	5	6	All plots entered into BAM C
Veg Zone 7 281 Exotic (paddock trees)	0	1	NA	Paddock tree data entered into BAM C. One plot confirmed exotic groundcover
Veg Zone 8 1610 Forest	0	1	1	Plot entered into BAM C
Veg Zone 9 1610 Degraded	0	4	4	All plots entered into BAM C

Field plot data collected in May 2018 can be found in Appendix A.1.2 and representative photos of each plot are shown in Appendix A.1.1. Data from the vegetation integrity survey plots (where collected onsite) was entered into the BAM calculator. Sources of data used for the BAM calculator can be seen in table 3-6 above. The results of the vegetation integrity assessment are provided in Table 3-7 below.

Table 3-7 Table of current vegetation integrity scores for each vegetation zone within the development site.

Zone ID	Composition score	Structure score	Function score	Vegetation Integrity Score
Veg zone 1 1303_BoxGumWL	68.3	87.7	30.6	56.8
Veg zone 2 1303_DerivedNativeGL	59	38.3	0.4	9.4
Veg Zone 3 1303_Cultivated Low	39.4	15.3	2.5	11.4
Veg Zone 4	NA	NA	NA	NA

Zone ID	Composition score	Structure score	Function score	Vegetation Integrity Score
1303 Exotic (Paddock trees)				
Veg Zone 5 281 BoxGumWL	64.9	50.1	65.1	59.6
Veg Zone 6 281 DerivedNativeGL	58.7	27.1	1.1	11.9
Veg Zone 7 281 Exotic (paddock trees)	NA	NA	NA	NA
Veg Zone 8 1610 Forest	49.3	23.1	17.2	27
Veg Zone 9 16010 Degraded	35.7	4.7	0.1	2.3

4 THREATENED SPECIES

4.1 ECOSYSTEM CREDIT SPECIES

The following ecosystem credit species were returned by the calculator as being associated with the PCTs present on the development site.

Table 4-1 Ecosystem Credit Species assessed.

Ecosystem credit species	Vegetation type(s)	NSW Status	National Status
Anthochaera phrygia Regent Honeyeater (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Critically Endangered	Critically Endangered
Artamus cyanopterus Dusky Woodswallow	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Callocaphalon fibbriatum Gang-gang Cockatoo (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Chthonicola sagittata Speckled Warbler	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Circus assimilis Spotted Harrier	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed

Ecosystem credit species	Vegetation type(s)	NSW Status	National Status
Climacteris picumnus victoriae Brown Treecreeper	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Daphoenositta chrysoptera Varied Sittella	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Dasyurus maculatus Spotted-tailed Quoll	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Endangered
Falsistrellus tasmaniensis Eastern False Pipistrelle	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	Vulnerable	Not Listed
Glossopsitta pusilla Little Lorikeet	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Vulnerable
Grantiella picta Painted Honeyeater	1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Vulnerable

Ecosystem credit species	Vegetation type(s)	NSW Status	National Status
Haliaeetus leucogaster White-bellied Sea-Eagle (Foraging)	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Hieraaetus morphnoides Little Eagle (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Lathamus discolor Swift Parrot (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Endangered	Critically Endangered
Lophoictinia isura Square-tailed Kite (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Melanodryas cucullata cucullata Hooded Robin	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Melithreptus gularis gularis Black-chinned Honeyeater	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed

Ecosystem credit species	Vegetation type(s)	NSW Status	National Status
Miniopterus orianae oceanensis Large Bent-wing Bat (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Micronomus norfolkensis Eastern Coastal Freetail-bat	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	Vulnerable	Not Listed
Neophema pulchella Turquoise Parrot	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Ninox connivens Barking Owl (Foraging)	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion 1610 - White Box - Black Cypress Pine shrubby woodland of the Western Slopes	Vulnerable	Not Listed
Ninox strenua Powerful Owl (Foraging)	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Petroica boodang Scarlet Robin	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Petroica phoenicea Flame Robin	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the	Vulnerable	Not Listed

Ecosystem credit species	Vegetation type(s)	NSW Status	National Status
	northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion		
Phascolarctos cinereus Koala (Foraging)	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Vulnerable
Pomatostomus temporalis temporalis Grey-crowned Babbler	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Pteropus poliocephalus Grey-headed Flying-fox (Foraging)	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Vulnerable
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Vulnerable
Stagonopleura guttata Diamond Firetail	1303 -White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion 281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Tyto novaehollandiae Masked Owl (Foraging)	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed
Varanus rosenbergi Rosenberg's Goanna	281 – Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Vulnerable	Not Listed

4.1.1 Species excluded from the assessment

Only one ecosystem credit species was partially excluded from the assessment. This was Painted Honeyeater (*Grantiella picta*). This was due to there being less than five mistletoes per hectare within all vegetation zones

with exception for PCT 1610_Forest. This was based on the observation of some mistletoes within White Box Trees within PCT 1610_Forest (Veg zone 8)

All other ecosystem credit species were included in the BAM assessment.

4.2 SPECIES CREDIT SPECIES

4.2.1 Candidate species to be assessed

The BAM Calculator predicted the following species credit species to occur at the development site as can be seen in Table 4-2 below.

Table 4-2 Candidate species credit species requiring assessment

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
FAUNA							
Anthochaera phrygia **Regent Honeyeater (Breeding)**	Mapped Important areas (OEH)	High	Critically Endangered	Critically Endangered	Outside mapped important areas (OEH)	Included	Parts of the solar farm site contained preliminary 'important mapped areas' mapping.
Aprasia parapulchella **Pink-tailed Legless Lizard**	Rocky areas or within 50 m of rocky area	High	Vulnerable	Vulnerable	Optimal habitat within the development site	Included	Survey required and undertaken
Burhinus grallarius **Bush Stone-curlew**	Fallen/standing dead timber including logs	High	Endangered	Not Listed	Distinct lack of fallen timber resources inside the development site.	Included (partial)	No suitable habitat in solar farm site due to the absence of preferred timber resources Assumed present in timbered PCTs for Barigan Road
Callocephalon fimbriatum **Gang-gang Cockatoo (Breeding)**	Living or dead tree with hollows greater than 10 cm diameter and greater than 9 m above ground.	High	Vulnerable	Not Listed	Suitable Hollow-bearing Trees (HBTs) present within development site	Included	Survey required and undertaken

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Chalinolobus dwyeri **Large-eared Pied Bat**	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	Very High	Vulnerable	Not Listed	No suitable habitat in development site however suitable habitat is located within surrounding sandstone ridgelines	Included	Survey required and undertaken
Haliaeetus leucogaster **White-bellied Sea-Eagle (Breeding)**	Living or dead trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines (BioNet).	High	Vulnerable	Not Listed	Large trees exist near large dams along Spring Creek Flat.	Included	Survey required and undertaken
Hieraaetus morphnoides **Little Eagle**	Nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	High	Vulnerable	Not Listed	Woodland and paddock trees present inside the development site.	Included	Survey required and undertaken
Lathamus discolor **Swift Parrot**	Mapped Important areas (OEH)	Moderate	Endangered	Critically Endangered	Outside mapped important areas (OEH)	Excluded	Outside mapped important area (OEH)
Lophoictinia isura **Square-tailed Kite (Breeding)**	Nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	High	Vulnerable	Not listed	Large waterbody within 1 km of development site	Included	Survey required and undertaken

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Miniopterus orianae oceanensis **Large Bent-wing-bat (Breeding)**	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	Very High	Vulnerable	Not listed	Potential habitat within areas containing rocky outcrops, farm sheds, road culverts.	Included	Survey required and undertaken
Ninox connivens **Barking Owl (Breeding)**	Hollow-bearing trees. Woodland and open forest, including fragmented remnants and partly cleared farmland. Known in subregion.	High	Vulnerable	Not listed	Suitable HBTs present within development site	Included	Survey required and undertaken
Ninox strenua **Powerful Owl (Breeding)**	Large mature trees likely to contain large hollows.	High	Vulnerable	Not listed	Suitable HBTs present within development site	Included	Survey required and undertaken
Petaurus norfolcensis **Squirrel Glider**	Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart).	High	Vulnerable	Not listed	Suitable HBTs present within development site	Included	Survey required and undertaken

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Petrogale penicillata **Brush-tailed Rock-wallaby**	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.	High	Endangered	Vulnerable	Distinct lack of suitable rocky outcrop within the development site. More suitable habitat on the north facing southern ridgeline outside of the development site	Excluded	No suitable habitat to be impacted.
Phascogale tapoatafa **Brush-tailed Phascogale**	Hollows with entrances 2.5 - 4 cm wide	High	Vulnerable	Not listed	Suitable HBTs present in development site	Included	Survey required and undertaken
Phascolarctos cinereus **Koala (Breeding)**	Areas identified via survey as important habitat based on density of Koalas and quality of habitat.	High	Vulnerable	Vulnerable	Survey required to identify	Included	Survey required and undertaken
Pteropus poliocephalus **Grey-headed Flying-fox (Breeding)**	Breeding camps. Breeding camps will need to be identified by survey	High	Vulnerable	Vulnerable	Suitable vegetation and riparian areas for camps not within development site	Excluded	No suitable habitat to be impacted.

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Tyto novaehollandiae **Masked Owl**	Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	High	Vulnerable	Not Listed	Suitable HBTs present within development footprint (Barigan Rd)	Included	Survey undertaken for solar farm site. Limited large hollow habitat inside Barigan Rd, accounted for in BAM C.
Vespadelus troughtoni **Eastern Cave Bat**	A cave roosting species found in dry forest or woodland, near cliffs and rocky overhangs	Very High	Vulnerable	Not Listed	Potential habitat within areas containing rocky outcrops, farm sheds, road culverts.	Included	Survey undertaken for solar farm site. No rocky habitat inside Barigan Rd and therefore assumed absent.
FLORA							
Acacia ausfeldii **Ausfeld's Wattle**	Associated species include *Eucalyptus albens, E. blakelyi and Callitris* spp. Although killed by fire, the seedbank will be stimulated.	Moderate	Vulnerable	Not listed	PCTs 1303, 281 & 1610 known habitat for this species. *E. albens* present within Development site.	Included	Survey undertaken for solar farm site. Assumed present inside timbered zones for Barigan Road.

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Commersonia procumbens	Often found as a pioneer species of disturbed sandy habitats. It has been recorded colonising disturbed areas such as roadsides, the edges of quarries and gravel stockpiles and a recently cleared easement under power lines. Associated species include E. *dealbata, E. sideroxylon, E. albens, Calytrix tetragona, Callitris spp*.	Moderate	Vulnerable	Vulnerable	PCT 1610 known habitat for this species. *E. albens* present within Development site	Included	Survey undertaken for solar farm site. Assumed present inside timbered zones for Barigan Road.
Eucalyptus cannonii **Capertee Stringybark**	Capertee Stringybark has a broad altitudinal range, from around 450m to 1,050m. Within this range, the species appears to tolerate most situations except the valley floors.	Moderate	Vulnerable	Not listed	Entire development footprint is located on valley floor <450m in elevation. Inappropriate habitat for this species.	Excluded	No suitable habitat to be impacted.

Species Credit Species	Habitat components	Sensitivity to gain class	NSW Listing status	National listing status	Presence of habitat onsite	Include/exclude from assessment	Action undertaken
Prostanthera cyrptandriodes subsp. cryptandroides **Wollemi Mint-bush**	Associated with rocky ridgelines on sandstone in a range of vegetation	Moderate	Vulnerable	Vulnerable	PCT 1303 known habitat for this species. Rocky outcrop sites exist within PCT 1610 & 1303.	Included	Survey undertaken for solar farm site. Assumed absent due to lack of rocky habitat for Barigan Road.
Monotaxis macrophylla **Large-leafed Monotaxis**	Grows on rocky ridges and hillsides. The distribution is related to the occurrence of fire.		Endangered	Not listed	Timbered habitat in PCT 1303, 281 & 1610	Included	Survey undertaken for solar farm site. Assumed present inside timbered zones for Barigan Road.

4.2.2 Exclusions based on habitat features

Under Section 6.4.1.17 of the BAM, a species credit species can be considered unlikely to occur on a development site (or within specific vegetation zones) if following field assessment, it is determined that the habitat is substantially degraded such that the species is unlikely to utilise the development site (or specific vegetation zones). These species are identified in Table 4-3 along with justification regarding the habitats present.

Table 4-3 Species credit species excluded based on habitat

Species Credit Species	Zones excluded	Reason for exclusion
Eucalyptus cannonii	All zones	The development footprint is located on valley floor <450m in elevation and therefore considered unlikely to occur. No further assessment required
Lathamus discolor **Swift Parrot** ***Petrogale penicillata*** **Brush-tailed Rock-wallaby** ***Pteropus poliocephalus*** **Grey-headed Flying-fox (Breeding)**	All zones	These zones are excluded, as there is no suitable habitat that occurs within the impacted native vegetation zones. The species are unlikely to utilise these zones on a regular basis for breeding due to a lack of relevant critical habitat required for that species i.e. large rocky escarpments. Habitat assessment of the likelihood of a breeding camp for the Grey-headed Flying Fox was undertaken and considered unlikely due to the presence of fragmented vegetation within the development site and the lack of good condition riparian vegetation. Additionally, surveys undertaken in May, August and October did not locate any evidence of individuals or camps within the development site. Consultation with OEH confirmed that there are no 'important mapped areas' for Swift Parrot within the development site. Site surveys confirmed that vegetation located within the development site is unlikely to be utilised by Swift parrots during migration with better more suitable habitat located in the broader locality.
Burhinus grallarius **Bush Stone-curlew** ***(partial)***	Zones 1, 2, 3, 4, 6, 7, 9	There is no suitable timbered habitat within these vegetation zones. Bush Stone-curlew is unlikely to utilise these zones on a regular basis for breeding due to a lack of fallen timber. Timbered PCTs (Zones 5 & 8) alongside Barigan Road still included and assumed for presence for Bush Stone Curlew.

4.2.3 Candidate species requiring confirmation of presence or absence

The species listed in Table 4-4 are those that are considered to have habitats present at the development site and where targeted surveys are required within suitable habitat. Targeted survey inside the solar farm site was undertaken for Koala and all Owls onsite and commenced in May 2018. Targeted surveys in August and October 2018 were also undertaken for all potential threatened flora species, as well as diurnal and nocturnal fauna where the timing of survey was appropriate. The results of the targeted survey are summarised in Table 4-4. There have been some recent changes to data in the BAM calculator which has altered acceptable survey times for certain candidates. Where this has occurred, footnotes have been added to Table 4-4 to flag those species with recently updated survey times.

Habitat for Barigan road reserve was unable to be targeted for survey before submission of this BDAR. Therefore the assumption of suitable habitat/presence was entered into the calculator where habitat was identified. This included wooded habitat inside the development footprint for PCT 281 (all of Zone 5 inside Barigan Rd) and PCT 1610 (All of Zone 8 inside Barigan Rd).

Specific hollow bearing trees also generated species credits for hollow dependant candidates. Hollow bearing trees located inside the development site (within Barigan road reserve) were also assumed to be impacted because the canopy and branches of these trees may overhang the development footprint and encounter disturbances during road widening activities. Species polygons for hollow bearing trees were calculated in accordance with instructions in the threatened species database (where available) for each candidate species. For the Barking Owl, Masked Owl and Powerful Owl, each suitable hollow tree had a 100m buffer applied (where the vegetation zone was relevant) and area calculated inside the Barigan road development site. The areas of some species polygon buffers exceeded the maximum areas of vegetation zones within the development footprint. Where this occurred, the maximum vegetation zone for the development footprint was used to calculate the species polygon (Pers comm David Geering). The same buffer of 100m was applied around trees suitable for the Gang-gang Cockatoo.

The Brush-tailed Phascogale is known to prefer tree hollows that have small entrance holes (van der Ree *et. al.* 2015). As such, hollow-bearing trees with large hollows were excluded as breeding habitat for this species. For Brush-tailed Phascogale, a 15m buffer was applied around hollow-bearing trees with small and medium sized hollows. The smaller buffer was applied because Phascogales are known to utilise paddock trees which are surrounded by heavily disturbed habitat (i.e. cultivated land, BioNet, 2019) but in terms of breeding, have a preference for areas with a high density of large (>80cm DBH) hollow-bearing trees (van der Ree *et. al.*, 2015). Brush-tailed Phascogales are also known to have a large foraging range, with females an average of 5 ha and males up to 100 ha (van der Ree *et. al.,* 2001). As such, the trees within the development footprint are considered likely to provide 'stepping stone' habitat as opposed to preferred breeding habitat and a 15m buffer has been applied to account for the actual impacts on the potential breeding habitat for this species.

Details of the survey methodologies and results are provided for each species below. Targeted survey locations are mapped on Figure 4.1. Species polygons have been defined for the species present on the site as mapped on Figure 4.1.

Table 4-4 Summary of species credit species surveyed at the development site.

Species Credit Species	Biodiversity risk weighting	Survey Period[2]	Assumed to occur/survey/ expert report	Present on site?	Species polygon/ area (ha) assumed habitat (Veg Zone in BAM C)
FLORA					
Acacia ausfeldii **Ausfeld's Wattle**	2	Aug - Oct	Surveyed on solar farm site August 2018	No	0 ha Not recorded on solar farm site. Assumed presence for Barigan Rd for PCT 281 Zone 5 (1.06ha) and PCT 1610 Zone 8 (0.14ha)
Commersonia procumbens	2	Jan – May Aug to Dec	Surveyed on solar farm site August 2018	No	0 ha Not recorded on solar farm site. Assumed presence in Barigan Rd for PCT 1610 Zone 8 (0.14ha) & Zone 9 (0.21ha)
Monotaxis macrophylla **Large-leafed Monotaxis**	2	Aug - Feb	Surveyed on solar farm site August 2018	No	0 ha Not recorded on solar farm site. Assumed presence in Barigan Rd Reserve for PCT 281 Zone 5 (1.06ha) and PCT 1610 Zone 8 (0.14ha)
Prostanthera cyrptandriodes subsp. cryptandroides **Wollemi Mint-bush**	2	Anytime	Surveyed on solar farm site [3]August 2018	No	0 ha Not recorded on solar farm site. No suitable habitat in Barigan Rd Reserve.
FAUNA					
Anthochaera phrygia **Regent Honeyeater**	3	Anytime	Important mapped habitat areas surveyed May, August & October 2018	Not recorded during survey. Mapped important habitat occurs survey indicated non-optimal habitat	0 ha Not recorded during survey. Unable to confirm 'important mapping' inside Barigan road and assumed not present in BAM C.

[2] As prescribed in the BAM calculator.

[3] August was an acceptable survey time for this species at the time of survey. Recently changed with BAM C update.

Species Credit Species	Biodiversity risk weighting	Survey Period[2]	Assumed to occur/survey/ expert report	Present on site?	Species polygon/ area (ha) assumed habitat (Veg Zone in BAM C)
Burhinus grallarius **Bush Stone-curlew**	2	Anytime	Assumed to occur (Only inside Barigan Road, timbered PCTs)	Not surveyed	PCT 281 Zone 5 (1.06ha) PCT 1610 Zone 8 (0.14ha)
Aprasia parapulchella **Pink-tailed Legless Lizard**	2	Sept-Nov	Surveyed October 2018	Not recorded during survey. Suitable habitat has been avoided.	0 ha Not recorded during survey on solar farm site. No suitable habitat in Barigan Rd Reserve.
Callocephalon fimbriatum **Gang-gang Cockatoo (breeding)**	2	Oct-Jan	Surveyed October 2018 Assumed to occur (Barigan Road only). 100m buffer applied.	No	Not recorded during survey on solar farm site. Assumed present where med/large HBTs exist in Barigan Rd reserve for PCT 281 Zone 5 (5.59ha), PCT 281 Zone 6 (2.08ha) PCT 1610 Zone 8 (0.14ha), PCT 1610 Zone 9 (0.99ha).
Chalinolobus dwyeri **Large-eared Pied Bat**	3	Nov-Jan	Surveyed [4] October 2018 for solar farm site. Assumed present in wooded PCTs for Barigan Road only	Yes	Not recorded on solar farm site. Recorded during survey however no impacts to optimal breeding and or foraging habitat) Barigan Road assumed presence for PCT 281 Zone 5 (1.06), PCT 1610 Zone 8 (0.14ha)
Haliaeetus leucogaster **White-bellied Sea-Eagle**	2	July-Dec	Surveyed August, September and October 2018/19	No	0 ha Not recorded during survey. No stick nests observed along Barigan Rd.
Hieraaetus morphnoides **Little Eagle**	1.5	Aug-Oct	Surveyed August, September and October 2018/19	No	0 ha Not recorded during survey. No stick nests observed along Barigan Rd.

[4] October was an acceptable survey time for this species at the time of survey. Recently changed with BAM C update.

Species Credit Species	Biodiversity risk weighting	Survey Period[2]	Assumed to occur/survey/ expert report	Present on site?	Species polygon/ area (ha) assumed habitat (Veg Zone in BAM C)
Lophoictinia isura **Square-tailed Kite (Breeding)**	1.5	Sept-Jan	Surveyed September, October 2018/19	No	0 ha Not recorded during survey. No stick nests observed along Barigan Rd.
Miniopterus orianae oceanensis **Large Bent-wing Bat (Breeding)**	3	Dec-Feb	[5] Surveyed October 2018	Probable, therefore assumed present. (Anabat recording)	0 ha Recorded during survey but there are no impacts to breeding habitat. No breeding habitat alongside Barigan Rd.
Ninox connivens **Barking Owl (Breeding)**	2	May-Dec	Surveyed May & August and October 2018. Assumed present where large hollow trees inside Barigan Rd reserve for relevant PCTs	No	Not recorded on solar farm site. Assumed present in Barigan Rd Reserve where suitable large HBTs for PCT 281 Zone 5 (1.2ha), PCT 281 Zone 6 (0.06ha) and PCT 1610 Zone 9 (0.08ha)
Ninox strenua **Powerful Owl (Breeding)**	2	May-Aug	Surveyed May & Aug 2018. Assumed present where large hollow trees inside Barigan Rd reserve for relevant PCTs. 100m buffer applied.	No	Not recorded on solar farm site. Assumed present in Barigan Rd Reserve where suitable large HBTs for PCT 281 Zone 5 (1.2ha) and PCT 281 Zone 6 (0.06ha)
Petaurus norfolcensis **Squirrel Glider**	2	Anytime	Surveyed August and October 2018. Assumed present where small/medium hollow trees inside Barigan Rd reserve	No	Not recorded on solar farm site. Assumed present in Barigan Rd Reserve within timbered habitat for PCT 281 Zone 5 (1.06), PCT 1610 Zone 8 (0.14ha)
Phascogale tapoatafa **Brush-tailed Phascogale**	2	Anytime	Surveyed August and October 2018 Assumed present where	No	Not recorded on solar farm site. Assumed present in Barigan Rd Reserve where suitable

[5] October was an acceptable survey time for this species at the time of survey. Recently changed with BAM C update.

Species Credit Species	Biodiversity risk weighting	Survey Period[2]	Assumed to occur/survey/ expert report	Present on site?	Species polygon/ area (ha) assumed habitat (Veg Zone in BAM C)
			small/medium hollow trees inside Barigan Rd reserve. (15m canopy diameter applied)		small/med HBTs found inside PCT 281 Zone 5 (0.94ha) and PCT 281 Zone 6 (0.38ha) and PCT 1610 Zone 8 (0.14ha), PCT 1610 Zone 9 (0.1ha)
Phascolarctos cinereus **Koala (Breeding)**	2	Anytime	Surveyed May 2018. Assumed present in timbered PCT 281/1610 Barigan Rd Reserve	No	Not recorded on solar farm site. Assumed present in Barigan Rd Reserve for PCT 281 Zone 5 (1.06 ha) and PCT 1610 Zone 8 (0.14ha)
Tyto novaehollandiae **Masked Owl (Breeding)**	2	May-Aug	Surveyed May & Aug 2018. Assumed present where large hollow trees inside Barigan Rd reserve for relevant PCTs. 100m buffer applied.	No	0 ha Not recorded on solar farm site. Assumed present in Barigan Rd Reserve where suitable HBTs exist for PCT 281 Zone 5 (1.2ha) and 281 Zone 6 (0.06ha)
Vespadelus troughtoni **Eastern Cave Bat**	3	Nov-Jan	Surveyed [6]October 2018	Possible, therefore assumed present. (Anabat recording)	0 ha Recorded during survey but there are no impacts to breeding habitat. No suitable breeding habitat inside Barigan Rd and therefore assumed absent.

4.3 THREATENED SPECIES SURVEY

General and targeted biodiversity surveys was undertaken to target NSW listed candidate species and Commonwealth listed species nominated in the Supplementary SEARs (Appendix B). surveys were undertaken in three survey sessions:

- 22nd-24th May 2018
- 27th-29th August 2018
- 22nd-26th October 2018

[6] October was an acceptable survey time for this species at the time of survey. Recently changed by BAM C update.

- 2-4th September 2019

Methods and effort are provided below. Weather conditions recorded for these dates from the Bureau of Meteorology (BOM) at the Mudgee Weather Station are as follows:

Table 4-5 Weather Conditions onsite during targeted surveys

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall (mm)	Max Wind Gust (km/h)
22nd May 2018	19	6.1	0	37 (3.16pm)
23rd May 2018	21	3	0	24 (11.19am)
24th May 2018	23.3	1.0	0	22 (7.01pm)
27th August 2018	17.2	2.8	9.8	31 (2.47pm)
28th August 2018	14.7	1.6	0	24 (3.47pm)
29th August 2018	15.2	-2.8	0	35 (3.58pm)
22nd October 2018	25.8	14.5	0	24 (7.42pm)
23rd October 2018	29.2	11.4	0	37 (11.23pm)
24th October 2018	8.8	28	0	31 (12.57pm)
25th October 2018	27.3	14.1	0	30 (2.25pm)
26th October 2018	27.6	6.6	0	46 (11.57am)
2 September 2019	24.0	3.1	0	41 (10:53am)
3 September 2019	26.9	2.6	0	43 (14:48pm)
4 September 2019	28.8	5.2	0	54 (12:55pm)

Diurnal Woodland Birds (Regent Honeyeater, Swift Parrot, Gang-gang Cockatoo, White-bellied Sea Eagle, Little Eagle, Square-tailed Kite)

SURVEY EFFORT

May 2018

A woodland bird census consisting of a five (5) transect and five (5) 20 minute point opportunistic surveys were completed on the mornings and evenings of the 22-24 May for a total of seven (7) hours. Five one kilometre transect surveys targeting swift parrot as well as general avifauna were walked over one hour, as well as one 20 minute point opportunistic survey at the centre of each transect. Remnant trees were surveyed for evidence of stick nests used by raptors. Weather conditions recorded at Mudgee weather station included minimum temperature 1.0°C, maximum temperature 23.3°C, and 0 mm of rainfall.

August 2018

Three (3) 20 minute two (2) ha diurnal bird surveys were completed on the mornings of the 28th and 29th August over a total one hour survey time. Targeted hollow-bearing tree surveys as well as surveys for large stick nests were carried out for evidence of suitable breeding habitat. All paddock trees within the development footprint were surveyed for the presence of hollows. The number, size and height of hollows were recorded for each tree along with any evidence of use. Hollows were categorised as small (< 10 cm), medium (10 – 20 cm), and large (> 20 cm).

October 2018

Six (6) 20 minute two (2) ha diurnal bird surveys as well as area searches and call playback were completed within mapped regent honeyeater habitat and undertaken early mornings between the 23rd-26th October. Additionally, any suitable Eucalypt species in flower within the development site were also observed for a period for 20 mins to monitor avifauna activity. Targeted hollow-bearing tree surveys and opportunistic surveys were also undertaken for evidence Gang-gang cockatoo within the development site.

September 2019

All trees inside the Barigan Road reserve part of the development footprint were inspected for evidence of large stick nests. A hollow bearing tree inventory was also carried out inside Barigan road reserve with size class range of hollows classified into small (< 10 cm), medium (10 – 20 cm), and large (> 20 cm) categories.

SURVEY RESULTS

None of the targeted candidate diurnal avifauna species or evidence of breeding (i.e. large stick nests for raptors) were observed during the surveys.

No regent honeyeater or swift parrots were observed during the targeted surveys. Approximately 0.34ha of regent honeyeater mapped important habitat is predicted to occur within the development site. Generally, habitat within the development site is fragmented and consisted of isolated individuals or small remnant clumps without a consistent shrub layer or complex structure. Therefore, fragmented habitat throughout the majority of the development site is dominated by more common and disturbance tolerant native and exotic species as well as aggressive native species such as noisy miners and noisy friarbirds. Vegetation throughout the site is recovering from a recent bushfire with large amounts or epicormic growth and very little evidence of flowering. However, the vegetation on the lower slopes that occur on the boundaries of the development site and subject land contain more complex structure and contain a high abundance of common and threatened woodland avifauna. Sporadic *E. melliodora* were observed to be flower at the far southern end of the development site, however limited avifauna species were observed utilising these blossoming individuals. Vulnerable listed Grey-crowned Babbler, Speckled Warbler, Diamond Firetail were detected directly south of the development footprint within vegetation equivalent of PCT 1610 forest (Zone 8). Dusky Wood swallow and Brown Treecreeper were also detected within PCT 1610 forest/disturbed (Zone 8 and 9). Refer to Appendix A.1.3 for a complete list of species observed.

Hollow bearing trees inspected during targeted surveys did had no evidence of use by any threatened flora. More common species such as galahs and red rump parrots were observed utilising hollow bearing trees within the development footprint.

The development would impact five (5) paddock trees inside the Wollar property and fifty-six (56) trees inside Barigan road reserve that contain suitable hollows that may be utilised for various threatened species. In accordance with the BAM, paddock trees assessed under the streamlined paddock tree assessment are not considered as species credit polygons.

Nocturnal Birds (Barking Owl, Masked Owl & Powerful Owl)

SURVEY EFFORT

May 2018

Three (3) separate targeted species surveys were completed on the nights between 22nd - 24th May for a total of 4 hours. Call playback with a megaphone was used from the vehicle along remnant vegetation, followed by a period of listening for responses and spotlighting.

August 2018

An additional four separate sites were surveyed above on the nights of the 27th-28th August 2018 for a total of three (3) hours. Spotlighting in addition to call playback with a megaphone and Bluetooth speakers were used from the vehicle and whilst walking through patches of remnant vegetation and isolated paddock trees, followed by a period of listening for responses in accordance with OEH threatened species guidelines.

SURVEY RESULTS

During the May survey, no threatened birds were seen or heard during the survey. One Southern Boobook, (*Ninox novaeseelandiae)* and Barn Owl (*Tyto alba)* were seen in open farmland in the north of the development footprint. During August survey, no threatened birds were seen or heard during the survey. One Barn Owl (*Tyto alba*), Tawny Frogmouth (*Podargus strigoides*) and Owlet Nightjar (*Aegotheles cristatus*) were observed during spotlighting.

Microbats (Eastern Cave Bat, Large Bent-winged Bat, Large-eared Pied Bat)

SURVEY EFFORT

October 2018

A targeted Anabat survey was completed for the nights of 22nd – 25th October. One (1) Anabat Swift unit was placed at two locations within the development site and surrounding areas for two separate nights at each location (Figure 4-1). The Anabat was placed outside of the development site within suitable habitat for cave dwelling microbats including sandstones caves and overhangs approximately 400m from the development site on the 22nd – 23rd October. The Anabat was relocated to within management zone 1 in the central eastern boundary of the development site on the 24th – 25th October. Recordings produced were filtered and analysed by NGH Environmental ecologists.

SURVEY RESULTS

Numerous microbats' species were identified from the Anabat recordings, including the Large-eared Pied Bat and potentially the Eastern Cave Bat and Large Bent-winged Bat. Definite calls from the Large-eared Pied Bat were recorded whilst calls from at the Large Bent-winged Bat and Eastern Cave Bat were deemed as probable and possible respectively when compared to reference calls. Difficulties in differentiating calls from other sympatric species such as Little Forest Bat (*Vespadelus vulturnus*) resulted in lower confidence in identification for the Easter Cave Bat. It therefore has been assumed as present within the subject land.

Nocturnal Mammals (Squirrel Glider, Brush-tailed Phascogale, Koala)

SURVEY EFFORT

May 2018

Targeted spotlighting surveys were undertaken at night during the 22nd - 24th May over four (4) separate areas (Figure 4.1) for approximately one hour each night (30 mins per area). A 100-watt spotlight was used in both vehicle-based and foot surveys within remnant woodland patches and isolated paddock trees prior to nocturnal owl call playback surveys. Seven separate scat surveys were completed for Koalas on the 23rd and 24th May 2018, with mature feed trees searched for signs of Koalas for approximately 8 person hours.

August 2018

An additional four surveys were undertaken via spotlighting from a vehicle and on foot on the 30th and 31st August for approximately two hours each night. A 100-watt spotlight was used in both vehicle-based and foot

surveys within remnant woodland patches and isolated paddock trees prior to nocturnal owl call playback surveys.

SURVEY RESULTS

None of the targeted arboreal mammals were detected during spotlighting in May or August. No Koalas were observed, or their evidence of use were recorded during the surveys. Multiple wombats (*Vombatus ursinus*), Eastern Grey Kangaroos (*Macropus giganteus*), Wallaroos (*Macropus robustus*), and Red-necked Wallabies (*Macropus rufogriseus*) were detected during the August survey and were generally confined to the southern sites (see Appendix A.1.3).

Reptiles (Pink-tailed Legless Lizard)

SURVEY EFFORT

Areas of rocky outcrop were assessed and surveyed by two ecologists on the 24th and 25th October 2018 for approximately 30 minutes at each site within and surrounding the development site. This included traversing the rocky outcrop area and randomly turning and inspecting loose rocks and partially embedded rock that occurred before being placed back into their original position. Where practicable, between 100-150 rocks were turned and inspected at each surveyed area.

SURVEY RESULTS

The vast majority of the rocky outcrops consist of embedded rock and occasional loose rock within paddocks containing improved pastures species with little or no native grasses or forb presence. These was considered non-optimal habitat for the Pink-tailed Legless Lizard. One identified area development site contains optimal habitat (Figure 4.1) with an abundance of partially embedded rock and loose rock surrounded by high cover of native grasses occur within the development site however has been largely avoided. A further two areas are considered to contain potential habitat based on the availability of rock outcrop, however, has a low abundance of native grass and subject to consistent disturbance. Of the areas surveyed, one common species, Two-clawed worm-skink (*Anomalopus leuckartii*), was observed. Small areas of rock outcrop were observed within remnant woodland areas and surveyed accordingly. No threatened species were observed during the survey and in addition of avoiding and minimise better quality habitat within the development site, it is considered that this species would not be impacted.

Threatened flora (*Acacia ausfeldii, Monotaxis macrophylla, Commersonia procumbens, Prostanthera cryptandroides)*

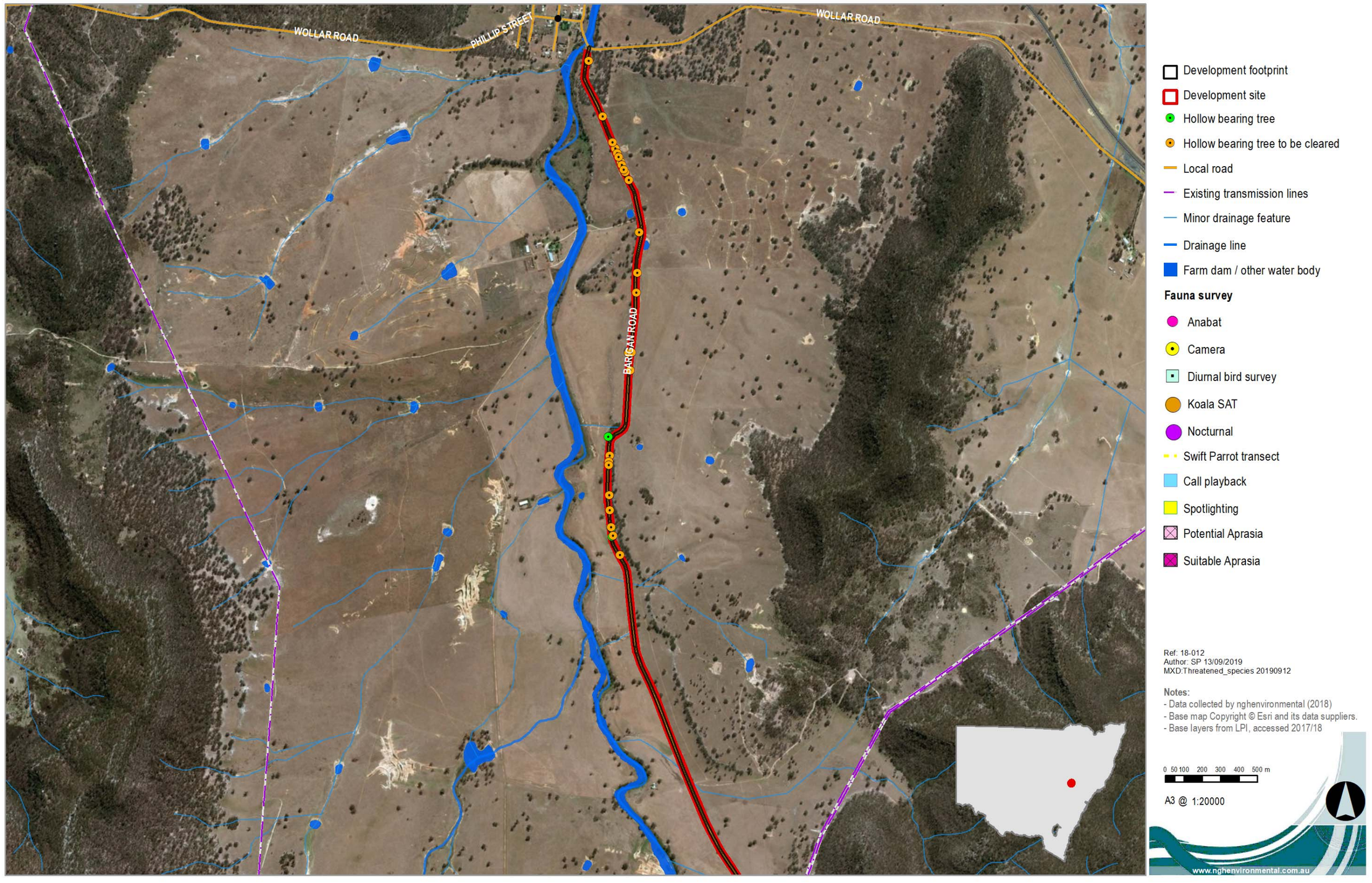
SURVEY EFFORT

Suitable habitat for these species occurs in the small remnant patches of moderate to good condition vegetation associated with PCT 1303, PCT 281 and PCT 1610 (vegetation zones 1, 2, 5 and 8). Areas of vegetation within the development site that had been recently burnt and recovering following the 2017 bushfire were also surveyed. Areas of suitable habitat within the development site were surveyed using the parallel field traverse survey technique were practicable in conjunction with random meander where vegetation became more degraded and less optimal during suitable survey periods in accordance with the NSW Guide to Surveying Threatened Plants (OEH 2016).

SURVEY RESULTS

No threatened flora were detected within the survey area. Although not required to be surveyed based on PCTs present and on distribution limitations, a potential observation of *Swainsona sericea*, listed as vulnerable within the BC Act, was observed and sent to the National Herbarium of New South Wales for confirmation. It was confirmed on the 13th November that species identified was *S. behriana*, an uncommon observation of the region, and not *S. sericea*.

Considering the extensive survey effort undertaken in suitable habitat during flowering season, targeted threatened flora species are not considered to occur within the development site.


WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
BARIGAN ROAD
Development footprint
Development site
Hollow bearing tree
Hollow bearing tree to be cleared
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Fauna survey
Anabat
Camera
Diurnal bird survey
Koala SAT
Nocturnal
Swift Parrot transect
Call playback
Spotlighting
Potential Aprasia
Suitable Aprasia
Ref: 18-012
Author: SP 13/09/2019
MXD:Threatened_species 20190912
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
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www.nghenvironmental.com.au

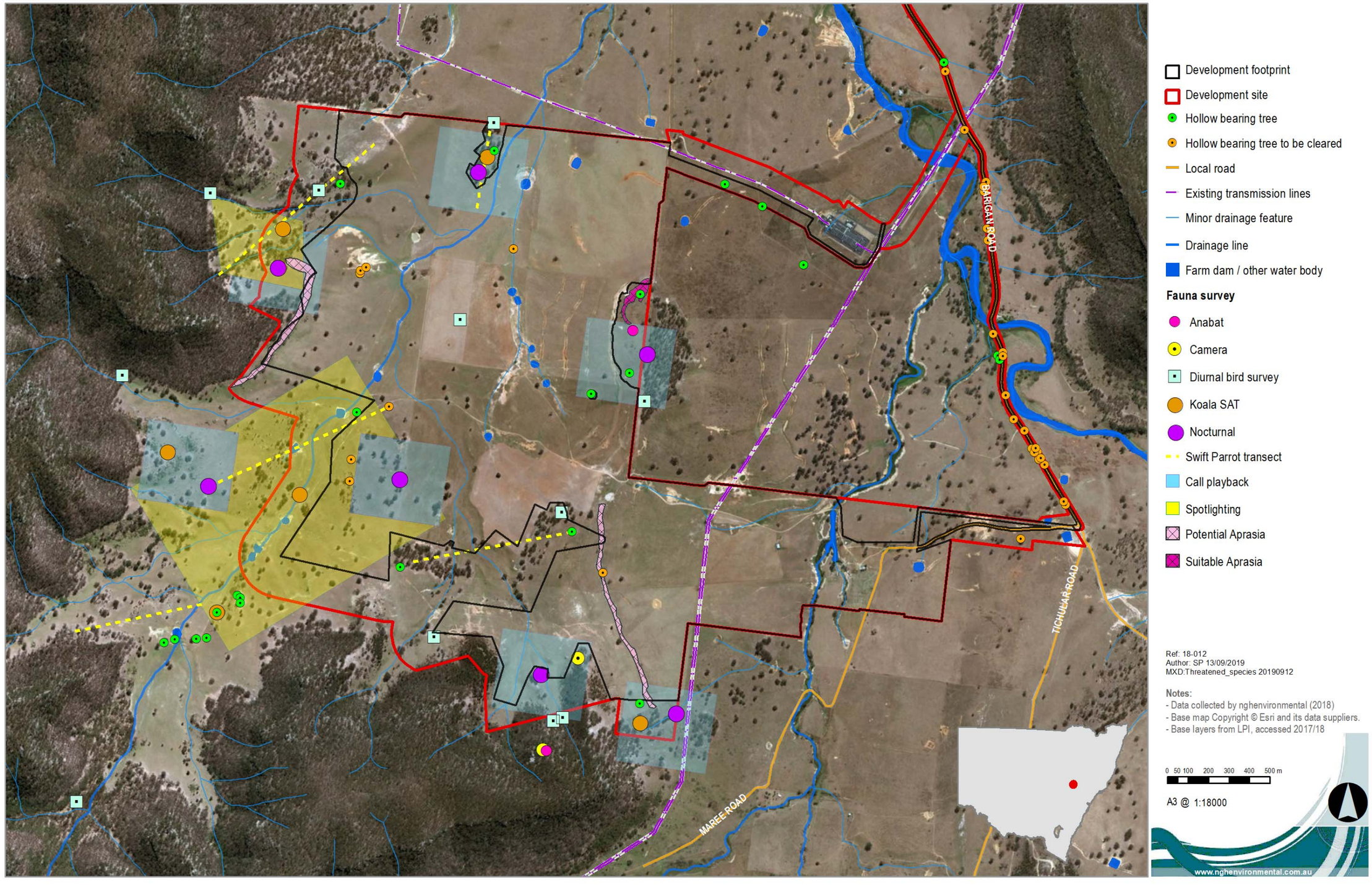


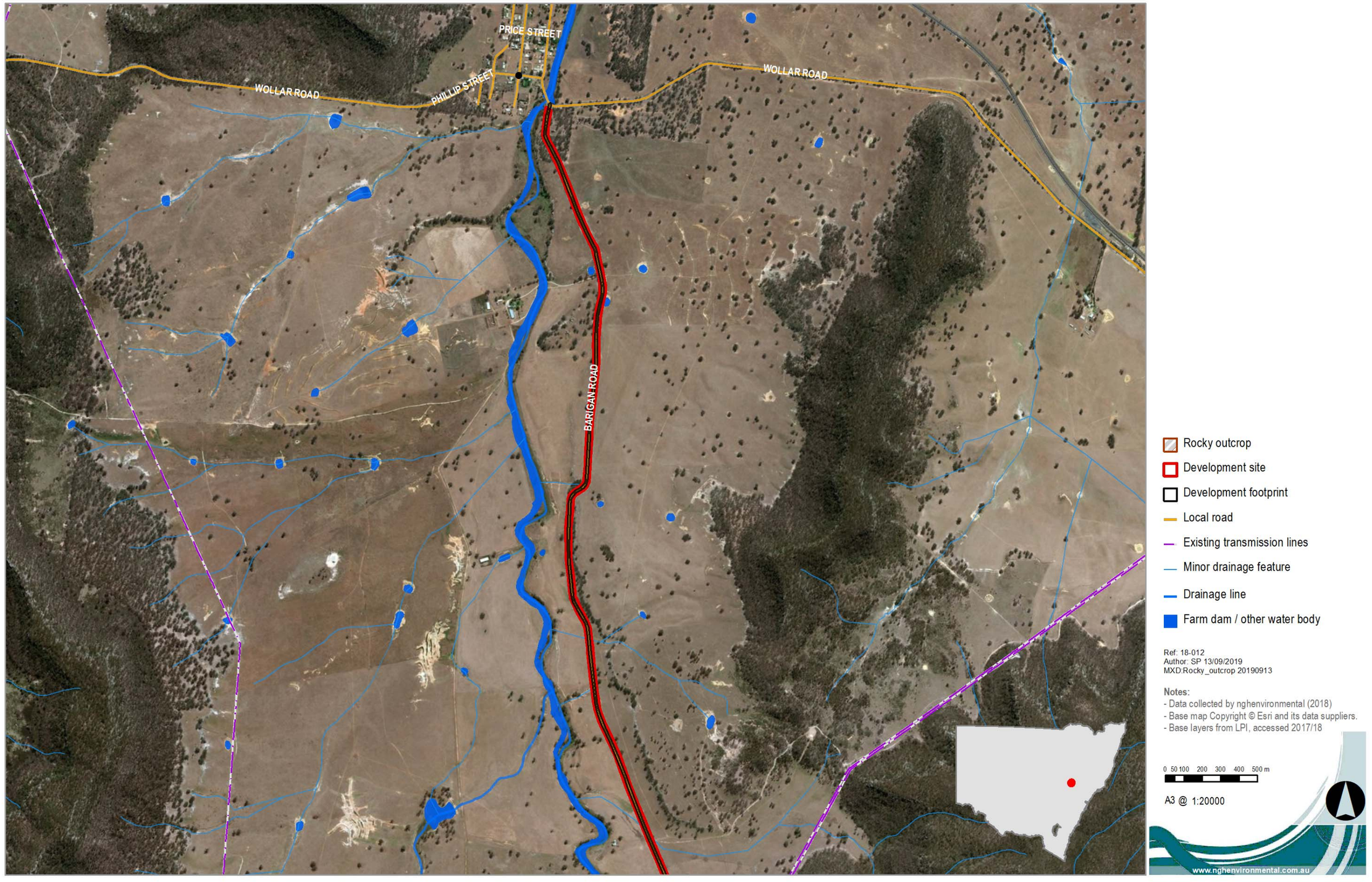
Figure 4-1 Threatened fauna targeted survey locations (shown over 2 maps)

4.4 ADDITIONAL HABITAT FEATURES RELEVANT TO PRESCRIBED BIODIVERSITY IMPACTS

4.4.1 Occurrences of karst, caves, crevices and cliffs

There are several occurrences of largely embedded linear rock outcrop that contain shallow crevices within the development site as illustrated on Figure 4-2 below and Figure 4-3. Rocky outcrops may provide candidate species habitat for Pink-tailed Legless Lizard, Large-eared Pied Bat, Eastern Bent-wing Bat and Eastern Cave Bat and therefore targeted surveys for these species were undertaken in these areas. Vegetated sandstone ridgelines surrounding the development site contain suitable roosting habitat such as caves, crevices and overhangs for the Microchiroptera bats mentioned above. Although outside of the development site and would not be impacted, ridgelines at the southern end of the subject land were surveyed via with remote camera and Anabat ultrasonic detectors for baseline data.

There are no known biological processes onsite that are known to preserve these features in their current state, other than the site being largely undisturbed farming land.


PRICE STREET
WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
BARIGAN ROAD
Rocky outcrop
Development site
Development footprint
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Ref: 18-012
Author: SP 13/09/2019
MXD:Rocky_outcrop 20190913
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
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www.nghenvironmental.com.au

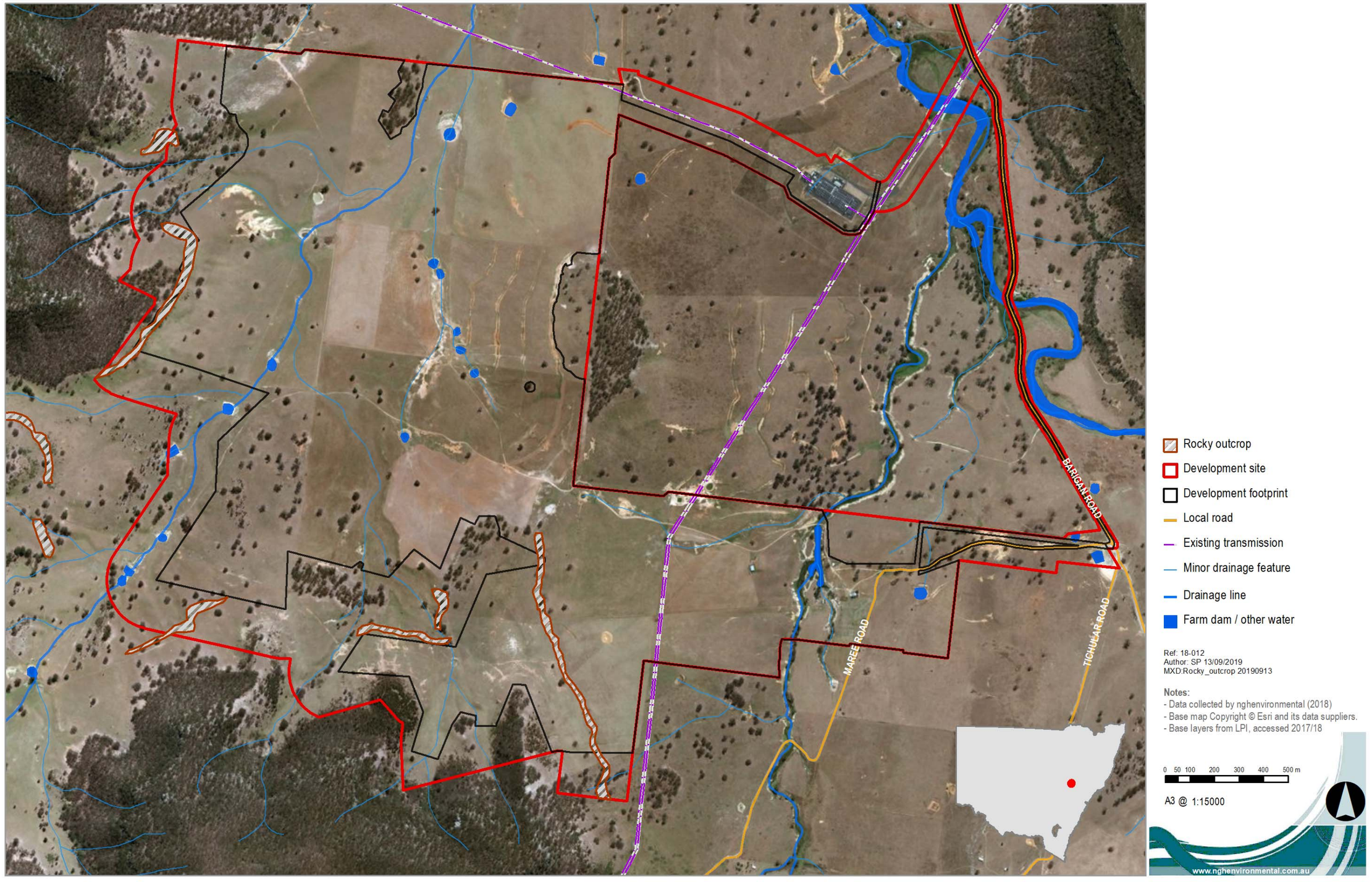


Figure 4-2 Rocky crevice habitat present within and close to the Development footprint

Figure 4-3 Examples of rocky crevices found within the development site.

4.4.2 Occurrences of rock

There are several distinct bands of Narrabeen Sandstone outcropping along the 70-80m contour line south and west of the development site as can be seen in Figure 4-4. In total, there are five separate areas consisting of rocky outcrops/crevices that required targeted survey for the following candidate species;

- Pink-tailed Legless Lizard (*Aprasia parapulchella*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Large Bent-winged Bat (*Miniopterus schreibersii oceanensis*)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- *Monotaxis macrophylla*
- Wollemi Mint Bush (*Prostanthera cryptandroides)*


Figure 4-4 Examples of rocky outcrops within the development site.

4.4.3 Occurrences of human made structures and non-native vegetation

There is one large agricultural building within the development footprint used to store farm machinery and one small tin shed within some stockyards located within the centre of the property. There is also one culvert within Wollar Creek on the substation access track near the intersection of Barigan Road (Figure 4-4 below). No evidence of use by Microchiroptera bats was observed during the field surveys. The culvert (Figure 4-) is unlikely to provide suitable roosting habitat for Large Bent-winged-bat because the culvert is quite short in length and exposed to the outdoor elements. The existing tunnel is not likely to allow any build-up of heat or humidity thus not providing ideal maternity habitat for the Eastern Bent-wing Bat (BioNet).

Figure 4-4 Small Culvert under access road to substation which is unlikely to provide any roosting habitat for Eastern Bent-wing Bat.

4.4.4 Hydrological processes that sustain and interact with the rivers, streams and wetlands

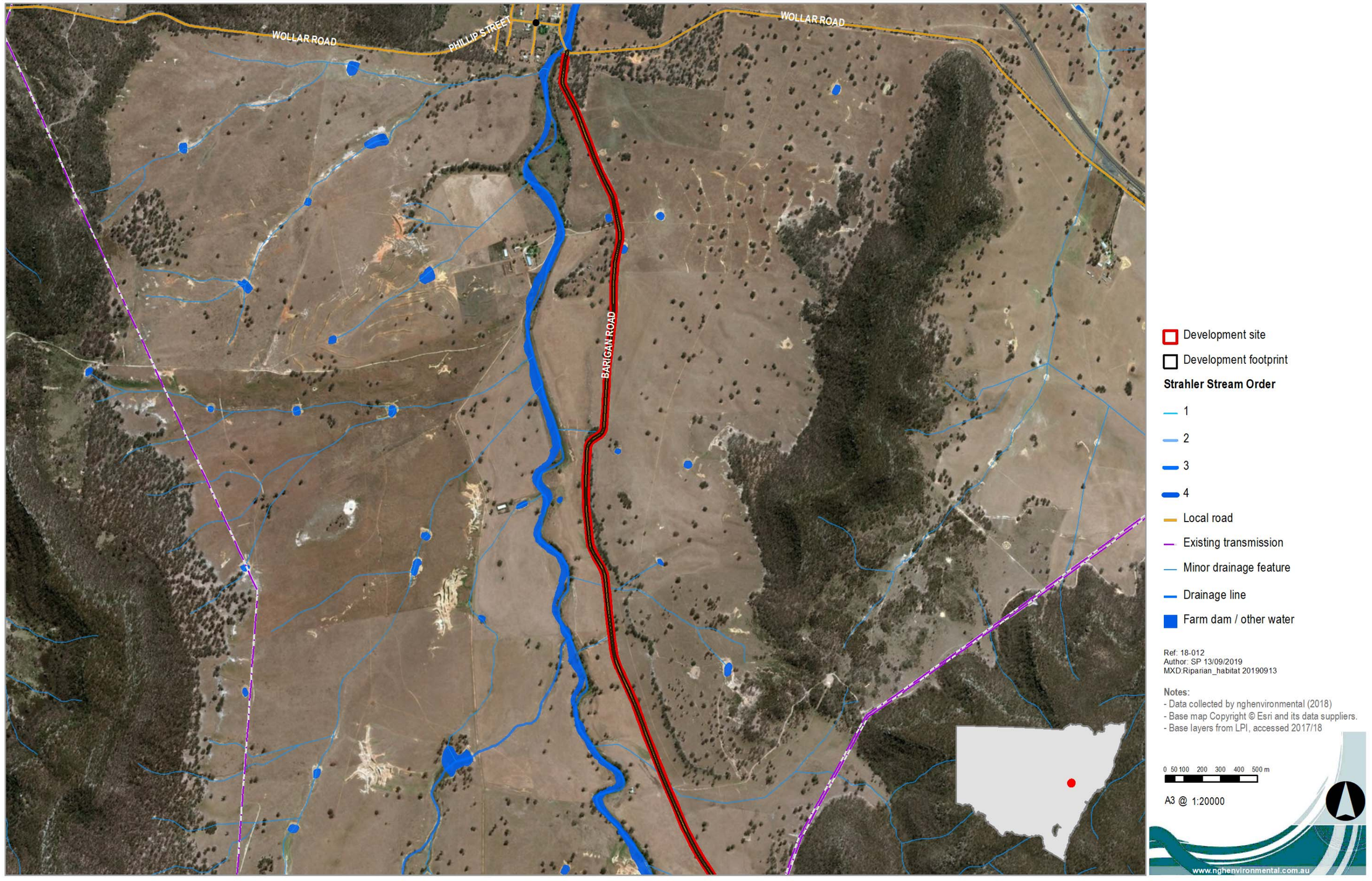
There are two main hydrological habitats within the Wollar Subject land. Spring Flat Creek (a fourth order watercourse) dissects through the middle of the development site (refer to Figure 4-). Spring Flat Creek did not contain any ponded water at the time of inspection during May 2018. The creek is ephemeral, only flowing during periods of high rainfall where it is presumed that much of this water lies under the ground within the sandy soils present. Several lesser order streams flow into Spring Flat Creek. All appeared dry at the time of inspection in May, August and October 2018.

There are numerous farm dams within the development footprint that provide water resources to sheep grazing over the land (Figure 4-).

There are 7 creek crossings consisting of 1 first order, 4 second order, 1 third order and 1 sixth order streams which may be impacted when widening this road.

A review of the candidate species (as listed in Table 4-3) indicates that some birds of prey like White-bellied Sea Eagle and Square-tail Kite may utilise hydrological habitats. Targeted surveys were carried out onsite that involved opportunistic survey of trees near water bodies and diurnal bird surveys (see Chapter 4.2.1).

Figure 4-5 Examples of hydrological habitats that are found within the development footprint. Farm dam (left) and dry creek bed (right).


WOLLAR ROAD
PHILLIP'S STREET
WOLLAR ROAD
BARIGAN ROAD
Development site
Development footprint
Strahler Stream Order
1
2
3
4
Local road
Existing transmission
Minor drainage feature
Drainage line
Farm dam / other water
Ref: 18-012
Author: SP 13/09/2019
MXD:Riparian_habitat 20190913
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
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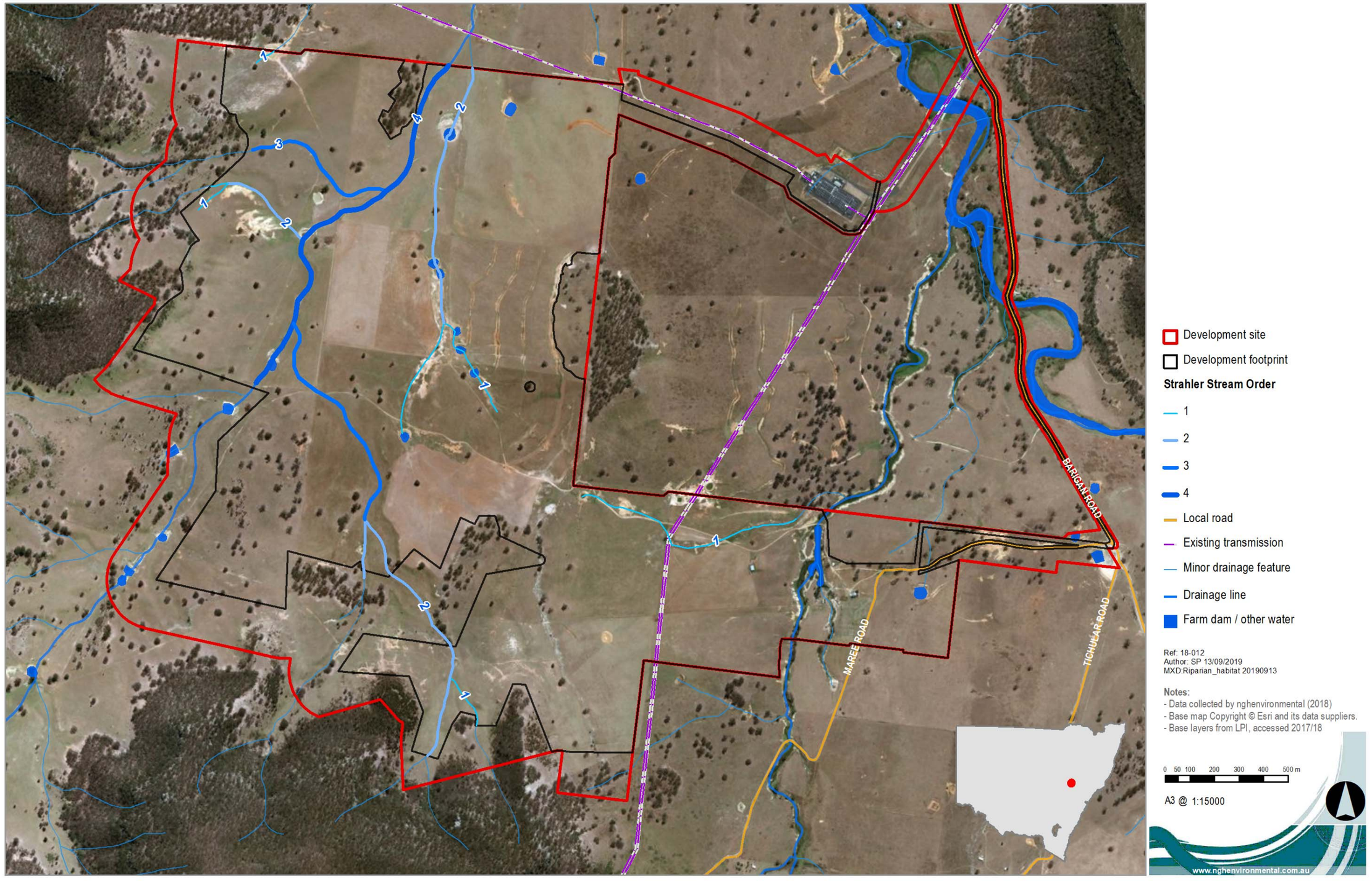

Figure 4-6 Riparian habitat within Wollar development site (shown over 2 maps)

5 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

An EPBC protected matters report was undertaken on the 25th Jan 2018 (10 km buffer of the development site) to identify Matters of National Environmental Significance (MNES) that have the potential to occur within the development site (refer to Appendix C). Relevant to Biodiversity these include:

- Wetlands of International Importance
- Threatened Ecological Communities
- Threatened species
- Migratory species

Section 5.1 to 5.4 set out relevant matters to be considered under the Act.

Incorporation of MNES assessment in this BDAR

> *Following data collected during initial site surveys in May 2018, a referral to the Commonwealth Department of Environment and Energy commenced in July 2018. On 3 October 2018, the proposed Wollar Solar Farm was determined to be a controlled action for impacts on MNES protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Supplementary SEARs were issued for the project (provided in Appendix B: EPBC requirements which includes a checklist of where these matters are addressed in the EIS or this BDAR).*
>
> *The assessment of MNES is contained within this BDAR, as follows:*
>
> - *Sections 5.1 to 5.4 set out relevant matters to be considered under the Act.*
> - *Section 7.4 examines MNES impacts in detail, with reference to the additional surveys undertaken in October 2018 to address additional MNES requirements of the Supplementary SEARs.*
> - *Section 7.4 is supported by Appendix D EPBC Habitat Assessment Evaluations. This evaluation considers all entities returned in the MNES search and included in the Supplementary SEARs. In consideration of entity habitat requirements, the surveys undertaken onsite, the habitat that is available onsite and the likelihood of occurrence, the potential for impact is determined in this table.*
> - *Where entities are deemed to have less than a low risk of impact, an EPBC Assessment of Significant Impact is undertaken, Appendix E. The assessments also assist to target mitigation strategies as required.*
> - *Only for those entities where significant impact is evaluated likely to occur, are Commonwealth offsets required. Appendix F sets out the quantification of offsets for relevant entities.*
> - *Section 10.1.4 provides an offset strategy for relevant entities, as determined above.*

5.1 WETLANDS OF INTERNATIONAL IMPORTANCE

Five wetlands of international importance were identified. The two closest wetlands (Hunter estuary wetlands & The Macquarie Marshes) are located 150-300km upstream of the Subject land. The remaining three wetlands are greater than 800 km from the development site and are not connected to the subject land.

There is no apparent connectivity between the Wollar Solar farm development site and the Macquarie River. All other wetlands returned from the search are over 500 km away.

5.2 THREATENED ECOLOGICAL COMMUNITIES

Three Commonwealth listed Threatened Ecological Communities were identified in the PMST report. These TEC's are:

1. Central Hunter Valley eucalypt forest and woodland (Critically Endangered)
2. Upland Basalt Eucalypt forests of the Sydney Basin Bioregion (Endangered)
3. White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland – Critically Endangered Ecological Community.

One occurs onsite and would be impacted; 229.58 ha of remnant White Box – Yellow Box – Blakely's Red Gum Grassy Woodland (Box-gum woodland and derived native grassland). Of this 24.59 ha is considered high diversity structural woodland and the residual areas of derived native grassland (89%) are relatively degraded.

Figure 5-1 illustrates the larger extent of Box-gum woodland/derived native grassland assumed to occur inside Wollar Valley. It was not possible to access these areas due to private property however trees and groundcovers were observed from public roads where possible to do so inside Wollar Valley.

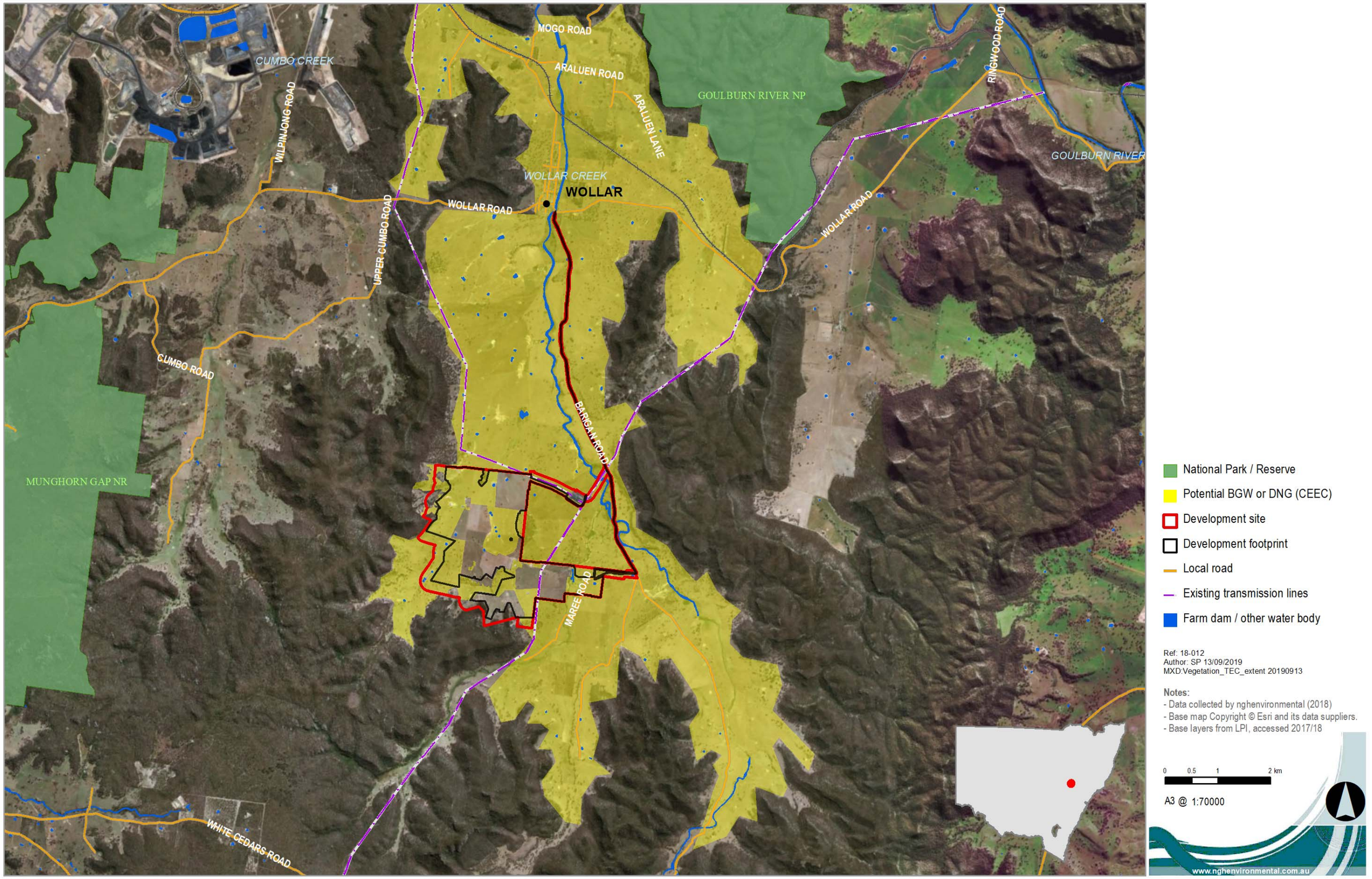

Figure 5-1 Larger extent of assumed box gum woodland inside Wollar Valley in relation to the development footprint.


WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
WOLLAR ROAD
Zone 9
Zone 8
Zone 5
BARIGAN ROAD
Zone 6
Development site
Development footprint
Area not classified under EPBC Act
Zone 6: PCT 281: Derived
Zone 5: PCT 281: Good
Zone 3: Cultivated: Low condition
Zone 4, 7: Cultivated/substation land
Zone 9: PCT 1610: Cleared low
Zone 8: PCT1610: Good
Vegetation classified under EPBC Act
Zone 2: PCT 1303: Derived grassland
Zone 1: PCT 1303: Good condition
Zone 6: PCT 281: Derived grassland
Zone 5: PCT 281: Good condition
Zone 9: PCT 1610: Cleared low
Zone 8: PCT1610: Good
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Ref: 18-012
Author: SP 20/09/2019
MXD:vegetation 20190912_100
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
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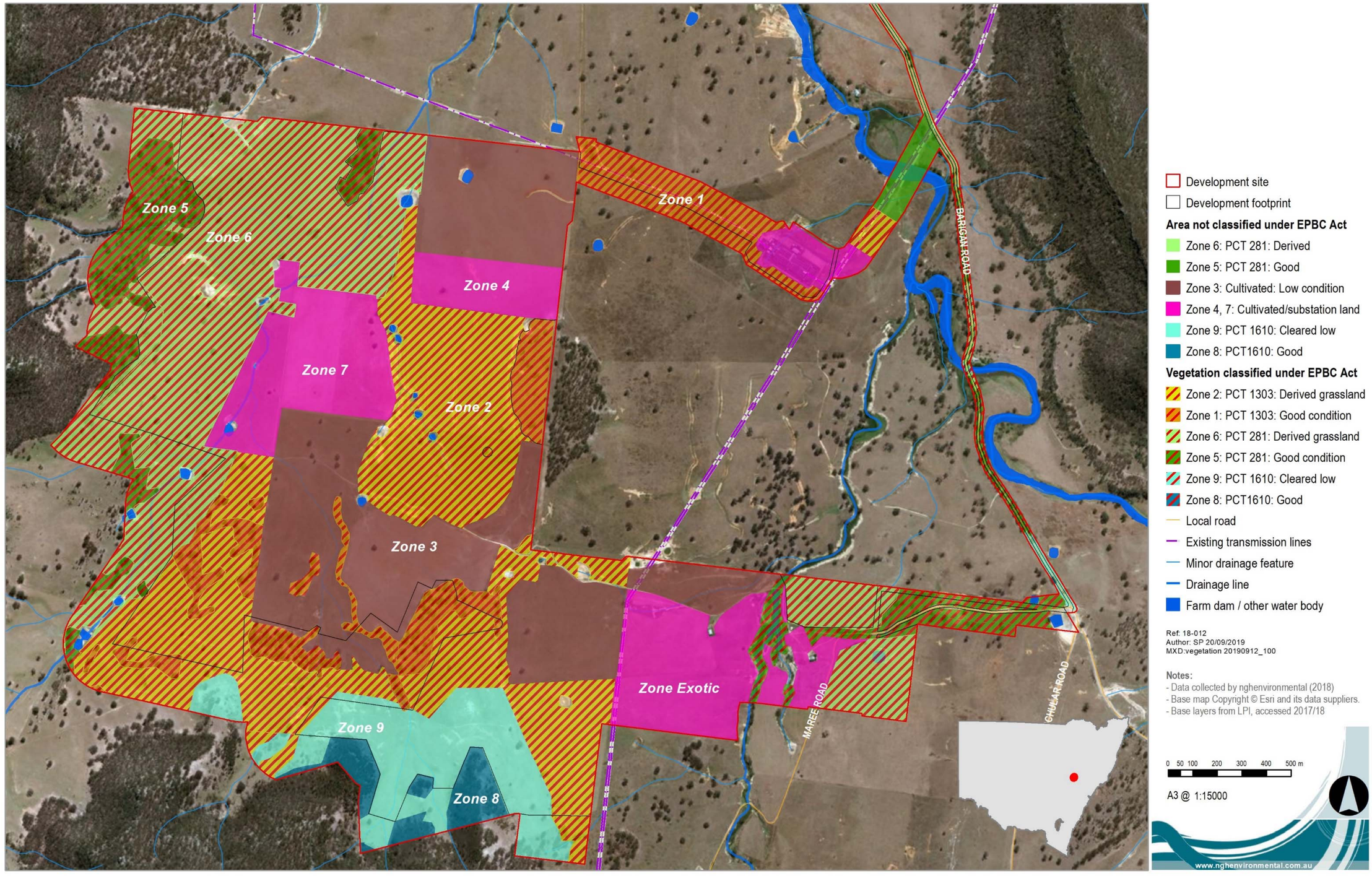

Figure 5-2 Confirmed extent of Box-Gum Woodland and Derived Native Grassland EPBC listed CEEC inside the development site (shown over 2 maps).

5.3 THREATENED SPECIES

Thirty-three threatened species were returned from the protected matters report. Of these, nine are considered to have the potential to utilise the habitats at the development site of which all have been adequately surveyed for to determine potential presence;

- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered EPBC Act
- Spotted-tailed Quoll (*Dasyurus maculatus*) – Endangered EPBC Act
- Painted Honeyeater (*Grantiella picta*) – Vulnerable EPBC Act
- Pink-tailed Legless Lizard (*Aprasia parapulchella*) – Vulnerable EPBC Act
- Brush-tailed Rock-wallaby (*Petrogale penicillata*) – Vulnerable EPBC Act
- Swift Parrot (*Lathamus discolor*) – Critically Endangered EPBC Act
- Superb Parrot (*Polytelis swainsonii*) – Vulnerable EPBC Act
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable EPBC Act
- Koala (*Phascolarctos cinereus*) – Vulnerable EPBC Act

Based on the survey results, three were considered to have potential for greater than low impacts:

- Large-eared Pied Bat
- Regent Honeyeater
- Pink-tailed worm-lizard

The Large-eared Pied Bat was recorded via ultrasonic detector during the October surveys with further assessment of potential impacts undertaken and discussed in Section 7.

Based on the comprehensive reptile, mammal and bird surveys undertaken (in accordance to EPBC threatened survey guidelines and habitat evaluation), no other listed MNES are considered likely to occur in the development site regularly or rely on the habitats present.

5.4 MIGRATORY SPECIES

Eleven listed migratory species were returned from the protected matters report. Two of these species may utilise box gum woodland habitat within the development site.

- Satin Flycatcher (*Myiagra cyanoleuca*)
- Rufous Fantail (*Rhipidura rufifrons*)

None of these species were detected during diurnal bird surveys undertaken. It is concluded that they are unlikely to occur within the development site regularly or would rely on the habitats present.

6 AVOID AND MINIMISE IMPACTS

6.1 AVOIDING AND MINIMISING IMPACTS ON NATIVE VEGETATION AND HABITAT

6.1.1 Site selection – consideration of alternative locations/routes

Photovoltaic solar technology was chosen because it is cost-effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology which is readily available for broad scale deployment at the site. In terms of its impacts on biodiversity, PV solar installation creates minimal ground disturbances where footprint, mounts being either pile driven or on small footings.

However, the impacts of shading on groundcover species composition over the long term is largely unknown. Solar panels will cause extensive shading over the site. Seventy-four percent of the development footprint contains TEC. It is not known whether shading would lead to a change in groundcover species composition so in taking a precautionary approach it would have to be assumed to be an impact unless proven otherwise. The layout can be flexible to minimising impacts on site constraints and therefore avoid areas of better quality TEC. The Wollar Subject land was considered to be feasible because:

- It has been established within a landscape with little or sparse tree cover which is disturbed by farming practices, including cultivation and grazing,
- It has excellent solar exposure
- It has excellent access to local and major roads
- It has excellent access to the grid transmission network
- There are a low number of non-involved neighbouring dwellings
- It has favourable, low relief terrain

The Draft Large Scale Solar Energy Guideline for State Significant Development (SSD) provides recommendations regarding selection of suitable solar farm sites and areas of constraint that should be identified. These are addressed in Table 6-1 and Table 6-2 for the site.

Table 6-1 Site selection criteria: preferable site conditions

Preferable site condition	Site observation
Optimal solar resources	Good solar irradiance observed
Suitable Land	Low relief land far from existing development.
Local impacts minimised	Consultation underway.
Capacity to rehabilitate	Minimal site disturbance, if using pile driven array mounts.
Community support	Consultation underway
Proximity to electrical network	Close to existing substation. Connection point crosses site.
Connection capacity	Optimal location to connect to the existing transmission network with high grid system strength

Table 6-2 Site selection criteria: Areas of constraint

Areas of constraint	Site observation
Native vegetation	Much of the site is devoid of trees and has been subjected to past agricultural use.
Potential residences	Few residential receivers.
Waterways	Few permanent waterways.
Aboriginal/Heritage significance	Requires investigation.
Important agricultural land	Not mapped as Biophysical Strategic Agricultural Land (BSAL)
Residential zones	No residential zones.
Resource developments	No current mineral leases.

Photovoltaic solar technology was chosen because it is cost effective, low profile, durable and flexible regarding layout and siting. It is a proven and mature technology which is readily available for broad scale deployment at the site.

The mixture of fixed and tracking panels is to be determined after further analysis.

6.1.2 Proposal components – consideration of alternate modes or technologies

Other alternative sources of energy generation include coal mining, hydro-electric, wind, tidal and thermal industries.

Coal is a finite resource and contributes to green-house gas emissions. Mudgee and Wollar Valley surrounds are known areas containing coal seams with Wilpinjong open cut mine to the north west of the development site. Establishing new coal mines is likely to generate more direct and indirect impacts as a result of extracting ore and the need for stockpiling the waste in tailings ponds.

For hydro-electric industries to work, they require specialised landscapes and large water bodies. These resources are not present at Wollar Valley.

According to the Clean Energy Council of Australia, wind turbines are proving a popular renewable energy resource contributing to 5.7 percent of Australia's electricity generation. Their success is dependent on exposure to consistent winds for the site to be feasible. According to Wind power Engineering and Development 2013, valleys (such as Wollar valley) are not optimal for wind turbines because the terrain surrounding the valley shelters the site from consistent winds leading to inefficient electricity generation.

Tidal energy requires oceanic waters to generate electricity. As Wollar Valley is inland this option is not a feasible choice for producing power at the site.

Geothermal energy uses the earth's natural internal heat to generate electricity and heating. Geothermal energy may be stored in granite rocks or trapped in liquids such as water and brine (referred to as hydrothermal process). AREANA's international geothermal expert group found that utility-scale generation from geothermal projects was not expected to be commercially viable by 2020. The technology was only expected to become

competitive with traditional fossil fuel power generation by 2030 with the help of a high carbon price and in the most favourable scenario for cost reductions.

6.1.3 Proposal planning phase – detailed design

A preliminary constraints analysis was conducted by NGH Environmental in April 2018, which was then followed up with further field work (to stratify the property into vegetation zones) which informed the site layout design. Vegetation constituting the highest ecological constraints such as forming high quality TECs, as well as providing key threatened flora and fauna habitat were avoided and minimised as far as practical by;

- Reducing the clearing footprint of the project and avoiding trees and woodland areas wherever possible to do so,
- Locating ancillary facilities in areas where there are minimal biodiversity values, such as where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score),
- Minimising development within areas containing high constraint vegetation (e.g. an EEC and CEEC),
- Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.

The current site layout and location has not been able to completely avoid all areas of native vegetation because of the distribution of resources over the development site and is still considered indicative and a worst-case scenario, ahead of final construction drawings.

Designing a panel layout to avoid all TEC onsite would essentially render the site unfeasible for solar panels. As such, some areas of the more degraded TEC will need to form part of the development footprint. Refer to Figure 6-1 below for a map of areas which are defined as TEC onsite. Although the indicative development footprint shows clearing across the whole area, solar panels are to be constructed in blocks across the development footprint, solar panels are able to be arranged in segmented rows to accommodate the area that is available. While a typical / generic layout for a 5 MW generation block (on open land) is generally proposed to cover an area of approximately 182 metres by 231 metres this physical layout can be easily modified where land constraints including some areas of TEC make this exact configuration impractical. In practice the rows of panels can be physically laid out in any geometric configuration and then electrically grouped to form a 5 MW generation block.

Additionally, road upgrades for access to the site along Maree Road will be reduced upon final design. As mentioned above, and although assumed that up to 24.59 ha of high diversity structural Box Gum Woodland (Zone 1 and Zone 5) may require removal, it is anticipated that following final design of the access roads along Maree Road and final proposal design, a reduction in the amount of better condition Box-gum Woodland can be reduced by a further 30%. The current design footprint is detailed in Figure 6-2. Specifically, it is noted that:

- Development areas maximise the use of cultivated and non-native vegetation.
- Most hollow bearing trees are avoided.
- All mapped Regent Honeyeater habitat has been able to be avoided.
- Most high diversity CEEC has been avoided.
- Waterway and riparian areas are buffered, and water crossings limited to the essential site requirements.


Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9
Zone Exotic
BARIGAN ROAD
MAREE ROAD
TICHULEAR ROAD
Development site
Development footprint
Zone 1: PCT 1303: Good (confirmed TEC)
Zone 2: PCT 1303: Derived grassland (confirmed TEC)
Zone 5: PCT 281: Good condition (confirmed TEC)
Zone 6: PCT 281: Derived grassland (confirmed TEC)
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Ref: 18-012
Author: SP 13/09/2019
MXD:Vegetation_TEC_zones 20190912
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
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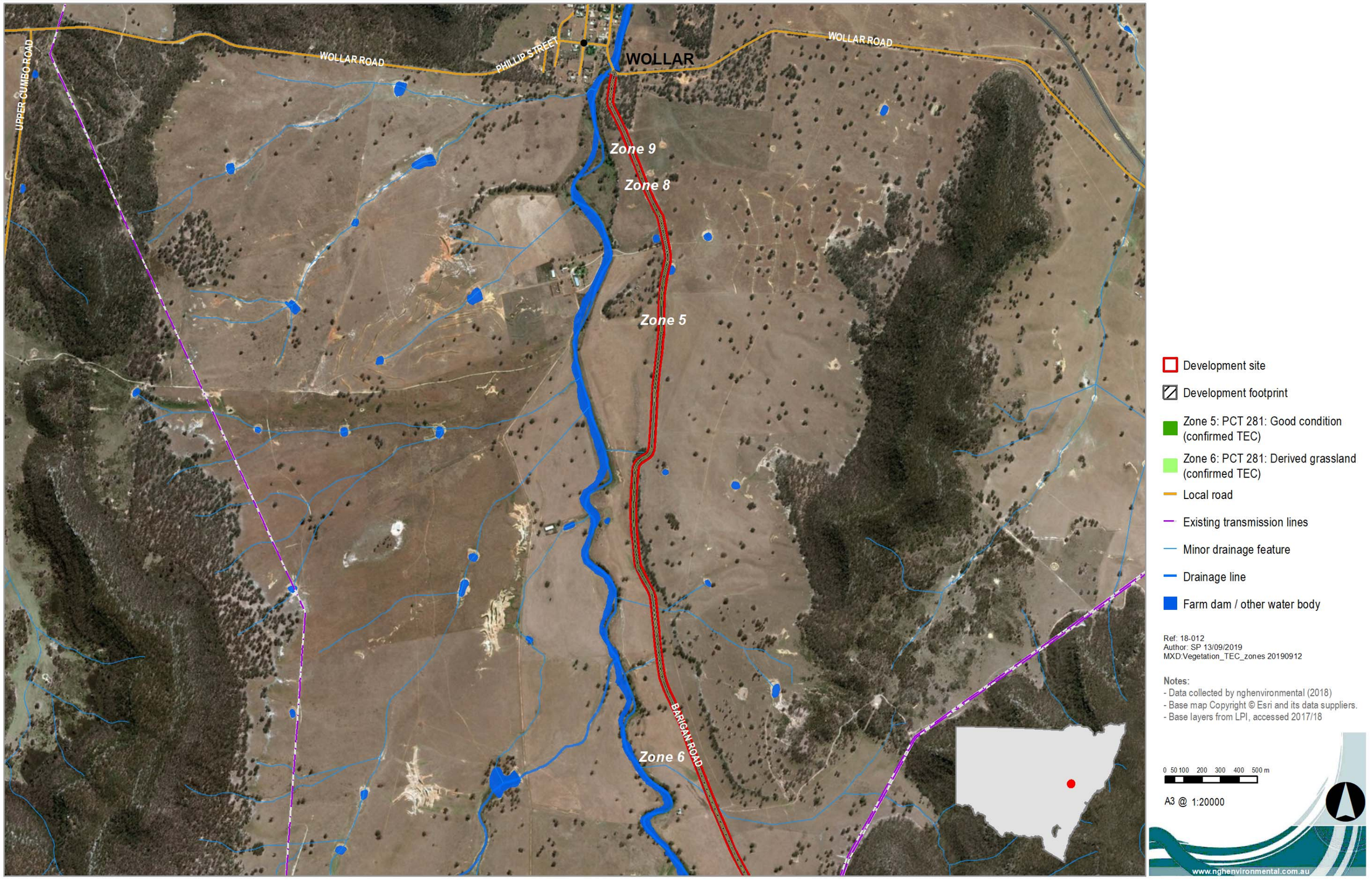
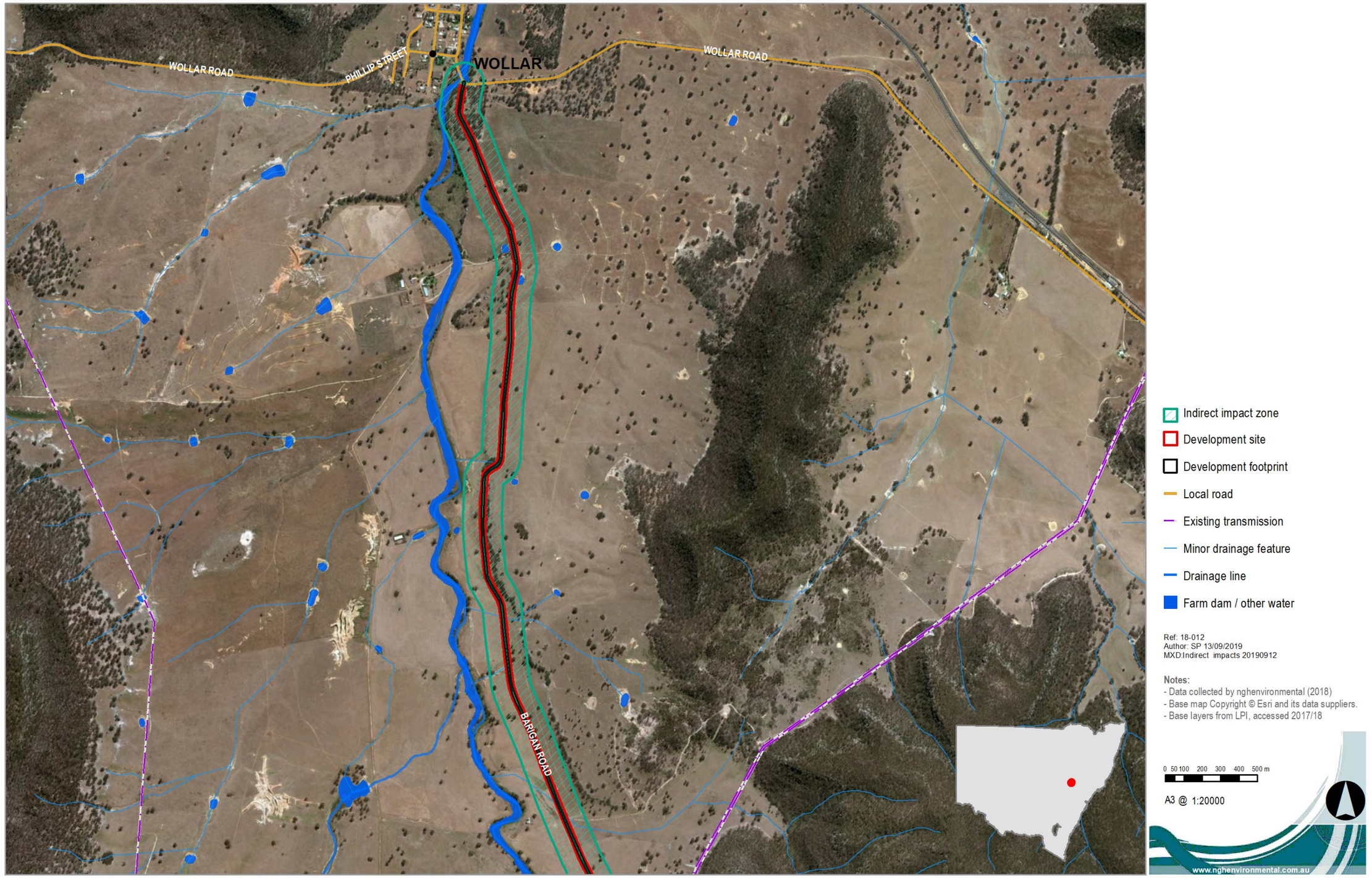


Figure 6-1 TEC (NSW EEC) within the development site (Zones 1, 2, 3, 5 and 6).


WOLLAR ROAD
PHILLIP STREET
WOLLAR
WOLLAR ROAD
BARIGAN ROAD
Indirect impact zone
Development site
Development footprint
Local road
Existing transmission
Minor drainage feature
Drainage line
Farm dam / other water
Ref: 18-012
Author: SP 13/09/2019
MXD:Indirect impacts 20190912
Notes:
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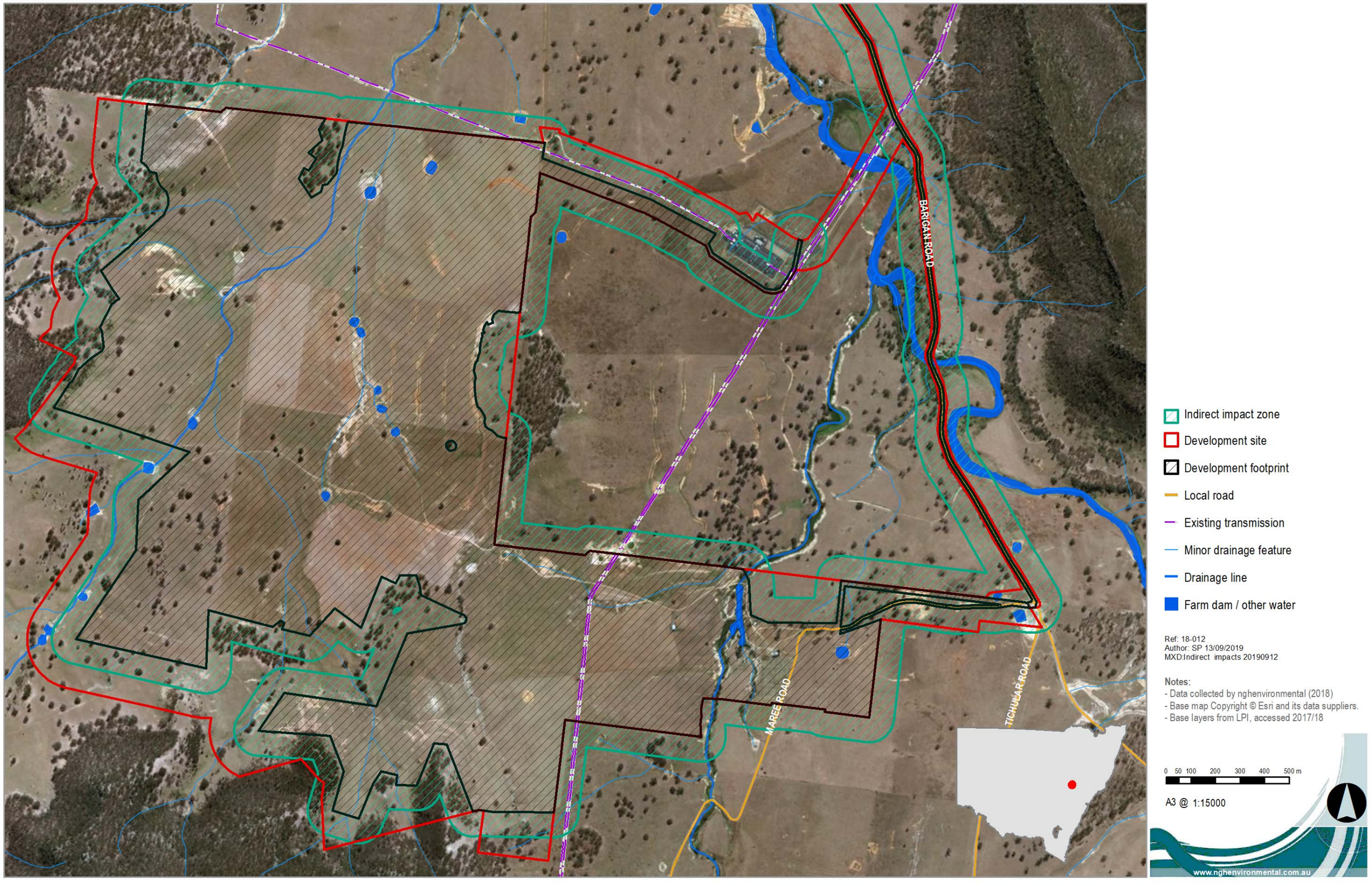


Figure 6-2 Development footprint, Development site and area of indirect impact (shown over 2 maps).

6.2 AVOIDING AND MINIMISING PRESCRIBED BIODIVERSITY IMPACTS

The BC Regulation (clause 6.1) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme:

The following prescribed impacts are relevant to the proposal:

- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of these species across their range
- Impacts of development on movement of threatened species that maintains their life cycle
- Impacts of development on the habitat of threatened species or ecological communities associated with human made structures or non-native vegetation
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

How these prescribed impacts have been avoided and minimised by the proposal is detailed below.

6.2.1 Impacts of development on the connectivity of different areas of habitat or threatened species that facilitate the movement of these species across the range.

Major habitat features within the Wollar Valley include;

- Woody and steep ridgeline vegetation with rocky scarps found above the Wollar Valley,
- Box gum woodland and derived native grasslands found on the plains of Wollar Valley,
- Rivers and streams across the Wollar Valley.

In terms of connectivity of woody vegetation, there is some minor tree connectivity (where trees are less than 50m away from each other) running east to west across the southern section of the development footprint. The connectivity of trees (off the property boundary and to the east) is already broken with a distance of greater than 100m separating isolated trees. As such the existing connection is considered very weak and generally not feasible in providing habitat links to more extensive woody vegetation that is found 2.5km east and would only provide connection habitat opportunity for highly mobile species such as birds (Parrots, Honeyeaters, Cockatoos).

In terms of native groundcover requiring assessment under the BAM, it is assumed that the development footprint will impact on approximately 367.07 ha. Although the area of native grasslands to be impacted is quite large, the expanse of native grasslands remaining within the Wollar Valley (that will not be impacted) is greater than 8000ha. Also, the area of grassy groundcover within the development site has been subjected to intensive farming disturbances including cultivation and regular grazing by sheep. Vegetation integrity plots undertaken substantiate groundcover was influenced by exotic flora in many areas or compacted with many areas containing bare ground devoid of groundcover. As such, the removal of native groundcover in the context of impacting on a large quantity of derived grassland habitat is considered negligible.

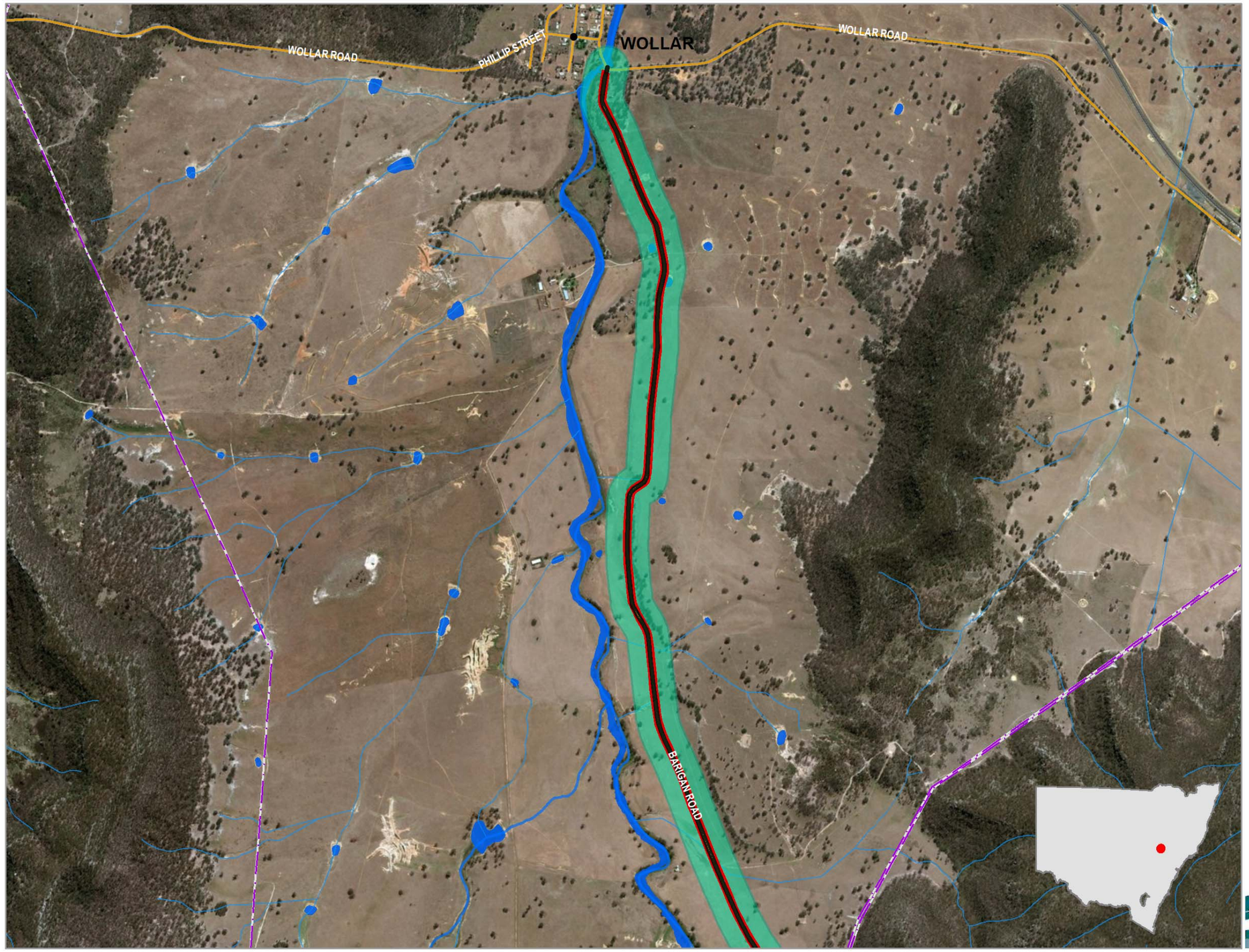
6.2.2 Impacts of development on movement of threatened species that maintains their life cycle

In term of key habitat for threatened species onsite, they include:

- Box Gum Woodlands (where trees are less than 50m apart),
- Isolated hollow bearing trees,
- Rocky scarps,

- Areas of thick native groundcover,
- Watercourses, especially where areas contain large eucalypts.

The development footprint chosen has attempted to avoid as much key habitat as possible and where this cannot be avoided then more degraded habitat was targeted for impact. Modifications to the development footprint were undertaken to avoid important mapped areas for the regent honeyeater as well as avoiding the majority of better quality TEC that is considered to the meet the requirement of MNES. No impacts would occur to the movement of threatened species across the landscape. Refer to Figure 6-3 below.



Regent Honeyeater mapped
Indirect impact zone
Development site
Development footprint
Local road
Existing transmission
Minor drainage feature
Drainage line
Farm dam / other water

Ref: 18-012
Author: SP 13/09/2019
MXD:Regent 20190913

Notes:
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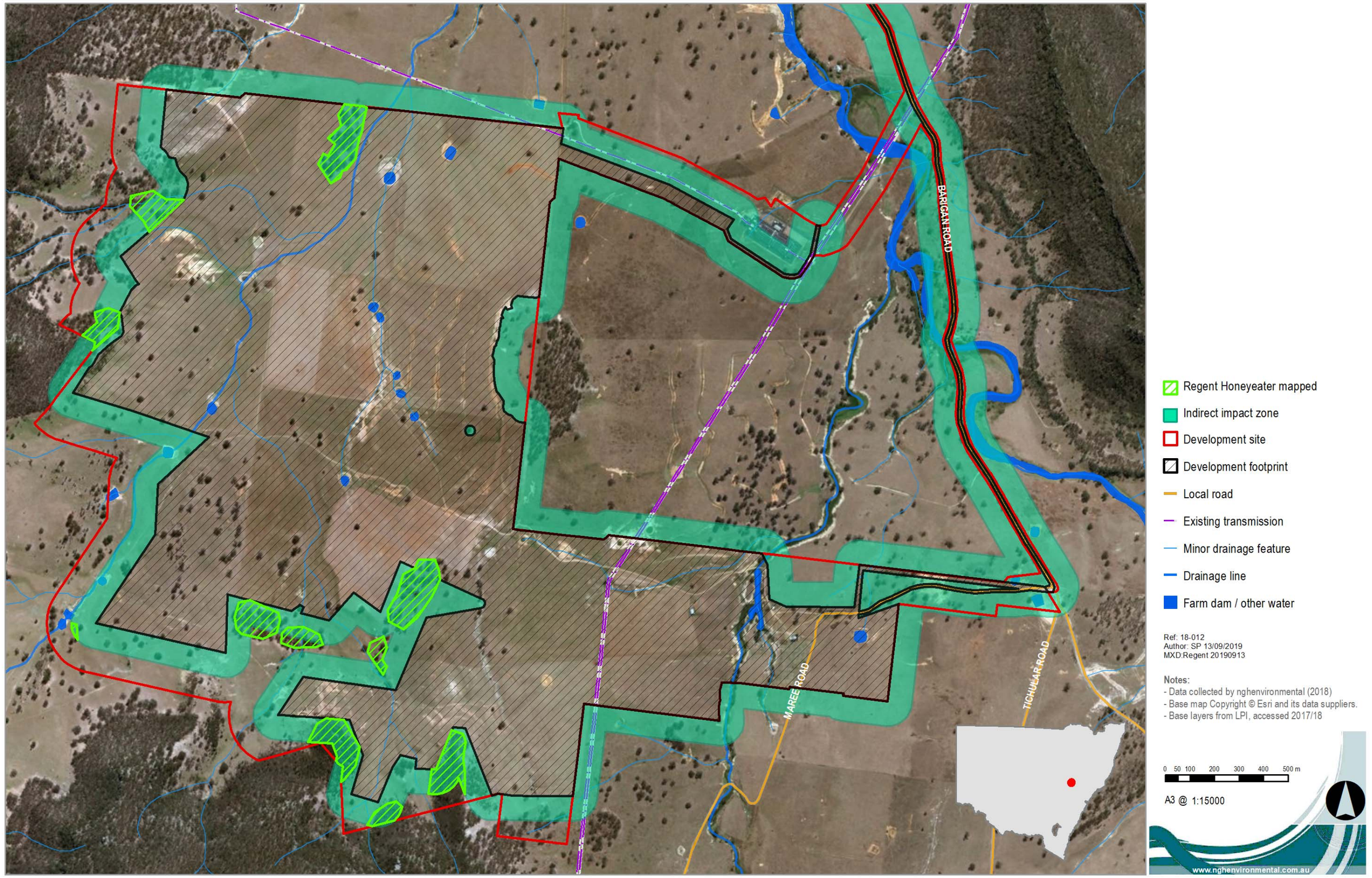


Figure 6-3 Confirmed Regent Honeyeater 'Important Habitat Mapping' as presented by LMBC/OEH in Sept 2018 (green hatching) inside the development site (shown over 2 maps).

6.2.3 Impacts of development on habitat of threatened species or ecological communities associated with human made structures or non-native vegetation

An agricultural shed (within the south east corner of the development site) could provide potential roosting habitat for Eastern Bentwing-bat and other threatened bats that roost in buildings. The Eastern Bent Wing Bat was detected onsite via ultrasonic detection during targeted survey however upon inspection of the agricultural shed, and there being no evidence of use by microbats this structure was ruled out in forming potential habitat. Better quality habitat occurs in the surrounding sandstone ridgelines with abundance of crevices and overhangs present.

A road culvert is present within Wollar creek road crossing on the access track to the substation (see Figure 4-4). On inspection the culvert is highly unlikely to be utilised for microbats due to its exposure onsite. The culvert will not be impacted directly but may be impacted indirectly, especially if there is an increase in the volume of traffic onsite and size of vehicles using the road.

No substantive impacts for habitat of threatened species or ecological communities associated with human made structures or non-native vegetation are anticipated.

6.2.4 Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities

Spring Flat Creek is a fourth order watercourse, which runs through the centre of the Wollar subject land and development site. The creek itself, although a fourth order stream, has no distinguishable bed and banks, primarily due to the large size of Wollar Valley being a broad expansive flat where energy dissipation of water is very low. The creek itself is spread over a wide flat plain and any water does not concentrate into a channel. No ponded water was observed at the time of inspection in May 2018. Much of its water resources, especially during drier times would be contained within the alluvial sands underground. Based on observation during May 2018, it is assumed that Spring Flat Creek and its associated tributaries are dry most of the time and would only flow during heavy rainfall events. A network of dams exists on Spring Flat Creek providing more permanent water resources to stock.

Due to the ephemeral nature of Spring Flat Creek, the placement of infrastructure within riparian buffers is considered feasible. The designated 40 metre buffer zone either side of the centreline of this creek is devoid of trees and shrubs and is highly degraded. It is not optimal habitat for birds of prey due to the lack of permanent water onsite. The establishment of solar panels is not expected to generate many indirect impacts. There will be minimal ground disturbance when installing the infrastructure. The most impacting activity would be constructing new roads and hardstand areas with the highest impact occurring during construction. Due to the local topography being largely flat and mildly sloping, the momentum of runoff during heavy rainfall events is not expected to cause flash flooding or impact on any watercourses onsite.

The impacts on watercourses from road works to expand the width of Barigan road (to support large machinery during construction) cannot be avoided and is considered the most feasible for minimising impacts to riparian zones. The construction of alternative roads (to gain access) would also need to cross riparian land.

6.2.5 Impacts of vehicle strikes on threatened species or on animals that are part of a TEC

The proposal would not directly increase impacts of vehicle strikes on threatened species. Threatened species would not be funnelled into transport corridors as a result of the development proposed. However, an increase in vehicle traffic is likely to indirectly increase (albeit marginally) the risk of vehicle strikes on common species

such as Kangaroos and Wombats as well as common and threatened avifauna such as the Regent Honeyeater. Site management to enforce and reduce site speed limits would minimise impacts of vehicle strikes.

7 IMPACTS UNABLE TO BE AVOIDED

7.1 DIRECT IMPACTS

The construction and operational phases of the proposal has the potential to impact biodiversity values at the site that cannot be avoided. This would occur through direct impacts such as habitat clearance and installation and existence of infrastructure.

Table 7-1 Potential impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	Consequence
Direct impacts				
Habitat clearance for permanent and temporary construction facilities (e.g. solar infrastructure, transmission lines, compound sites, stockpile sites, access tracks)	463.28 ha (assuming total impact over development footprint)	Regular	Construction	Direct loss of native flora and fauna habitat Potential impacts of additional clearing outside the proposed development footprint Injury and mortality of fauna during clearing of fauna habitat and habitat trees Disturbance to stags, fallen timber, and bush rock
Displacement of resident fauna	Unknown	Regular	Construction, operation	Direct loss of native fauna Decline in local fauna populations
Injury or death of fauna	Unknown	Regular	Construction	Direct loss of native fauna Decline in local fauna populations
Removal of habitat features e.g. HBTs	9 HBTs (Wollar property) 55 HBTs (Barigan road reserve) 7 waterbodies	Regular	Construction	Direct loss of native fauna habitat Injury and mortality of fauna during clearing of habitat features
Shading by solar infrastructure	250.5 ha	Regular	Operational Phase: Long-term	Indirect impacts of altered light (i.e. shading) on derived native grasslands of TECs which could lead to altered species composition and cover abundance. Modification of native fauna habitat.

Nature of impact	Extent	Frequency	Duration and timing	Consequence
				Potential loss of ground cover resulting in unstable ground surfaces and sedimentation of adjacent waterways.
Existence of permanent infrastructure (Fencing)	Approx. 15.6km	Regular	Operational Phase: long-term	Reduced fauna movements across landscape due to fencing. Collision risks to birds and microbats due to fencing.

7.1.1 Changes in vegetation integrity scores

The changes in vegetation integrity scores as a result of clearing are documented for each vegetation zone in Table 7-2 below. For the purpose of this preliminary BDAR, it is assumed that there will be total removal/modification of all vegetation zones, leading to future scores of zero.

Table 7-2 Table of current and future vegetation integrity scores for each vegetation zone within the development footprint.

Zone ID	PCT	NSW EEC and/or threatened species habitat?	Area (ha)	Current vegetation Integrity Score	Future vegetation Integrity Score
1	1303_BoxGumWL	Yes	16.46	56.8	0
2	1303_Derived Native GL	Yes	102.30	9.4	0
3	1303_Cultivated_Low	Yes	110.72	11.4	0
4	1303_Exotic (Paddock tree)	No	12.83	NA	NA
5	281_BoxGumWL	Yes	7.99	59.4	0
6	281_Derived Native GL	Yes	102.83	11.9	0
7	281_Exotic (Paddock tree)	No	31.64	NA	NA
8	1610_Good	No	0.14	27	0
9	1610_Degraded	No	27.07	2.3	0

7.1.2 Loss of species credit species habitat or individuals

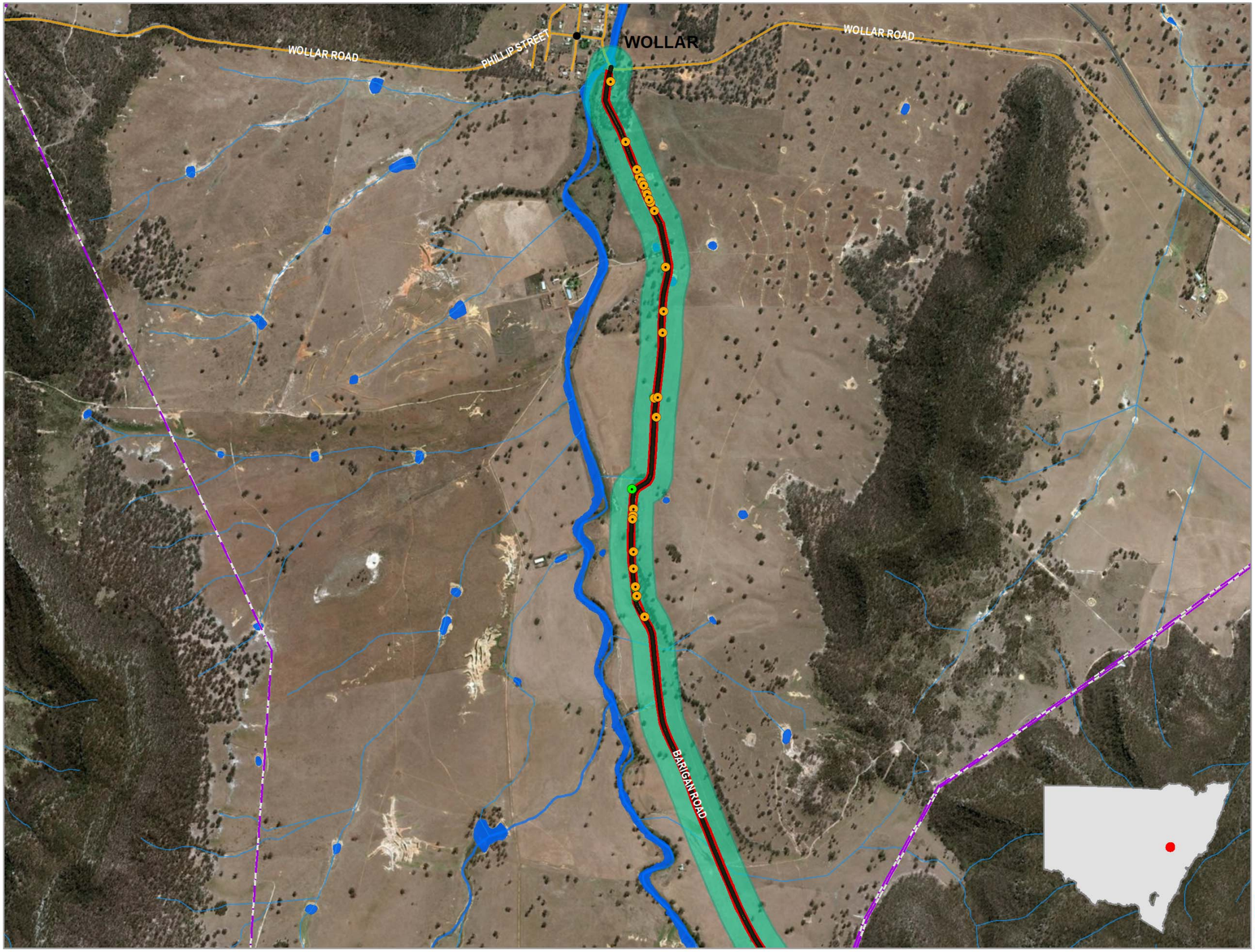
The proposal would not result in the loss of species credit species habitat or individuals. Although the Large-eared Pied Bat, Eastern Bentwing Bat and Eastern Cave bat were detected during surveys, optimal breeding, roosting or foraging habitat would not be impacted. Ecosystem credits have been generated to account for available foraging habitat which is mainly within wooded PCTs alongside Barigan Road.

7.1.3 Loss of hollow-bearing trees

Sixty-four hollow bearing trees (HBTs) were recorded inside the development footprint (see Table 7-3 and Figure 7-1 below). Five occur within the solar farm site and 55 within the Barigan Road impact area.

Table 7-3 Hollow bearing trees that would be removed and associated vegetation zone – Barigan Road.

ZONE	HBTs within zone (Wollar Property)	HBTs within zone Barigan Road
1) 1303_BoxGumWL	2	0
2) 1303_DerivedNativeGL	3	0
3) 1303_Cultivated_Low	0	0
4) 1303_Exotic (paddock tree)	0	0
5) 281_BoxGumWL	1	30
6) 281_DerivedNativeGL	3	13
7) 281_Exotic (paddock trees)	0	0
8) 1610_Good	0	11
9) 1610_Disturbed	0	1
TOTAL	**9**	**55**


WOLLAR ROAD
PHILLIP STREET
WOLLAR
WOLLAR ROAD
BARIGAN ROAD
Hollow bearing tree to be
Hollow bearing tree
Indirect impact zone
Development site
Development
Local road
Existing transmission
Minor drainage feature
Drainage line
Farm dam / other water
Ref: 18-012
Author: SP 13/09/2019
MXD:HBT_trees 20190913
Notes:
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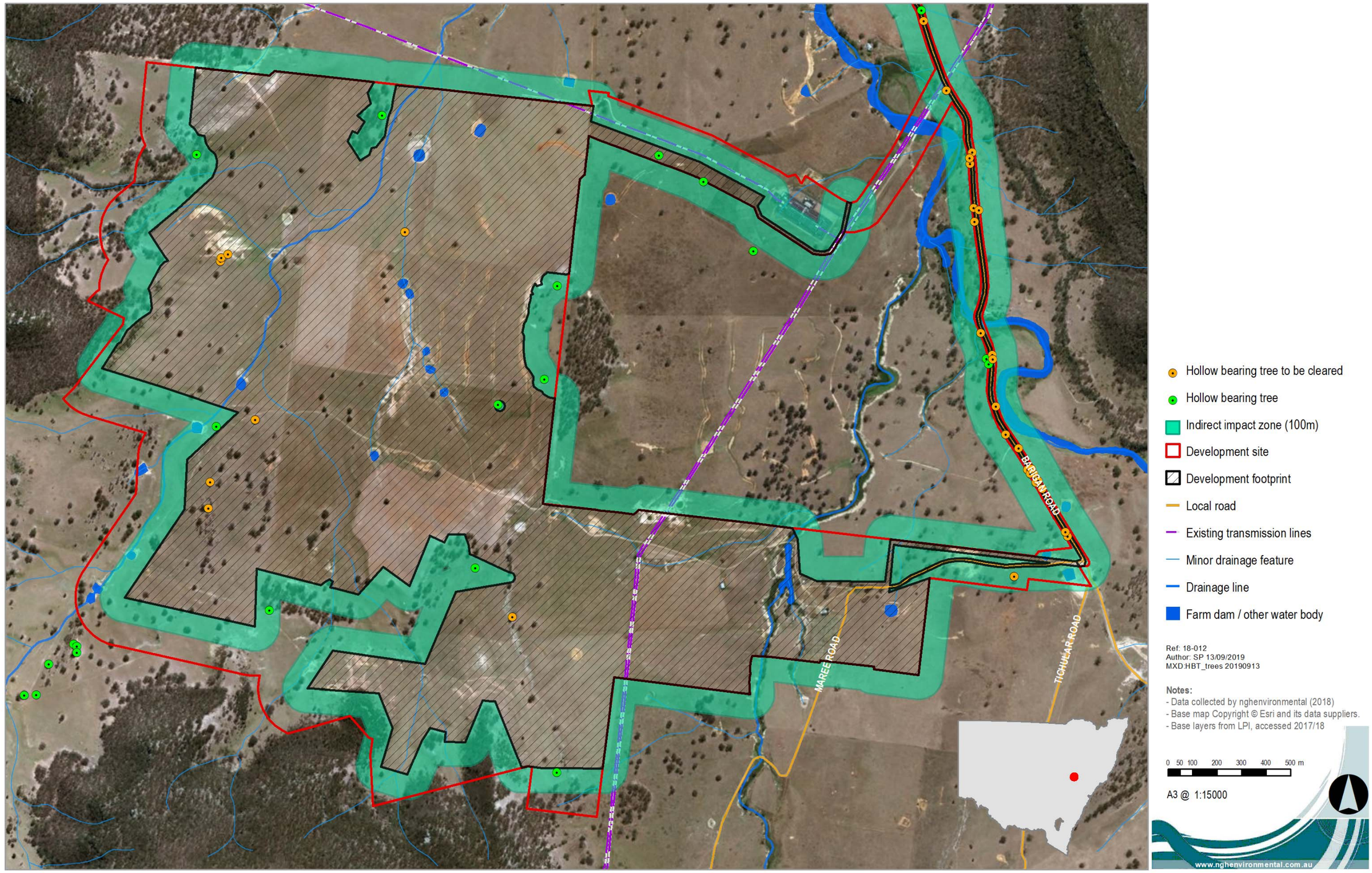


Figure 7-1 Hollow bearing trees (HBTs) within and within 150m of the development site (shown over 2 maps).

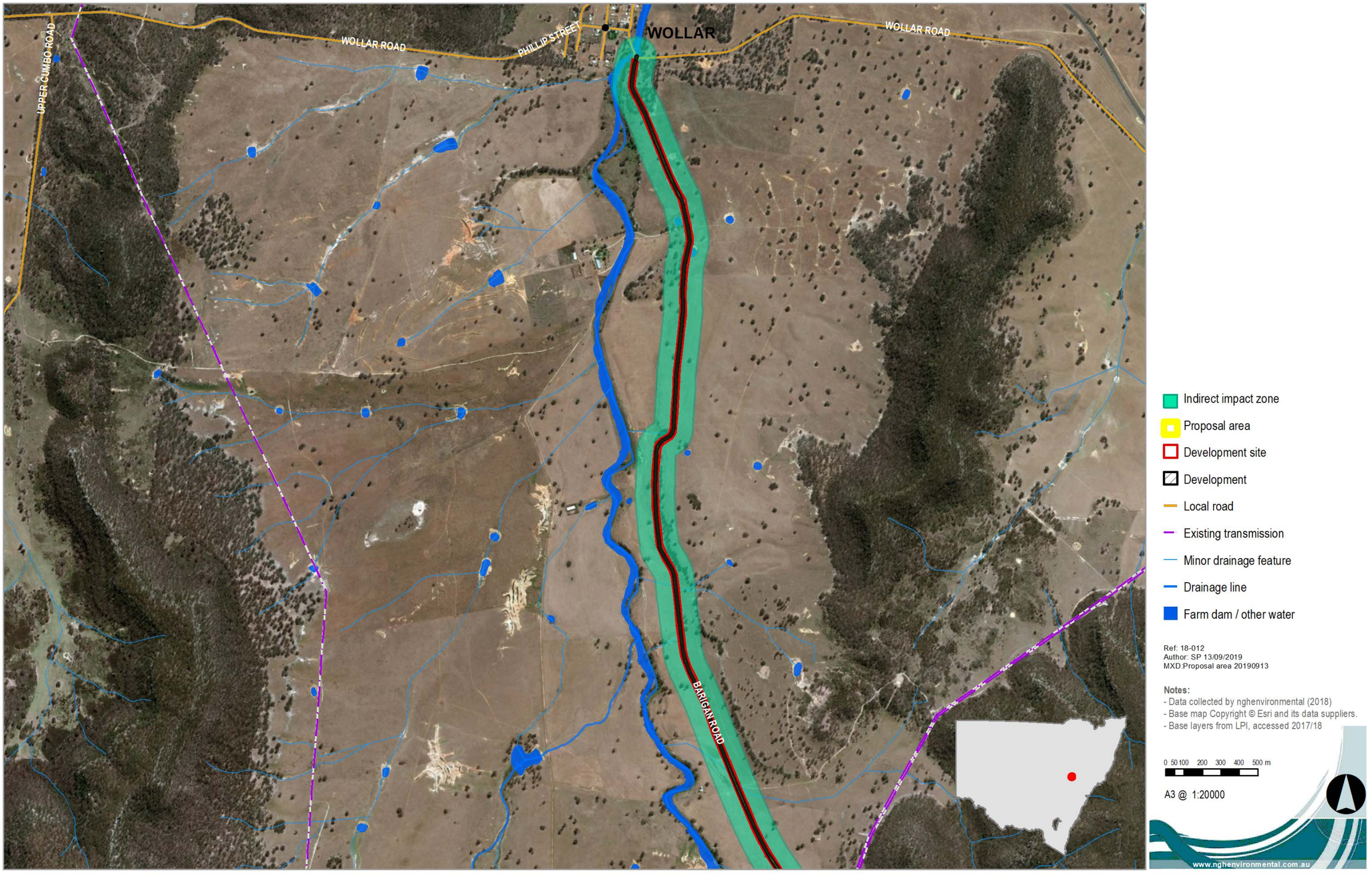
7.2 INDIRECT IMPACTS

Indirect impacts of the proposal include soil and water contamination, creation of barriers to fauna movement, or the generation of excessive dust, light or noise and inadvertent disturbances to retained hollow bearing trees. Table 7-1 below details the type, frequency, intensity, duration and consequence of the direct and indirect impacts of the proposal. The zone of indirect impact is mapped on Figure 7-1 above and separately on Figure 7-2.

Table 7-4 Potential indirect impacts to biodiversity during the construction and operational phases

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
Indirect impacts (those listed below are included in the BAM)					
Inadvertent impacts on adjacent habitat or vegetation	Unknown	Rare	Construction Phase: Short-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Direct loss of native flora and fauna habitat • Injury and mortality of fauna during clearing of fauna habitat and habitat trees • Disturbance to stags, fallen timber, and bush rock • Increased edge effects
Reduced viability of adjacent habitat due to edge effects	Unknown	Constant	Operational Phase: Long-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Further degradation of TECs. • Loss of native flora and fauna habitat
Reduced viability of adjacent habitat due to noise, dust or light spill	Unknown	Rare	Operational Phase: Short-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• May alter fauna activities and/or movements • Loss of foraging or breeding habitat • Inhibit the function of plant species, soils and dams
Transport of weeds and pathogens from the site to adjacent vegetation	Unknown	Irregular	Construction & Operational Phase: Long-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Degradation of TEC onsite through future weed invasion
Increased risk of starvation, exposure and loss of shade or shelter	Unknown	Rare	Construction & Operational Phase: Long-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Loss of foraging habitat

Nature of impact	Extent	Frequency	Duration and timing	TEC, threatened species and habitats likely to be affected	Consequence for bioregional persistence
Loss of breeding habitats	12 HBTS adjacent to impact areas	Constant	Construction Phase: Long-term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Loss of potential breeding habitat
Increase in pest animal populations	Devt footprint	Regular	Long term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Solar arrays may provide potential habitat for pest species like rabbits and foxes to take refuge under panels.
Bush rock removal and disturbance	TBA	One off	Long term	• White Box – Yellow Box – Blakely's Red Gum Woodland EEC (NSW) • White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland (EPBC)	• Loss of potential breeding habitat


WOLLAR
WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
UPPER CUMBO ROAD
BARIGAN ROAD
Indirect impact zone
Proposal area
Development site
Development
Local road
Existing transmission
Minor drainage feature
Drainage line
Farm dam / other water
Ref: 18-012
Author: SP 13/09/2019
MXD:Proposal area 20190913
Notes:
- Data collected by nghenvironmental (2018)
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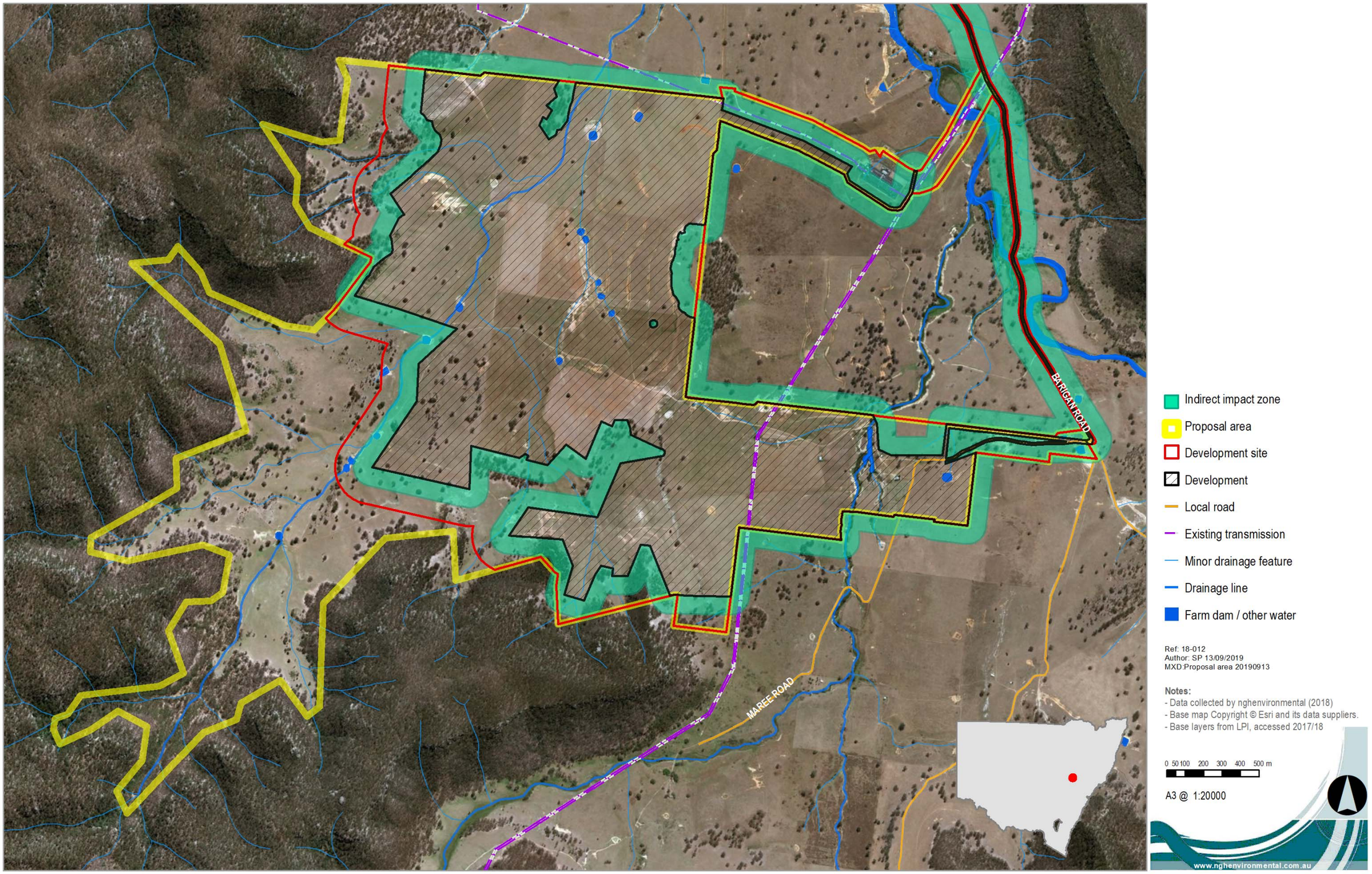

Figure 7-2 Zone of indirect impact for the proposal.

The following prescribed biodiversity impacts are relevant to the proposal:

- Impacts to karst, caves, crevices, cliffs, rocks and other features of geological significance
- Impacts of the development on the connectivity of different areas of habitat of threatened species that facilitates the movement of these species across their range
- Impacts of the development on movement of threatened species that maintains their life cycle
- Impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation.
- Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC

These are discussed in detail below and the necessary information required by Section 9.2 of the BAM provided.

7.2.1 Impacts of development on the habitat of threatened species or ecological communities associated with rocks

There are several distinct bands of Narrabeen Sandstone outcropping along the 70-80m contour line south and west of the development site as can be seen in Figure 4-2 .

Fringing foraging habitat for the Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat occurs within the development site however would not be directly impacted by the proposal. Vegetated ridgelines surrounding the development contains significant sandstone caves, crevices and overhangs caves which is suitable roosting sites for Large-eared Pied Bats in the subject land. The Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat were all detected via ultrasonic detection during surveys in the sandstone ridgeline. Areas containing suitable roosting habitats will not be impacted. Surveys did not detect these species within the development site however it is considered that this species may utilise fringing vegetation within the lower slopes surrounding the development site. No suitable foraging habitat or roosting habitat occurs within the development footprint or will be impacted. Linear rocky outcrops that are within the development site largely contain embedded rock with shallow crevices unlikely to be utilised regularly. No observations or evidence of their use was observed during the field surveys in these areas. The proposed development will be avoiding some, but not all rocky scarps. Some of these areas were unable to be avoided due to their proximity inside the development site. As such, there will be some direct impacts to this habitat. There is unlikely to be any indirect impacts if solar panels are located close to rocky outcrops. The solar panels will be directed towards the sky to capture sunlight and impacts from glare and reflection are unlikely to affect species utilising adjacent rocky habitat. All outcrops within Wollar Valley development site are exposed to sunny weather elements. Solar panel glare is unlikely to impact rocky habitat providing dark caves or crevices.

Suitable and potential foraging and breeding habitat for the Pink-tailed worm-lizard occurs within the development site and would be removed by the proposal. Surveys did not detect this species and so the development site is not considered known habitat.

There is approximately 0.9 ha of suitable habitat within the development site, of which 0.1 ha of partially embedded and loose rock surrounded native grass species including *Themeda triandra* may be impacted. Additionally, there approximately 4.9 ha of rocky outcrop through the development site considered potential habitat of which 3.2 ha may be impacted during construction. The quality of potential habitat for this species is low, being largely embedded rock and subject to persistent grazing and dominated by predominately exotic grasses. With the implementation of the recommended mitigation measures, the proposal would not lead to a long-term decrease in the size of an important population of this species.

7.2.2 impacts of development on the habitat of threatened species or ecological communities associated with human made structures

There is one large agricultural building within the development footprint used to store farm machinery and one small tin shed within some stockyards located within the centre of the property. The shed may have potential to provide suitable roosting habitat for the Eastern Bentwing-bat. No evidence of use was observed during the surveys within the shed.

There is also one culvert installed over Wollar Creek on the substation access track near the intersection of Barigan Road (See Figure 4-). This structure will not be impacted directly. This structure is not likely to provide roosting habitat for the Eastern Bent-wing Bat because the culvert structure does not provide good protection from the outdoor elements and would be unable to provide thermal benefits or offer high humidity which are required for suitable roosting habitat (BioNet). Therefore, it is unlikely to be considered habitat for any microbats addressed in this report.

7.2.3 impacts of development on the habitat of threatened species or ecological communities associated with non-native vegetation

Large portions of the development footprint contain areas of non-native vegetation which did not require assessment under the BAM. Most areas consisted of ploughed paddocks being sown with Lucerne and oats. These areas (excluding the paddock trees) are not expected to provide any unique habitat opportunities for any of the candidate species assessed.

7.2.4 impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range

Box-gum woodland is currently highly fragmented through the central portions of the development site due to historical land use with only small clumps and isolated paddock trees remaining. More connected and better condition box- gum woodland occurs on the boundary of the development site and lower slopes outside of the development site. Connectivity of the woodland would still be maintained through these areas. The loss of a number of paddock trees and smaller patches within the development footprint would result in minor loss of connectivity for more transient, agile and disturbance tolerant species, however as these areas occur as canopy species only, and lack the more complex vegetative structure of the lower slopes and larger patches of vegetation within and outside of the development site that would not be impacted, ensuring that species that rely of box-gum woodland as well as genetic variation would be maintained and not considered to significantly increase fragmentation of the box-gum woodland.

The remnant treed Box Gum Woodland habitat provides connectivity for threatened woodland birds such as Regent Honeyeater, Speckled Warbler, Brown Treecreeper, Varied Sittella, Little Lorikeet, Swift Parrot, Hooded Robin, Black-chinned Honeyeater, Turquoise Parrot, Scarlet Robin, Flame Robin, Grey-crowned Babbler and Diamond Firetail. Where hollow-bearing trees are present there are key breeding habitat opportunities for Gang-gang Cockatoo, Barking Owl, Powerful Owl, Masked Owl, Squirrel Glider and Brush-tailed Phascogale. These patches of woodland have been subjected to a history of clearing and farming and are fragmented. This has resulted in these patches becoming isolated and less viable, especially for terrestrial fauna such as Koalas and the Spotted-tail Quoll. The degree of impact on these already fragmented patches is not seen to pose a substantial impact on any threatened species.

The derived native grasslands and paddock trees and woodland habitat provide habitat for threatened birds of prey like the Spotted Harrier, White-bellied Sea Eagle, Little Eagle and Square-tailed Kite, especially around areas containing large dams found on Spring Flat Creek.

The proposal is therefore not likely to disrupt the movement of these species and would not have a substantive impact on their bioregional persistence.

7.2.5 impacts of the development on movement of threatened species that maintains their life cycle

In term of key habitat for threatened species onsite, they include;

- Box Gum Woodlands (where trees are less than 50m apart)
- Isolated hollow bearing trees
- Rocky scarps
- Areas of thick native groundcover
- Watercourses, especially where areas contain large eucalypts.

The development footprint chosen will not remove large quantities of key habitat such that the life-cycles of any Candidate species (assessed within the BDAR) will be significantly affected. Fringing foraging habitat for the Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat occurs within the development site however would not be directly impacted by the proposal. Vegetated ridgelines surrounding the development contains significant sandstone caves, crevices and overhangs caves which is suitable roosting sites for Large-eared Pied Bats in the subject land. The Large-eared Pied Bat, Eastern Bentwing-bat and Eastern Cave Bat were all detected via ultrasonic detection during surveys approximately 400m south of the development site in the sandstone ridgeline. Areas containing suitable roosting habitats will not be impacted.

No suitable foraging habitat or roosting habitat occurs within the development footprint or will be impacted. These microchiropteran bats are sub canopy foragers preferring to forage along the edges of vegetation and sandstone escarpments and are not known to utilises open grasslands or small area vegetated areas for foraging. Eastern Cave Bats may forage away from sub canopy and fringing shrubby vegetation and forage up to 500m over grassland areas on occasion, however the proposal would not impact upon the ability of this species to forage within these areas. Although detected within the subject land, no species credits have been generated for these species from the proposal as optimal breeding, roosting or foraging habitat would not be impacted.

7.2.6 Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)

In terms of TECs onsite, the proposed solar farm will not alter water quality or influence hydrological processes onsite or cause any new impacts on Box Gum Woodlands beyond what is impacted by installing solar panels. The development footprint is located within the riparian zone where panels will be constructed either side of the watercourse. The watercourse (although 4th order) does not contain a definable bed and banks where most of its water flows under the ground. The designated 40 metre buffer zone either side of the bank is devoid of trees and shrubs and is highly degraded.

The establishment of solar panels is not expected to generate many indirect impacts on threatened species. There will be minimal ground disturbance when installing the infrastructure. The most impacting activity would be constructing new roads and hardstand areas with the highest impact occurring during construction. Due to the local topography being largely flat and mildly sloping, the momentum of runoff during heavy rainfall events is not expected to generate indirect impacts from stormwater runoff.

Two of the candidate species rely on aquatic habitat for food and shelter. These are the White-bellied Sea Eagle and Square-tail Kite. Neither species were observed during any of the field assessment inspections including targeted survey and it is therefore assumed that they do not utilise habitat onsite. No stick nest trees were observed inside the development footprint or site. Based on these inspections, it is concluded that the area is not optimal breeding or foraging habitat for birds of prey, primarily because of the lack of permanent water onsite.

7.2.7 Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC

An increase in vehicle traffic during construction and required maintenance may slightly increase the risk of vehicle strike on threatened species occurring in or near the development site. As most machinery will be large it is likely to travel at lower speeds thus lowering the incidence of vehicle strikes.

Fencing may act as a barrier to the movement and may funnel species into transport corridors.

Mitigation measures will be implemented to enforce a site speed. With the recommended mitigation measures, it is therefore not likely that vehicles associated with the proposal will have a substantive impact on any species.

7.3 IMPACTS TO BIODIVERSITY VALUES THAT ARE UNCERTAIN

The majority of the development footprint (55%) will consist of solar panels. The impacts of shading and diversion of rainfall runoff from the panels themselves is largely unknown. This aspect is discussed in more detail under section 7.5 below in relation to potential impacts on the composition and cover abundance of groundcover.

For the purpose of this BDAR report, the entire development footprint is assumed to be removed however, as the indicative layout shows, substantial peripheral areas are likely to be unimpacted and it is likely that a number of perennial native species will persist underneath the solar arrays. Certainly, only a minor proportion of the seed bank will be impacted, given the limited excavation proposed.

In this assessment an assumption has been made that all vegetation within the development footprint would be removed. This is a 'worst case' conservative approach. There is currently limited ability to vary this assumption without specific scientific data to justify a lesser impact; such as the results of ground cover monitoring beneath the solar array. Therefore, the costs associated with purchasing and retiring ecosystem and species credits or the need for offset areas is currently an 'over estimated result' of the impacts of this solar farm undertaken to address current uncertainty.

7.4 IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

To address the Supplementary SEARs regarding MNES:

- Additional field survey was undertaken in October 2018 to better characterise CEEC vegetation and undertake targeted surveys for other species listed under the EPBC.
- Evaluation of floristics was undertaken.
- A condition threshold evaluation was undertaken against the Commonwealth criteria
- Assessments of Significance were undertaken.

The results are summarised below.

7.4.1 Threatened Ecological Communities

One EPBC listed community – 'White Box -Yellow Box – Blakely's Red Gum Grassy Woodlands and Derived Native Grassland' (PCT 281 & 1303) was present within the development site.

490.31 ha of Box Gum Woodland (BGW) and Derived Native Grasslands (DNG) occurs within the development site of which 229.58 ha will be directly impacted. 24.59 ha of this is considered high diversity structural woodland and the residual areas (93%) of derived native grassland are relatively degraded. Development footprint revisions were undertaken to exclude as much of the high diversity CEEC as possible.

It is interesting to note that while much of the site is very weedy and degraded, the native species persisting are perennial and therefore the proportion of native biomass (ignoring exotic annuals) is often over 50%. While occurring at low density and in low numbers, the total number of native grass and forb species was often relatively high. This may be due to the effects of recent fire, stimulating the soil seed bank and also the use of cattle grazing in preference to sheep grazing. Excluding the high diversity areas mapped for the site, the residual areas are considered to have relatively low conservation value despite meeting the CEEC criteria. Table 7-5 below illustrates the analysis of floristics and cover abundance undertaken of the BAM plots to assess the status of vegetation and its classification of box gum woodland and derived native grassland requiring assessment under Matters of National Significance (MNES).

An EPBC Assessment of significance was completed for Box Gum Woodland EEC (Appendix E) and concluded the proposal will result in the loss of 229.58 ha of box-gum woodland, approximately 43% of the know extent of BGW/DNG within the development site. Although additional areas of box-gum woodland occur within the Wollar Valley, many of areas are fragmented and subjected to degradation of invasion of exotic flora and other land use practices. As all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria are considered critical to the survival of this ecological community, as well as degraded woodland areas not considered part of the listed ecological community being considered essential to the long-term conservation of Box-Gum Grassy Woodland, due to landscape setting or habitat features, the assessment has concluded that although unlikely, there is a potential for a significant impact and referral to the Commonwealth Department of Environment is recommended for legal certainty.

Table 7-5 Analysis of floristics and cover abundance of BAM plots for classifying box gum woodland and derived native grassland requiring assessment under EPBC Act criteria.

Zone ID and PCT	Area	Plot ID	Field BAM Plot ID (refer to Figure 3-2)	Trees present	No of grass species	No of forb/fern /Other species	% proportion of native biomass over plot (ignoring exotic annuals)	EPBC Act criteria met	Presence of one important species for this CEEC.	VI score BAM C
Zone 1 1303_BGW	16.46 ha	1	W1	No trees but present <75m away	9	**6**	>50%	No	*Calotis lappulacea*	**56.8**
		2	W7	Yes trees	8	26	>50%	Yes	***Calotis lappulacea***	
		3	W2	Yes trees	11	18	>50%	Yes	***Calotis lappulacea***	
		4	W8	No trees	13	**16**	>50%	Yes	***Calotis lappulacea***	
Zone 2 1303_DNG	102.30 ha	1	W9	No trees	13	**5**	<50%	No	*Calotis lappulacea*	9.4
		2	W10	No trees	8	**11**	>50%	No	*Calotis lappulacea*	
		3	W29	No trees	2	**10**	>50%	No	*Vittadinia cuneata*	
		4	W12	No trees	8	**11**	>50%	No	*Calotis lappulacea*	
		5	W11	No trees	6	**13**	**>50%**	Yes	***Calotis lappulacea***	
		6	W4	No trees	15	**15**	**>50%**	Yes	***Vittadinia muelleri***	
Zone 3 1303_Cultivated_Low	110.72 ha	1	W3	No trees	6	**2**	>50%	No	*Calotis lappulacea*	11.4
		2	W13	No trees	7	**5**	>50%	No	*Calotis lappulacea*	
		3	W16	No trees	10	**7**	>50%	No	*none*	
		4	W14	No trees	7	**9**	>50%	No	*Calotis lappulaceae*	
		5	W17	No trees	5	**11**	>50%	No	*Vittadinia muelleri*	
		6	W15	No trees	3	**4**	**<50% (rye grass)**	No	*Goodenia pinnatifolia*	
Zone 4 1303_Paddock tree	12.83 ha	1	W18	No trees	1	**2**	**<50% (Lucerne)**	No	**none**	-
Zone 5 281_BGW	7.99 ha	1	W6	Yes trees/16 forbs	20	**16**	**>50%**	Yes	***Glycine clandestina***	**59.4**
		2	W20	Yes trees/10 forbs	4	**12**	**>50%**	Yes	***Glycine clandestina***	
		3	W19	Yes trees/22 forbs	5	**26**	**>50%**	Yes	***Glycine clandestina***	
Zone 6 281_DNG	102.83 ha	1	W5	No trees	11	**15**	**>50%**	Yes	***Calotis lappulaceae***	11.9
		2	W21	No trees	5	**14**	**>50%**	Yes	***Calotis lappulaceae***	
		3	W28	No trees	7	**15**	**>50%**	Yes	***Calotis lappulaceae***	

Zone ID and PCT	Area	Plot ID	Field BAM Plot ID (refer to Figure 3-2)	Trees present	No of grass species	No of forb/fern /Other species	% proportion of native biomass over plot (ignoring exotic annuals)	EPBC Act criteria met	Presence of one important species for this CEEC.	VI score BAM C
		4	W22	No trees	6	**13**	**>50%**	Yes	***Calotis lappulaceae***	
		5	W30	No trees	8	**9**	>50%	No	*Calotis lappulaceae*	
		6	W23	No trees	7	10	>50%	No	*Calotis lappulaceae*	

7.4.2 Threatened species

One EPBC-listed species was recorded during the surveys; the Large-eared Pied Bat.

A habitat evaluation (Appendix D) assessing the presence of habitat and likelihood for potential EPBC listed species including species identified within supplementary SEARS being impacted was undertaken, after the October 2018 targeted field surveys. The habitat evaluation determined EPBC Assessments of significance were completed for Regent Honeyeater, Pink-tailed worm-lizard and Large-eared Pied Bat; these were the only species required to be considered as the other species were evaluated as having no to very low likelihood to occur onsite and be impacted.

While considered to have low potential to occur, a Koala habitat assessment was undertaken using the Commonwealth tool to characterise the potential for impact to this species.

Large-eared Pied Bat, Regent Honeyeater, Pink-tailed worm-lizard

The Large-eared Pied Bat was recorded via ultrasonic detection. Optimal breeding and roosting habitat for this species is primarily limited to sandstone crevices and overhangs within the surrounding ridgelines outside of the development site. Additionally, foraging habitat consisting of complex forest or woodland structure which is not considered to occur within the development footprint. As this is a sub canopy forager and species would unlikely utilise grasslands for foraging, therefore only utilising areas within the development footprint for transient purposes, impacts to this species are not considered to occur as a result of the proposal.

The Assessments of significance (provided in full Appendix E) concluded that a significant impact was unlikely for Regent Honeyeater, Pink-tailed worm-lizard and Large-eared Pied Bat, on the basis that the proposal would not:

- Lead to a reduction of the size or area of occupancy of a population, or fragment or disrupt the breeding cycle of a population
- Affect habitat critical to the survival of these species
- Affect habitat or introduce disease such that these species would decline
- Introduce invasive species harmful to the species
- Interfere with the recovery of these species

Koalas

No Koalas were found during targeted SAT surveys onsite in May 2018. Habitat for this species within the development site is isolated and highly degraded. It is considered unlikely that the Koala would utilise the habitats available.

The EPBC Referral Guidelines for the Koala (DoE 2014) documents the 'Koala habitat assessment tool' to assist proponents in determining if a proposal may impact on habitat critical to the survival of the Koala. The tool is provided as Table 7-6 below as it applies to the proposal. Impact areas that score five or more using the habitat assessment tool contain habitat critical to the survival of the Koala. The assessment in Table 7-6 resulted in a score of 3 and as such, habitat within the subject land is not considered to be critical to the survival of the Koala. An assessment of significant impact according to the EPBC Act significant impact criteria is not required.

Table 7-6 Koala habitat assessment tool for inland areas (DoE 2014)

Attribute	Score	Inland	Applicable to the proposal?
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 5 years.	No evidence of Koalas recorded during the surveys
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years.	
	0 (low)	None of the above.	✓ (0)
Vegetation composition	+2 (high)	Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, **OR** 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	✓ (2) White Box & Yellow Box are listed food tree species, and both are present in the upper strata
	+1 (medium)	Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.	
	0 (low)	None of the above.	
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 1000 ha.	
	+1 (medium)	Area is part of a **contiguous landscape** < 1000 ha, but ≥ 500 ha.	
	0 (low)	None of the above.	✓ (0)
Key existing threats	+2 (high)	Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence. Areas which score 0 for koala occurrence and have no dog or vehicle threat present	
	+1 (medium)	Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, **OR** Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present.	✓(1) No Koala mortality observed during the survey
	0	Evidence of frequent or regular koala mortality from vehicle strike or dog attack	

Attribute	Score	Inland	Applicable to the proposal?
	(low)	in the subject land at present, **OR** Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high)	Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	+1 (medium)	Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	
	0 (low)	Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	✓(0) Subject land is not considered a habitat refuge, nor does it provide important connectivity to large areas surrounding a habitat refuge
Total	**3**	**Decision: Habitat is NOT critical to the survival of the Koala—assessment of significance NOT required**	

7.5 LIMITATIONS TO DATA, ASSUMPTIONS AND PREDICTIONS

7.5.1 Assumptions about impact extent

For the purpose of this BDAR report, the entire development footprint is assumed to be removed however, as the indicative layout shows, substantial peripheral areas are likely to be unimpacted and it is likely that a number of perennial native species will persist underneath the solar arrays. Certainly, only a minor proportion of the seed bank will be impacted, given the limited excavation proposed.

In this assessment an assumption has been made that all vegetation within the development footprint would be removed. This is a 'worst case' and highly conservative approach. There is currently limited ability to vary this assumption without specific scientific data to justify a lesser impact; such as the results of ground cover monitoring beneath the solar array. Therefore, the costs associated with purchasing and retiring ecosystem and species credits or the need for offset areas is currently an 'over estimated result' of the impacts of this solar farm.

7.5.2 Survey timing and efficacy

The seasonal conditions at the time of targeted survey for threatened plants, especially *Monotaxis macrophylla* were not ideal. A declared drought during the optimal time for survey (August) means there are limited resources available for this plant to grow and set seed. The optimal habitat zone would also be frequented by hungry stock causing a further decline in groundcover from overgrazing and trampling onsite.

The calculation of hollow-bearings trees, in particular the size and number of hollows, was made from ground level. It is possible that some hollows are present that were not visible from ground level, which may result in underestimates of the number of hollows (Gibbons and Lindenmayer, 2000). However, it was noted where it was considered likely that hollows were present but not visible from ground level.

It is possible that some species were not recorded during the survey due to the timing of the survey outside their recommended survey period. Where survey effort or timing is not consistent with the BAM or relevant guidelines, this is stated explicitly in the assessment and measures identified to address the limitation; i.e. assumption of occurrence for species whose survey window could not be met.

8 MITIGATING AND MANAGING IMPACTS

8.1 MITIGATION MEASURES

A general summary of the key measures required to mitigate the impacts of the proposal are provided below. Mitigation measures proposed to manage impacts, including proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure and an analysis of the consequences of any residual impacts are provided in Table 8-1.

8.1.1 Impacts from the clearing of vegetation and habitats

1. Time works to avoid critical life cycle events on threatened species
2. Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler
3. Relocate habitat features (fallen timber, hollow logs) from within the development site

8.1.2 Indirect impacts

1. Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is preferable in situations where partial clearing is proposed
2. Adaptive dust monitoring programs to control air quality
3. Temporary fencing to protect significant environmental features such as riparian zones
4. Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas
5. Staff training and site briefing to communicate environmental features to be protected and measures to be implemented

8.1.3 Prescribed impacts

1. Appropriate landscape plantings of local indigenous species to replace loss of planted vegetation Adaptive dust monitoring programs to control air quality
2. Sediment barriers and spill management protocols to control the quality of water runoff from the site into the receiving environment Temporary fencing to protect significant environmental features such as riparian zones
3. Enforce site speed limits to reduce impacts of vehicle strikes on threatened fauna.

Table 8-1 Mitigation measures proposed to avoid and minimise impacts on native vegetation and habitat

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Displacement of resident fauna through vegetation clearing and habitat removal						
Time works to avoid critical life cycle events	• Hollow-bearing trees would not be removed during breeding season (spring to summer) for threatened hollow dependant fauna. • If clearing outside of this period cannot be achieved, pre-clearing surveys would be undertaken to ensure no impacts to fauna would occur	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Implement clearing protocols during tree clearing works, including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or wildlife handler	• A tree clearing procedure would be implemented to minimise harm to resident fauna.	Construction	Regular	Contractor	Moderate	Species not detected during pre-clearing surveys may be impacted.
Relocate habitat features (fallen timber, hollow logs) from within the development site	• Procedure for relocation of habitat features to adjacent area for habitat enhancement would be implemented.	Construction	Regular	Contractor	Low	None
Indirect impacts on native vegetation and habitat						
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chainsaw, rather than heavy machinery, is	• Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. • No stockpiling or storage within dripline of any mature trees.	Construction	Regular	Contractor	Low	None

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
preferable in situations where partial clearing is proposed	• Access and laydown in areas of Box-Gum Woodland TEC will be minimised to reduce impacts. • Exclusion fencing and signage or similar would be installed around habitat to be retained.					
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	• Construction Environmental Management Plan will include measures to avoid noise encroachment on adjacent habitats such as avoiding night works as much as possible.	Construction	Regular	Contractor	Low	None
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	• Avoid Night Works where possible • Direct lights away from vegetation	Construction/ Operation	Regular	Contractor	Low	None
Adaptive dust monitoring programs to control air quality	• Daily monitoring of dust generated by construction activities • Construction would cease if dust observed being blown from site until control measures were implemented • All activities relating to the proposal would be undertaken with the objective of preventing visible dust emissions from the development site	Construction	Regularly	Contractor	Moderate	Sedimentation in ephemeral waterways and dams.
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	• A Weed Management procedure would be developed for the proposal to prevent and minimise	Construction, Operation	Regular	Contractor	Moderate	Weed encroachment

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	the spread of weeds. This would include: o Management protocol for declared priority weeds under the Biosecurity Act 2015 during and after construction o Weed hygiene protocol in relation to plant, machinery, and fill • Any occurrences of pathogens such as Myrtle Rust and Phytophthora would be monitored, treated, and reported. • The weed management procedure would be incorporated into the Biodiversity Management Plan.					
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	• Site induction and toolbox talks for ecologically sensitive areas would be undertaken.	Construction	Regular	Contractor	Moderate	Impacts to native vegetation or threatened species for Staff training not being followed
Preparation of a vegetation management plan to regulate activity in vegetation and habitat adjacent to the proposed development	• Preparation of a Biodiversity management plan that would include protocols for: o Protection of native vegetation to be retained o Best practice removal and disposal of vegetation o Staged removal of hollow-bearing trees and other habitat features such as	Construction	One-off	Contractor	Moderate	Impacts to native vegetation or threatened species for Biodiversity Management Plan not being followed.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
	fallen logs with attendance by an ecologist o Weed management o Unexpected threatened species finds o Exclusion of vehicles through sensitive areas. o Rehabilitation of disturbed areas					
Preparation of a vegetation management plan to monitor ground cover beneath the solar array modules.	• A Ground cover management plan would be developed to: o Ensure that ground cover is retained beneath panels, to resist erosion and weeds o Preserve the native composition as much as possible	Operation	Regula	Contractor	Moderate	Weed cover and erosion may increase. Native species composition may decline.
Erosion and sediment controls	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented	Construction	Regular	Contractor	Moderate	Impacts may occur if erosion and sedimentation control plan not implemented.
Prescribed biodiversity impacts						
Sediment barriers and spill management procedures to control the quality of water runoff released from the site into the receiving environment	• An erosion and sediment control plan would be prepared in conjunction with the final design and implemented • Spill management procedures would be implemented.	Construction	Regular	Contractor	Moderate	Impacts may occur to waterway if erosion and sedimentation control plan not implemented.

Mitigation measure	Proposed techniques	Timing	Frequency	Responsibility	Risk of failure	Risk and consequences of residual impacts
Appropriate landscape plantings of local indigenous species (where possible) within the development site	• Landscape plantings will be comprised of local indigenous species.	Operation	Regular	Client	Moderate	Plants not surviving
Staff training and site briefing to communicate impacts of traffic strikes on native fauna.	• Awareness training during site inductions regarding enforcing site speed limits. • Site speed limits to be enforced to minimise fauna strike.	Construction and Operation	Regular	Contractor	Moderate	Fauna strikes from vehicles

8.2 ADAPTIVE MANAGEMENT STRATEGY

The largest impact expected from this solar farm is the impact of solar panels and shading on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland onsite. The assumption that solar panel arrays will result in 100% impact on groundcover is used because there is a lack of scientific data proving otherwise. It is recommended that monitoring of groundcover under the solar panels is undertaken:

1. Primarily to ensure that ground cover is retained to resist erosion and potential weed ingress managed,
2. But also, to provide information to the scientific community regarding the impact of shading on native grasslands in this location.

It may be that the conservative assumptions of this assessment (regarding 100% impact on vegetation) are an unnecessarily high impost on projects that assist the transition to reduced greenhouse gas emissions and that thereby have many broader environmental benefits.

9 SERIOUS AND IRREVERSIBLE IMPACTS (SAII)

9.1 POTENTIAL SERIOUS AND IRREVERSIBLE IMPACT ENTITIES

The principles used to determine if a development will have serious and irreversible impacts, include impacts that:

- Will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- Will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- Impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- Impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

9.1.1 Threatened ecological communities

One threatened ecological community will be impacted on by the proposal that is listed as a potential SAII entity in the *Guidance to assist a decision-maker to determine a serious and irreversible impact*. This is the;

- White Box-Yellow Box- Blakely's Red Gum Woodland (Box-gum Woodland).

9.1.2 Threatened species

The following are SAII candidate species that have been identified for assessment within the Wollar development site.

- Regent Honeyeater (important habitat mapping)

9.1.3 Additional potential entities

No further species were considered to be potential SAII entities.

9.2 ASSESSMENT OF SERIOUS AND IRREVERSIBLE IMPACTS

9.2.1 White Box – Yellow Box – Blakely's Red Gum Woodland (Box-gum Woodland)

An assessment of the impacts to the NSW EEC Box-gum woodland was undertaken. Figure 6-1 shows the location of the Box-gum woodland EEC in context to the development footprint.

a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII

340.31 ha of vegetation that meets the NSW criteria for Endangered Ecological Communities, most (315.49ha, 93%) in degraded condition that does not generate offsets.

Around fifty percent of the Wollar development site contains vegetation matching White Box – Yellow Box – Blakely's Red Gum Woodland (Box Gum Woodland). This makes the option to fully avoid this TEC impossible if the solar farm is to proceed. Most of the higher quality woodlands with trees are found towards the southern parts of the development footprint, where larger patches of intact wooded TEC have been avoided.

b) the area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone

Table 9-1 Vegetation Zones defined as BGW/DNG inside the development site. The development proposal is not expected to indirectly impact any vegetation zones.

Zone ID and PCT	Vegetation Integrity Score	Area of direct impact	Area of indirect impact	Condition
Veg zone 1 1303_BoxGumWL	56.8	16.46	0	Good
Veg zone 2 1303_DerivedNativeGL	9.4	102.30	0	Moderate
Veg zone 3 1303_Low cultiv	11.4	110.72	0	Low
Veg Zone 5 281 BoxGumWL	59.4	7.99	0	Good
Veg Zone 6 281 DerivedNativeGL	11.9	102.83	0	Moderate

c) a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact

No threshold has yet been defined by OEH for the extent of Box-gum Woodland to be removed that constitutes a serious and irreversible impact**.**

d) the extent and overall condition of the potential TEC within an area of 1000ha, and then 10,000ha, surrounding the proposed development footprint

The development footprint is 463.28 ha in area and 340.31 ha consists of vegetation defined as Box-gum Woodland /Derived native grassland TEC. Using Google Earth to view aerial imagery, it is estimated that approximately the same percentage (51%) of the surrounding landscape also contains Box Gum Woodland. Confirmation of groundcover outside of the Wollar study locality site, however, cannot be verified by field survey.

e) an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration

It was not possible to accurately assess the percentage of Box Gum Woodlands and Derived Native Grasslands inside the Kerribee IBRA Subregion. This was because of the lack of vegetation mapping covering Wollar and surrounds. The use of GIS programs to estimate the percentage of mapped Box Gum Woodlands TEC could not be undertaken.

To try and overcome this constraint, a general review of Google Earth aerial photography was viewed in conjunction with Kerribee Subregion mapping. Areas of Box Gum Woodlands are most likely be confined to broad valleys within Kerribee Subregion which generally relate to cleared farming land. It is estimated that around 30% of Kerribee Subregion consists of farming country with potential for Box Gum Woodlands. Of this 30%, it is estimated that the Wollar solar farm would constitute about 1% of this area.

f) an estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion

In NSW Box-gum grassy Woodland is known to occur within at least 42 reserve systems. 8,000 ha of Box-gum woodland is estimated to occur in national parks and nature reserves within the NSW South Western Slopes IBRA Region (Benson 2008).

g) the development proposal's impact on:

i. abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns

It is predicted that the proposal could have impacts on,

- surface water flows across the ground, this would be limited as minimal excavation is proposed and panels would be mounted above the ground,
- change in light levels reaching the ground due to shading of panels, mitigated by spacing between panels,
- modification to ground moisture levels where solar panels may block or concentrate rain over certain areas.

The proposal could potentially benefit the BGW/DNG by;

- Removing disturbances caused by farming activities such as application of fertilisers and overgrazing by stock.

There is little scientific information on the effects of solar farms on these factors. Until sufficient monitoring of Solar farms is carried out, it is largely unknown whether solar farms are likely to have a detrimental impact on abiotic factors. A 'worst case' assumption would be that alterations to sunlight reaching the ground and changes to surface water flows due to the large surface area of solar panels over the ground, could modify abiotic factors necessary for survival of the TEC.

A review of the National Recovery Plan for BGW/DNG, indicates that;

- Altered hydrological regimes may lead to impacts,
- Prolonged shading may lead to impacts and
- Mowing and slashing associated with managing grasslands may lead to impacts

To address the uncertainty, it is therefore assumed that this proposal may lead to modification and destruction of important abiotic factors for preserving the integrity of this TEC onsite.

ii. characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants

The proposal would impact on the character and function of Box Gum Woodland in the following ways;

- Removing 64 hollow bearing trees (with small, medium and large hollows) within this TEC. Most occur alongside Barigan Road.
- Removing (or shading) 340.31 ha of this TEC (24.45 ha of which is structural woodland).

The groundcover within particular areas of the subject site is modified due to weed invasion, trampling by stock, past cultivation and past application of fertilisers which have all impacted on groundcover diversity. This reduces the severity of impacts that may result from any further changes to species composition.

No introduced fire or flooding regimes would occur and no increase of natural occurrences of these events is anticipated from the development. The harvesting of plants will not occur within the remaining Box-gum woodland.

iii. the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts

24.59 ha (5.3 %) is relatively intact Box Gum Woodland with trees and 367.52 ha (80.92%) is degraded native grasslands of varying condition (but requiring assessment and offsetting under BOS). The proposed development is not expected to indirectly impact on any additional areas of this TEC. It may be that remaining land is used as an offset and if this is the case then management action would be expected to improve any remaining patches of TEC not directly impacted.

h) direct or indirect fragmentation and isolation of an important area of the potential TEC

Upper assumed extent

The proposal occurs within a much larger patch of BGW/DNG within the Wollar Valley. At present, this patch is bordered to the north (extending 11km from the subject site), to the south west and west (extending approximately 500m from the subject site) and to the east (extending approximately 2km), by vegetated mountains not defined or likely to constitute BGW/DNG.

The location of the area of direct impact will isolate a portion of BGW/DNG directly south-west of the subject site. This patch is estimated to be 210 ha in area which would become separated from the existing patch of BGW/DNG. It is estimated that the proposal would isolate around 4% of the current patch of BGW/DNG (not including the 4% to be removed for solar panels).

Smallest extent

The proposal forms the majority of the patch of BGW/DNG which extends off the property to the south west. The proposal will not result in fragmentation of this patch however it will substantially reduce its extent as outlined in a).

i) the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.

The 24.06 ha of Box-gum woodland generating offsets will be offset in accordance with the Biodiversity Conservation Act 2016 to ensure protection in perpetuity for similar habitat in the IBRA region.

There is good potential to offset the south western portion of the property (all remaining areas of Box Gum Woodland and other non-Box Gum Woodland vegetation) to preserve and enhance TEC habitat onsite. These areas are in better condition and have better connectivity values due to the more mature/hollow bearing trees. There is scope to improve connectivity values within this area. Key abiotic factors inside these areas (like rocky scarp habitat) can also be protected for targeted candidate species.

9.2.2 Threatened species assumed present

No species are assumed present. The development footprint has been modified to avoid impacting any important mapped habitat for the Regent Honeyeater.

10 REQUIREMENT TO OFFSET

10.1 IMPACTS REQUIRING AN OFFSET

The total offset requirement for the project is 668 ecosystem credits. This section shows which zones generate the offset requirement.

Figure 10-1 (below) shows areas requiring offsets, areas not requiring offsets and non-native areas not requiring assessment under the BAM

10.1.1 Ecosystem credits

An offset is required for all impacts of development on PCTs that are associated with:

a) a vegetation zone that has a vegetation integrity score ≥15 where the PCT is representative of an endangered or critically endangered ecological community, or
b) a vegetation zone that has a vegetation integrity score of ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or
c) a vegetation zone that has a vegetation integrity score ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

The PCTs and vegetation zones requiring offset and the ecosystem credits required are documented and mapped within Table 10-1 below.

Table 10-1 Zones that require offsets

Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation Integrity Score	Vegetation integrity loss	Ecosystem credits required
1_BoxGumWL	1303	White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	16.46	56.8	56.8	468
5_BoxGumWL	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	7.99	59.6	59.6	238
8_Good	1610	White Box - Black Cypress Pine shrubby woodland of the Western Slopes	0.14	27	27	2

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix G.

10.1.2 Paddock tree credits

Offsets are required for the clearing of Class 2 & 3 paddock trees.

There are five class 3 paddock trees inside the development site. Four of the paddock trees form part of PCT 281 Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion. The remaining paddock tree forms part of PCT 1303 White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion. The combined PCT ecosystem credits required are documented in Table 10-2.

Table 10-2 Paddock trees that require offsets

Class of Paddock Tree being cleared	Hollows Present	Number of Paddock Trees to be cleared	Number of Credits Required	Ecosystem credits required
Class 3 **>50cm DBH**	**No**	5	5	5

10.1.3 Species credits

Offsets are required for some candidate species assessed. See Table 10-3. Most candidate species credit have been generated through the assumption of impact alongside Barigan Road, where targeted surveys have not been able to be undertaken.

The full Biodiversity Credit Report generated by the BAM Calculator is provided in Appendix G.

Table 10-3 Candidate species generating species credits

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species credits required
Acacia ausfeldii Austfeld's Wattle	2	1.2	**34**
Burhinus grallarius Bush Stone-curlew	2	1.2	**34**
Callocephalon fimbriatum Gang-gang Cockatoo	2	8.8	**182**
Chalinolobus dwyeri Large-eared Pied Bat	3	1.2	**50**
Commersonia procumbens	2	0.4	**2**
Monotaxis macrophylla Large-leafed Monotaxis	2	1.2	**34**
Ninox connivens *Barking Owl*	2	1.3	**36**

Species Credit Species	Biodiversity risk weighting	Area of habitat or count of individuals lost	Species credits required
Ninox strenua *Powerful Owl*	2	1.3	**36**
Petaurus norfolcensis Squirrel Glider	2	1.1	**34**
Phascogale tapoatafa Brush-tailed Phascogale	2	0.2	**32**
Phascolarctos cinereus Koala	2	1.2	**34**
Tyto novaehollandiae *Masked Owl*	2	1.3	**36**
TOTAL species credits			***544***

10.1.4 Commonwealth offset strategy

Current legislative context

Prior to the introduction of the NSW *Biodiversity Conservation Act 2016*, the NSW Framework for Biodiversity Assessment was the Commonwealth endorsed NSW offset scheme for Major Projects such as the Wollar Solar Farm proposal. Assessment and offset requirements were able to be determined through the NSW scheme, with final approval then provided by the Commonwealth Department of Environment (DoE).

The updated NSW BOS is currently seeking the same endorsement. As it is not yet endorsed by the Commonwealth, offset quantification and options are considered using Commonwealth tools below.

Quantification of the offset requirement

For MNES, offsets are required only where significant impacts may result. For this project, that is limited to White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland – Critically Endangered Ecological Community.

Appendix F sets out the offset requirement using the EPBC offset tool. The minimum direct offset requirement (90% direct offset required for Commonwealth physical offsets) equates to 413 ha in total comprised of:

- 205 ha for treed BGW.
- 208 ha for derived native grassland BGW.

Offset options under consideration

Within the development site, in areas that would not be impacted by the development, around 217 ha of CEEC is available for protection under an offset agreement. Based on available mapping, though not subject to detailed survey, it is estimated that an additional 258 ha remains within subject land, that would not be impacted

by the development and may provide suitable direct offsets. If suitable, this exceeds the required amount by 62 ha.

It is noted that an estimated 5,497ha of similar vegetation occurs in the local area and outside the project area. This figure has been assumed from aerial photography, knowledge of the landscape, and observation of vegetation within the landscape during field surveys.

In advance of the NSW BOS being endorsed by the Commonwealth (as of 15 February 2019 it is on public exhibition), the Wollar Solar Farm offset strategy retains flexibility. This strategy demonstrates that:

- Securing in perpetuity physical offsets within the subject land are likely to be feasible.
- Similar vegetation occurs in the locality and could also be considered, if required, for physical offsets.

Payment options may also be considered, such as making payments into the NSW Biodiversity Conservation Fund using the offset payments calculator or funding a biodiversity action.

Pending project approval, consultation would be undertaken with NSW OEH and Commonwealth DoE to provide a detailed offset strategy that meets legislative requirements that are currently in flux.

10.2 IMPACTS NOT REQUIRING AN OFFSET

Table 10-4 Zones that do not require offsets

Zone ID	PCT ID	PCT name	Zone area (ha)	Vegetation Integrity Score
2	1303_Derived Native GL	White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	102.30	9.4
3	1303_Cultivated_Low	White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	110.72	11.4
6	281_Derived Native GL	White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion	102.83	11.9
9	1610_Degraded	White Box - Black Cypress Pine shrubby woodland of the Western Slopes	27.07	2.3

The BAM assessment tools adequately address all the impacts associated with this solar farm. No other impacts which don't require offsets are anticipated.

10.3 AREAS NOT REQUIRING ASSESSMENT

The areas that do not require assessment in accordance with BAM and are not defined as native vegetation are mapped below. These areas are cultivated and non-native.

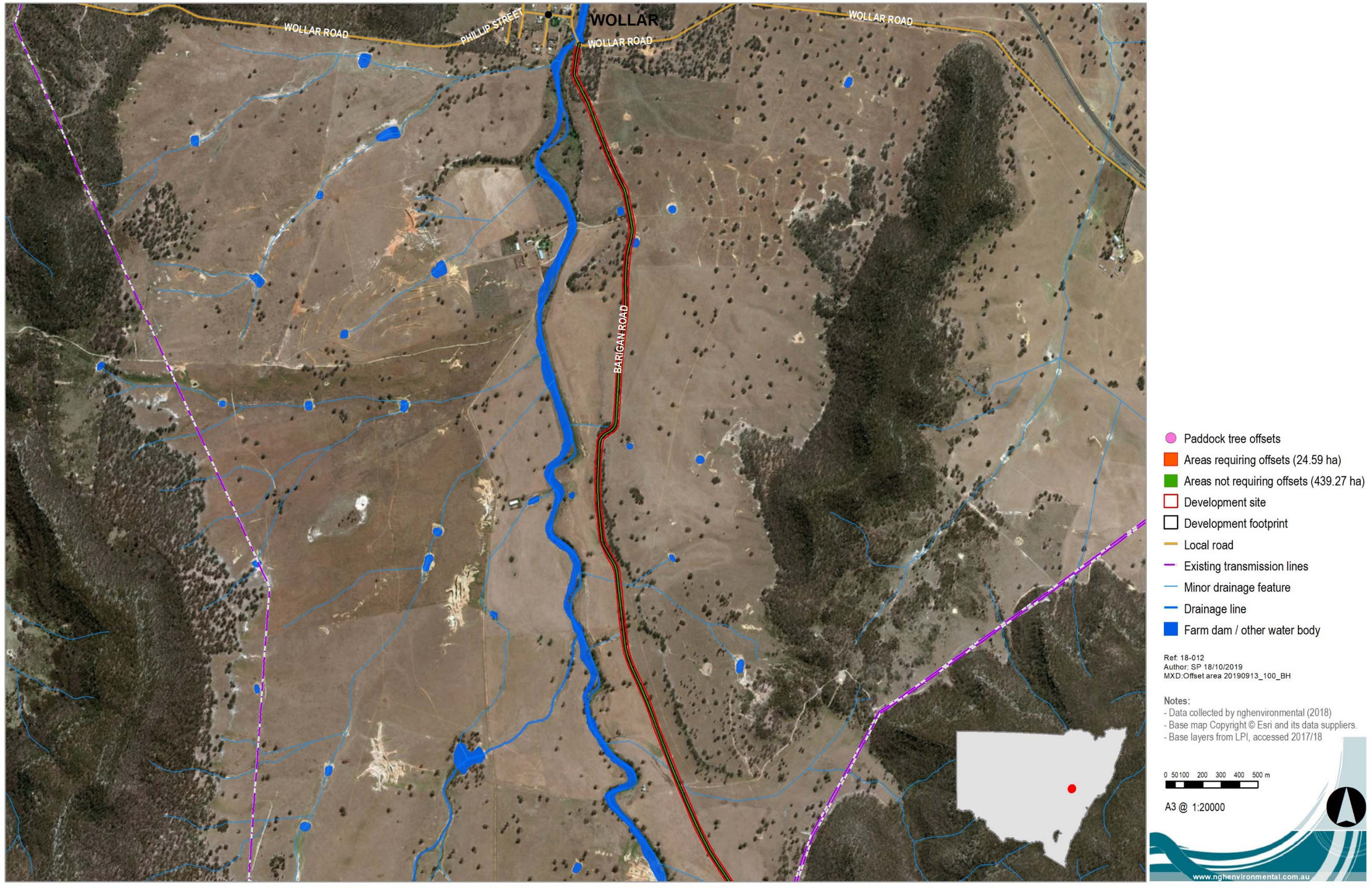
WOLLAR
WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
WOLLAR ROAD
BARIGAN ROAD
Paddock tree offsets
Areas requiring offsets (24.59 ha)
Areas not requiring offsets (439.27 ha)
Development site
Development footprint
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Ref: 18-012
Author: SP 18/10/2019
MXD:Offset area 20190913_100_BH
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
0 50100 200 300 400 500 m
A3 @ 1:20000
www.nghenvironmental.com.au

Figure 10-1 Areas requiring offsets, areas not requiring offsets and non-native areas not requiring assessment under the BAM (shown on 2 maps).

11 CONCLUSIONS

11.1 NSW BAM ASSESSMENT

NGH Environmental has prepared this BDAR for the proposed Wollar Solar Farm, located within the Mid-Western Regional Local Government Area (LGA), NSW. The purpose of this BDAR was to address the requirements of the BAM and to address the biodiversity matters raised in the SEARs and supplementary SEARs.

This updated BDAR now supersedes the BDAR provided as part of the Environmental Impact Statement (EIS) for the proposal (NGH Environmental, 2019a) to address additional access options and upgrades. All areas and credits now reflect this increase.

In this BDAR, biodiversity impacts have been assessed through comprehensive mapping and assessment completed in accordance with the BAM. Regarding onsite surveys, three targeted survey programs were undertaken to address all candidate species. Three were confirmed onsite: The Large-eared Pied Bat (*Chalinolobolus dwyeri*), Large Bentwinged-bat (*Miniopterus orianae oceanensis*) and Eastern Cave Bat (*Vespadelus troughtoni*). These were detected on Anabat recordings. Although detected onsite, it was concluded after extensive inspection of rocky scarp habitat that no specialised breeding/roosting/refuge habitat was present inside the development footprint.

As no targeted survey was undertaken for the new proposed widening of Barigan Road, the assumption of presence for several candidate species has occurred which has generated species credits.

Five paddock trees occur within areas that are primarily exotic. These were assessed using the paddock tree calculator. The paddock tree assessment generated 5 ecosystem credits that will need to be retired to remove these trees. In addition to the paddock trees, impacted native vegetation was of sufficient quality to generate an offset requirement, totalling 713 credits. This is comprised of White Box Yellow Box Blakely's Red Gum Woodland listed under the BC Act.

The credit requirement has therefore been defined as:

- 713 ecosystem credits (5 of these credits generated by paddock tree removal)
- 544 species credits

Mitigation measures which have been outlined to reduce the impacts to biodiversity.

The retirement of these credits will be carried out in accordance with the NSW Biodiversity Offsets scheme, and will be achieved by either;

(a) Retiring credits under the Biodiversity Offsets Scheme, or

(b) Making payments into the Biodiversity Conservation Fund using the offset payments calculator, or

(c) Funding a biodiversity action that benefits the threatened entity impacted by the development.

11.2 COMMONWEALTH ASSESSMENT

Following data collected during initial site surveys in May 2018, a referral to the Commonwealth Department of Environment and Energy commenced in July 2018. On 3 October 2018, the proposed Wollar Solar Farm was determined to be a controlled action for impacts on MNES protected under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Supplementary SEARs were issued for the project (provided in Appendix B: EPBC requirements). As such the project is subject to a 'streamlined assessment', to capture MNES as well as NSW matters.

- Additional field survey was undertaken in October 2018 to better characterise White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland vegetation and undertake targeted surveys for other species listed under the EPBC.
- A condition threshold evaluation was undertaken against the Commonwealth criteria
- Assessments of Significance were undertaken.

Regarding MNES, potential impacts on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived native grassland – Critically Endangered Ecological Community are considered likely to be significant and warrant offsets. 229.58 ha of vegetation that meets the Commonwealth criteria for Critically Endangered Ecological Communities, most (89%) in degraded condition, would be impacted.

In advance of the NSW BOS being endorsed by the Commonwealth (as of 15 February 2019 it is on public exhibition), the Wollar Solar Farm offset strategy retains flexibility. The strategy demonstrates that:

- Securing in perpetuity physical offsets within the subject land are likely to be feasible.
- Similar vegetation occurs in the locality and could also be considered, if required, for physical offsets.

Payment options may also be considered, such as making payments into the NSW Biodiversity Conservation Fund using the offset payments calculator or funding a biodiversity action.

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APPENDIX A VEGETATION INTEGRITY PLOT DATA

REPRESENTATIVE VEGETATION INTEGRITY PLOT PHOTOS

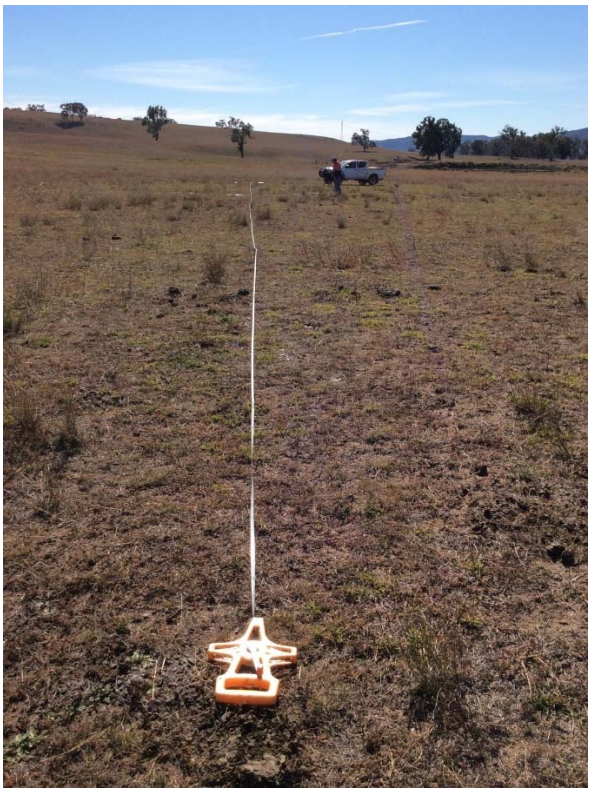
BAM VI Plot 1

BAM VI Plot 2

VI Plot 3

VI Plot 4

VI Plot 5



VI Plot 6

A.1.1 BAM Electronic Field Data Sheets

BAM Site Field Survey

Project:	18-012 Wollar Solarfarm	**Plot Identifier**	Plot 1/W1	**Pic 20x20**	GIS pro	**Pic 20x50**	GIS pro	
Survey date:	23/05/2018		**Compass Orientation (head of 20x20 plot)**				Northwest	
Recorders	Gyoung		**PCT:**	1303				
GPS Easting	777164	**GPS Northing**	6410444		**Datum**	UTM	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology	simple slope		**Soil Texture**		sandy clay	**Slope**	5 degrees	
Land Element	Lower slope		**Soil Colour**		red/brown	**Aspect**	north west	
Landform	bottom		**Soil Depth**		>1m	**Drainage**	well drained	
Microrelief	vegetation		**Geology**		sandstone	**Watercourses**	None	

Plot Disturbance

	Severity	Age	Observational Evidence
Clearing	0		
Cultivation	0		
Soil erosion	0		
Firewood	0		
Grazing	1	R	Cow pats
Fire Damage	0		
Storm Damage	0		
Weediness	1	R	Light weed cover
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Grazing land

Age class, condition,disturbance (dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution)

Cattle, thick groundcover

High Threat Weeds

Carthamnus lanatus

Significant and threatened species and communities

Dominant Species outside Plot	E. albens 50m to south

Plot 1/W1

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	6
	Grass/Sedge (GG)	0
	Fern (EG)	0
	Other (OG)	0
	TOTAL	6

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	0.6
	Grass/Sedge (GG)	56.3
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	56.9
	TOTAL 'HT'	0.2

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	0	0	0
30-49	0	0	0
20-29	0	0	0
10-19	0	0	0
5-9	0	0	N/A
<5	0	0	N/A
Length of logs (m)		0	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	30%	47%	6308
	15m	60%		6309
	25m	40%		6310
	35m	70%		6311
	45m	35%		6312
Bare	5m	5%	1%	6308
	15m	0%		6309
	25m	2%		6310
	35m	0%		6311
	45m	0%		6312
Cryptogam cover	5m	0%	0%	6308
	15m	0%		6309
	25m	0%		6310
	35m	0%		6311
	45m	0%		6312
Rock Cover	5m	0%	0%	6308
	15m	0%		6309
	25m	0%		6310
	35m	0%		6311
	45m	0%		6312

Species recorded for		Plot 1/W1							
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**N, E or 'HT'**	**Exotic**	**BCA Status**	**EPBC Status**
TREE (TG)									
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Cover%**	**Abundance**	**N, E or 'HT'**	**Exotic**	**TSC Status**	**EPBC Status**
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Cover%**	**Abundance**	**N, E or 'HT'**	**Exotic**	**TSC Status**	**EPBC Status**
Verb bona	*Verbena bonariensis*	Purpletop	Verbenaceae	0.5	15	E	*		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	4	N			
Glyc taba	*Glycine tabacina*	Variable Glycine	Fabaceae (Faboidea	0.1	5	N			
Cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	0.2	20	HT	*		
Datu stra	*Datura stramonium*	Common Thornapple	Solanaceae	0.2	15	E	*		
schk pinn abro	*Schkuhria pinnata var. abrotanoide*	Dwarf Marigold	Asteraceae	3	500	E	*		
Rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	2	N			
Eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiaceae	0.1	3	N			
Port oler	*Portulaca oleracea*	Pigweed	Portulacaceae	0.1	1	N			
Modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.1	4	E	*		
Lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	0.1	1	E	*		
Alte pung	*Alternanthera pungens*	Khaki Weed	Amaranthaceae	0.1		E	*		
Sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.1	10	N			
Malv	*Malva spp.*	Mallow	Malvaceae	0.1	1	E	*		
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A
GRASS/SEDGE (G	***Scientific Name***	**Common Name**	**Family**	**Cover%**	**Abundance**	**N, E or 'HT'**	**Exotic**	**TSC Status**	**EPBC Status**
Both macr	*Bothriochloa macra*	Red Grass	Poaceae	15	200	N			
Aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae	3	40	N			
Pasp dist	*Paspalidium distans*		Poaceae	30	500	N			
Erag alve	*Eragrostis alveiformis*		Poaceae	2	50	N			
Ryti fulv	*Rytidosperma fulvum*	Wallaby Grass	Poaceae	0.1	10	N			
Phal Aqua	*Phalaris aquatica*	Phalaris	Poaceae	0.2	6	E	*		
Ryti	*Rytidosperma spp.*		Poaceae	0.5	50	N			
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.4	20	N			
Echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	0.1	3	E	*		

Erio pseu	*Eriochloa pseudoacrotricha*	Early Spring Grass	Poaceae	0.2	50	N			
Pasp dila	*Paspalum dilatatum*	Paspalum	Poaceae	0.1	4	E	*		
Aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	5	80	N			
Plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginaceae	0.1	1	N	*		
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Cover%**	**Abundance**	**N, E or 'HT'**	**Exotic**	**TSC Status**	**EPBC Status**
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Cover%**	**Abundance**	**N, E or 'HT'**	**Exotic**	**TSC Status**	**EPBC Status**
	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A

BAM Site Field Survey

Project:	18-012	**Plot Identifier**	Plot 2	**Pic 20x20**	GIS pro	**Pic 20x50**	GIS pro		
Survey date:	23/05/2018		**Compass Orientation (head of 20x20 plot)**				223		
Recorders	G Young		**PCT:**						
GPS Easting	776262	**GPS Northing**	6408847		**Datum**	UTM	**Zone**	55	
Landform			**Soils**			**Drainage & Slope**			
Morphology	Simple slope		**Soil Texture**		Sandy clay	**Slope**			
Land Element	Mid slope		**Soil Colour**		Light Brown	**Aspect**	300 degrees west		
Landform	Valley footslope		**Soil Depth**		>1m	**Drainage**	Well drained		
Microrelief	Vegetation		**Geology**		Sandstone	**Watercourses**	None		

Plot Disturbance

	Severity	Age	Observational Evidence
Clearing	0		
Cultivation	0		
Soil erosion	0		
Firewood	3	R	Mostly cleaned up - occasional fallen timber
Grazing	2	R	Cattle
Fire Damage	2	R	Fire in Feb 2017 (according to land owner)
Storm Damage	0		
Weediness			
Other			

Additional information

Current land use

Grazing country

Age class, condition,disturbance (inc. dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Senescent with regeneration occurring, fire Feb 2017, cattle grazing and fire wood collection. Some mistletoe in surrounding Eucs

High Threat Weeds

None

Significant and threatened species and communities (if present, note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Dominant Species outside Plot	**E. blakelyi**

Plot 2

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	2
	Shrub (SG)	0
	Forb (FG)	16
	Grass/Sedge (GG)	20
	Fern (EG)	0
	Other (OG)	0
	TOTAL	38

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	12.1
	Shrub (SG)	0
	Forb (FG)	1.8
	Grass/Sedge (GG)	31
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	44.9
	TOTAL 'HT'	0

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	1	0	0
30-49	0	0	0
20-29	3	0	0
10-19	0	0	0
5-9	1	0	N/A
<5	37	0	N/A
Length of logs (m)		26	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	40%	18%	6313
	15m	30%		6314
	25m	10%		6315
	35m	5%		6316
	45m	7%		6317
Bare	5m	20%	36%	6313
	15m	40%		6314
	25m	25%		6315
	35m	5%		6316
	45m	90%		6317
Cryptogam cover	5m	0%	0%	6313
	15m	0%		6314
	25m	0%		6315
	35m	0%		6316
	45m	0%		6317
Rock Cover	5m	0%	0%	6313
	15m	0%		6314
	25m	0%		6315
	35m	0%		6316
	45m	0%		6317

Species recorded for	Plot 2								
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**Exotic**	**% Cover**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**BCA Status**
TREE (TG)									
Euca blak	*Eucalyptus blakelyi*	Blakely's Red Gum	Myrtaceae		12	35	N		
Euca	*Eucalyptus spp.*		Myrtaceae		0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Alte sp.	*Alternanthera sp. A*		Amaranthace		0.1	20	N		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae		0.1	10	N		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae		0.2	20	N		
Good hede	*Goodenia hederacea*	Ivy Goodenia	Goodeniacea		0.1	15	N		
Glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fa		0.1	1	N		
Glyc sten	*Glycine stenophita*		Fabaceae (Fa		0.1	10	N		
Eina nuta	*Einadia nutans*	Climbing Saltbush	Chenopodiac		0.1	15	N		
Tric elat	*Tricoryne elatior*	Yellow Autumn-lily	Anthericacea		0.1	4	N		
Dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiac		0.2	40	N		
Eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiac		0.1	6	N		
Port oler	*Portulaca oleracea*	Pigweed	Portulacacea		0.1	2	N		
Paro bras	*Paronychia brasiliana*	Chilean Whitlow Wort	Caryophyllac	*	0.1	3	E		
Cony bona	*Conyza bonariensis*	Flaxleaf Fleabane	Asteraceae	*	0.1	1	E		
Modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	*	0.1	1	E		
Sper rubr	*Spergularia rubra*	Sandspurry	Caryophyllac	*	0.1	4	E		
Eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	*	0.1	4	E		
Mair ench	*Maireana enchylaenoides*	Wingless Fissure-wee	Chenopodiac		0.1	1	N		
Lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	*	0.1	4	E		
Sola nigr	*Solanum nigrum*	Black-berry Nightshad	Solanaceae	*	0.1	1	E		
Wahl	*Wahlenbergia spp.*	Bluebell	Campanulace		0.1	3	N		
Sole domi	*Solenogyne dominii*		Asteraceae		0.1	1	N		
Gono tetr	*Gonocarpus tetragynus*	Poverty Raspwort	Haloragaceae		0.1	1	N		
Hype gram	*Hypericum gramineum*	Small St John's Wort	Clusiaceae		0.1	1	N		

	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
GRASS/SEDGE (G	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Ente acic	*Enteropogon acicularis*	Curly Windmill Grass	Poaceae		10	500	N		
Aust scab	*Austrostipa scabra*	Speargrass	Poaceae		0.2	45	N		
Chlo trun	*Chloris truncata*	Windmill Grass	Poaceae		15	800	N		
Pani simi	*Panicum simile*	Two-colour Panic	Poaceae		0.1	10	N		
Ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae		0.2	50	N		
Aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae		3	200	N		
Eula aure	*Eulalia aurea*	Silky Browntop	Poaceae		0.5	100	N		
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gras	Poaceae		0.4	100	N		
Chlo vent	*Chloris ventricosa*	Tall Chloris	Poaceae		0.1	20	N		
Erag cili	*Eragrostis cilianensis*	Stinkgrass	Poaceae	*	0.1	1	E		
Cyno dact	*Cynodon dactylon*	Common Couch	Poaceae		0.2	5	N		
Erag parv	*Eragrostis parviflora*	Weeping Lovegrass	Poaceae		0.1	20	N		
Micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae		0.2	50	N		
Erag lacu	*Eragrostis lacunaria*	Purple Lovegrass	Poaceae		0.1	10	N		
Aust seta	*Austrostipa setacea*	Corkscrew Grass	Poaceae		0.1	1	N		
Ryti race	*Rytidosperma racemosum*	Wallaby Grass	Poaceae		0.2	50	N		
Ryti caes	*Rytidosperma caespitosum*	Ringed Wallaby Grass	Poaceae		0.1	20	N		
Ryti bipa	*Rytidosperma bipartitum*	Wallaby Grass	Poaceae		0.1	20	N		
Digi brow	*Digitaria brownii*	Cotton Panic Grass	Poaceae		0.1	5	N		
Junc fili	*Juncus filicaulis*		Juncaceae		0.1	20	N		
Loma mult mult	*Lomandra multiflora subsp*	Many-flowered Mat-r	Lomandracea		0.2	5	N		
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W7	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**					
Recorders	MP BT		**PCT:**	1303 good				
GPS Easting	775684	**GPS Northing**	6408603		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Age class of trees (DBH range) , Condition of Vegetation, Hollows

10 - 100cm DBH

Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot

FUNCTION

Function attributes for	W7

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	2
	Shrub (SG)	3
	Forb (FG)	21
	Grass & grasslike (GG)	8
	Fern (EG)	1
	Other (OG)	4
	TOTAL	39

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	30.1
	Shrub (SG)	2.1
	Forb (FG)	33.8
	Grass & grasslike (GG)	7.7
	Fern (EG)	0.1
	Other (OG)	0.4
	TOTAL Native	74.2
	TOTAL 'HTE'	0

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	3	0	3
30-49	0	0	0
20-29	3	0	0
10-19	4	0	0
5-9	0	0	0
<5	0	0	N/A
Length of logs (m)		52	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	20%	18.40%	
	15m	12%		
	25m	18%		
	35m	37%		
	45m	5%		
Bare ground cover	5m	3%	49%	
	15m	45%		
	25m	40%		
	35m	60%		
	45m	95%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	35%	7%	
	15m	2%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W7									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
euca albe	*Eucalyptus albens*	White Box	Myrtaceae	30			Tree (TG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	10			Forb (FG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	5			Forb (FG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	5			Forb (FG)	No		
eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiace	5			Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	5			Forb (FG)	No		
gono tetr	*Gonocarpus tetragynus*	Poverty Raspwort	Haloragaceae	0.1	1		Forb (FG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.1	5	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.2	10	*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	1			Grass & grasslike (GG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	5			Grass & grasslike (GG)	No		
vitt muel	*Vittadinia muelleri*	A Fuzzweed	Asteraceae	0.5	20		Forb (FG)	No		
eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiace	0.5	5		Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1			Grass & grasslike (GG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.1	5		Other (OG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.1	2		Grass & grasslike (GG)	No		
tric elat	*Tricoryne elatior*	Yellow Autumn-lily	Anthericacea	0.1	1		Forb (FG)	No		
glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.1	1		Other (OG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	2		Forb (FG)	No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	10		Forb (FG)	No		
euca blak	*Eucalyptus blakelyi*	Blakely's Red Gum	Myrtaceae	0.1	1		Tree (TG)	No		
micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae	0.2	10		Grass & grasslike (GG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.5	100		Forb (FG)	No		
eina nuta	*Einadia nutans*	Climbing Saltbush	Chenopodiace	0.1	1		Forb (FG)	No		
swai gale	*Swainsona galegifolia*	Smooth Darling Pea	Fabaceae (Fal	1			Forb (FG)	No		
conv erub	*Convolvulus erubescens*	Pink Bindweed	Convolvulace	0.1	2		Other (OG)	No		
hydr laxi	*Hydrocotyle laxiflora*	Stinking Pennywort	Apiaceae	0.1	10		Forb (FG)	No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.2	5		Grass & grasslike (GG)	No		
sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae	1			Shrub (SG)	No		
acac impl	*Acacia implexa*	Hickory Wattle	Fabaceae (Mi	1			Shrub (SG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.2	20	*		No		
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	0.2	20		Forb (FG)	No		
pand pand	*Pandorea pandorana*	Wonga Wonga Vine	Bignoniaceae	0.1	1		Other (OG)	No		
chei	*Cheilanthes spp.*	Cloak Fern, Mulga Fe	Pteridaceae	0.1	2		Fern (EG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
conv	*Convolvulus spp.*	A Bindweed	Convolvulace	0.1	1	*		No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	1		Forb (FG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	1	*		No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	1		Forb (FG)	No		

tolp barb	*Tolpis barbata*	Yellow Hawkweed	Asteraceae	0.1	10	*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	0.5	50	*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	10	*		No		
sola nigr	*Solanum nigrum*	Black-berry Nightshad	Solanaceae	0.2	1	*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	0.1	1	*		No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	1		Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.1	10	*		No		
aris pers	*Aristida personata*		Poaceae	0.1	2		Grass & grasslike (GG)	No		
arth minu	*Arthropodium minus*	Small Vanilla Lily	Anthericaceae	0.1	1		Forb (FG)	No		
acac deco	*Acacia decora*	Western Silver Wattle	Fabaceae (Mi	0.1	1		Shrub (SG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W8	**Pic 20x20**		**Pic 20x50**		
Survey date:	25/10/2018		**Compass Orientation (head of 20x20 plot)**				270	
Recorders	MP BT		**PCT:**	303 DNG good				
GPS Easting	776697	**GPS Northing**	6409790		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W8

BAM Attribute (20x20m plot)

	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	1
	Forb (FG)	14
	Grass & grasslike (GG)	13
	Fern (EG)	1
	Other (OG)	1
	TOTAL	30

BAM Attribute (20x20m plot)

	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	10
	Forb (FG)	10
	Grass & grasslike (GG)	53.8
	Fern (EG)	1
	Other (OG)	0.1
	TOTAL Native	74.9
	TOTAL 'HTE'	5.1

BAM Attribute (20 x 50m plot) Tree Stem Counts

DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)

	Tape length	% cover	Average %	Photos
Litter Cover	5m	3%	4.20%	
	15m	5%		
	25m	5%		
	35m	3%		
	45m	5%		
Bare ground cover	5m	25%	20%	
	15m	10%		
	25m	25%		
	35m	20%		
	45m	20%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	20%	14%	
	15m	3%		
	25m	25%		
	35m	20%		
	45m	1%		

COMPOSITION & STRUCTURE

Species recorded for		W8								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
Aust scab	*Austrostipa scabra*	Speargrass	Poaceae	20			Grass & grasslike (GG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	5			Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	1			Fern (EG)	No		
vitt muel	*Vittadinia muelleri*	A Fuzzweed	Asteraceae	0.5	1		Forb (FG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	10			Grass & grasslike (GG)	No		
dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiace	0.1	1			No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.1	5	*		No		
eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiace	2			Forb (FG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.1	2	*		No		
cony	*Conyza spp.*	A Fleabane	Asteraceae	0.1	1	*		No		
sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae	10			Shrub (SG)	No		
eina nuta	*Einadia nutans*	Climbing Saltbush	Chenopodiace	0.2	5		Forb (FG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	5	*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	5		Forb (FG)	No		
aris vaga	*Aristida vagans*	Threeawn Speargrass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	1		*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	10			Grass & grasslike (GG)	No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	1		*		No		
aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae	1			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	5		*		HTE		
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	0.1	2		Forb (FG)	No		
them tria	*Themeda triandra*		Poaceae	5			Grass & grasslike (GG)	No		
cymb laws	*Cymbonotus lawsonianu*	Bear's Ear	Asteraceae	0.1	1		Forb (FG)	No		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae	0.1	1		Forb (FG)	No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	1		Forb (FG)	No		
alte pung	*Alternanthera pungens*	Khaki Weed	Amaranthace	0.1	1	*		HTE		
erag brow	*Eragrostis brownii*	Brown's Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
erag alve	*Eragrostis alveiformis*		Poaceae	0.2	5			No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	1			Forb (FG)	No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	1		*		No		
pani simi	*Panicum simile*	Two-colour Panic	Poaceae	0.5	5		Grass & grasslike (GG)	No		
digi brow	*Digitaria brownii*	Cotton Panic Grass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.2	5		Grass & grasslike (GG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		
verb bona	*Verbena bonariensis*	Purpletop	Verbenaceae	0.1	1	*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.1	2		Other (OG)	No		

erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.1	10	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	2	*		No		
vero pleb	*Veronica plebeia*	Trailing Speedwell	Plantaginacea	0.5	10		Forb (FG)	No		
paro bras	*Paronychia brasiliana*	Chilean Whitlow Wor	Caryophyllace	0.2	10	*		No		
cras colo	*Crassula colorata*	Dense Stonecrop	Crassulaceae	0.1	5		Forb (FG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	2		Forb (FG)	No		

BAM Site Field Survey								
Project:	18-012 Wollar solarfarm	**Plot Identifier**	Plot 4 / W4	**Pic 20x20**	GIS pro	**Pic 20x50**	GIS pro	
Survey date:	24/05/2018		**Compass Orientation (head of 20x20 plot)**					
Recorders	G Young		**PCT:**					
GPS Easting	775649	**GPS Northing**	6408917		**Datum**	UTM	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology	Lower slope		**Soil Texture**		Clay	**Slope**	4 degrees	
Land Element	Lower slope		**Soil Colour**		Orange brown	**Aspect**	NN E	
Landform	footslope		**Soil Depth**		>1m	**Drainage**	Well drained	
Microrelief	None		**Geology**		Alluvial sandstor	**Watercourses**	56m SW	

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing	3	O	
Cultivation	0		
Soil erosion	1	NR	
Firewood	0		
Grazing	2	R	Cattle
Fire Damage	2	R	Fire Feb 2017
Storm Damage	0		
Weediness	2	R	
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Grazing for cattle

Age class, condition,disturbance (inc. dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Rabbit scats observed

High Threat Weeds

Carthamnus lanatus

Significant and threatened species and communities (if present, note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	E. albens directly east of plot

Plot 4 / W4

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	1
	Shrub (SG)	0
	Forb (FG)	15
	Grass/Sedge (GG)	15
	Fern (EG)	0
	Other (OG)	0
	TOTAL	31

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	12
	Shrub (SG)	0
	Forb (FG)	1.7
	Grass/Sedge (GG)	15.5
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	29.2
	TOTAL 'HT'	0.1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	0	0	0
30-49	0	0	0
20-29	0	0	0
10-19	0	0	0
5-9	0	0	N/A
<5	0	0	N/A
Length of logs (m)		0	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter	5m	5%	9%	
	15m	7%		
	25m	15%		
	35m	17%		
	45m	3%		
Bare	5m	40%	35%	
	15m	50%		
	25m	35%		
	35m	40%		
	45m	10%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

Species recorded for	Plot 4 / W4								
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**Exotic**	**% Cover**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**BCA Status**
TREE (TG)									
euca albe	*Eucalyptus albens*	White Box	Myrtaceae		12	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiace		0.1	8	N		
Erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	*	0.3	100	E		
Arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	*	0.2	40	E		
Dich repe	*Dichondra repens*	Kidney Weed	Convolvulace		0.2	25	N		
Modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	*	0.1	20	E		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae		0.1	20	N		
Plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginace	*	0.2	200	E		
Vitt muel	*Vittadinia muelleri*	A Fuzzweed	Asteraceae		0.1	10	N		
Erod crin	*Erodium crinitum*	Blue Crowfoot	Geraniaceae		0.1	1	N		
Mair ench	*Maireana enchylaenoide*	Wingless Fissure-wee	Chenopodiac		0.1	6	N		
Eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiac		0.1	5	N		
Alte pung	*Alternanthera pungens*	Khaki Weed	Amaranthace	*	0.1	1	E		
Malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	*	0.1	10	E		
Cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	*	0.1	20	HT		
Lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	*	0.1	3	E		
Glyc taba	*Glycine tabacina*	Variable Glycine	Fabaceae (Fa		0.1	1	N		
Eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	*	0.1	2	E		
Eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiac		0.1	1	N		
Cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	*	0.1	1	E		
plan hisp	*Plantago hispida*		Plantaginace		0.1	3	N		
Medi	*Medicago spp.*	A Medic	Fabaceae (Fa	*	0.1	2	E		
Vitt	*Vittadinia spp.*	Fuzzweed	Asteraceae		0.1	1	N		
Paro bras	*Paronychia brasiliana*	Chilean Whitlow Wor	Caryophyllac	*	0.1	1	E		

Good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea		0.2	100	N		
Good hede	*Goodenia hederacea*	Ivy Goodenia	Goodeniacea		0.1	20	N		
Wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace		0.1	6	N		
Trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fa	*	0.1	20	E		
Cymb laws	*Cymbonotus lawsonianus*	Bear's Ear	Asteraceae		0.1	2	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
GRASS/SEDGE (G	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Chlo trun	*Chloris truncata*	Windmill Grass	Poaceae		3	300	N		
Chlo vent	*Chloris ventricosa*	Tall Chloris	Poaceae		1	200	N		
Both macr	*Bothriochloa macra*	Red Grass	Poaceae		5	500	N		
Ryti bipa	*Rytidosperma bipartitum*	Wallaby Grass	Poaceae		5	500	N		
Erio pseu	*Eriochloa pseudoacrotric*	Early Spring Grass	Poaceae		0.1	10	N		
Cyno dact	*Cynodon dactylon*	Common Couch	Poaceae		0.1	5	N		
Pani simi	*Panicum simile*	Two-colour Panic	Poaceae		0.1	10	N		
Ryti race	*Rytidosperma racemosur*	Wallaby Grass	Poaceae		0.5	100	N		
Aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae		0.1	5	N		
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gras	Poaceae		0.1	2	N		
Dich seri	*Dichanthium sericeum*	Queensland Bluegrass	Poaceae		0.1	10	N		
Cony bona	*Conyza bonariensis*	Flaxleaf Fleabane	Asteraceae	*	0.1	2	E		
Ryti caes	*Rytidosperma caespitosu*	Ringed Wallaby Grass	Poaceae		0.1	6	N		
Erag lept	*Eragrostis leptostachya*	Paddock Lovegrass	Poaceae		0.1	3	N		
Cype grac	*Cyperus gracilis*	Slender Flat-sedge	Cyperaceae		0.1	1	N		
Care inve	*Carex inversa*	Knob Sedge	Cyperaceae		0.1	2	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W9	**Pic 20x20**		**Pic 20x50**		
Survey date:	25/10/2018		**Compass Orientation (head of 20x20 plot)**				180	
Recorders	MP BT		**PCT:**	1303 DGL				
GPS Easting	776523	**GPS Northing**	6409645		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W9

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	1
	Forb (FG)	4
	Grass & grasslike (GG)	13
	Fern (EG)	0
	Other (OG)	1
	TOTAL	19

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	1
	Forb (FG)	1.2
	Grass & grasslike (GG)	33.4
	Fern (EG)	0
	Other (OG)	0.1
	TOTAL Native	35.7
	TOTAL 'HTE'	10

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	3%	2.40%	
	15m	3%		
	25m	3%		
	35m	2%		
	45m	1%		
Bare ground cover	5m	5%	4%	
	15m	5%		
	25m	5%		
	35m	3%		
	45m	1%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	1%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W9									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	5			Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	10		*		HTE		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	30		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	5		*		No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	0.5	20		Grass & grasslike (GG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.2	20	*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	1		*		No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	5			Grass & grasslike (GG)	No		
aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae	0.5	5		Grass & grasslike (GG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.1	50		Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	10			Grass & grasslike (GG)	No		
sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae	1			Shrub (SG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5	20		Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	1		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	0.5	20	*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.1	5		Other (OG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	1	*		No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	1			Grass & grasslike (GG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.5	20	*		No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.5	20	*		No		
ryti fulv	*Rytidosperma fulvum*	Wallaby Grass	Poaceae	5			Grass & grasslike (GG)	No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	1		*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	10		Forb (FG)	No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	1		*		No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	2		Forb (FG)	No		
ente acic	*Enteropogon acicularis*	Curly Windmill Grass	Poaceae	0.2	2		Grass & grasslike (GG)	No		
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	0.1	1	*		No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.1	5	*		No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	0.1	5	*		No		
pani simi	*Panicum simile*	Two-colour Panic	Poaceae	0.1	5		Grass & grasslike (GG)	No		
ryti dutt	*Rytidosperma duttonian*	Brown-back Wallaby	Poaceae	0.1	1		Grass & grasslike (GG)	No		
dich seri	*Dichanthium sericeum*	Queensland Bluegras	Poaceae	0.5	20		Grass & grasslike (GG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W10	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				170	
Recorders	MP and BT		**PCT:**	1303 DGL				
GPS Easting	776157	**GPS Northing**	6409279		**Datum**	GDA 94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W10

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	1
	Forb (FG)	10
	Grass & grasslike (GG)	8
	Fern (EG)	0
	Other (OG)	1
	TOTAL	20

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0.1
	Forb (FG)	4.3
	Grass & grasslike (GG)	36.2
	Fern (EG)	0
	Other (OG)	0.1
	TOTAL Native	40.7
	TOTAL 'HTE'	20.3

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	1.60%	
	15m	2%		
	25m	2%		
	35m	1%		
	45m	1%		
Bare ground cover	5m	35%	32%	
	15m	40%		
	25m	32%		
	35m	28%		
	45m	23%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m			

COMPOSITION & STRUCTURE

Species recorded for	W10									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	1			Forb (FG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.2	5		Forb (FG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	1			Forb (FG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	15			Grass & grasslike (GG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	1			Forb (FG)	No		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae	0.1	2		Forb (FG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	5			Grass & grasslike (GG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.1	5		Other (OG)	No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	0.5	20		Grass & grasslike (GG)	No		
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	2		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	20		*		HTE		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.5	20	*		No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	10		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	20	*		No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	2		Forb (FG)	No		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	0.1	3	*		HTE		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	2		Forb (FG)	No		
trif repe	*Trifolium repens*	White Clover	Fabaceae (Fal	0.2	10	*		No		
linu	*Linum spp.*		Linaceae	0.1	1	*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	10			Grass & grasslike (GG)	No		
pasp dila	*Paspalum dilatatum*	Paspalum	Poaceae	0.2	2	*		HTE		
phyl hirt	*Phyllanthus hirtellus*	Thyme Spurge	Phyllanthacea	0.1	1		Shrub (SG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.5	10		Forb (FG)	No		
cent meli	*Centaurea melitensis*	Maltese Cockspur	Asteraceae	0.2	10	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.2	50		Forb (FG)	No		
erag alve	*Eragrostis alveiformis*		Poaceae	0.5	10		Grass & grasslike (GG)	No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	5		*		No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	5			Grass & grasslike (GG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.5	10	*		No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.2	10	*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	0.5	10	*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	0.1	5	*		No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.1	2		Grass & grasslike (GG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.1	1		Forb (FG)	No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.1	1	*		No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.1	1	*		No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.5	50	*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W11	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2013		**Compass Orientation (head of 20x20 plot)**					
Recorders	MP BT		**PCT:**	1303 GL				
GPS Easting	775105	**GPS Northing**	6408789		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W11

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	11
	Grass & grasslike (GG)	6
	Fern (EG)	0
	Other (OG)	2
	TOTAL	19

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	8.7
	Grass & grasslike (GG)	17.5
	Fern (EG)	0
	Other (OG)	1.1
	TOTAL Native	27.3
	TOTAL 'HTE'	20

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	1.20%	
	15m	2%		
	25m	1%		
	35m	1%		
	45m	1%		
Bare ground cover	5m	75%	62%	
	15m	72%		
	25m	50%		
	35m	75%		
	45m	37%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W11								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	5		*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	1			Other (OG)	No		
wahl comm	*Wahlenbergia communis*	Tufted Bluebell	Campanulace	1			Forb (FG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	5			Forb (FG)	No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.5	20	*		No		
aspe conf	*Asperula conferta*	Common Woodruff	Rubiaceae	1			Forb (FG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	5	10		Grass & grasslike (GG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	5		Forb (FG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	20		*		HTE		
ryti	*Rytidosperma spp.*		Poaceae	1			Grass & grasslike (GG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	1		*		No		
cham drum	*Chamaesyce drummond*	Caustic Weed	Euphorbiacea	0.5	1		Forb (FG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	0.5		Forb (FG)	No		
brun aust	*Brunonia australis*	Blue Pincushion	Goodeniacea	0.1	1		Forb (FG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.1	2		Forb (FG)	No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	1	5		Grass & grasslike (GG)	No		
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	0.5	5		Grass & grasslike (GG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.2	10	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	1		Forb (FG)	No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.2	20		Forb (FG)	No		
linu	*Linum spp.*		Linaceae	0.2	5	*		No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.5	10	*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.5	10	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	2	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.5	10	*		No		
cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	1		*		No		
cymb laws	*Cymbonotus lawsonianu*	Bear's Ear	Asteraceae	0.1	1		Forb (FG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.5	20	*		No		
conv erub	*Convolvulus erubescens*	Pink Bindweed	Convolvulace	0.1	1		Other (OG)	No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	1		*		No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	5			Grass & grasslike (GG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.5	50	*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W12	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				260	
Recorders	MP BT		**PCT:**	1303				
GPS Easting	776220	**GPS Northing**	6408504		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Age class of trees (DBH range) , Condition of Vegetation, Hollows

10 - 100cm DBH

Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W12

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	9
	Grass & grasslike (GG)	8
	Fern (EG)	1
	Other (OG)	1
	TOTAL	19

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	4
	Grass & grasslike (GG)	17.8
	Fern (EG)	0.1
	Other (OG)	1
	TOTAL Native	22.9
	TOTAL 'HTE'	40

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	1.60%	
	15m	2%		
	25m	1%		
	35m	3%		
	45m	1%		
Bare ground cover	5m	40%	37%	
	15m	21%		
	25m	35%		
	35m	27%		
	45m	60%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	1%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W12								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	5			Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	10			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	40		*		HTE		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	1			Forb (FG)	No		
boer domi	*Boerhavia dominii*	Tarvine	Nyctaginacea	0.1	10		Forb (FG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	1			Forb (FG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	5		*		No		
them tria	*Themeda triandra*		Poaceae	0.1	10		Grass & grasslike (GG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1	100		Grass & grasslike (GG)	No		
erag alve	*Eragrostis alveiformis*		Poaceae	0.5	50			No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	0.5	50		Grass & grasslike (GG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.1	20		Grass & grasslike (GG)	No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	1				No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	1			Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.5	100		Forb (FG)	No		
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	1			Grass & grasslike (GG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	1			Other (OG)	No		
brom	*Bromus spp.*	A Brome	Poaceae	0.1	5	*	Grass & grasslike (GG)	No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.1	5	*		No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.1	5		Fern (EG)	No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1	2	*		No		
ryti fulv	*Rytidosperma fulvum*	Wallaby Grass	Poaceae	0.2	10			No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	20		Forb (FG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	5	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.5	50	*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	10		Forb (FG)	No		
sile	*Silene spp.*		Caryophyllace	0.1	20	*		No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	1	*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	0.1	5	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	1		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	1		*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	1		Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	2		Forb (FG)	No		
linu usit	*Linum usitatissimum*	Flax	Linaceae	0.1	1	*		No		
Schk pinn abro	*Schkuhria pinnata var. a*	Dwarf Marigold	Asteraceae	0.1	2	*		No		
tolp barb	*Tolpis barbata*	Yellow Hawkweed	Asteraceae	0.1	1	*		No		
conv	*Convolvulus spp.*	A Bindweed	Convolvulace	0.1	2	*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W29	**Pic 20x20**		**Pic 20x50**		
Survey date:	22/10/2018		**Compass Orientation (head of 20x20 plot)**				50	
Recorders	MP BT		**PCT:**	1610 Low				
GPS Easting	776672	**GPS Northing**	6408233		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W29

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	10
	Grass & grasslike (GG)	2
	Fern (EG)	0
	Other (OG)	0
	TOTAL	12

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	4.4
	Grass & grasslike (GG)	5.1
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	9.5
	TOTAL 'HTE'	22.2

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	3%	9.40%	
	15m	5%		
	25m	5%		
	35m	4%		
	45m	30%		
Bare ground cover	5m	12%	13%	
	15m	15%		
	25m	20%		
	35m	11%		
	45m	7%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	3%	1%	
	15m	3%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W29								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
Trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	30		*		No		
Trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	10		*		No		
Trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	5		*		No		
Both Macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	2			Forb (FG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	20		*		HTE		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	1			Forb (FG)	No		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	2		*		HTE		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.2	20		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
schk pinn abro	*Schkuhria pinnata var. a*	Dwarf Marigold	Asteraceae	1		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.2	20		Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.1	10		Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	10		Forb (FG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	5	*		No		
vulp	*Vulpia spp.*	Rat's-tail Fescue	Poaceae	0.5	50	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	50		Forb (FG)	No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	1		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	0.2	50	*		No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.1	1	*		No		
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	0.1	1		Grass & grasslike (GG)	No		
rosa rubi	*Rosa rubiginosa*	Sweet Briar	Rosaceae	0.2	1	*		HTE		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.1	5		Forb (FG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	1	*		No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.5	50		Forb (FG)	No		

BAM Site Field Survey

Project:	18-012 Wollar	**Plot Identifier**	Plot 3	**Pic 20x20**	GIS pro	**Pic 20x50**	Not done		
Survey date:	23/05/2018		**Compass Orientation (head of 20x20 plot)**						
Recorders	G Young		**PCT:**						
GPS Easting	776872	**GPS Northing**	6408534		**Datum**	UTM	**Zone**	55	
Landform			**Soils**			**Drainage & Slope**			
Morphology	Lower slope		**Soil Texture**		Sandy Clay	**Slope**	2 degrees		
Land Element	Lower slope		**Soil Colour**		Cream Orange	**Aspect**	eastly		
Landform	Bottom		**Soil Depth**		<1m?	**Drainage**	Well drained		
Microrelief	Vegetation		**Geology**		Sandstone	**Watercourses**	None		

Plot Disturbance

	Severity	Age	Observational Evidence
Clearing	3	O	Historically cultivated (signs of plouging)
Cultivation	1	O	As above
Soil erosion	0		
Firewood	0		
Grazing	2	R	Cattle/horses
Fire Damage	0		
Storm Damage	0		
Weediness	3		Carthamnus lanatus
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Grazing for horses

Age class, condition,disturbance (inc. dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Good cover of plants over ground

High Threat Weeds

Carthamnus lanatus

Significant and threatened species and communities (if present, note pop. size/area, structure, repro status, habit, habitat, threats, photos)

NOTE - Not enough time to complete 20 x 50 so 5 random photos taken inside 20 x 20 to estimate litter cover. No trees within 50m

Dominant Species outside Plot	None observed

Plot 3

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	2
	Grass/Sedge (GG)	6
	Fern (EG)	0
	Other (OG)	0
	TOTAL	8

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	0.2
	Grass/Sedge (GG)	47.8
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	48
	TOTAL 'HT'	15.5

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	0	0	0
30-49	0	0	0
20-29	0	0	0
10-19	0	0	0
5-9	0	0	N/A
<5	0	0	N/A
Length of logs (m)		0	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	70%	42%	6319
	15m	50%		6320
	25m	35%		6321
	35m	15%		6322
	45m	40%		6323
Bare	5m	0%	0%	6319
	15m	0%		6320
	25m	1%		6321
	35m	0%		6322
	45m	0%		6323
Cryptogam cover	5m	0%	0%	6319
	15m	0%		6320
	25m	0%		6321
	35m	0%		6322
	45m	0%		6323
Rock Cover	5m	0%	0%	6319
	15m	0%		6320
	25m	0%		6321
	35m	0%		6322
	45m	0%		6323

Species recorded for		Plot 3							
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**Exotic**	**% Cover**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**BCA Status**
TREE (TG)									
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	*	15	2000	HT		
Trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fa	*	10	1000	E		
Medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fa	*	0.2	20	E		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae		0.1	3	N		
Hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	*	0.5	50	HT		
Chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae		0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
GRASS/SEDGE (G	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Both macr	*Bothriochloa macra*	Red Grass	Poaceae		40	2000	N		
Aris pers	*Aristida personata*		Poaceae		5	30	N		
Erag alve	*Eragrostis alveiformis*		Poaceae		0.2	40	N		
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gras	Poaceae		0.5	100	N		
Cyno dact	*Cynodon dactylon*	Common Couch	Poaceae		2	50	N		
Ryti	*Rytidosperma spp.*		Poaceae		0.1	1	N		
Eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	*	1	100	E		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W13	**Pic 20x20**		**Pic 20x50**		
Survey date:	25/10/2018		**Compass Orientation (head of 20x20 plot)**				180	
Recorders	MP BT		**PCT:**	Cultivated				
GPS Easting	776634	**GPS Northing**	6410281		**Datum**	UTM	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W13

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	5
	Grass & grasslike (GG)	7
	Fern (EG)	1
	Other (OG)	0
	TOTAL	13

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	0.5
	Grass & grasslike (GG)	13.5
	Fern (EG)	0.1
	Other (OG)	0
	TOTAL Native	14.1
	TOTAL 'HTE'	30

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	1.80%	
	15m	1%		
	25m	1%		
	35m	3%		
	45m	2%		
Bare ground cover	5m	3%	3%	
	15m	2%		
	25m	3%		
	35m	3%		
	45m	2%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W13								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
Euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	2		Forb (FG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	30		*		HTE		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	10			Grass & grasslike (GG)	No		
trif camp	*Trifolium campestre*	Hop Clover	Fabaceae (Fal	2		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	10		*		No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	10		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
tolp barb	*Tolpis barbata*	Yellow Hawkweed	Asteraceae	0.1	10	*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	10		*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.2	10		Grass & grasslike (GG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	5		Forb (FG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	2		Grass & grasslike (GG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	10	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	1			Grass & grasslike (GG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	1		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	0.5	50	*		No		
junc fili	*Juncus filicaulis*		Juncaceae	0.1	1		Grass & grasslike (GG)	No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.1	5	*		No		
trif repe	*Trifolium repens*	White Clover	Fabaceae (Fal	0.1	5	*		No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	2			Grass & grasslike (GG)	No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	0.1	10	*		No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.1	10	*		No		
sile	*Silene spp.*		Caryophyllace	0.1	5	*		No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	1		Forb (FG)	No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.1	2	*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	5		Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.1	5		Fern (EG)	No		
sonc aspe	*Sonchus asper*	Prickly Sowthistle	Asteraceae	0.1	1	*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W14	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				110	
Recorders			**PCT:**	Cultivated				
GPS Easting	775692	**GPS Northing**	6409247		**Datum**	GD 94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W14

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	9
	Grass & grasslike (GG)	7
	Fern (EG)	0
	Other (OG)	0
	TOTAL	16

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.8
	Grass & grasslike (GG)	12.3
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	14.1
	TOTAL 'HTE'	5

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	2.40%	
	15m	1%		
	25m	3%		
	35m	5%		
	45m	2%		
Bare ground cover	5m	20%	13%	
	15m	11%		
	25m	13%		
	35m	8%		
	45m	13%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W14								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
Brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	10		*		No		
sile	*Silene spp.*		Caryophyllace	0.2		*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	10		*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1			Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	2		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	20		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	5		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	2		*		No		
plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginacea	1		*		No		
trif repe	*Trifolium repens*	White Clover	Fabaceae (Fal	0.5		*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	1		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	2		*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1			Grass & grasslike (GG)	No		
cycl lept	*Cyclospermum leptophy*	Slender Celery	Apiaceae	0.1		*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.2		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5			Forb (FG)	No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1			Forb (FG)	No		
cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	1		*		No		
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	0.1			Forb (FG)	No		
cham drum	*Chamaesyce drummond*	Caustic Weed	Euphorbiacea	0.1			Forb (FG)	No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	5		*		No		
wahl grac	*Wahlenbergia gracilento*	Annual Bluebell	Campanulace	0.1			Forb (FG)	No		
linu	*Linum spp.*		Linaceae	0.1		*		No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.2			Forb (FG)	No		
erag alve	*Eragrostis alveiformis*		Poaceae	0.1			Grass & grasslike (GG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	5			Grass & grasslike (GG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1			Forb (FG)	No		
gomp frut	*Gomphocarpus fruticosu*	Narrow-leaved Cotto	Apocynaceae	0.1		*		No		
junc fili	*Juncus filicaulis*		Juncaceae	0.1			Grass & grasslike (GG)	No		
care inve	*Carex inversa*	Knob Sedge	Cyperaceae	0.1			Grass & grasslike (GG)	No		
Eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	0.1		*		No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1		*		No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	0.1		*		No		
Echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	1		*		No		
verb bona	*Verbena bonariensis*	Purpletop	Verbenaceae	0.1		*		No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.1		*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.5		*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	1			Grass & grasslike (GG)	No		

calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5			Forb (FG)	No		
echi plan	*Echium plantagineum*	Patterson's Curse	Boraginaceae	0.1		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	5		*		HTE		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W15	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				186	
Recorders	MP BT		**PCT:**	Cultivated				
GPS Easting	776738	**GPS Northing**	6408708		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W15

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	4
	Grass & grasslike (GG)	3
	Fern (EG)	0
	Other (OG)	0
	TOTAL	7

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.3
	Grass & grasslike (GG)	1.7
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	3
	TOTAL 'HTE'	35

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	6%	5.20%	
	15m	7%		
	25m	3%		
	35m	4%		
	45m	6%		
Bare ground cover	5m	6%	3%	
	15m	4%		
	25m	1%		
	35m	2%		
	45m	1%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W15									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	0.1	2	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	5		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	30		*		HTE		
junc fili	*Juncus filicaulis*		Juncaceae	0.5	10		Grass & grasslike (GG)	No		
trif camp	*Trifolium campestre*	Hop Clover	Fabaceae (Fal	0.5	20	*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	5		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	10		*		No		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	5		*		HTE		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	10		*		No		
sile	*Silene spp.*		Caryophyllace	5		*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	25		*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	1			Grass & grasslike (GG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	0.2	5		Grass & grasslike (GG)	No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	1			Forb (FG)	No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.5	10	*		No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	1		Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	5		*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	5	*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	0.2	10	*		No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	1		Forb (FG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	1			No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	1		Forb (FG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	1	*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W16	**Pic 20x20**		**Pic 20x50**		
Survey date:	25/10/2018		**Compass Orientation (head of 20x20 plot)**				85	
Recorders	MP BT		**PCT:**	Cultivated				
GPS Easting	776501	**GPS Northing**	6409093		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W16

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	7
	Grass & grasslike (GG)	10
	Fern (EG)	0
	Other (OG)	0
	TOTAL	17

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.4
	Grass & grasslike (GG)	3.7
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	5.1
	TOTAL 'HTE'	25

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	3%	2.00%	
	15m	2%		
	25m	1%		
	35m	2%		
	45m	2%		
Bare ground cover	5m	40%	26%	
	15m	10%		
	25m	40%		
	35m	10%		
	45m	30%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	9%	
	15m	0%		
	25m	30%		
	35m	7%		
	45m	10%		

COMPOSITION & STRUCTURE

Species recorded for		W16								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	0.2	10	*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	1			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	25		*		HTE		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	2		*		No		
tolp barb	*Tolpis barbata*	Yellow Hawkweed	Asteraceae	0.1	2	*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	15		*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	10		Forb (FG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	10		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.2	50		Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.2	10		Forb (FG)	No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	5		Forb (FG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.2	10	*		No		
erag brow	*Eragrostis brownii*	Brown's Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.5	10		Grass & grasslike (GG)	No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	20		*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	5		*		No		
paro bras	*Paronychia brasiliana*	Chilean Whitlow Wor	Caryophyllace	0.2	10	*		No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	2		*		No		
pani simi	*Panicum simile*	Two-colour Panic	Poaceae	0.1	1		Grass & grasslike (GG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1			Grass & grasslike (GG)	No		
sile	*Silene spp.*		Caryophyllace	0.5	20	*		No		
ryti fulv	*Rytidosperma fulvum*	Wallaby Grass	Poaceae	2				No		
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	2		*		No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	0.2	5		Grass & grasslike (GG)	No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	1		*		No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	2				No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.2	10		Forb (FG)	No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	0.5	5		Grass & grasslike (GG)	No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.2	20	*		No		
dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiace	0.1	1		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.5	50	*		No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.2	10	*		No		
junc fili	*Juncus filicaulis*		Juncaceae	0.1	1		Grass & grasslike (GG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	1	*		No		
cras colo	*Crassula colorata*	Dense Stonecrop	Crassulaceae	0.1	10		Forb (FG)	No		
caps burs	*Capsella bursa-pastoris*	Shepherd's Purse	Brassicaceae	0.1	10	*		No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.5	50	*		No		
cype	*Cyperus spp.*		Cyperaceae	0.1	1		Grass & grasslike (GG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W17	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				270	
Recorders	MP BT		**PCT:**	Cultivated				
GPS Easting	776121	**GPS Northing**	6408961		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W17

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	11
	Grass & grasslike (GG)	5
	Fern (EG)	0
	Other (OG)	0
	TOTAL	16

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	2.9
	Grass & grasslike (GG)	6.2
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	9.1
	TOTAL 'HTE'	40

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	4%	2.00%	
	15m	2%		
	25m	2%		
	35m	1%		
	45m	1%		
Bare ground cover	5m	35%	15%	
	15m	15%		
	25m	10%		
	35m	15%		
	45m	2%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W17								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	5		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	40		*		HTE		
trif repe	*Trifolium repens*	White Clover	Fabaceae (Fal	1		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	2		*		No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.5			Grass & grasslike (GG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.2		*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.5			Grass & grasslike (GG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	1			Forb (FG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5			Forb (FG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.1		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5		*		No		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae	0.1			Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.2		*		No		
vitt muel	*Vittadinia muelleri*	A Fuzzweed	Asteraceae	0.2			Forb (FG)	No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.1		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	0.5		*		No		
sile	*Silene spp.*		Caryophyllace	0.5		*		No		
tolp barb	*Tolpis barbata*	Yellow Hawkweed	Asteraceae	0.1		*		No		
cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	0.5		*		No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.1		*		No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1			Forb (FG)	No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	5		*		No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	5		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1			Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1			Forb (FG)	No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1		*		No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.2		*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.2		*		No		
plan hisp	*Plantago hispida*		Plantaginacea	0.1			Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.5			Forb (FG)	No		
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	0.5		*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1			Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1			Forb (FG)	No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.2		*		No		
plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginacea	0.1		*		No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.1			Grass & grasslike (GG)	No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	0.1			Grass & grasslike (GG)	No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1		*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W18	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**					
Recorders	MP BT		**PCT:**	Cultivated				
GPS Easting	776641	**GPS Northing**	6410164		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W18

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	1
	Forb (FG)	2
	Grass & grasslike (GG)	1
	Fern (EG)	0
	Other (OG)	0
	TOTAL	4

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0.5
	Forb (FG)	0.2
	Grass & grasslike (GG)	2
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	2.7
	TOTAL 'HTE'	1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	0.80%	
	15m	1%		
	25m	0%		
	35m	2%		
	45m	0%		
Bare ground cover	5m	65%	57%	
	15m	60%		
	25m	60%		
	35m	50%		
	45m	50%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W18								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
bras	*Brassica spp.*	Brassica	Brassicaceae	5		*		No		
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	50		*		No		
sile	*Silene spp.*		Caryophyllace	0.1	5	*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	10		*		No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	2		Forb (FG)	No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	0.1	10	*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	1		*		HTE		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	1		*		No		
phal aqua	*Phalaris aquatica*	Phalaris	Poaceae	5		*		No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	0.1	10	*		No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	2			Grass & grasslike (GG)	No		
sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae	0.5	3		Shrub (SG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	1	*		No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.1	1	*		No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	20		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	1		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.1	1	*		No		

BAM Site Field Survey

Project:	18-012 Wollar Solarfarm	**Plot Identifier**	Plot 6, W6	**Pic 20x20**	GIS pro	**Pic 20x50**	GIS pro	
Survey date:	24/05/2018		**Compass Orientation (head of 20x20 plot)**					
Recorders	G Young		**PCT:**					
GPS Easting	774969	**GPS Northing**	6410290		**Datum**	UTS	**Zone**	55

Landform			**Soils**			**Drainage & Slope**		
Morphology	Lower slope		**Soil Texture**		Sandy	**Slope**	4 degrees	
Land Element	Lower slope		**Soil Colour**		Cream Orange	**Aspect**	East	
Landform	Bottom		**Soil Depth**		>1m	**Drainage**	Well drained	
Microrelief	None		**Geology**		Sandstone	**Watercourses**	40m north	

Plot Disturbance

	Severity	**Age**	**Observational Evidence**
Clearing	2	O	
Cultivation	0		
Soil erosion	0		
Firewood	1	O	
Grazing	3	O	
Fire Damage	2		Charred tree trunk
Storm Damage	0		
Weediness	2		Urtica
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Grazing by cattle

Age class, condition,disturbance (inc. dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Mixed aged trees young and old, some hollow observed outside plot, heavily grazed and very dry sandy soil

High Threat Weeds

Significant and threatened species and communities (if present, note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

Plot 6, W6

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	2
	Shrub (SG)	0
	Forb (FG)	18
	Grass/Sedge (GG)	11
	Fern (EG)	0
	Other (OG)	0
	TOTAL	31

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	25.1
	Shrub (SG)	0
	Forb (FG)	7.2
	Grass/Sedge (GG)	15.8
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	48.1
	TOTAL 'HT'	3

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	1	0
50-79	0	0	0
30-49	1	0	0
20-29	1	0	0
10-19	0	0	0
5-9	2	0	N/A
<5	22	0	N/A
Length of logs (m)		0	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	5%	19%	6336
	15m	40%		6337
	25m	10%		6338
	35m	15%		6339
	45m	25%		6340
Bare ground	5m	90%	32%	6336
	15m	3%		6337
	25m	30%		6338
	35m	15%		6339
	45m	20%		6340
Cryptogam cover	5m	0%	0%	6336
	15m	0%		6337
	25m	0%		6338
	35m	0%		6339
	45m	0%		6340
Rock Cover	5m	0%	0%	6336
	15m	0%		6337
	25m	0%		6338
	35m	0%		6339
	45m	0%		6340

Species recorded for		Plot 6, W6							
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**Exotic**	**% Cover**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**BCA Status**
TREE (TG)									
Ango flor	*Angophora floribunda*	Rough-barked Apple	Myrtaceae		25	1	N		
Brac popu	*Brachychiton populneus*	Kurrajong	Malvaceae		0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiac		5	1000	N		
Gera	*Geranium spp.*		Geraniaceae	*	0.1	5	E		
Glyc taba	*Glycine tabacina*	Variable Glycine	Fabaceae (Fa		0.2	100	N		
Poly tetr	*Polycarpon tetraphyllum*	Four-leaved Allseed	Caryophyllac	*	0.1	10	E		
Eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiac		0.2	25	N		
Cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	*	0.1	2	E		
Cony bona	*Conyza bonariensis*	Flaxleaf Fleabane	Asteraceae	*	0.1	3	E		
Modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	*	0.3	100	E		
Dich repe	*Dichondra repens*	Kidney Weed	Convolvulace		0.1	20	N		
Cotu aust	*Cotula australis*	Common Cotula	Asteraceae		0.1	1	N		
Paro bras	*Paronychia brasiliana*	Chilean Whitlow Wort	Caryophyllac	*	0.1	10	E		
Sola nigr	*Solanum nigrum*	Black-berry Nightshad	Solanaceae	*	0.1	3	E		
Cymb laws	*Cymbonotus lawsonianus*	Bear's Ear	Asteraceae		0.1	2	N		
Xant spin	*Xanthium spinosum*	Bathurst Burr	Asteraceae	*	0.2	10	E		
Sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	*	0.1	20	HT		
Plan hisp	*Plantago hispida*		Plantaginace		0.1	1	N		
Hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	*	0.2	30	E		
Cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	*	0.1	10	HT		
Arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	*	0.1	5	E		
Conv angu	*Convolvulus angustissimu*		Convolvulace		0.1	20	N		
Erod crin	*Erodium crinitum*	Blue Crowfoot	Geraniaceae		0.1	2	N		
Chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	*	0.2	30	E		
Sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae		0.1	1	N		

Desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fa		0.1	10	N		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae		0.1	10	N		
Wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace		0.1	6	N		
Sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae		0.1	15	N		
Sige	*Sigesbeckia spp.*		Asteraceae		0.1	1	N		
Erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	*	0.2	50	E		
Hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	*	0.1	5	HT		
Lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	*	0.1	1	E		
Tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	*	0.1	10	E		
Urti inci	*Urtica incisa*	Stinging Nettle	Urticaceae		0.4	12	N		
Verb virg	*Verbascum virgatum*	Twiggy Mullein	Scrophulariac	*	0.1	1	E		
Oxal thom	*Oxalis thompsoniae*		Oxalidaceae	*	0.1	2	E		
Dich sp.	*Dichondra sp. A*	Kidney Weed	Convolvulace		0.1	5	N		
Malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	*	0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
GRASS/SEDGE (G	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae		0.2	30	N		
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gras	Poaceae		0.1	2	N		
Micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae		5	150	N		
Aust scab	*Austrostipa scabra*	Speargrass	Poaceae		3	200	N		
Erag lept	*Eragrostis leptostycha*	Paddock Lovegrass	Poaceae		0.1	10	N		
Ryti caes	*Rytidosperma caespitosu*	Ringed Wallaby Grass	Poaceae		0.1	10	N		
Both macr	*Bothriochloa macra*	Red Grass	Poaceae		5	300	N		
Erag lacu	*Eragrostis lacunaria*	Purple Lovegrass	Poaceae		2	350	N		
Digi	*Digitaria spp.*	A Finger Grass	Poaceae	*	0.1	1	E		
Pani simi	*Panicum simile*	Two-colour Panic	Poaceae		0.1	2	N		
Chlo vent	*Chloris ventricosa*	Tall Chloris	Poaceae		0.1	1	N		
Chlo trun	*Chloris truncata*	Windmill Grass	Poaceae		0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W19	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				0	
Recorders	MP BT		**PCT:**	281 Good				
GPS Easting	775209	**GPS Northing**	6410425		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W19

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	1
	Shrub (SG)	2
	Forb (FG)	22
	Grass & grasslike (GG)	5
	Fern (EG)	0
	Other (OG)	4
	TOTAL	34

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	25
	Shrub (SG)	0.3
	Forb (FG)	16.4
	Grass & grasslike (GG)	15.2
	Fern (EG)	0
	Other (OG)	1.9
	TOTAL Native	58.8
	TOTAL 'HTE'	10

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49	1		
20-29	4		
10-19	7		
5-9	2		
<5	3		N/A
Length of logs (m)		4	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	8%	25.40%	
	15m	50%		
	25m	40%		
	35m	9%		
	45m	20%		
Bare ground cover	5m	40%	26%	
	15m	2%		
	25m	10%		
	35m	70%		
	45m	7%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	1%		
	45m	1%		

COMPOSITION & STRUCTURE

Species recorded for		W19								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	0.2	50		Forb (FG)	No		
euca blak	*Eucalyptus blakelyi*	Blakely's Red Gum	Myrtaceae	25			Tree (TG)	No		
pime lini	*Pimelea linifolia*	Slender Rice Flower	Thymelaeace	0.2	5		Shrub (SG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.2	50		Forb (FG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	1		*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.5	20		Other (OG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	5		*		No		
care inve	*Carex inversa*	Knob Sedge	Cyperaceae	5			Grass & grasslike (GG)	No		
good hede	*Goodenia hederacea*	Ivy Goodenia	Goodeniacea	0.5			Forb (FG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	1		*		No		
glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.2	5		Other (OG)	No		
cype grac	*Cyperus gracilis*	Slender Flat-sedge	Cyperaceae	0.1	1		Grass & grasslike (GG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	1			Forb (FG)	No		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae	0.2	10		Forb (FG)	No		
clem aris	*Clematis aristata*	Old Man's Beard	Ranunculacea	1			Other (OG)	No		
cymb laws	*Cymbonotus lawsonianu*	Bear's Ear	Asteraceae	0.5	5		Forb (FG)	No		
micr parv	*Microtis parviflora*	Slender Onion Orchid	Orchidaceae	0.1	5		Forb (FG)	No		P
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	0.1	5		Grass & grasslike (GG)	No		
elym scab	*Elymus scaber*	Common Wheatgrass	Poaceae	5			Grass & grasslike (GG)	No		
arth mill	*Arthropodium millefloru*	Pale Vanilla-lily	Anthericacea	0.5	20		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	1			Forb (FG)	No		
eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiace	0.5	5		Forb (FG)	No		
conv erub	*Convolvulus erubescens*	Pink Bindweed	Convolvulace	0.2	10		Other (OG)	No		
acae ovin	*Acaena ovina*	Acaena	Rosaceae	5			Forb (FG)	No		
micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae	5			Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	10		*		HTE		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	5			Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	0.5	10	*		No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.2	5		Forb (FG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	1		Forb (FG)	No		
linu	*Linum spp.*		Linaceae	0.1	1	*		No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.2	5		Forb (FG)	No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	20	*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	1		*		No		
plan hisp	*Plantago hispida*		Plantaginacea	0.1	1		Forb (FG)	No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.2	5		Forb (FG)	No		
hydr laxi	*Hydrocotyle laxiflora*	Stinking Pennywort	Apiaceae	0.1	1		Forb (FG)	No		
phyl hirt	*Phyllanthus hirtellus*	Thyme Spurge	Phyllanthacea	0.1	1		Shrub (SG)	No		

cyno echi	*Cynosurus echinatus*	Rough Dog's Tail	Poaceae	0.1	5	*		No		
sole	*Solenogyne spp.*		Asteraceae	0.1	1		Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.1	5			No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	0.1	5	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	2		Forb (FG)	No		
pter muti	*Pterostylis mutica*	Midget Greenhood	Orchidaceae	0.1	1		Forb (FG)	No		P
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	1		Forb (FG)	No		
rost pumi	*Rostraria pumila*	Roughtail	Poaceae	0.5	20	*		No		
dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiac	0.1	1			No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W20	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				185	
Recorders	MP BT		**PCT:**	281 good				
GPS Easting	774824	**GPS Northing**	6409137		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W20

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	1
	Shrub (SG)	1
	Forb (FG)	10
	Grass & grasslike (GG)	4
	Fern (EG)	0
	Other (OG)	2
	TOTAL	18

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	20
	Shrub (SG)	0.2
	Forb (FG)	5.3
	Grass & grasslike (GG)	10.3
	Fern (EG)	0
	Other (OG)	2.1
	TOTAL Native	37.9
	TOTAL 'HTE'	0

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79	4		1
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)		7	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	20.00%	
	15m	3%		
	25m	80%		
	35m	10%		
	45m	5%		
Bare ground cover	5m	90%	60%	
	15m	93%		
	25m	20%		
	35m	20%		
	45m	75%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W20								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	2			Other (OG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	5		*		No		
calo cune	*Calotis cuneata*	Mountain Burr-Daisy	Asteraceae	0.2	10		Forb (FG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	10			Grass & grasslike (GG)	No		
eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiac	2			Forb (FG)	No		
eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiac	1			Forb (FG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.5	20		Forb (FG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.5			Forb (FG)	No		
lepi afri	*Lepidium africanum*	Common Peppercres	Brassicaceae	5		*		No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	2		Forb (FG)	No		
euca albe	*Eucalyptus albens*	White Box	Myrtaceae	20			Tree (TG)	No		
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	0.1	1		Grass & grasslike (GG)	No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	5		*		No		
urti inci	*Urtica incisa*	Stinging Nettle	Urticaceae	0.5	5		Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.2	50		Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	2		Forb (FG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.2	10		Forb (FG)	No		
sola cine	*Solanum cinereum*	Narrawa Burr	Solanaceae	0.2	1		Shrub (SG)	No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	2		*		No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.1	5		Grass & grasslike (GG)	No		
lepi afri	*Lepidium africanum*	Common Peppercres	Brassicaceae	0.2	50	*		No		
erag parv	*Eragrostis parviflora*	Weeping Lovegrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.1	2		Other (OG)	No		

BAM Site Field Survey

Project:	18-012 Wollar Solarfarm	**Plot Identifier**	Plot 5	**Pic 20x20**	GIS pro	**Pic 20x50**	GIS pro	
Survey date:	24/05/2018		**Compass Orientation (head of 20x20 plot)**				185	
Recorders	G Young		**PCT:**					
GPS Easting	775463	**GPS Northing**	6409932		**Datum**	UTS	**Zone**	55

Landform			**Soils**			**Drainage & Slope**		
Morphology	Flat		**Soil Texture**		Sand	**Slope**	1-2 degrees	
Land Element	Lower slope		**Soil Colour**		Light Grey	**Aspect**	Flat	
Landform	Bottom		**Soil Depth**		>1m	**Drainage**	Moderate	
Microrelief	None		**Geology**		Sandstone	**Watercourses**	120m east	

Plot Disturbance

	Severity	**Age**	**Observational Evidence**
Clearing	3	O	
Cultivation	2	O	
Soil erosion	0		
Firewood	0		
Grazing	2		Cattle observed
Fire Damage	0		
Storm Damage	0		
Weediness	2		Carthamnus lanatus
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Grazing by cattle

Age class, condition,disturbance (inc. dbh, hollows, fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Rabbit scats, burrows 100m away. History of cultivation/farming.

High Threat Weeds

Carthamnus lanatus

Significant and threatened species and communities (if present, note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	Nothing observed

Plot 5

BAM Attribute (20x20m plot)		
Count of Native Richness	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	15
	Grass/Sedge (GG)	11
	Fern (EG)	0
	Other (OG)	0
	TOTAL	26

BAM Attribute (20x20m plot)		
Count of cover abundance (native vascular plants)	Stratum	Sum
	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.7
	Grass/Sedge (GG)	16.8
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	18.5
	TOTAL 'HT'	1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80	0	0	0
50-79	0	0	0
30-49	0	0	0
20-29	0	0	0
10-19	0	0	0
5-9	0	0	N/A
<5	0	0	N/A
Length of logs (m)		0	

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	15%	22%	6331
	15m	20%		6332
	25m	25%		6333
	35m	15%		6334
	45m	35%		6335
Bare	5m	1%	5%	6331
	15m	5%		6332
	25m	7%		6333
	35m	5%		6334
	45m	7%		6335
Cryptogam cover	5m	0%	0%	6331
	15m	0%		6332
	25m	0%		6333
	35m	0%		6334
	45m	0%		6335
Rock Cover	5m	0%	0%	6331
	15m	0%		6332
	25m	0%		6333
	35m	0%		6334
	45m	0%		6335

Species recorded for	Plot 5								
N:Native	E:Exotic	HT: High Threat Exotic							
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**Exotic**	**% Cover**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**BCA Status**
TREE (TG)									
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
SHRUB (SG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FORB (FG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
Chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	*	2	300	E		
Cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	*	5	1000	HT		
Hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	*	0.2	100	E		
Erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	*	0.3	500	E		
Dich sp.	*Dichondra sp. A*	Kidney Weed	Convolvulace		0.1	10	N		
Glyc taba	*Glycine tabacina*	Variable Glycine	Fabaceae (Fa		0.1	20	N		
Modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	*	0.1	10	E		
Trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fa	*	0.2	100	E		
Sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae		0.1	20	N		
Wahl comm	*Wahlenbergia communis*	Tufted Bluebell	Campanulace		0.1	10	N		
Gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae		0.1	1	N		
Dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiac		0.1	50	N		
Alte nana	*Alternanthera nana*	Hairy Joyweed	Amaranthace		0.1	2	N		
Hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	*	0.2	50	E		
Cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea		0.1	1	N		
Calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae		0.1	1	N		
Cony bona	*Conyza bonariensis*	Flaxleaf Fleabane	Asteraceae	*	0.1	5	E		
Erod crin	*Erodium crinitum*	Blue Crowfoot	Geraniaceae		0.3	100	N		
Conv gram	*Convolvulus graminetinu*		Convolvulace		0.1	1	N		
Rume brow	*Rumex brownii*	Swamp Dock	Polygonacea		0.1	10	N		
Oxal pere	*Oxalis perennans*		Oxalidaceae		0.1	1	N		
Port oler	*Portulaca oleracea*	Pigweed	Portulacacea		0.1	3	N		
Dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiac		0.1	30	N		

GRASS/SEDGE (G	*Scientific Name*	Common Name	Family	Exotic	Cover%	Abundance	N, E or 'HT'	EPBC Stat	TSC Status
Ryti caes	*Rytidosperma caespitosu*	Ringed Wallaby Grass	Poaceae		0.2	50	N		
Erag lept	*Eragrostis leptostachya*	Paddock Lovegrass	Poaceae		0.1	20	N		
Erag cili	*Eragrostis cilianensis*	Stinkgrass	Poaceae	*	0.1	10	E		
Both macr	*Bothriochloa macra*	Red Grass	Poaceae		3	300	N		
Digi brow	*Digitaria brownii*	Cotton Panic Grass	Poaceae		2	200	N		
Pani simi	*Panicum simile*	Two-colour Panic	Poaceae		0.1	20	N		
Aris pers	*Aristida personata*		Poaceae		1	35	N		
Micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae		10	1000	N		
Chlo trun	*Chloris truncata*	Windmill Grass	Poaceae		0.1	20	N		
Spor creb	*Sporobolus creber*	Slender Rat's Tail Gras	Poaceae		0.1	10	N		
Cyno dact	*Cynodon dactylon*	Common Couch	Poaceae		0.1	10	N		
Digi	*Digitaria spp.*	A Finger Grass	Poaceae	*	0.1	1	E		
Pasp crin	*Paspalidium criniforme*		Poaceae		0.1	1	N		
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
FERN (EG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
Other (OG)	***Scientific Name***	**Common Name**	**Family**	**Exotic**	**Cover%**	**Abundance**	**N, E or 'HT'**	**EPBC Stat**	**TSC Status**
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A
	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W21	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				260	
Recorders	MP BT		**PCT:**	281 DGL				
GPS Easting	775798	**GPS Northing**	6410678		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W21

BAM Attribute (20x20m plot)

	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	12
	Grass & grasslike (GG)	5
	Fern (EG)	0
	Other (OG)	2
	TOTAL	19

BAM Attribute (20x20m plot)

	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	4.1
	Grass & grasslike (GG)	2.5
	Fern (EG)	0
	Other (OG)	0.6
	TOTAL Native	7.2
	TOTAL 'HTE'	40

BAM Attribute (20 x 50m plot) Tree Stem Counts

DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)

	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	1.20%	
	15m	1%		
	25m	1%		
	35m	1%		
	45m	1%		
Bare ground cover	5m	5%	13%	
	15m	10%		
	25m	15%		
	35m	25%		
	45m	10%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	1%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W21									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	40		*		HTE		
oxal pere	*Oxalis perennans*		Oxalidaceae	1			Forb (FG)	No		
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	1			Forb (FG)	No		
elym scab	*Elymus scaber*	Common Wheatgrass	Poaceae	1			Grass & grasslike (GG)	No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.2	10		Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	1			Grass & grasslike (GG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	5		Forb (FG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	2		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.2	20	*		No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.1	5		Forb (FG)	No		
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	1		*		No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	1		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	10		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.1	5		Forb (FG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.2	10	*		No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1	1	*		No		
cymb laws	*Cymbonotus lawsonianu*	Bear's Ear	Asteraceae	0.1	1		Forb (FG)	No		
micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae	0.2	20		Grass & grasslike (GG)	No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	0.2	10	*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.5	20		Other (OG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.2	4		Forb (FG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	1		Grass & grasslike (GG)	No		
arth minu	*Arthropodium minus*	Small Vanilla Lily	Anthericacea	0.2	20		Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	1		Forb (FG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	1		Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	1	100		Forb (FG)	No		
conv erub	*Convolvulus erubescens*	Pink Bindweed	Convolvulace	0.1	2		Other (OG)	No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	0.5	50	*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W22	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				260	
Recorders	MP BT		**PCT:**	281 DGL				
GPS Easting	775954	**GPS Northing**	6410219		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W22

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	13
	Grass & grasslike (GG)	6
	Fern (EG)	0
	Other (OG)	0
	TOTAL	19

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	3.7
	Grass & grasslike (GG)	12.2
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	15.9
	TOTAL 'HTE'	20.1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	1.40%	
	15m	2%		
	25m	1%		
	35m	1%		
	45m	1%		
Bare ground cover	5m	30%	33%	
	15m	25%		
	25m	35%		
	35m	25%		
	45m	50%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W22								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	20		*		HTE		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	1		*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.2	10		Forb (FG)	No		
xant spin	*Xanthium spinosum*	Bathurst Burr	Asteraceae	0.1	1	*		HTE		
cent sols	*Centaurea solstitialis*	St Barnabys Thistle	Asteraceae	0.1	2	*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1			Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	1			Grass & grasslike (GG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	1			Forb (FG)	No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	5		*		No		
brom cath	*Bromus catharticus*	Praire Grass	Poaceae	10		*		No		
plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginacea	5		*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	5		*		No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	5			Grass & grasslike (GG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.5	20		Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	1			Forb (FG)	No		
boer domi	*Boerhavia dominii*	Tarvine	Nyctaginacea	0.1	3		Forb (FG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.1	5		Forb (FG)	No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.2	10	*		No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	0.1	20	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	5		Forb (FG)	No		
erod botr	*Erodium botrys*	Long Storksbill	Geraniaceae	2		*		No		
sonc oler	*Sonchus oleraceus*	Common Sowthistle	Asteraceae	0.1	1	*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.2	5		Forb (FG)	No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	5			Grass & grasslike (GG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.1	5		Grass & grasslike (GG)	No		
eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiace	0.1	1		Forb (FG)	No		
plan debi	*Plantago debilis*	Shade Plantain	Plantaginacea	0.1	1		Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	1		*		No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	5	*		No		
uroc pani	*Urochloa panicoides*	Urochloa Grass	Poaceae	0.1	1	*		No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.1	1	*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	1		Forb (FG)	No		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	1		Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.5	1	*		No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	1		Forb (FG)	No		
eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	0.1	10	*		No		
verb bona	*Verbena bonariensis*	Purpletop	Verbenaceae	0.1	1	*		No		
aris vaga	*Aristida vagans*	Threeawn Speargrass	Poaceae	0.1	1		Grass & grasslike (GG)	No		

hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	10		*		No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W23	**Pic 20x20**		**Pic 20x50**		
Survey date:	25/10/2018		**Compass Orientation (head of 20x20 plot)**				20	
Recorders	MP BT		**PCT:**	281 DGL				
GPS Easting	777984	**GPS Northing**	6408353		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W23

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	9
	Grass & grasslike (GG)	7
	Fern (EG)	0
	Other (OG)	1
	TOTAL	17

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	4.7
	Grass & grasslike (GG)	31
	Fern (EG)	0
	Other (OG)	0.2
	TOTAL Native	35.9
	TOTAL 'HTE'	1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	2.40%	
	15m	3%		
	25m	2%		
	35m	2%		
	45m	3%		
Bare ground cover	5m	15%	18%	
	15m	20%		
	25m	10%		
	35m	20%		
	45m	23%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for		W23								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
brom cath	*Bromus catharticus*	Praire Grass	Poaceae	0.5		*		No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	25		*		No		
paro bras	*Paronychia brasiliana*	Chilean Whitlow Wor	Caryophyllace	0.5		*		No		
lepi afri	*Lepidium africanum*	Common Peppercress	Brassicaceae	2		*		No		
aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae	20			Grass & grasslike (GG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	10			Grass & grasslike (GG)	No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.1		*		No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.5			Forb (FG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.2			Other (OG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5			Forb (FG)	No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	10		*		No		
linu	*Linum spp.*		Linaceae	0.1		*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	1		*		No		
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	0.1		*		No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.2		*		No		
boer domi	*Boerhavia dominii*	Tarvine	Nyctaginacea	0.1			Forb (FG)	No		
schk pinn abro	*Schkuhria pinnata var. a*	Dwarf Marigold	Asteraceae	0.1		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	2		*		No		
eina nuta	*Einadia nutans*	Climbing Saltbush	Chenopodiace	0.2			Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1			Forb (FG)	No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.2		*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.1		*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	5		*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	0.5			Grass & grasslike (GG)	No		
wahl	*Wahlenbergia spp.*	Bluebell	Campanulace	2			Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.1			Grass & grasslike (GG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	1			Forb (FG)	No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1			Forb (FG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.2		*		No		
aris vaga	*Aristida vagans*	Threeawn Speargrass	Poaceae	0.2			Grass & grasslike (GG)	No		
erag lept	*Eragrostis leptocarpa*	Drooping Lovegrass	Poaceae	0.1			Grass & grasslike (GG)	No		
verb bona	*Verbena bonariensis*	Purpletop	Verbenaceae	0.2		*		No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.1			Grass & grasslike (GG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.2			Forb (FG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	1		*		HTE		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W28	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				255	
Recorders	MP BT		**PCT:**	281 DGL				
GPS Easting	775475	**GPS Northing**	6410571		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W28

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	13
	Grass & grasslike (GG)	7
	Fern (EG)	0
	Other (OG)	2
	TOTAL	22

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	15.6
	Grass & grasslike (GG)	18.3
	Fern (EG)	0
	Other (OG)	1.1
	TOTAL Native	35
	TOTAL 'HTE'	15

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	1.60%	
	15m	2%		
	25m	1%		
	35m	1%		
	45m	2%		
Bare ground cover	5m	5%	17%	
	15m	35%		
	25m	10%		
	35m	30%		
	45m	5%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W28

Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	15		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	10		*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
cirs	*Cirsium spp.*		Asteraceae	5		*		No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	10		Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.1	10		Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	15		*		HTE		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	10			Grass & grasslike (GG)	No		
wahl grac	*Wahlenbergia gracilenta*	Annual Bluebell	Campanulace	0.1	5		Forb (FG)	No		
arth minu	*Arthropodium minus*	Small Vanilla Lily	Anthericacea	0.2	10		Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	2		Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	5		*		No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	1			Grass & grasslike (GG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.3	20	*		No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	2		Forb (FG)	No		
plan hisp	*Plantago hispida*		Plantaginacea	2			Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	10			Forb (FG)	No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	5		*		No		
gera sola	*Geranium solanderi*	Native Geranium	Geraniaceae	0.1	10		Forb (FG)	No		
swai	*Swainsona spp.*		Fabaceae (Fal	0.1	5		Forb (FG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	1			Other (OG)	No		
trif camp	*Trifolium campestre*	Hop Clover	Fabaceae (Fal	1		*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.2	5		Forb (FG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.1	2	*		No		
micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
Elym scab	*Elymus scaber*	Common Wheatgrass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.1	5	*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.5	10	*		No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	2			Grass & grasslike (GG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	2			Forb (FG)	No		
Glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.1	2		Other (OG)	No		
desm gunn	*Desmodium gunnii*	Slender Tick-trefoil	Fabaceae (Fal	0.1	1		Forb (FG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	10		Forb (FG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W30	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				300	
Recorders	MP and BT		**PCT:**	281 DGL				
GPS Easting	775122	**GPS Northing**	6409100		**Datum**	Gda 94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W30

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	8
	Grass & grasslike (GG)	8
	Fern (EG)	0
	Other (OG)	1
	TOTAL	17

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.6
	Grass & grasslike (GG)	12.9
	Fern (EG)	0
	Other (OG)	0.5
	TOTAL Native	15
	TOTAL 'HTE'	15.2

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	5%	10.00%	
	15m	1%		
	25m	3%		
	35m	1%		
	45m	40%		
Bare ground cover	5m	17%	23%	
	15m	14%		
	25m	35%		
	35m	38%		
	45m	11%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m			

COMPOSITION & STRUCTURE

Species recorded for		W30								
Abbreviation	Scientific Name	Common Name	Family	% Cover	Abundance	Exotic	Growth Form	High Threat?	EPBC Status	BCA Status
xant	*Xanthium spp.*		Asteraceae	0.1	1	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	20		*		No		
plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginacea	1		*		No		
sile	*Silene spp.*		Caryophyllace	0.1	10	*		No		
pani simi	*Panicum simile*	Two-colour Panic	Poaceae	0.1	5		Grass & grasslike (GG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	15		*		HTE		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	10			Grass & grasslike (GG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.5	20		Other (OG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5	50		Forb (FG)	No		
aust vert	*Austrostipa verticillata*	Slender Bamboo Gras	Poaceae	0.5	5		Grass & grasslike (GG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	1		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	0.1	5	*		No		
care inve	*Carex inversa*	Knob Sedge	Cyperaceae	0.1	5		Grass & grasslike (GG)	No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	5		*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	20	*		No		
cycl lept	*Cyclospermum leptophy*	Slender Celery	Apiaceae	0.1	5	*		No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	1		*		No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	1		*		No		
cirs vulg	*Cirsium vulgare*	Spear Thistle	Asteraceae	1		*		No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.5	20		Forb (FG)	No		
acet vulg	*Acetosella vulgaris*	Sheep Sorrel	Polygonaceae	0.1	5	*		HTE		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.1	1		Forb (FG)	No		
Echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	0.5	10	*		No		
junc fili	*Juncus filicaulis*		Juncaceae	0.1	1		Grass & grasslike (GG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1	1	*		No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.1	2	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	1		Forb (FG)	No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	0.2	10	*		No		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	0.1	2	*		HTE		
aspe conf	*Asperula conferta*	Common Woodruff	Rubiaceae	0.1	10		Forb (FG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	1		Forb (FG)	No		
lepi afri	*Lepidium africanum*	Common Peppercres	Brassicaceae	0.1	20	*		No		
ryti caes	*Rytidosperma caespitos*	Ringed Wallaby Gras	Poaceae	0.1	5		Grass & grasslike (GG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	0.5	20	*		No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	1	10		Grass & grasslike (GG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	1	5		Grass & grasslike (GG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.5	50	*		No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	0.5	50	*		No		

wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	2		Forb (FG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W24	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				120	
Recorders			**PCT:**	Exotic				
GPS Easting	775725	**GPS Northing**	6410100		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W24

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	3
	Grass & grasslike (GG)	1
	Fern (EG)	0
	Other (OG)	0
	TOTAL	4

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	0.3
	Grass & grasslike (GG)	0.5
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	0.8
	TOTAL 'HTE'	0.1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	10%	4.00%	
	15m	3%		
	25m	2%		
	35m	3%		
	45m	2%		
Bare ground cover	5m	5%	45%	
	15m	55%		
	25m	50%		
	35m	55%		
	45m	60%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W24									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
aven fatu	*Avena fatua*	Wild Oats	Poaceae	50		*		No		
loli pere	*Lolium perenne*	Perennial Ryegrass	Poaceae	20		*		No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	0.5	10		Grass & grasslike (GG)	No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	1		*		No		
brom cath	*Bromus catharticus*	Praire Grass	Poaceae	0.5	20	*		No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	10		*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	5	*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	10	*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	1		Forb (FG)	No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	0.1	5	*		No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.2	20	*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.1	5	*		No		
eina hast	*Einadia hastata*	Berry Saltbush	Chenopodiace	0.1	1		Forb (FG)	No		
cham drum	*Chamaesyce drummondi*	Caustic Weed	Euphorbiacea	0.1	2		Forb (FG)	No		
onop	*Onopordum spp.*		Asteraceae	0.1	1	*		No		
uroc pani	*Urochloa panicoides*	Urochloa Grass	Poaceae	0.1	5	*		No		
bras	*Brassica spp.*	Brassica	Brassicaceae	0.1	5	*		No		
eleu tris	*Eleusine tristachya*	Goose Grass	Poaceae	0.1	5	*		No		
poa annu	*Poa annua*	Winter Grass	Poaceae	0.1	1	*		No		
plan lanc	*Plantago lanceolata*	Lamb's Tongues	Plantaginacea	0.1	10	*		No		
xant spin	*Xanthium spinosum*	Bathurst Burr	Asteraceae	0.1	1	*		HTE		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W25	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2018		**Compass Orientation (head of 20x20 plot)**				290	
Recorders	MP BT		**PCT:**	1610 low				
GPS Easting	775756	**GPS Northing**	6408327		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W25

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	6
	Grass & grasslike (GG)	3
	Fern (EG)	1
	Other (OG)	2
	TOTAL	12

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	2.6
	Grass & grasslike (GG)	6.1
	Fern (EG)	0.5
	Other (OG)	0.3
	TOTAL Native	9.5
	TOTAL 'HTE'	20

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	2.40%	
	15m	5%		
	25m	1%		
	35m	4%		
	45m	1%		
Bare ground cover	5m	13%	15%	
	15m	35%		
	25m	12%		
	35m	9%		
	45m	7%		
Cryptogam cover	5m	2%	2%	
	15m	2%		
	25m	2%		
	35m	3%		
	45m	2%		
Rock Cover	5m	1%	1%	
	15m	4%		
	25m	0%		
	35m	0%		
	45m	2%		

COMPOSITION & STRUCTURE

Species recorded for		W25								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
pter muti	*Pterostylis mutica*	Midget Greenhood	Orchidaceae	0.5	20		Forb (FG)	No		P
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	10		*		HTE		
wahl comm	*Wahlenbergia communis*	Tufted Bluebell	Campanulace	0.2	10		Forb (FG)	No		
schk pinn abro	*Schkuhria pinnata var. a*	Dwarf Marigold	Asteraceae	0.5	50	*		No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.2	10		Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	1			Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	5		*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	5		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	10		*		HTE		
cham drum	*Chamaesyce drummond*	Caustic Weed	Euphorbiacea	1			Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	5		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	1		*		No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.2	10		Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.5	30		Fern (EG)	No		
sile	*Silene spp.*		Caryophyllace	0.2	50	*		No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.5	20	*		No		
glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.1	1		Other (OG)	No		
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	1		*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.5	20		Forb (FG)	No		
hord lepo	*Hordeum leporinum*	Barley Grass	Poaceae	1		*		No		
UNK forb	*#N/A*	#N/A	#N/A	0.1	1	#N/A		FALSE	#N/A	#N/A
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.2	10		Other (OG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W27	**Pic 20x20**		**Pic 20x50**		
Survey date:	22/10/2018		**Compass Orientation (head of 20x20 plot)**				89	
Recorders	MP BT		**PCT:**	1610 Low				
GPS Easting	776121	**GPS Northing**	6408177		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W27

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	6
	Grass & grasslike (GG)	8
	Fern (EG)	0
	Other (OG)	0
	TOTAL	14

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.9
	Grass & grasslike (GG)	12.6
	Fern (EG)	0
	Other (OG)	0
	TOTAL Native	14.5
	TOTAL 'HTE'	10.1

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	2%	3.20%	
	15m	2%		
	25m	4%		
	35m	3%		
	45m	5%		
Bare ground cover	5m	3%	10%	
	15m	2%		
	25m	4%		
	35m	25%		
	45m	17%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	1%	1%	
	15m	3%		
	25m	3%		
	35m	0%		
	45m	0%		

COMPOSITION & STRUCTURE

Species recorded for	W27									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	10		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	10		*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.5	20	*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	10			Grass & grasslike (GG)	No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	2			Grass & grasslike (GG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	1			Forb (FG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	10		*		HTE		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	5		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	1		*		No		
care inve	*Carex inversa*	Knob Sedge	Cyperaceae	0.1	10		Grass & grasslike (GG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	1		Forb (FG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	0.5	50	*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.2	50	*		No		
cent meli	*Centaurea melitensis*	Maltese Cockspur	Asteraceae	0.1	10	*		No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	10		Forb (FG)	No		
salv verb	*Salvia verbenaca*	Vervain	Lamiaceae	1		*		No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.5	50		Forb (FG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	5	*		No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	0.1	5		Forb (FG)	No		
briz mino	*Briza minor*	Shivery Grass	Poaceae	0.1	1	*		No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1	5	*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	1		Forb (FG)	No		
arct cale	*Arctotheca calendula*	Capeweed	Asteraceae	0.1	2	*		No		
sile	*Silene spp.*		Caryophyllace	0.5	100	*		No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.1	20		Grass & grasslike (GG)	No		
erag alve	*Eragrostis alveiformis*		Poaceae	0.1	2		Grass & grasslike (GG)	No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	0.1	20	*		No		
cycl lept	*Cyclospermum leptophyl*	Slender Celery	Apiaceae	0.1	5	*		No		
cyno dact	*Cynodon dactylon*	Common Couch	Poaceae	0.1	2		Grass & grasslike (GG)	No		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	0.1	1	*		HTE		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W31	**Pic 20x20**		**Pic 20x50**		
Survey date:	22/10/2016		**Compass Orientation (head of 20x20 plot)**				0N	
Recorders	MP BT		**PCT:**	1610 Low				
GPS Easting	775979	**GPS Northing**	6408008		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W31

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	11
	Grass & grasslike (GG)	4
	Fern (EG)	1
	Other (OG)	0
	TOTAL	16

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	6.6
	Grass & grasslike (GG)	5.4
	Fern (EG)	0.1
	Other (OG)	0
	TOTAL Native	12.1
	TOTAL 'HTE'	5

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	2.00%	
	15m	2%		
	25m	2%		
	35m	3%		
	45m	2%		
Bare ground cover	5m	2%	2%	
	15m	3%		
	25m	1%		
	35m	4%		
	45m	2%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	7%	2%	
	15m	1%		
	25m	3%		
	35m	0%		
	45m	1%		

COMPOSITION & STRUCTURE

Species recorded for	W31									
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	20		*		No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	10		*		No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	1		*		No		
briz mino	*Briza minor*	Shivery Grass	Poaceae	0.1	5	*		No		
paro bras	*Paronychia brasiliana*	Chilean Whitlow Wor	Caryophyllace	0.2	20	*		No		
care inve	*Carex inversa*	Knob Sedge	Cyperaceae	0.2	20		Grass & grasslike (GG)	No		
salv verb	*Salvia verbenaca*	Vervain	Lamiaceae	0.2	20	*		No		
sile	*Silene spp.*		Caryophyllace	10		*		No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	5			Grass & grasslike (GG)	No		
oxal pere	*Oxalis perennans*		Oxalidaceae	5			Forb (FG)	No		
chon junc	*Chondrilla juncea*	Skeleton Weed	Asteraceae	0.1	2	*		No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.1	5		Forb (FG)	No		
rost pumi	*Rostraria pumila*	Roughtail	Poaceae	1	20	*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	0.5	50	*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.5	10	*		No		
cirs	*Cirsium spp.*		Asteraceae	0.2	20	*		No		
acae ovin	*Acaena ovina*	Acaena	Rosaceae	0.1	5		Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.1	2		Fern (EG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	0.1	10		Grass & grasslike (GG)	No		
eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiace	0.2	5		Forb (FG)	No		
eina nuta	*Einadia nutans*	Climbing Saltbush	Chenopodiace	0.1	1		Forb (FG)	No		
dysp pumi	*Dysphania pumilio*	Small Crumbweed	Chenopodiace	0.5			Forb (FG)	No		
trif camp	*Trifolium campestre*	Hop Clover	Fabaceae (Fal	1		*		No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.1	10		Forb (FG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	1		Forb (FG)	No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	2		Forb (FG)	No		
trif subt	*Trifolium subterraneum*	Subterranean Clover	Fabaceae (Fal	5		*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	5		*		No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	5		*		HTE		
cotu aust	*Cotula australis*	Common Cotula	Asteraceae	0.1	2		Forb (FG)	No		
malv parv	*Malva parviflora*	Small-flowered Mallo	Malvaceae	0.1	2	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	15		*		No		
tara offi	*Taraxacum officinale*	Dandelion	Asteraceae	0.1	5	*		No		
verb	*Verbascum spp.*		Scrophulariac	0.1	1	*		No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.2	100		Forb (FG)	No		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	0.1	2		Grass & grasslike (GG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W32	**Pic 20x20**		**Pic 20x50**		
Survey date:	24/10/2018		**Compass Orientation (head of 20x20 plot)**				15	
Recorders	MP BT		**PCT:**	1610 low				
GPS Easting	776521	**GPS Northing**	6407941		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information

Current land use

Age class of trees (DBH range) , Condition of Vegetation, Hollows

10 - 100cm DBH

Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)

Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W32

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	11
	Grass & grasslike (GG)	4
	Fern (EG)	1
	Other (OG)	1
	TOTAL	17

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	0
	Forb (FG)	1.8
	Grass & grasslike (GG)	0.9
	Fern (EG)	0.1
	Other (OG)	0.2
	TOTAL Native	3
	TOTAL 'HTE'	80

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9			
<5			N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	3%	8.40%	
	15m	6%		
	25m	8%		
	35m	13%		
	45m	12%		
Bare ground cover	5m	9%	10%	
	15m	8%		
	25m	16%		
	35m	9%		
	45m	7%		
Cryptogam cover	5m	2%	1%	
	15m	0%		
	25m	1%		
	35m	1%		
	45m	0%		
Rock Cover	5m	1%	1%	
	15m	0%		
	25m	2%		
	35m	1%		
	45m	3%		

COMPOSITION & STRUCTURE

Species recorded for		W32								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	60		*		HTE		
hype perf	*Hypericum perforatum*	St. Johns Wort	Clusiaceae	20		*		HTE		
arth minu	*Arthropodium minus*	Small Vanilla Lily	Anthericacea	0.1	2		Forb (FG)	No		
trif arve	*Trifolium arvense*	Haresfoot Clover	Fabaceae (Fal	5		*		No		
trif dubi	*Trifolium dubium*	Yellow Suckling Clove	Fabaceae (Fal	2		*		No		
swai gale	*Swainsona galegifolia*	Smooth Darling Pea	Fabaceae (Fal	0.2	5		Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.1	5		Forb (FG)	No		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.2	5			No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.2	10		Forb (FG)	No		
euch spha	*Euchiton sphaericus*	Star Cudweed	Asteraceae	0.1	1		Forb (FG)	No		
erod cicu	*Erodium cicutarium*	Common Crowfoot	Geraniaceae	0.1	5	*		No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	0.5	20	*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.5	50		Forb (FG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	0.1	5		Forb (FG)	No		
brom hord	*Bromus hordeaceus*	Soft Brome	Poaceae	1		*		No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.1	10	*		No		
salv verb	*Salvia verbenaca*	Vervain	Lamiaceae	0.1	20	*		No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.2	5		Other (OG)	No		
linu	*Linum spp.*		Linaceae	0.1	20	*		No		
hypo radi	*Hypochaeris radicata*	Catsear	Asteraceae	0.2	20	*		No		
sile	*Silene spp.*		Caryophyllace	0.1	1	*		No		
desm gunn	*Desmodium gunnii*	Slender Tick-trefoil	Fabaceae (Fal	0.1	5		Forb (FG)	No		
elym scab	*Elymus scaber*	Common Wheatgrass	Poaceae	0.1	2		Grass & grasslike (GG)	No		
cymb laws	*Cymbonotus lawsonianu*	Bear's Ear	Asteraceae	0.1	2		Forb (FG)	No		
loma mult mult	*Lomandra multiflora sub*	Many-flowered Mat-r	Lomandracea	0.1	1		Grass & grasslike (GG)	No		
medi sati	*Medicago sativa*	Lucerne	Fabaceae (Fal	0.1	2	*		No		
rume brow	*Rumex brownii*	Swamp Dock	Polygonaceae	0.1	5		Forb (FG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.2	20		Grass & grasslike (GG)	No		
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	0.2	5		Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	0.1	5		Fern (EG)	No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	0.5	50		Grass & grasslike (GG)	No		

BAM Site Field Survey								
Project:	Wollar SF	**Plot Identifier**	W26	**Pic 20x20**		**Pic 20x50**		
Survey date:	23/10/2016		**Compass Orientation (head of 20x20 plot)**				10	
Recorders	MP BT		**PCT:**	1610 good				
GPS Easting	775228	**GPS Northing**	6408435		**Datum**	94	**Zone**	55
Landform			**Soils**			**Drainage & Slope**		
Morphology			**Soil Texture**			**Slope**		
LandF Element			**Soil Colour**			**Aspect**		
LandF Pattern			**Soil Depth**			**Drainage**		
Microrelief			**Geology**			**Watercourses**		

Plot Disturbance			
	Severity	**Age**	**Observational Evidence**
Clearing			
Cultivation			
Soil erosion			
Firewood			
Grazing			
Fire Damage			
Storm Damage			
Weediness			
Other			

Severity: 0 = no evidence, 1=light, 2=moderate, 3=severe **Age:** R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Additional information
Current land use
Age class of trees (DBH range) , Condition of Vegetation, Hollows
10 - 100cm DBH
Disturbances (i.e. fire, grazing,ferals, clearing, logging, soil degradation, pollution, weeds, dieback)
Significant and threatened species and communities (Note pop. size/area, structure, repro status, habit, habitat, threats, photos)

Dominant Species outside Plot	

FUNCTION

Function attributes for	W26

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of Native Richness	Tree (TG)	0
	Shrub (SG)	3
	Forb (FG)	13
	Grass & grasslike (GG)	10
	Fern (EG)	1
	Other (OG)	3
	TOTAL	30

BAM Attribute (20x20m plot)		
	Stratum	Sum
Count of cover abundance (native vascular plants)	Tree (TG)	0
	Shrub (SG)	15.6
	Forb (FG)	22.9
	Grass & grasslike (GG)	18.5
	Fern (EG)	1
	Other (OG)	1.3
	TOTAL Native	59.3
	TOTAL 'HTE'	10

BAM Attribute (20 x 50m plot) Tree Stem Counts			
DBH (cm)	Euc	Non Euc	Hollows
>80			
50-79			
30-49			
20-29			
10-19			
5-9		10	
<5		5	N/A
Length of logs (m)			

BAM Attributes (1 x 1m Plots)				
	Tape length	% cover	Average %	Photos
Litter Cover	5m	1%	1.20%	
	15m	1%		
	25m	1%		
	35m	1%		
	45m	2%		
Bare ground cover	5m	50%	42%	
	15m	30%		
	25m	70%		
	35m	40%		
	45m	20%		
Cryptogam cover	5m	0%	0%	
	15m	0%		
	25m	0%		
	35m	0%		
	45m	0%		
Rock Cover	5m	1%	1%	
	15m	2%		
	25m	1%		
	35m	1%		
	45m	1%		

COMPOSITION & STRUCTURE

Species recorded for		W26								
Abbreviation	**Scientific Name**	**Common Name**	**Family**	**% Cover**	**Abundance**	**Exotic**	**Growth Form**	**High Threat?**	**EPBC Status**	**BCA Status**
sida corr	*Sida corrugata*	Corrugated Sida	Malvaceae	5			Forb (FG)	No		
zorn dyct dyct	*Zornia dyctiocarpa var. d*	Zornia	Fabaceae (Fal	1			Forb (FG)	No		
desm vari	*Desmodium varians*	Slender Tick-trefoil	Fabaceae (Fal	0.2	10		Other (OG)	No		
chlo trun	*Chloris truncata*	Windmill Grass	Poaceae	0.5	20		Grass & grasslike (GG)	No		
both macr	*Bothriochloa macra*	Red Grass	Poaceae	10			Grass & grasslike (GG)	No		
calo lapp	*Calotis lappulacea*	Yellow Burr-daisy	Asteraceae	5			Forb (FG)	No		
vitt cune	*Vittadinia cuneata*	A Fuzzweed	Asteraceae	10			Forb (FG)	No		
chei sieb	*Cheilanthes sieberi*	Rock Fern	Pteridaceae	1			Fern (EG)	No		
wahl stri	*Wahlenbergia stricta*	Tall Bluebell	Campanulace	0.5	20		Forb (FG)	No		
dich repe	*Dichondra repens*	Kidney Weed	Convolvulace	0.5	100		Forb (FG)	No		
acac ixio	*Acacia ixiophylla*		Fabaceae (Mi	15			Shrub (SG)	FALSE		
aris ramo	*Aristida ramosa*	Purple Wiregrass	Poaceae	1			Grass & grasslike (GG)	No		
aris pers	*Aristida personata*		Poaceae	0.1	2		Grass & grasslike (GG)	No		
gono tetr	*Gonocarpus tetragynus*	Poverty Raspwort	Haloragaceae	0.1	5		Forb (FG)	No		
ryti tenu	*Rytidosperma tenuius*	A Wallaby Grass	Poaceae	0.1	5		Grass & grasslike (GG)	No		
loma fili	*Lomandra filiformis*	Wattle Matt-rush	Lomandracea	0.2	10		Grass & grasslike (GG)	No		
trif glom	*Trifolium glomeratum*	Clustered Clover	Fabaceae (Fal	0.5	10	*		No		
lysi arve	*Lysimachia arvensis*	Scarlet Pimpernel	Myrsinaceae	1		*		No		
conv erub	*Convolvulus erubescens*	Pink Bindweed	Convolvulace	1	1		Other (OG)	No		
cart lana	*Carthamus lanatus*	Saffron Thistle	Asteraceae	10		*		HTE		
ryti race	*Rytidosperma racemosu*	Wallaby Grass	Poaceae	0.5	20		Grass & grasslike (GG)	No		
glyc clan	*Glycine clandestina*	Twining glycine	Fabaceae (Fal	0.1	5		Other (OG)	No		
schk pinn abro	*Schkuhria pinnata var. a*	Dwarf Marigold	Asteraceae	0.5	50	*		No		
micr stip	*Microlaena stipoides*	Weeping Grass	Poaceae	0.1	10		Grass & grasslike (GG)	No		
pter muti	*Pterostylis mutica*	Midget Greenhood	Orchidaceae	0.1	2		Forb (FG)	No		P
aspe conf	*Asperula conferta*	Common Woodruff	Rubiaceae	0.1	50		Forb (FG)	No		
burs spin	*Bursaria spinosa*	Native Blackthorn	Pittosporacea	0.1	1		Shrub (SG)	No		
echi crus	*Echinochloa crus-galli*	Barnyard Grass	Poaceae	1		*		No		
sile	*Silene spp.*		Caryophyllace	0.2	50	*		No		
spor creb	*Sporobolus creber*	Slender Rat's Tail Gra	Poaceae	1			Grass & grasslike (GG)	No		
petr nant	*Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllace	0.1	1	*		No		
oxal pere	*Oxalis perennans*		Oxalidaceae	0.1	5		Forb (FG)	No		
good pinn	*Goodenia pinnatifida*	Scrambles Eggs	Goodeniacea	0.2	20		Forb (FG)	No		
eina poly	*Einadia polygonoides*	Knotweed Goosefoot	Chenopodiac	0.2	10		Forb (FG)	No		
aust scab	*Austrostipa scabra*	Speargrass	Poaceae	5			Grass & grasslike (GG)	No		
plan hisp	*Plantago hispida*		Plantaginacea	0.1	1		Forb (FG)	No		
modi caro	*Modiola caroliniana*	Red-flowered Mallow	Malvaceae	0.5	10	*		No		
davi geni	*Daviesia genistifolia*	Broom Bitter Pea	Fabaceae (Fal	0.5	2		Shrub (SG)	No		
UNK Forb	*#N/A*	#N/A	#N/A	0.5		#N/A		FALSE	#N/A	#N/A

poly avic	*Polygonum aviculare*	Wireweed	Polygonaceae	0.2	50	*		No		

FAUNA SPECIES LIST

August Survey

Scientific name	Common name	BC Act	EPBC Act	Nocturnal Survey				Diurnal Survey			Opportunistic
				FS 1	FS 2	FS 3	FS 7	FS 4	FS 5	FS 6	
BIRDS											
Acanthiza nana	Yellow Thornbill					x					x
Acanthorhynchus tenuirostris	Eastern Spinebill					x		x			x
Aegotheles cristatus	Owlet Nightjar				x						
Anthus novaeseelandiae	Australian Pipit					x					x
Aquila audax	Wedge-tailed Eagle					x				x	x
Artamus cyanopterus	**Dusky Woodswallow**	**V**						**x**		**x**	
Cacatua sanguinea	Corella					x		x	x		x
Chenonetta jubata	Australia Wooduck					x					x
Cheramoeca leucosterna	White-backed Swallow					x				x	x
Climacteris picumnus	**Brown Treecreeper**	**V**								**x**	
Colluricincla harmonica	Grey-shrike Thrush					x				x	x
Corcorax melanorhamphos	White-winged Chough					x			x		x
Corvus coronoides	Australian Raven					x					x
Cracticus nigrogularis	Pied Butcherbird					x					x
Cracticus-tibicen	Australian Magpie					x		x			x

Scientific name	Common name	BC Act	EPBC Act	Nocturnal Survey				Diurnal Survey			Opportunistic
				FS 1	FS 2	FS 3	FS 7	FS 4	FS 5	FS 6	
Dacelo novaeguineae	Kookaburra					x					x
Elanus axillaris	Black-shouldered Kite					x					x
Eolophus roseicapilla	Galah							x			
Eopsaltria australis	Eastern Yellow Robin					x				x	x
Falco cenchroides	Australian Kestrel					x		x			x
Grallina cyanoleuca	Magpie Lark					x		x		x	x
Hirundo neoxena	Welcome Swallow					x		x			x
Lichenostomus melanops	Yellow-tufted Honeyeater									x	
Malurus cyaneus	Superb Fairy Wren					x		x	x	x	x
Manorina melanocephala	Noisy Miner					x			x		x
Microeca fascinans	Jacky Winter					x		x	x	x	x
Mirafra javanica	Horsfields Bushlark					x					x
Neochmia temporalis	Red-browed Finch					x				x	x
Nesoptilotis leucotis	White-eared Honeyeater									x	
Ocyphaps lophotes	Crested Pigeon					x			x		x
Pardalotus punctatus	Spotted Pardalote					x		x	x	x	x
Platycercus elegans	Crimson Rosella					x			x		x
Platycercus eximius	Eastern Rosella							x	x		
Podargus strigoides	Tawny Frogmouth					x					x
Pomatostomus temporalis	**Grey-crowned Babbler**	**V**								**x**	
Psephotus haematonotus	Red-rumped Parrot					x		x	x		x

Scientific name	Common name	BC Act	EPBC Act	Nocturnal Survey				Diurnal Survey			Opportunistic
				FS 1	FS 2	FS 3	FS 7	FS 4	FS 5	FS 6	
Ptilotula fusca	Fuscous Honeyeater					x					x
Pyrrholaemus sagittatus	**Speckled Warbler**	**V**								**x**	
Rhipidura albiscapa	Grey Fantail					x		x			x
Rhipidura leucophrys	Willie Wagtail					x				x	x
Stagonopleura guttata	**Diamond Firetail**	**V**							**x**	**x**	
Strepera graculina	Currawong					x			x		x
Sturnus vulgaris	Starling*					x					x
Tyto alba	Barn Owl					x					x
MACROPODS											
Macropus giganteus	Eastern Grey Kangaroo				x	x					
Vombatus ursinus	Common Wombat			x			x				
Macropus robustus	Wallaroo				x	x					
Macropus refogriseus	Red-necked Wallaby				x	x					

APPENDIX B EPBC REQUIREMENTS

NSW GOVERNMENT | Planning & Environment

Planning Services
Resource & Energy Assessments
Contact: Anthony Ko
Phone: (02) 8217 2022
Email: anthony.ko@planning.nsw.gov.au

Rhyson Li
Wollar Solar Development Pty Ltd
52 Dalton Road
ST IVES NSW 2075

Dear Mr Li

Wollar Solar (SSD 9254)
Supplement to Environmental Assessment Requirements

I refer to the Secretary's Environmental Assessment Requirements (SEARs) issued for the Springdale Solar project on 3 October 2018.

As you are aware, the project was determined to be a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 1 May 2018, for likely impacts on listed threatened species and communities. Therefore, in accordance with Schedule 2, clause 3(5) of the NSW *Environmental Planning & Assessment Regulation 2000*, I have enclosed the Commonwealth's requirements for the assessment.

I can also confirm that the administrative procedures in relation to the accredited assessment process will apply to the assessment of this project under the EPBC Act, so that the Department can undertake an environmental impact assessment of the project to satisfy the requirements of both NSW and Commonwealth legislation.

You must ensure that the Environmental Impact Statement adequately addresses the SEARs issued on 3 October 2018, and the supplementary requirements attached to this letter.

If you have any enquiries about these requirements, please do not hesitate to contact Anthony Ko on the above contact details.

Yours sincerely

1/11/18

Clay Preshaw
Director
Resource & Energy Assessments
as nominee of the Secretary

Checklist of Supplementary SEARs, demonstrating where each matter has been addressed.

Guidelines for preparing Assessment Documentation relevant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

Wollar Solar Farm (EPBC 2018/8258; SSD 9254)

1. On 3 October 2018, the proposed Wollar Solar Farm was determined to be a controlled action for impacts on the following matter of national environmental significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

    - **threatened species and communities (sections 18 and 18A)**

2. The project will be assessed by NSW under an accredited assessment in accordance with section 87 of the EPBC Act. These requirements are a supplement to the NSW Secretary's Environmental Assessment Requirements (SEARs) issued on 4 May 2018 and should be addressed in conjunction with those requirements.

3. Assessment documentation prepared for the purposes of approval under the EPBC Act must address the statutory requirements outlined in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000 (*Cth) (EPBC Regulations). Proponents are advised to check these requirements have been appropriately addressed: http://www.austlii.edu.au/au/legis/cth/consol_reg/epabcr2000697/.

4. The requirements are intended to ensure MNES are sufficiently addressed in the EIS such that the Commonwealth decision-maker can make a determination on whether or not to approve the action.

5. The EIS must include an assessment of **all** protected matters that may be impacted by the proposed action under the controlling provision identified in paragraph 1, noting that:

    - Protected matters that the Department considers are likely to be significantly impacted by the proposed action are listed at Attachment A.

    - This list is not exhaustive and it is the proponent's responsibility to ensure any relevant protected matters under this controlling provision are adequately assessed for the Commonwealth decision-maker's consideration.

Project Description

6. The title of the action, background to the development and current status.

7. The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on MNES.

8. How the action relates to any other actions that have been, or are being taken, in the region affected by the action.

Identification of threatened species and communities

9. The EIS must identify **each** EPBC Act-listed species and community likely to be significantly impacted by the proposed action and provide evidence as to why other EPBC Act-listed species and communities likely to be located in the project area or in the vicinity are unlikely to be impacted.

10. For **each** of the relevant EPBC Act-listed species and communities likely to be impacted, the EIS must provide:

    - A description of the habitat and habits (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans, threat abatement plans and wildlife conservation plans; and

- details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements.

Note: the relevant guidelines and policy statements for each species and community are available from the Department of the Environment and Energy's Species Profiles and Threats Database.
http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Impacts

11. The EIS must include a comprehensive assessment of impacts on any relevant EPBC Act-listed species and communities. The assessment must address the nature, geographic extent, magnitude, timing and duration of any likely direct, indirect and consequential impacts. The description of impacts must have regard to the full national extent of the species or community's range (i.e. not just NSW).

Avoidance and mitigation

12. For each of the EPBC Act-listed species and communities that are likely to be impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the impacts of the action, and a description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve.

Offsets

13. Where a significant residual adverse impact to EPBC Act-listed species or communities is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy, how offsets will be secured, and timing of protection.

Note: For the purposes of approval under the EPBC Act, it is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action i.e. 'like for like'.

14. For each EPBC Act-listed species and community likely to be significantly impacted by the action, the EIS must provide reference to, and consideration of, relevant approved conservation advice or recovery plan for the species or community.

Note: the relevant guidelines and policy statements for each species and community are available from the Department of the Environment Species Profiles and Threats Database.
http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Environmental Record of person proposing to take the action

15. Information in relation to the environmental record of a person proposing to take action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.

Information Sources

16. For information given in the EIS, the EIS must state the source of the information, how recent the information is, how the reliability of the information was tested; and what uncertainties (if any) are in the information.

Attachment A

The Department's Environment Reporting Tool (ERT) identifies threatened species and communities that may occur within 5 km of the proposed action. Based on the information in the referral documentation, the location of the action, species records and likely habitat present in the area, there are likely to be significant impacts to:

- White box- yellow box- Blakely's red gum grassy woodland and derived native grassland (Box Gum Woodland) – Critically endangered

In addition, there is some risk that there may be significant impacts on the following matters and levels of impact should be further investigated.

- *Tylophora linearis* – Endangered
- *Commersonia procumbens* – Vulnerable
- *Prostanthera discolor* – Vulnerable
- Mount Vincent Mintbrush - *Prostanthera stricta* – Vulnerable
- Bluegrass (*Dichanthium setosum*) - Vulnerable
- *Euphrasia arguta* – Critically endangered
- *Homoranthus darwinioides* – Vulnerable
- Hoary Sunray, Grassland Paper-daisy (*Leucochrysum albicans var. tricolor*) – Endangered
- *Ozothamnus tesselatus* – Vulnerable
- *Philotheca ericifolio* – Vulnerable
- A Leek Orchid (*Prasophyllum sp. Wybong*) – Critically endangered
- Austral Toadflax (*Thesium australe*) – Vulnerable
- Small Purple-pea (*Swainsona recta*) – Endangered
- Regent Honeyeater (*Anthochaera Phrygia*) – Critically Endangered
- Painted Honeyeater (*Grantiella picta*) – Vulnerable
- Malleefowl (*Leipoa ocellata*) – Vulnerable
- Superb Parrot (*Polytelis swainsonii*) – Vulnerable
- Striped Legless Lizard (*Delma impar*) – Vulnerable
- Grey-headed Flying-fox (*Pteropus poliocephalus*) – Vulnerable
- Swift Parrot (*Lathamus discolor*) – Critically endangered
- Koala (*Phascolarctos cinereus*) – Vulnerable
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – Vulnerable
- Pink Tailed Worm Lizard (*Aprasia parapulchella*) - Vulnerable

Requirement	Addressed:
Assessment documentation prepared for the purposes of approval under the EPBC Act must address the statutory requirements outlined in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) (EPBC Regulations).	Consultation with DoEE occurred on 13 June 2018 regarding the requirement for lodgement of an EPBC referral. Specific matters required by Schedule 4 were included in the EPBC referral which was publicly exhibited: EPBC 2018/SSD 9254. On October 3, the project was deemed a controlled action.
The EIS must include an assessment of all protected matters that may be impacted by the proposed action under the controlling provision identified in paragraph 1, noting that: • **Protected matters that the Department considers are likely to be significantly impacted by the proposed action are listed at Attachment A.** • **This list is not exhaustive, and it is the proponent's responsibility to ensure any relevant protected matters under this controlling provision are adequately assessed for the Commonwealth decision-maker's consideration.**	Protected matters are addressed in the BDAR. Specifically: • Sections 5.1 to 5.4 set out relevant matters to be considered under the Act. • Section 7.4 examines MNES impacts in detail, with reference to the additional surveys undertaken in October 2018 to address additional MNES requirements of the Supplementary SEARs. • Section 7.4 is supported by Appendix D EPBC Habitat Assessment Evaluations. This evaluation considers all entities returned in the MNES search and included in the Supplementary SEARs. In consideration of entity habitat requirements, the surveys undertaken onsite, the habitat that is available onsite and the likelihood of occurrence, the potential for impact is determined in this table. • Where entities are deemed to have less than a low risk of impact, an EPBC Assessment of Significant Impact is undertaken, Appendix E. The assessments also assist to target mitigation strategies as required. • Only for those entities where significant impact is evaluated likely to occur, are Commonwealth offsets required. Appendix F sets out the quantification of offsets for relevant entities. • Section 10.1.4 provides an offset strategy for relevant entities, as determined above.
Project description • **The title of the action, background to the development and current status.** • **The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be**	The project description is provided in detail in Section 4 of the EIS.

Requirement	Addressed:
built or elements of the action that may have impacts on MNES. • **How the action relates to any other actions that have been, or are being taken, in the region affected by the action.**	
Identification of threatened species and communities • **The EIS must identify each EPBC Act-listed species and community likely to be significantly impacted by the proposed action and provide evidence as to why other EPBC Act-listed species and communities likely to be located in the project area or in the vicinity are unlikely to be impacted.** • **For each of the relevant EPBC Act-listed species and communities likely to be impacted, the EIS must provide:** o **A description of the habitat and habits (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans, threat abatement plans and wildlife conservation plans; and** o **Details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Commonwealth guidelines and policy statements.** • **The EIS must include a comprehensive assessment of impacts on any relevant EPBC Act-listed species and communities. The assessment must address the nature, geographic extent,**	As above, threatened species and communities are addressed in Section 7.4 of this BDAR. Relevant species and communities considered likely to be impacted we determined to be: • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (CEEC). • Regent Honeyeater • Large-eared pied bat • Pink-tailed worm lizard Appendix E contains the Assessments of significance for these entities, which set out habitat requirements and how these are met onsite, references relevant policies and plans, and concludes with a determination of the significance of the impacts proposed. Impacts on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (CEEC) were deemed likely to be significant. Survey methodology is included in Section 4.3.

Requirement	Addressed:
magnitude, timing and duration of any likely direct, indirect and consequential impacts. The description of impacts must have regard to the full national extent of the species or community's range (i.e. not just NSW).	
Avoidance and mitigation • **For each of the EPBC Act-listed species and communities that are likely to be impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the impacts of the action, and a description of the predicted effectiveness and outcomes that the avoidance and mitigation measures will achieve.**	Proposed avoidance and mitigation measures to deal with the potential impacts of the proposal are addressed in Section 7.1 and the BDAR. Indirect impacts are included in Section 7.2. All impacts and measures are relevant to: • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (CEEC). • Regent Honeyeater • Large-eared pied bat • Pink-tailed worm lizard
Offsets • **Where a significant residual adverse impact to EPBC Act-listed species or communities is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy, how offsets will be secured, and timing of protection.** • **For each EPBC Act-listed species and community likely to be significantly impacted by the action, the EIS must provide reference to, and consideration of, relevant approved conservation advice or recovery plan for the species or community.**	An offset strategy for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (CEEC) is provided in Section 10.1.4.
Environmental Record of the person proposing to take action • **Information in relation to the environmental record of a person proposing to take action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.**	Information about the proponent is provided in Section 1.3 of the EIS and the EPBC referral which was publicly exhibited: EPBC 2018/SSD 9254.
Information sources • **For information given in the EIS, the EIS must state the source of the**	Information sources are provided in the references list of the BDAR and Section 11 of this EIS.

Requirement	Addressed:
information, how recent the information is, how the reliability of the information was tested; and what uncertainties (if any) are in the information.	Reference citation makes clear published from non-published (i.e. website) sources. Areas of uncertainty, specifically around the impacts of shading, are stated clearly and conservative assumptions made in place of reliable data.

APPENDIX C EPBC PROTECTED MATTERS SEARCH

Australian Government
Department of the Environment and Energy

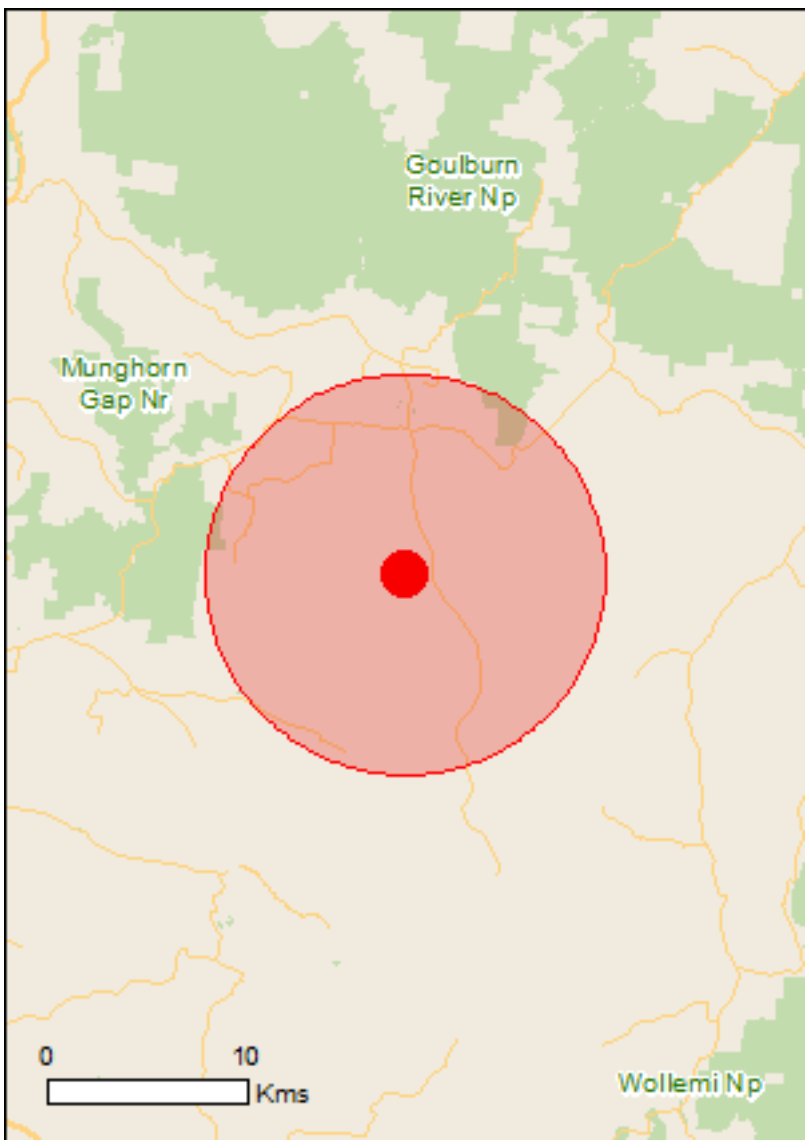
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/01/18 10:00:50



Coordinates

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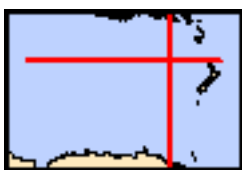

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	5
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	33
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	30
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Banrock station wetland complex	900 - 1000km upstream
Hunter estuary wetlands	150 - 200km upstream
Riverland	800 - 900km upstream
The coorong, and lakes alexandrina and albert wetland	1000 - 1100km
The macquarie marshes	200 - 300km upstream

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community may occur within area
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Fish		
Galaxias rostratus Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Homoranthus darwinioides [12974]	Vulnerable	Species or species habitat known to occur within area
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Ozothamnus tesselatus [56203]	Vulnerable	Species or species habitat likely to occur within area
Pelargonium sp. Striatellum (G.W.Carr 10345) Omeo Stork's-bill [84065]	Endangered	Species or species habitat may occur within area
Philotheca ericifolia [64942]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Lathamus discolor		
Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Goulburn River	NSW
Munghorn Gap	NSW

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.41826 149.94788

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX D EPBC HABITAT ASSESSMENT EVALUATION TABLE

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
FAUNA				
Anthochaera phrygia Regent Honeyeater	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Occurs in woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Present - Non optimal habitat occurs within the development site. More suitable vegetation occurs on *E. albens* dominated lower slopes outside of development site boundary.	Possible - Mapped important areas occur within the development site (OEH) however is considered not optimal. May occur on occasion in better condition vegetation outside of the development site with more complex structure. Not detected during surveys	**YES – Assessment of Significance undertaken**
Curlew Sandpiper *Calidris ferruginea*	Intertidal mudflats in both fresh and brackish waters in sheltered coastal areas, such as estuaries, bays, inlets, and lagoons. Also recorded inland, including around ephemeral and permanent lakes, dams, and waterholes, usually with bare edges of mud or sand	Absent - no intertidal mudflats	Unlikely	No – Unlikely to occur on site
Painted Honeyeater *Grantiella picta*	Boree/Weeping Myall, Brigalow, and Box-Gum Woodlands and Box-Ironbark Forests. Specialist feeder on the fruits of mistletoes.	Marginal - Scattered paddock trees of box-gum woodland. Minimal mistletoes present.	Unlikely – not detected during site surveys.	No – Unlikely to occur on site
Swift Parrot *Lathamus discolor*	On the coast and southwest slopes in areas with abundant flowering eucalypts or lerp. Feed	Present	Unlikely – outside mapped important areas	No – Unlikely to occur on site

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
	trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box and Lerp infested trees such as Grey Box and Black Butt.		(OEH). Not detected during surveys	
Mallee Fowl *Leipoa ocellata*	Semi-arid to arid shrublands and low woodlands, especially those dominated by Mallee and/or Acacia which are tall, dense, and floristically rich. A sandy to sandy-loam substrate and abundance of leaf litter are required for breeding.	Absent	Unlikely	No – Unlikely to occur on site
Eastern Curlew *Numenius madagascariensis*	Large intertidal mudflats often with seagrass beds along sheltered coasts including in estuaries, bays, harbours, inlets, lagoons, and among saltmarshes and mangroves.	Absent	Unlikely	No – Unlikely to occur on site
Superb Parrot *Polytelis swainsonii*	Box-Gum, Box-Cypress, and Boree Woodlands and River Red Gum Forests. They nest in hollows of large trees in tall open forest or woodland.	Marginal - Outside of normal habitat range.	Unlikely – No detected during surveys	No – Unlikely to occur on site
Australian Painted Snipe *Rostratula australis*	Shallow terrestrial freshwater or occasionally brackish wetlands, including temporary and permanent lakes, swamps, and claypans, as well as inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms, and bore drains. Fringes of swamps, dams, and nearby marshy areas with cover of grasses, lignum, low scrub, or open timber. Shallow wetlands with areas of bare wet mud.	Absent	Unlikely	No – Unlikely to occur on site
Booroolong Frog *Litoria booroolongensis*	Permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Requires cobble banks, riffles and other rock structures within stream margins.	Absent	Unlikely	No – Unlikely to occur on site
Large-eared Pied Bat	Caves (near their entrances), crevices in cliffs, old mine	Present – Large shallow	Present – No breeding habitat	**YES – Assessment of**

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
Chalinolobus dwyeri	workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features.	sandstone caves and crevices in ridges surrounding development site. Fairy martins recorded within southern end of development site	observed within development site however may be used for foraging with potential breeding habitat within 2km. Recorded via ultrasonic detection in ridgelines outside of development site.	**Significance undertaken**
Spotted-tail Quoll *Dasyurus maculatus*	Variety of vegetation types including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Present	Unlikely – May occur on a transient basis. No evidence of presence detected during survey	No – Unlikely to occur on site
Corben's Long-eared Bat *Nyctophilus corbei*	Variety of vegetation types, most commonly Mallee, Bulloke, and Box-dominated communities, but most common in vegetation with distinct canopy and dense understorey. Roost in tree hollows, crevices, and under loose bark.	Marginal	Unlikely	No – Unlikely to occur on site
Greater Glider *Petauroides volans*	Tall, montane, moist eucalypt forests with relatively old trees and abundant hollows and a high diversity of eucalypts	Absent	Unlikely	No – Unlikely to occur on site
Brush-tailed Rock-wallaby *Petrogale penicillata*	Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north	Present – North facing sandstone rock outcrop on ridges at the southern end of development site	Unlikely – Unlikely to venture outside of optimal habitat in ridges to the south of the development site. No evidence off presence detected during site surveys	No – No direct or indirect impacts on optimal habitat

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
Koala *Phascolarctos cinereus*	Temperate, subtropical and tropical eucalypt woodlands and forests where suitable food trees grow, of which there are more than 70 eucalypt species and 30 non-eucalypt species that are particularly abundant on fertile clay soils.	Present	Unlikely – no evidence of presence detected during site surveys	No – Unlikely to occur on site
Pseudomys novaehollandiae New Holland Mouse,	Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes.	Absent	Unlikely	No – Unlikely to occur on site
Grey-headed Flying-fox *Pteropus poliocephalus*	Range of vegetation communities including rainforest, open forest, and closed and open woodland. Roost sites usually near water, including lakes, rivers, and coastlines.	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Pink-tailed Worm-lizard *Aprasia parapulchella*	Inhabits sloping open woodland areas with predominantly native grassy ground layers. Commonly found beneath small, partially-embedded rock.	Present - Majority of potential habitat within the development site considered no-optimal due to embedded rock and lack of native grass cover however one area of optimal habitat does occur.	Possible – Optimal habitat occurs with DNG to the north east of the development site with partially embedded/loose rock and good grass cover. No evidence of presence detected during site surveys	**YES – Assessment of Significance undertaken**
Striped legless lizard *Delma impar*	Inhabits grassland dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa spp*. and Poa tussocks *Poa spp*., and occasionally wallaby grasses *Rhytidosperma spp* and exotic components.	Marginal - Groundcover dominated by exotic flora	Unlikely– development site outside known distribution	No – Unlikely to occur on site
FLORA				

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
Commersonia procumbens	Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recorded in *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and Callitris area. Also, in *Eucalyptus fibrosa subsp. nubila, Eucalyptus dealbata, Eucalyptus albens* and *Callitris glaucophylla* woodlands north of Dubbo.	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Cryptostylis hunteriana	Typically occurs in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata)* and the Tartan Tongue Orchid (*C. erecta*)	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Dichanthium setosum	Associated with heavy basaltic black soils and red-brown loams with clay subsoils in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Euphrasia arguta	Eucalypt forest with a mixed grass and shrub understorey in an open disturbed area and along the roadside.	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Homoranthus darwinioides	Grows in in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
	ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand.			
Leucochrysum albicans var. tricolor	Variety of grassland, woodland and forest habitats, generally on relatively heavy soils	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Ozothamnus tesselatus	Grows in eucalypt woodland.	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Pelargonium sp. Striatellum (G.W. Carr 10345)	High-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Philotheca ericifolia	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops.	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Prasophyllum petilum	Open sites within Natural Temperate Grassland	Absent	Unlikely	No – Unlikely to occur on site
Prasophyllum sp. Wybong (C. Phelps ORG 5269)	Perennial orchid, appearing as a single leaf over winter and spring in open eucalypt woodland and grassland	Marginal - Groundcover dominated by exotic flora	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Prostanthera discolor	Restricted to only a few localities from Bylong to the Baerami Valley within the Rylstone and Muswellbrook local government areas. Grows in dry sclerophyll forest in the side gullies of main creek lines, often on rocky or well-drained alluvial substrates.	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Prostanthera stricta	Occurs from Mt Vincent to Genowlan Mountain in the Capertee Valley. Prostanthera aff. stricta is found at Dingo Creek and the Widden and Baerami Valleys in the Upper Hunter. Is often a locally	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
	dominant undershrub in heath or scrub communities along cliff edges, or as an understorey species within a range of open forest or tall open forest types, or in adjacent transitional communities. Associated vegetation includes *Eucalyptus blaxlandii, Eucalyptus cannonii and Eucalyptus viminalis* with *Acacia implexa* and *Goodenia ovata*. Other associated species recorded at sites include *Angophora floribunda, Eucalyptus punctata, Brachychiton populneus, Acacia parvipinnula, Beyeria viscosa, Microlaena stipoides and Cheilanthes species*.			
Swainsona recta	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils.	Marginal - Groundcover dominated by exotic flora. Outside of known distribution.	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Tylophora linearis	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, *Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii.*	Marginal	Unlikely – not detected during site surveys	No – Unlikely to occur on site
Thesium australe	Coastal headlands or grassland and grassy woodland away from the coast in association with Kangaroo Grass (*Themeda triandra*)	Marginal - Groundcover dominated by exotic flora	Unlikely – not detected during site surveys	No – Unlikely to occur on site
TEC				
Central Hunter Valley eucalypt forest and woodland	The Central Hunter Valley eucalypt forest and woodland ecological community is an open forest or woodland—typically with a tree canopy dominated by eucalypt species; an open to sparse mid-layer of shrubs; and	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
	a ground layer of native grasses, forbs and small shrubs. Typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from finer grained sedimentary rocks. The woodland or forest canopy is dominated by one or more of the following four eucalypt species: – narrow-leaved ironbark (*Eucalyptus crebra*), spotted gum (*Corymbia maculata (syn. Eucalyptus maculata*), slaty gum (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*).			
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	The Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion are generally tall open eucalypt forests found on igneous rock (predominately Tertiary basalt and microsyenite) in, or adjacent to, the Sydney Basin Bioregion. The ecological community occurs in areas of high rainfall, generally ranging from 950 to 1600 mm/year. Dominant canopy species are most often *Eucalyptus fastigata* (brown barrel), *E. viminalis* (ribbon gum) and *E. radiata subsp. radiata* (narrow-leaved peppermint). *Eucalyptus obliqua* (messmate stringybark), *E. elata* (river peppermint), *E. quadrangulata* (white-topped box) and *E. smithii* (ironbark peppermint) are also common components.	Absent	Unlikely – not detected during site surveys	No – Unlikely to occur on site
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box *Eucalyptus*	Present	Present – Recorded onsite	**YES – Assessment of Significance undertaken**

Name	Habitat	Habitat Present	Likelihood of occurrence	Potential for impact?
	albens, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi.* Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs.			

APPENDIX E EPBC ASSESSMENT OF SIGNIFICANT IMPACT

The EPBC specifies factors which are considered in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level. The following is an assessment of the likely impacts associated with:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (CEEC).
- Regent Honeyeater
- Large-eared pied bat
- Pink-tailed worm lizard

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (Referred to as 'BGW') and Derived Native Grasslands (referred to as 'DNG') which is listed as a Critically Endangered Ecological Community (CEEC).

Significant impact criteria a) to g) as specified in the EPBC Significant Impact Guidelines (v1.1 2013) have been assessed below within Table 1. For the purposes of the assessment in within Table 1, the definition of 'extent' is provided below. Extent has been defined in terms of:

- An upper estimate of extent – that which could potentially occur within and outside the development site
- A lower estimate of extent – that which is known and likely to occur within and outside the development site

Upper estimate of extent

An upper extent of BGW and DNG outside of the development site can be viewed on Figure 5-1 and is assumed based on the following evidence;

- Observing vegetation along and immediately adjacent to Wollar Road, Barigan Rd and Maree road during field work in late May 2018. These roads traverse through the Wollar valley which is similar in landscape setting to that of the Wollar Solar Farm impact area.
- Aerial photo interpretation undertaken of surrounding properties using Google Earth imagery. This involved observing aerial photography of the Wollar Solar farm property and comparing this to adjoining grasslands and woodlands with similar topographic setting and landscape position.

This patch of BGW/DNG is approximately 5,947ha and comprises most of the Wollar Valley flats and foot slopes. The occurrence of BGW and DNG in the areas outside of the Wollar Solar Farm site has not been field validated through quantitative surveys.

Lower estimate of extent

For the purposes of this assessment a 'worst case scenario' of extent is given to assess the 'worst case' potential impact on BGW/DNG that could occur as a result of the Wollar Solar Farm development. For this assessment, it is assumed all groundcover where trees are greater than 75m apart[7] are not 'DNG' and do not form part of the patch for the purpose of this assessment.

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[7] As defined in accordance with the White Box – Yellow Box – Blakley's Red Gum grassy woodlands and derived native grasslands EPBC Act Policy Statement and Appendix 2 of the National Recovery Plan (DEH 2012).

An illustration of this patch (only containing BGW within the development site) is provided in Attachment B. DNG within the Wollar Solar Farm property are included within this patch due to confirmation with limited BAM survey during the site inspection in late May. The smaller estimate of the patch of BGW/DNG is 463ha.

Limitations

Without field verification, the assumed extent of BGW/DNG cannot be confirmed outside of the surveyed areas of the Wollar Solar Farm site.

Table 1 – Significant Impact Criteria to assess impacts on a CEEC

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:
a) Will the action reduce the 'extent' of a community?
The action will reduce the extent of the community by approximately 228 hectares (worst case scenario) when assuming that solar panels will destroy all components of BGW/DNG where solar panels are to be established. *Upper assumed extent* There is 24 ha of BGW and 204 ha of DNG directly impacted which adjoins onto a patch that is estimated to be around 5497ha in area (inclusive of powerlines and dirt roads running through Wollar valley). The area of CEEC directly impacted comprises around about 4% of the overall adjoining patch, (assuming that surrounding grasslands and woodlands contain similar vegetation). A reduction of 4% of this patch of BGW/DNG is a reduction in the extent but is not likely to be a reduction that would affect the ongoing survival of the overall patch of BGW/DNG over the Wollar Valley considering the large areas (>5,500ha) that would remain. However, a loss of 204 ha of the patch is still substantial and could be deemed a significant loss of the CEEC. *Lower known extent* There is 24 ha of BGW and 204 ha of DNG directly impacted which adjoins onto a patch that is estimated to be around 210 ha in area. The area of CEEC directly impacted is estimated to comprise 55% of the overall adjoining patch (when only assuming connection with wooded vegetation off the Wollar Solar Farm site). A reduction of 55% is a major reduction in the extent of this community and may affect the ongoing survival of this patch of BGW/DNG.
b) Will the action fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines?
Upper assumed extent The proposal occurs within a much larger patch of BGW/DNG within the Wollar Valley. At present, this patch is bordered to the north (extending 11km from the subject site), to the south west and west (extending approximately 500m from the subject site) and to the east (extending approximately 2km), by vegetated mountains not defined or likely to constitute BGW/DNG. The location of the area of direct impact will isolate a portion of BGW/DNG directly south-west of the subject site. This patch is estimated to be 210 ha in area which would become separated from the existing patch of BGW/DNG. It is estimated that the proposal would isolate around 4% of the current patch of BGW/DNG (not including the 4% to be removed for solar panels). *Smallest extent* The development footprint contains the majority of the patch of BGW/DNG where the remaining extent (45%) extends off the property to the south west. The proposal will not result in fragmentation of this patch however it will substantially reduce its extent as outlined in a).
c) Will the action adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species?
The National Recovery Plan for the CEEC identifies habitat critical to the survival of Box-Gum Grassy Woodland as: *The moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. Given the currently highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet*

the minimum condition criteria… should be considered critical to the survival of this ecological community. In addition, degraded woodland areas not considered part of the listed ecological community may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting (e.g. providing connectivity) or remaining flora/fauna habitat features (e.g. occurrence of rare or threatened species, tree hollows), and should also be considered as potential habitat critical to the survival of this ecological community.

Vegetation zones 1, 2, 5, 6 and 8 within the development footprint meet the condition criteria for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grasslands and would be considered critical habitat. As such the proposal will adversely affect habitat critical to the survival of the community.

d) Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?

It is predicted that the proposal could have impacts on,

- surface water flows across the ground, this would be limited as minimal excavation is proposed and panels would be mounted above the ground,
- change in light levels reaching the ground due to shading of panels, mitigated by spacing between panels,
- to ground moisture levels where solar panels may block or concentrate rain over certain areas.

The proposal could potentially benefit the BGW/DNG by;

- Removing disturbances caused by farming activities such as application of fertilisers and overgrazing by stock.

There is little scientific information on the effects of solar farms on these factors. Until sufficient monitoring of Solar farms is carried out, it is largely unknown whether solar farms are likely to have a detrimental impact on abiotic factors. A 'worst case' assumption would be that alterations to sunlight reaching the ground and changes to surface water flows due to the large surface area of solar panels over the ground, could modify abiotic factors necessary for survival of the CEEC.

A review of Table 4, proposed actions within the National Recovery Plan for BGW/DNG, indicates that;

- Altered hydrological regimes may lead to impacts,
- Prolonged shading may lead to impacts and
- Mowing and slashing associated with managing grasslands may lead to impacts

To address the uncertainty, it is therefore assumed that this proposal may lead to modification and destruction of important abiotic factors for preserving the integrity of this CEEC onsite.

e) Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?

The proposal may cause a change in species composition of DNG onsite, as solar panels will block sunlight to the ground. At present the DNG receives full sun so changing to full or partial shade is likely to influence what species may grow onsite. As stated above, scientific data in this regard is not available and a 'worst case' assumption would be that functionally important species could decline or be lost.

The majority of CEEC to be impacted consists of degraded DNG (i.e. 89% of the total area of CEEC impacted). The DNGs are subjected to annual weed invasion, trampling by stock, past cultivation and past application of fertilisers which have all impacted on groundcover structure and diversity. The current impacts encountered reduce the severity of impacts that will be caused by the solar farm. With active management of weeds, it may be that DNGs may improve in floristics and composition without grazing and pasture improvement, but it is largely unknown. In relation to the box-gum woodland containing trees, these areas have also been subjected to ongoing disturbances similar to the derived native grasslands. Firewood collection is an added impact within these areas where at the time of assessment during May the landholder was collecting firewood from fallen timber onsite. With existing impacts of agricultural practises onsite, the impacts of establishing a solar farm may reduce impacts to Box-gum woodland and derived native grassland but it largely unknown.

f) Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - assisting invasive species, that are harmful to the listed ecological

community, to become established; and - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?

There are existing impacts currently affecting the integrity of the BGW/DNG that include activities associated with farming. This has resulted in the introduction of Saffron Thistle, a high threat weed which has high cover abundance readings within some of the vegetation integrity plots conducted onsite. Farming activities have also removed a lot of BGW converting it into a DNG. The existing remnants of BGW which contain sparse fallen timber resources which are still being subjected to firewood collection as observed during survey in May. The use of fertilisers and herbicides is very likely to have occurred in the past as part of the farming practises onsite. All these farming practises contribute to a decline in species diversity.

Installing a solar farm may benefit the DNG by removing stock and stopping the future cultivation of the land, both of which are likely to contribute to the spread of existing weeds onsite. The solar farm is unlikely to require any fertilisers although managed application may be needed to maintain groundcovers within certain areas.

The proposal is unlikely to result in further assisting invasive flora species to become established with the implementation of appropriate weed management. Any herbicide applications would be conducted in accordance with recommended guidelines. Increases in invasive fauna species are unlikely given that these species are already present, and the proposal would not introduce any factors that would increase the populations.

Considering the above, the proposal is unlikely to cause a substantial reduction in quality or integrity as a result of assisting invasive species, or causing regular mobilisation of fertilisers, herbicides, chemicals or pollutants.

g) Will the action interfere with the recovery of an ecological community?

The National Recovery Plan for the CEEC (DEH 2012) specifies the following criteria as indicators of CEEC recovery;

1. An increase in the area of listed CEEC,
2. An increase in areas meeting minimum condition criteria,
3. Maintenance of floristics, structure, ecological function across its distribution,
4. Improved landscape connectivity and
5. Improved overall condition in BGW/DNG

The proposal is inconsistent with the recovery criteria as it will:

- Decrease the area of CEEC.
- Potentially further degrade the CEEC which may lead to certain areas of this CEEC not fitting the 'minimum condition criteria',
- Modify the floristics (by removing trees), 'structure' (by removal of canopy cover) and 'ecological function' through modifying key habitat resources such as hollow bearing trees and fallen timber as a result of tree removal.
- Result in a decline in landscape connectivity in further distancing patches of BGW onsite and a general decline in overall condition of the BGW/DNG onsite.

The effects of a solar farm on the recovery of DNG is uncertain. Construction of the solar farm is unlikely to introduce negative impacts in addition to those that are currently associated with farming, for example, new invasive weeds that contribute to reduced condition of BGW/DNG onsite. Strict weed hygiene and control protocols would be implemented as part of the proposal managing this risk.

Table 4 (Current Best Practice Site Management Practices) of the National Recovery Plan stipulates that;

- Altered hydrological regimes (e.g. diversion of rainfall caused by solar panels)
- Prolonged shading (e.g. caused by solar panels) and
- Regular mowing and slashing (e.g. maintenance around solar panels)

are actions that should be avoided in managing CEECs sustainably. Shading may lead to a reduction in groundcover floristics and may also lead to some areas of CEEC DNG not meeting the minimum condition criteria. Altered hydrological regimes may result in some areas receiving more ground moisture and other areas becoming drier. This may affect groundcover composition and diversity.

Conclusion

The proposal is likely to impact on the existing extent of BGW/DNG within the Wollar Valley. Assuming all areas under infrastructure (including panel arrays) are permanently removed, the lower value of impact is estimated to be around

4% of the existing patch of BGW/DNG assuming that adjoining properties contain 'like for like' groundcover to that found on the Wollar Solar Farm site (See Figure 5-1). The upper-value impact scenario could lead to a 55% reduction in the patch of existing BGW/DNG within the Wollar Valley (See Figure 5-2).

All habitat to be impacted is considered to be or is potentially habitat critical to the survival of the EEC. The loss of 55% of the patch is likely to be significant. Similarly, even the loss of 4% could be determined to be a significant impact on the CEEC

Fragmentation of the existing patch, when assuming the upper extent, would result in the isolation of 210ha of BGW/DNG directly southwest of the Wollar Solar Farm property.

The removal of BGW/DNG from the site may reduce foraging habitat for many birds of prey and habitat for various reptiles, however these microhabitats are likely to be present in adjoining farmland within Wollar Valley which is around 6000ha.

There may be potential impacts to abiotic factors affecting DNG onsite. Impacts in relation to shading changes to ground moisture may lead to altered groundcover composition and floristics. Some areas are likely to receive more or less rainfall depending on the diversion of rainfall onsite. The potential effects of this are unknown.

This assessment has taken a conservative approach in assuming all native vegetation within the development footprint would be removed. On this basis, the assessment has concluded that there is a potential for a significant impact.

Regent Honeyeater

a) Will the action lead to a long-term decrease in the size of a population of a species?
Regent Honeyeater
Potential foraging habitat for Regent Honeyeater occurs within the development site. OEH mapping determines that mapped areas of critical habitat occur on the lower slopes within and surrounding the development site. The development footprint has been defined to avoid these areas. Numerous diurnal avifauna surveys and call play back surveys were undertaken and did not detect these species. Following a habitat assessment of the broader subject land, it was determined that areas surrounding the development site that contain a more complex vegetative structure on the lower slopes contains potential habitat that may be used on occasion by these nomadic species. These areas, although recovering from a major bushfire in the last 2 years, had a high abundance of woodland birds' species present. However, vegetation within development footprint is considered non-optimal for the regent honeyeater due to low canopy cover, dominance of aggressive native fauna i.e. noisy miner and noisy friarbird as well as general poor health of the species present. This could be attributed to recover from the recent bushfire as well the trees subjected to more frequent indirect fertilisers use. Only one preferred forage species, *E. melliodora*, was observed in flowering over the many survey periods, at the most southern point of the subject land, well outside of the development site and development footprint. The proposal would involve the removal of around 25.66 ha of woody vegetation of which most of it is largely fragmented and isolated remnant vegetation. There would also be some disturbance associated with construction, including noise, vibration, light, and risk of introduction or spread of weeds, pests, and pathogens. The quality of potential habitat impacted for these species is low, being largely cleared, with few mature or hollow-bearing trees, and highly disturbed by agriculture. Given the amount of non-optimal habitat to be removed, the amount of higher quality habitat on the lower slopes of the ridgelines surrounding the development site that would not be impacted and with the recommended mitigation measures, the likelihood of the proposal leading to a long-term decrease in the size of a population of this species is minimal.
b) Will the action reduce the area of occupancy of the species?
Regent Honeyeater
The proposal would involve the removal of around 30.5 ha of woody but non-optimal habitat. No critical habitat for the regent honeyeater mapped by the OEH would be affected. The quality of potential habitat for this species is low within the development site. Large areas surrounding the development site on the lower slopes of the ridgelines contain better quality and more suitable habitat, that if present on occasion, would be utilised in preference to the poorer quality, sparse non-optimal habitat impacted.

c) Will the action fragment an existing population into two or more populations?

Regent Honeyeater

There would also be some disturbance associated with construction. The development site is not considered known habitat and the likelihood of occurrence of these species is low within the development site.

The proposal would not fragment an existing population of these species into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Regent Honeyeater

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these species.

e) Will the action disrupt the breeding cycle of a population?

Regent Honeyeater

Regent Honeyeaters breed in specific breeding areas, with the development site being within the Mudgee-Wollar key breeding area. However, considering the non-optimal habitat impacted, and better quality habitat being avoided, the likelihood of the action disrupting the breeding cycle of a population of these species is minimal.

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

Regent Honeyeater

The proposal would not remove any important mapped habitat. There would also be some disturbance associated with construction, which could decrease the quality of some habitat temporarily.

The quality of habitat impacted is low, and the area of habitat to be removed is relatively small and would not disrupt habitat connectivity for canopy species. With the implementation of the recommended mitigation measures, the likelihood of the action modifying, destroying, removing, isolating, or decreasing the availability or quality of habitat to the extent that these species would be likely to decline is minimal.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered / critically endangered /vulnerable species habitat?

Regent Honeyeater

The proposal has the potential to contribute to the spread of invasive species in the subject land through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. Currently, field surveys and observations noted a high abundance of aggressive native avifauna such as noisy miner and noisy friarbird in the vegetation to be impacted, however these species became less abundant in the better quality vegetation outside of the development site were more complex vegetative structure and connected vegetation occurs, as noted by the higher abundance of other woodland avifauna including a number of state listed threatened species. The proposal is therefore unlikely to result in invasive species, native or exotic, that are harmful ore restrictive to the Regent Honeyeater becoming established in future.

h) Will the action introduce disease that may cause the species to decline?

Regent Honeyeater

There is a risk that diseases could be introduced to the development site via machinery, vehicles, and materials during construction and operation. With the implementation of the recommended mitigation measures, the proposal is therefore unlikely to result in the introduction of any disease that may cause these species to decline.

i) Will the action interfere with the recovery of the species?

Regent Honeyeater

The National Recovery Plan for the Regent Honeyeater lists the following objectives:

1. Reverse the long-term population trend of decline and increase the numbers of Regent Honeyeaters to a level where there is a viable, wild breeding population, even in poor breeding years.

2. Enhance the condition of habitat across the Regent Honeyeater range to maximise survival and reproductive success and provide refugia during periods of extreme environmental fluctuation.

The proposal would not interfere with any of these objectives.

Conclusion

The proposal will result in the loss of around 30.5 ha of woody but non-optimal Regent Honeyeater habitat. Areas impacted are isolated patches or paddock trees with low to moderate canopy cover, lacking complex vegetative structure, and subjected to regular occurrence of aggressive native species such as the noisy miner. Better quality vegetation occurs outside of the development site that would not be impacted. It is unlikely that the proposal would significantly impact on the existence of the Regent Honeyeater and therefore, referral to the Commonwealth Department of Environment is not required.

Large-eared pied bat/Pink-tailed worm lizard

a) Will the action lead to a long-term decrease in the size of an important population of a species?

Large-eared Pied Bat

Fringing foraging habitat for the Large-eared Pied Bat occurs within the development site however would not be directly impacted by the proposal. Vegetated ridgelines surrounding the development contains significant sandstone caves, crevices and overhangs caves which is suitable roosting sites for Large-eared Pied Bats in the subject land.

The Large-eared Pied Bat was detected via ultrasonic detection during surveys approximately 400m south of the development site in the sandstone ridgeline. Areas containing suitable roosting habits will not be impacted. Surveys did not detect these species within the development site however it is considered that this species may utilise fringing vegetation within the lower slopes surrounding the development site. No suitable foraging habitat or roosting habitat occurs within the development footprint or will be impacted. Linear rocky outcrops that are within the development site largely contain embedded rock with shallow crevices. No observations or evidence of their use was observed during the field surveys in these areas.

The Large-eared Pied Bat is a sub canopy forager preferring to forage along the edges of vegetation and sandstone escarpments and are not known to utilises open grasslands or small area vegetated areas for foraging. The proposal is not located in a known important population of these species. In this context, the proposal would not lead to a long-term decrease in the size of an important population of these species.

Pink-tailed worm-lizard

Suitable and potential foraging and breeding habitat for the Pink-tailed worm-lizard occurs within the development site and would be removed by the proposal. Surveys did not detect this species and so the development site is not considered known habitat.

There is approximately 0.9 ha of suitable habitat within the development site, of which 0.1 ha of partially embedded and loose rock surrounded native grass species including *Themeda triandra* may be impacted. Additionally, there approximately 4.9 ha of rocky outcrop through the development site considered potential habitat of which 3.2 ha may be impacted during construction. The quality of potential habitat for this species is low, being largely embedded rock and subject to persistent grazing and dominated by predominately exotic grasses. With the implementation of the recommended mitigation measures, the proposal would not lead to a long-term decrease in the size of an important population of this species.

b) Will the action reduce the area of occupancy of an important population of a species?

Large-eared Pied Bat

The proposal would not directly impact upon suitable roosting or foraging habit for this species. Indirect impacts such as noise, dust and light spill may occur during construction but would be short term and temporary. It is not considered that the proposal would reduce the area of occupancy for this species.

Pink-tailed worm-lizard

The proposal would involve the removal of around 0.1 ha of potential habitat. These areas were surveyed, and the species was not detected. Areas of rocky outcrop were assessed and surveyed by two ecologists on the 24th and 25th October 2018 for approximately 30 minutes at each site within and surrounding the development site. This included

traversing the rocky outcrop area and randomly turning and inspecting loose rocks and partially embedded rock that occurred before being placed back into their original position. Where practicable, between 100-150 rock were turned and inspected at each surveyed area.

If assumed to occur, there would be some disturbance associated with construction. The quality of potential habitat for this species is low, and the area of habitat to be removed is relatively small. In this context, while removal of this habitat could reduce the area of occupancy, it would not have a significant impact on an important population of this species.

c) Will the action fragment an existing important population into two or more populations?

Large-eared Pied Bat

The proposal would not impact upon suitable roosting or foraging habit for this species and therefore the proposal would not fragment an existing important population of these species into two or more populations.

Pink-tailed worm-lizard

The proposal would involve the removal of around 0.1 ha of potential habitat. There would also be some disturbance associated with construction. The quality of potential habitat is low, and the area of habitat to be removed is relatively small. The proposal would not fragment an existing important population of this species into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Large-eared Pied Bat

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for these species.

Pink-tailed worm-lizard

The Register of Critical Habitat established under the EPBC Act does not list any critical habitat for this species.

e) Will the action disrupt the breeding cycle of an important population?

Large-eared Pied Bat

There is no suitable breeding habitat for these species in the development site. The proposal would not disrupt the breeding cycle of an important population of these species.

Pink-tailed worm-lizard

The proposal would involve the removal of around 0.1 ha of potential habitat. There would also be some disturbance associated with construction. The quality of potential habitat is low, and the area of habitat to be removed is relatively small. The proposal would not disrupt the breeding cycle of an important population of this species.

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

Large-eared Pied Bat

The proposal would not impact upon suitable roosting or foraging habit for this species. Suitable habitat does occur in the vegetated lower slopes and sandstone ridgelines, but these areas would not be directly impacted. Indirect impacts such as noise, dust and light spill may occur during construction but would be short term and temporary.

With the implementation of the recommended mitigation measures, the proposal would not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that an important population of these species would be likely to decline.

Pink-tailed worm-lizard

The proposal would involve the removal of around 0.1 ha of suitable habitat, including some areas of grassland. There would also be some disturbance associated with construction. The quality of potential habitat is low, and the area of habitat to be removed is relatively small and would not disrupt habitat significantly. With the implementation of the recommended mitigation measures, the proposal would not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that an important population of these species would be likely to decline.

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

Large-eared Pied Bat and Pink-tailed worm-lizard

The proposal has the potential to contribute to the spread of invasive species in the subject land through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these vulnerable species becoming established in potential habitat.

h) Will the action introduce disease that may cause the species to decline?

Large-eared Pied Bat and Pink-tailed worm-lizard

There is a risk that diseases could be introduced to the development site via machinery, vehicles, and materials during construction and operation. With the implementation of the recommended mitigation measures, the proposal is therefore unlikely to result in the introduction of any disease that may cause these species to decline.

i) Will the action interfere substantially with the recovery of the species?

Large-eared Pied Bat

The National Recovery Plan for the Large-eared Pied Bat lists the following specific objectives:

1. Identify priority roost and maternity sites for protection.
2. Implement conservation and management strategies for priority sites.
3. Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat.
4. Research the Large-eared Pied Bat to augment biological and ecological data to enable conservation management.
5. Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat.

The proposal would not interfere with any of these objectives.

Pink-tailed worm-lizard

There is no National Recovery Plan for Pink-tailed worm-lizard at this time, however conservation actions include

1. Identify priority sites for protection
2. Ensure appropriate grazing regimes
3. Educate the community and industry to understand and participate in the conservation of the Pink-tailed worm-lizard.
4. Information and research priorities.
5. Survey and monitoring priorities

Conclusion

Pink-tailed worm-lizard

The proposal will result in the loss of 0.1 ha of potential habitat for the Pink-tailed worm-lizard. Approximately 0.8 ha would remain and not be impacted. Areas of rocky outcrop were assessed and surveyed by two ecologists; between 100-150 rock were turned and inspected at each surveyed area. No individuals were observed during field surveys.

Large-eared Pied Bat

Although detected in close proximity to the development site in suitable sandstone ridgelines containing appropriate foraging habitat, only suboptimal roosting or foraging habitat for the Large-eared Pied Bat would be impacted.

It is highly unlikely that the proposal would significantly impact on the existence of the Large-eared Pied Bat or Pink-tailed worm-lizard.

APPENDIX F EPBC OFFSET CALCULATIONS

COMMONWEALTH OFFSETTING REQUIREMENTS

The EPBC Act Environmental Offsets Policy (EOP) outlines the Australian Government's approach to the use of environmental offsets ('offsets') under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This policy relates to all matters protected under the EPBC Act. Offsets are required where a significant impact is anticipated. For the proposed Wollar Solar Farm, this could include:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC (henceforth, Box-Gum Woodland).

No other entities are considered likely to have a significant impact. Commonwealth offset requirement calculations are detailed below for this entity.

COMMONWEALTH OFFSET METHODOLOGY

The Offsets Assessment Guide (OAG) was run according to the information contained in the document titled 'How to use the Offsets Assessment Guide' (which is published on the DoEE's EPBC Act environmental offsets policy web page). In running the OAG, the user is required to enter a number of variables which require a quantitative assessment of the condition of the vegetation at the development and offset site and also factors such as the time until the ecological benefit of the offset is realised, the risk of the loss of the offset and the level of confidence in these results. The reasoning used in reaching these values is discussed individually for each below.

F.1.1 Box Gum Woodland

Conservation listing

The *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (aka Box Gum Woodland, BGW) is listed as Critically Endangered.

Area of impacted community

A total of 229.58 ha will be impacted, of this:

- 24.59 ha are structural woodland and contain 64 hollow-bearing trees.
- 205.13 ha are relatively degraded secondary grasslands, modified by agriculture.

It is noted for the solar farm area, the majority of the development footprint, that the impacts of the project in derived grasslands do not involve total removal of vegetation. The vast majority of impact will be from shading by panel modules which may not lead to substantive composition or structural changes. For the purpose of this assessment however, 100% removal is assumed.

Habitat quality

The overall habitat quality score (0-10) was determined by considering the following factors (as outlined in the 'How to use the Offsets Assessment Guide') individually:

- Site condition. Including vegetation condition, structure and species diversity;
- Site context. The biodiversity importance of the site in terms of its landscape position;
- Species stocking rate. The number of individual populations at the site.

The contribution of these factors was noted according to their level of importance. The results of this analysis are provided in the below table. As potential offset sites are within the project boundary or immediate area, the start quality of both areas was considered to be the same.

Table 1 Overall habitat quality score for Box Gum Woodland / Derived Native Grassland CEEC

Factor	Score	Importance Ranking	Reasoning
Site condition	6 (BGW treed) 1 (BGW grassland)	1	Where BGW CEEC occurs with tree cover within the solar farm it was classified as being in moderate condition. A total of 30.5 ha is considered to support high diversity and nine hollow-bearing trees. **A condition rating of 6 has been given to the grassland areas based on the floristics analysis presented in Table 7-5 against EPBC criteria.** Where BGW occurs as a derived grassland it is primarily of low condition. A total of 205 ha is degraded. **A condition rating of 1 has been given to the grassland areas based on the floristics analysis presented in Table 7-5 against EPBC criteria.**
Site context	6 (BGW treed) 2 (BGW grassland)	2	Aerial imagery demonstrates the site itself varies between cleared and sparsely treed areas of vegetation. The site comprises mostly paddocks within flatter land or foot slopes, which have been cleared for agricultural purposes. There are no significant connectivity features within the development site itself. At a local scale the project area supports some small patches of treed BGW directly south of the site, but this only provides some minor connectivity value. The value of the treed BGW within the site is therefore important locally given the prior clearance and fragmented nature of the woodland within the project area. **A score of 6 has been given to the treed BGW habitat as its importance value is assumed higher than the grassland areas.** The Wollar Valley has a patchy distribution of both exotic and native pastures. The proposed solar farm is not expected to disrupt connectivity of native grasslands when consideration is given the large area of native grasslands surrounding the development site that exist within Wollar Valley (~8000ha). At a regional scale, the project area can be seen to be located within cleared agricultural land, with woodland outside the development zone to the west and south. As treed vegetation is primarily non-existent or patchy within the project area, it does not facilitate direct linkages to the woodland located outside the project area. **A score of 1 has been given to the BGW grassland habitat as its importance value is lower than the treed BGW and it is more abundant in the landscape.**
Species stocking rate	N/A	N/A	N/A
Overall quality score	**6 (BGW treed)** **1 (BGW grassland)**		

Quantum of impact

For treed BGW the quantum of impact (adjusted hectares), based on the habitat quality score of six is: 14.31 ha.

For BGW grassland the quantum of impact (adjusted hectares), based on the habitat quality score of one is: 20.31 ha.

Offset description

An offset site has not been identified at the time of writing; however, it is proposed to offset impacts within the local area under one offset site, protecting the better-quality residual areas within the project area. There is good potential to offset the south western portion of the project area where Box Gum Woodland (BGW) is not impacted to preserve and enhance CEEC habitat onsite. These areas are in better condition and have better connectivity values due to the more mature/hollow bearing trees. There is scope to improve connectivity values within this area.

The Wollar Valley comprises largely of BGW and Derived Native Grassland (DNG) habitat on the valley flats and foot slopes. It is estimated around 5497ha of BGW/DNG in area (inclusive of powerlines and dirt roads running through Wollar valley) is present within the wider area (i.e. outside the project area). This figure has been assumed from aerial photography, knowledge of the landscape, and observation of vegetation within the landscape during field surveys. The occurrence of BGW/DNG however, has not been validated through quantitative field surveys.

Time horizon

The risk-related time horizon has been set at the maximum forecast term of 20 years as the offset site would be legally secured and managed in perpetuity under a NSW BC Act Stewardship agreement.

The time until ecological benefit was entered as 5 years, as the offset package would not expect to be finalised until after construction of the solar farm so that all impacts can be accurately accounted for.

Start area and quality

The start area required to achieve 90% offset for impact to 30.5 ha of treed BGW in moderate condition is 205 ha.

The start area required to achieve 90% offset for impact to 20.3 ha of BGW grassland in low condition is 208 ha.

It is assumed this total number of ha to offset the impact can be achieved in the local area if the assumption that approximately 5497 ha of BGW/DNG is present within the Wollar Valley, as described above.

Offset quality has been given the condition rank of 6 (from ten), as the surrounding vegetation within the landscape is considered to represent 'moderate' quality habitat.

Future area and quality without offset

RISK OF LOSS

An estimate of 45% risk of loss without offset has been applied to the treed BGW and 70% risk of loss without offset to the grassland BGW as the site is unprotected and subject to agricultural activities. The sites are currently utilised for agriculture and are situated in an area where this is the dominant land use. A widespread fire is likely to have stimulated the seed bank and is reflected in current plot data composition however, the ground cover amount shows impacts of drought and grazing and is unlikely to improve, in consideration of land use alone. The land is privately owned and not protected by any conservation agreements or reservation schemes. There are no known pending mining leases or development applications that apply to the candidate offset sites. As stated in the 'How to use the Offsets Assessment Guide', degradation to the quality of the site due to current management practices and use should not be incorporated into the risk of loss as these factors are incorporated

in the quality score. However, it is considered reasonable that future land management practices be considered. These may include broad scale spraying and cropping.

QUALITY

The future quality of the treed BGW without offset has been entered as four, as degradation over time would be expected to reduce habitat and vegetation condition and quality.

The future quality of the BGW grassland without offset has been entered as two, as the land is already heavily degraded and further degradation above that already occurring is not expected.

Future area and quality with offset

RISK OF LOSS

The Stewardship agreement for the offset site would be a formal, legal protection mechanism for BGW/DNG. However, there may still be some natural attrition and the intentions of landowners are unknown. Therefore, the future risk of loss with offset has been set at 5%.

With 5% risk of loss, the offset calculator shows the adjusted hectares of an offset site as 194.8 ha for the treed BGW.

With 5% risk of loss, the offset calculator shows the adjusted hectares of an offset site as 197.6 ha for the BGW grassland.

QUALITY

Management of offset sites would include managing grazing for conservation, minimising clearing as well as weed and erosion control. With these measures in place, over time it is expected that the quality of the vegetation on site would improve to 'moderate-good'. A quality factor of eight has been entered for the treed BGW area and a quality factor of seven has been entered for the BGW grassland areas.

Gain from offset

RAW GAIN

For the treed BGW offsetting is expected to bring about a raw gain of 82 ha and a quality score increase of eight. This assumes active management.

For the BGW grassland offsetting is expected to bring about a raw gain of 135.20 ha and a quality score increase of five. This assumes active management such as planting overstorey species appropriate to the community.

CONFIDENCE IN RESULT

The estimated values for risk of loss are based on factors outside the control of the Wollar Solar Farm, but are considered reasonable, given the known land use history. An 80% confidence in these results has been applied.

ADJUSTED GAIN

Considering an 80% confidence, the potential adjusted gain from offsetting the impact is 65.6 ha for the treed BGW and 108.16 ha for the BGW grassland.

NET PRESENT VALUE

The net present value (adjusted hectares) is 14.08 ha for treed BGW.

The net present value (adjusted hectares) is 20.31 ha for BGW grassland.

Results

PERCENTAGE OF IMPACT OFFSET

The minimum direct offset requirement (90% direct offset required) equates to:

- 205 ha for treed BGW.
- 208 ha for BGW grassland.
- **413 ha in total.**

REQUIRED AREA OF LIKE-FOR-LIKE

It is noted that the Wollar Valley comprises largely of BGW and Derived Native Grassland (DNG) habitat on the valley flats and foot slopes. It is estimated around 5497ha of BGW/DNG in area (inclusive of powerlines and dirt roads running through Wollar valley) is present within the wider area (i.e. outside the project area). This figure has been assumed from aerial photography, knowledge of the landscape, and observation of vegetation within the landscape during field surveys. The occurrence of BGW/DNG however, has not been validated through quantitative field surveys.

Within the project boundaries, in areas that would not be impacted by the development, around 217 ha of CEEC is available for protection under an offset agreement. Based on available mapping, though not subject to detailed survey, it is estimated that an additional 258 ha remains within the property boundary, that would not be impacted by the development and may provide suitable direct offsets. If suitable, this exceeds the required amount by 62 ha.

APPENDIX G BAM CALCULATOR CREDIT REPORT

BAM Credit Summary Report

Proposal Details

Assessment Id
00011361//19/00012396

Proposal Name
Wollar Solar Farm BDAR_Major Project_BDAR Ver 2_11-10-19

BAM data last updated *
17/10/2019

Assessor Name
Mitch Palmer

Report Created
23/10/2019

BAM Data version *
16

Assessor Number
17051

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
3

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion								
4	281_BGW_Zone5	59.6	8.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	238

5	281_DNG_Zone6	11.9	102.8	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							Subtotal	**238**
White Box - Black Cypress Pine shrubby woodland of the Western Slopes								
6	1610_Good_Zone 8	27.0	0.1	0.25	High Sensitivity to Potential Gain	1.75		2
7	1610_Degraded_ Zone9	2.3	27.1	0.25	High Sensitivity to Potential Gain	1.75		0
							Subtotal	**2**
White Box - Grey Gum - Kurrajong grassy woodland on slopes of the northern Capertee Valley, Sydney Basin Bioregion								
1	1303_BGW_Zone 1	56.8	16.5	0.25	High Sensitivity to Potential Gain	2.00	TRUE	468
2	1303_DNG_Zone 2	9.4	102.3	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
3	1303_Cultivated_ Low_Zone3	11.4	110.7	0.25	High Sensitivity to Potential Gain	2.00	TRUE	0
							Subtotal	**468**
							Total	**708**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Acacia ausfeldii / Ausfeld's Wattle (Flora)						
281_BGW_Zone5	59.6	1.06	0.25	2	False	32

1610_Good_Zone8	27.0	0.14	0.25	2	False	2
					Subtotal	**34**
Burhinus grallarius / Bush Stone-curlew (Fauna)						
281_BGW_Zone5	59.6	1.06	0.25	2	False	32
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
					Subtotal	**34**
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)						
281_BGW_Zone5	59.6	5.59	0.25	2	False	167
281_DNG_Zone6	11.9	2.08	0.25	2	False	12
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
1610_Degraded_Zone9	2.3	0.99	0.25	2	False	1
					Subtotal	**182**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)						
281_BGW_Zone5	59.6	1.06	0.25	3	True	47
1610_Good_Zone8	27.0	0.14	0.25	3	True	3
					Subtotal	**50**
Commersonia procumbens / Commersonia procumbens (Flora)						
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
1610_Degraded_Zone9	2.3	0.21	0.25	2	False	0
					Subtotal	**2**

Monotaxis macrophylla / Large-leafed Monotaxis (Flora)						
281_BGW_Zone5	59.6	1.06	0.25	2	False	32
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
					Subtotal	**34**
Ninox connivens / Barking Owl (Fauna)						
281_BGW_Zone5	59.6	1.2	0.25	2	False	36
281_DNG_Zone6	11.9	0.06	0.25	2	False	0
1610_Degraded_Zone9	2.3	0.08	0.25	2	False	0
					Subtotal	**36**
Ninox strenua / Powerful Owl (Fauna)						
281_BGW_Zone5	59.6	1.2	0.25	2	False	36
281_DNG_Zone6	11.9	0.06	0.25	2	False	0
					Subtotal	**36**
Petaurus norfolcensis / Squirrel Glider (Fauna)						
281_BGW_Zone5	59.6	1.06	0.25	2	False	32
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
					Subtotal	**34**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)						
281_BGW_Zone5	59.6	0.94	0.25	2	False	28
281_DNG_Zone6	11.9	0.38	0.25	2	False	2
1610_Good_Zone8	27.0	0.14	0.25	2	False	2

1610_Degraded_Zone9	2.3	0.1	0.25	2	False	0
					Subtotal	**32**
Phascolarctos cinereus / Koala (Fauna)						
281_BGW_Zone5	59.6	1.06	0.25	2	False	32
1610_Good_Zone8	27.0	0.14	0.25	2	False	2
					Subtotal	**34**
Tyto novaehollandiae / Masked Owl (Fauna)						
281_BGW_Zone5	59.6	1.2	0.25	2	False	36
281_DNG_Zone6	11.9	0.06	0.25	2	False	0
					Subtotal	**36**
Vespadelus troughtoni / Eastern Cave Bat (Fauna)						
1303_BGW_Zone1	56.8	0	0.25	3	True	0
281_BGW_Zone5	59.6	0	0.25	3	True	0
					Subtotal	**0**

APPENDIX H ASSESSMENT PERSONNEL

Name	Title	Qualifications	Roles
Brooke Marshall	Project Director	• Certified Environmental Practitioner (CEnvP) • BAM Accredited Assessor • B. Nat Res (First Class Honours)	Review and approval of BDAR
Dave Maynard	Principal Ecologist	• BAM Accredited Assessor • B Science (Ecology, First Class Honours)	Direction in BAM assessment and BDAR. Preliminary review.
Gillian Young	Senior Ecologist	• BAM Accredited Assessor • B. Nat Res (Second Class Honours)	Field work including PCT identification, vegetation mapping, vegetation plots and threatened flora surveys. Main author and assessor of the BDAR report. Author of BAM Calculator report. AOS assessment for EPBC listed CEECs onsite.
Colin Bower	Field ecologist	• BAM Accredited Assessor • Bachelor of Science (Hons) and Ph.D. Entomology	Field work including stratifying vegetation and collection of VI Plot data.
Zoe Quaas	Field ecologist	• B. Env. Sc. and Mgmt (First Class Honours)	Field work including threatened fauna surveys. Writing parts of the BDAR report. GIS Mapping
Mitch Palmer	Field ecologist and co author	• BAM Accredited Assessor • B. Science	Field work including threatened flora/fauna surveys. AOS assessment of EPBC listed fauna species.
Lauren Byrne	Field ecologist	• B. Science	Assistant to field work including threatened flora/fauna surveys.
Brendon True	Field ecologist	• BAM Accredited Assessor • Master of Conservation Biology • Bachelor of Science (Ecology and Biodiversity)	Field work including habitat trees survey and PCT mapping alongside Barigan Road.

APPENDIX C ADDENDUM ACHA REPORT

NGH 2019

Report Title	Addendum Aboriginal Cultural Heritage Assessment Eastern Expansion Area-Wollar Solar Farm- Final
Author(s) Name	Kirsten Bradley and Matthew Barber
Author(s)' Organisation Name (if applicable)	NGH Environmental Pty Ltd
Author(s) contact details	Email: matthew.b@nghenvironmental.com.au Phone: 02 6153 6320
Address of Subject Area	No: 96 Street: Maree Road Suburb: Trichular State: NSW Postcode: 2580 Title Reference: • portion of Lot 84 DP 755430, Lot 46 DP 755430, an unused road reserve Lot extending north from the existing Maree Road alignment and Barigan Road. Local Government Area: Mid-Western Regional Other:
Report prepared for	Company Name: Wollar Solar Development Pty Ltd Contact Person: Bruce Howard Address: PO Box K1053 Haymarket NSW 1240 Email: bruce.howard@wollarsolarfarm.com Phone: m: 0438 198 385
Date of Report	14 October 2019
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Addendum Aboriginal Cultural Heritage Assessment

EASTERN EXPANSION AREA AND BARIGAN ROAD UPGRADE - WOLLAR SOLAR FARM

OCTOBER 2019

Document Verification

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NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622).

www.nghenvironmental.com.au e: ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
8/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Brisbane
suite 4, level 5, 87 wickham terrace
spring hill qld 4000 (t 07 3129 7633)

Newcastle - Hunter and North Coast
2/54 hudson st
hamilton nsw 2303 (t 02 4929 2301)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Bega - ACT and South East NSW
89-91 auckland st (po box 470)
bega nsw 2550 (t 02 6492 8333

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INTRODUCTION

NGH Pty Ltd (NGH) has been contracted by Wollar Solar Development Pty Ltd (WSD) to complete an Aboriginal Cultural Heritage Assessment (ACHA) to investigate and examine the presence, extent and nature of any Aboriginal heritage sites within the Wollar Solar Farm proposal area as part of an Environmental Impact Assessment (EIS). Subsequent to the finalisation of the Wollar Solar Farm ACHA a 2.3 ha area outside the previous heritage assessment was identified in April 2019 for inclusion in the proposed Wollar Solar Farm development footprint. This area is referred to in this addendum report as the Eastern Expansion area. Following investigation of this area, the eastern expansion area has been refined to 0.8 ha and will be referred to herein as the 'Maree Road reserve construction corridor'. The Eastern Expansion area has been assessed in full, however the impact of the proposal will be limited to the Maree Road reserve construction corridor as indicated.

In addition to this area, a second additional area requiring assessment was identified in August 2019 relating to access. Access to the site during the construction of the solar farm will be via Barigan Road and Maree Road, both of which are unsealed local roads. Due to the increased usage which will occur as a result of this project and the nature of the usage – primarily heavy vehicles – an upgrade to Barigan Road including widening is required to improve safety.

It is understood that ground disturbance associated with the proposed Eastern Expansion of the Wollar Solar Farm development footprint and the upgrade to Barigan Road have the potential to impact on Aboriginal heritage sites and objects which are protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act).

This addendum report documents the ACHA undertaken for the additional 2.3 ha for the proposed Eastern Expansion development footprint (which includes the refined 0.8 ha Maree Road reserve construction corridor) and the additional 8.8 ha for proposed upgrade works to Barigan Road, to investigate the presence of any Aboriginal sites, assess impacts to cultural heritage values, and provide management strategies to mitigate any potential impacts within the additional areas. This addendum report is intended to be read in conjunction with the original Wollar Solar Farm ACHA report (NGH Environmental 2018).

ABORIGINAL CONSULTATION

The consultation with Aboriginal stakeholders has been undertaken in accordance with clause *80C of the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010* following the consultation steps outlined in the ACHCRP guide provided by OEH. All consultation undertaken for the original Wollar Solar Farm ACHAR is clearly outlined and documented in the original report. Consultation about the Eastern Expansion area has been a continuation of this process in accordance with provisions of acceptability outlined by OEH and in line with Guidelines for *Aboriginal cultural heritage consultation requirements for proponents 2010.*

The full consultation steps completed for this addendum are outlined in Section 2 and the consultation log is provided in Appendix A.

ARCHAEOLOGICAL CONTEXT

Given that the initial AHIMS search was conducted nearly 12 months ago a new search of the database was conducted for this addendum report. The updated search identified that no new sites had been recorded on AHIMS in close proximity to the proposal area beyond those recorded during the survey of the Wollar Solar Farm.

Given that Aboriginal people have lived in the region for tens of thousands of years, there is potential for archaeological evidence to occur throughout the proposed Eastern Expansion area and the proposed Barigan Road Upgrade area for the Wollar Solar Farm, this is most likely to be in the form of stone artefacts or as scarred trees.

SURVEY RESULTS

PROPOSED EASTERN EXPANSION AREA

Survey transects were undertaken on foot and traversed the entire proposed Eastern Expansion area. While the survey was impeded by poor visibility across the majority of the proposed Eastern Expansion area a number of exposures were present that were inspected. However, no surface Aboriginal objects or culturally modified trees were recorded.

PROPOSED BARIGAN ROAD UPGRADE AREA

A single survey transect was undertaken on foot by the NGH archaeologist and three representatives from registered Aboriginal parties from the northern end of the proposed road upgrade area to the intersection with Maree Road. Ground surface visibility was high and four artefacts scatters and three isolated finds were identified, containing a total of 44 artefacts. The two largest artefact scatters, containing the majority of the total assemblage, were located in close proximity to the banks of Wollar Creek. All site identified had been extensively disturbed as a result of previous road construction and maintenance.

POTENTIAL IMPACTS

PROPOSED EASTERN EXPANSION AREA

Given that no Aboriginal archaeological sites were located within the proposed Eastern Expansion area for the Wollar Solar Farm the assessment of harm and impact to Aboriginal heritage values for this proposed expansion to the development is nil. Consequently, there are no mitigation methods proposed for the expansion of the Wollar Solar Farm development footprint into the Eastern Expansion area.

PROPOSED BARIGAN ROAD UPGRADE AREA

In the Barigan Road Upgrade Area, a total of nine sites, including four artefact scatters and five isolated finds were identified within the Proposed Barigan Road Upgrade Area. All of these sites will likely be subject to impacts as a result of the proposed upgrade works due to the movement of plant and vehicles within the road reserve and the ground surface disturbance required for the road widening. Table 6-1 provides a summary of the impacts.

Table 1-1 Summary of the degree of harm and consequence of harm for sites

AHIMS ID	Site Name	Type of Harm	Degree of Harm	Consequence of Harm
TBC	NGH Barigan AFT 1	Direct	Complete (for known extent of site)	Total loss of value (for known extent of site)
TBC	NGH Barigan AFT 2	Direct	Complete	Total loss of value
TBC	NGH Barigan AFT 3	Direct	Complete	Total loss of value
TBC	NGH Barigan AFT 4	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 1	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 2	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 3	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 4	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 5	Direct	Complete	Total loss of value

RECOMMENDATIONS

It is recommended that:

1. The proposed Eastern Expansion of the Wollar Solar Farm development footprint as detailed in this addendum report has negligible potential to impact Aboriginal objects.
2. The proposed Eastern Expansion of the Wollar Solar Farm development footprint should now be able to proceed without any additional Aboriginal archaeological investigation.
3. The proposed Barigan Road Upgrade as detailed in this addendum report will impact nine artefact sites recorded as part of this assessment.
4. The artefacts identified at NGH Barigan AFT 1, 2, 3 and 4; and NGH Barigan IF 1, 2, 3, 4 and 5, must be salvaged prior to the proposed work commencing and moved to a safe area within the Wollar Solar Farm development footprint. Note that this in addition to artefacts referenced in Recommendation 4 of the Wollar Solar Farm ACHA (NGH 2018) which are to be salvaged prior to construction.
5. The surface collection and relocation of the artefacts must be undertaken by an archaeologist and representatives of the registered Aboriginal parties. The salvage should be consistent with the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* A new site card must be completed once the artefacts are moved to record their new location on the AHIMS database. Note that RAP comments include a request for the option to test

excavate where topsoils are present within the impact zone. This will be determined by the proposed road upgrade design (refer to Section 2.1 Table 2-1).

6. It is recommended that the proposed upgrade works be designed to avoid subsurface disturbance further than one metre from the edge of the gravel road on the eastern side of Barigan Road between NGH Barigan Rd AFT 3 and NGH Barigan Rd IF3. This relates to the presence of topsoils which are present along the side of the road in this location, which have some potential to contain Aboriginal objects.
7. With reference to the Wollar Solar Farm ACHA (NGH 2018), reburial of artefacts is the preferred option for the management of Aboriginal objects recovered during salvage works. Artefacts recovered from Barigan Road should be reburied within the road reserve and as close to their original location/s as possible. The Aboriginal community requests that a Cultural Smoking Ceremony be accommodated to cleanse the salvaged artefacts and the reburial location.
8. WSD should prepare a Cultural Heritage Management Plan (CHMP) which includes an unexpected finds procedure. Preparation of the CHMP should be undertaken in consultation with the registered Aboriginal parties and be incorporated into the overall management plan for the solar farm.
9. In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH, the local police and the registered Aboriginal parties should be notified. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal.

Further archaeological assessment would be required if the proposal activity extends beyond the proposed Eastern Expansion area or the proposed Barigan Road upgrade area as assessed in this addendum report and the Heritage study area as detailed in the original Wollar Solar Farm ACHA. This would include consultation with the registered Aboriginal parties and may include further field survey.

1 INTRODUCTION

NGH was previously contracted by Wollar Solar Development Pty Ltd (WSD) to complete an Aboriginal Cultural Heritage Assessment (ACHA) to investigate and examine the presence, extent and nature of any Aboriginal heritage sites within the Wollar Solar Farm proposal area as part of an Environmental Impact Assessment (EIS). An ACHA report for the proposal area was prepared and the draft document was sent to the Registered Aboriginal Parties (RAPs) for review and comment before being finalised.

Following the finalisation of the Wollar Solar Farm ACHA (NGH 2018), an area outside the boundary covered by the original heritage assessment was identified for the expansion of the proposed Wollar Solar Farm development footprint in April 2019. This area is referred to in this report as the Eastern Expansion area (see Figure 1 and 2). The Eastern Expansion area had a development footprint of 2.3 ha which is entirely outside the area accessed in the initial Wollar Solar Farm ACHA report. Following investigation of this area, the eastern expansion area has been refined to 0.8 ha.

In addition to this area, a second additional area requiring assessment was identified in August 2019 relating to access. Access to the site during the construction of the solar farm will be via Barigan Road and Maree Road, both of which are unsealed local roads. Due to the increased usage which will occur as a result of this project and the nature of the usage – primarily heavy vehicles – an upgrade to Barigan Road is required to improve safety.

The proposal areas are within the Mid Western Regional local government area (LGA).

It is understood that ground disturbance associated with the proposed Eastern Expansion development footprint and Barigan Road upgrade has the potential to impact on Aboriginal heritage sites and objects which are protected under the NSW *National Parks and Wildlife Act 1974* (NPW Act).

This addendum report documents the assessment undertaken for the additional 2.3 ha for the proposed Eastern Expansion development footprint and Barigan Road upgrade to investigate the presence of any Aboriginal sites, assess impacts to cultural heritage values, and provide management strategies to mitigate any potential impacts within the additional area. This addendum report is intended to be read in conjunction with the original Wollar Solar Farm ACHA report (NGH 2018) as the background analysis, predictive modelling and general discussion detailed therein continues to be relevant to the analysis undertaken in this addendum and are therefore not repeated.

It is intended that this addendum report will be submitted as part of an amended Development Application (DA) for the development footprint of the Wollar Solar Farm to cover the entirety of the additional Eastern Expansion area and Barigan Road upgrade. Continued Aboriginal consultation, an updated AHIMS search, survey results, coverage and impact assessment are detailed in this addendum to inform the recommendation and mitigation strategies to minimise impacts within the Eastern Expansion area for the proposed Wollar Solar Farm.

1.1 PROPOSED EASTERN EXPANSION AREA

The proposed Eastern Expansion of the Wollar Solar Farm development footprint which was assessed in April 2019 includes a portion of Lot 84 DP 755430, Lot 46 DP 755430 and unused road reserve Lot extending north from the existing Maree Road alignment that encompasses an area of approximately 2.3 ha. This area was assessed in April 2019.

Subsequent to the completion of the assessment covering the 2.3 ha, the proposed development footprint was refined to a 0.8 ha portion of the unused road reserve which is wholly within the assessed area, and is known as the Maree Road reserve construction corridor.

While specific design details are currently not available, construction of a new road is proposed in this area will include ground disturbances.

Figure 1-1 shows the general location of the Wollar Solar Farm and Figure 1-2 shows the project area to which this addendum refers, the Maree Road reserve construction corridor is shown in Figure 1-3. It is understood that impacts will occur only within the Maree Road reserve construction corridor, however this addendum assessment report addresses the Eastern Expansion area as the project area, while the Maree Road reserve construction corridor is considered to be the impact area.

1.2 PROPOSED BARIGAN ROAD UPGRADE

The proposed road upgrade for the Wollar Solar Farm is located on Barigan Road between Wollar township and Maree Road, and will occur wholly within road reserve. This area was assessed in September 2019.

Where the pavement is less than 7m in width, Barigan Road between Wollar township and Maree Road will require widening to achieve a 7m wide pavement (and slightly wider along bends within the road) to ensure simultaneous two-way traffic movement. All widening would occur within a 12m corridor of Barigan Road. The route is approximately 7.2 km in length and is located entirely within existing road reserve.

These works will include ground surface disturbance as well as the movement of vehicles and plant along the road and road verges during the construction works.

Figure 1-1 shows the general location of the Wollar Solar Farm and Figure 1-2 shows the project area to which this addendum refers. It should be noted that the project area includes the full road reserve of Barigan Road, while the proposed impact area is likely to be a smaller area inside the reserve.

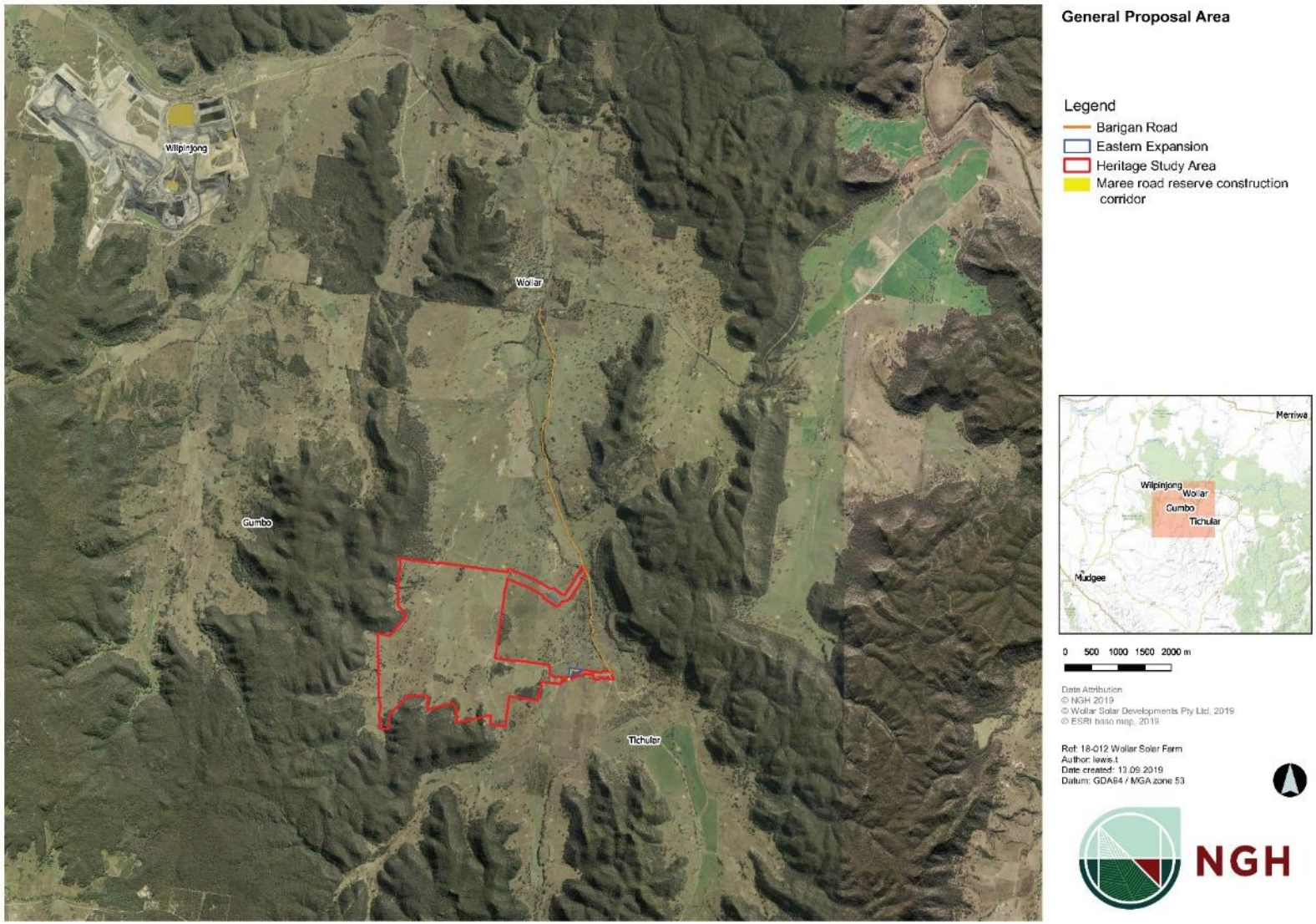


Figure 1-1. General proposal area

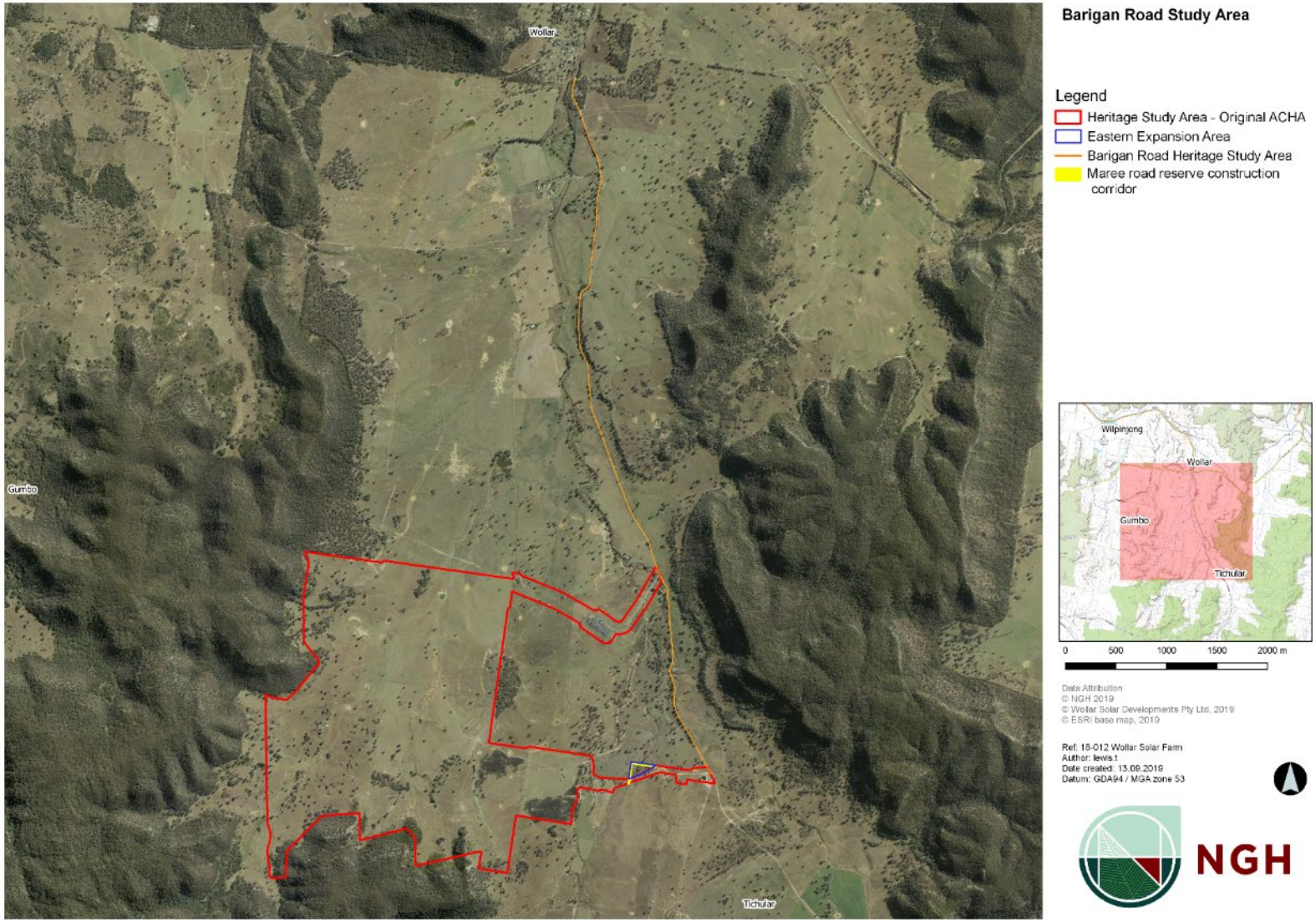


Figure 1-2. Proposal Area – Eastern Expansion Area and Barigan Road Upgrade Area

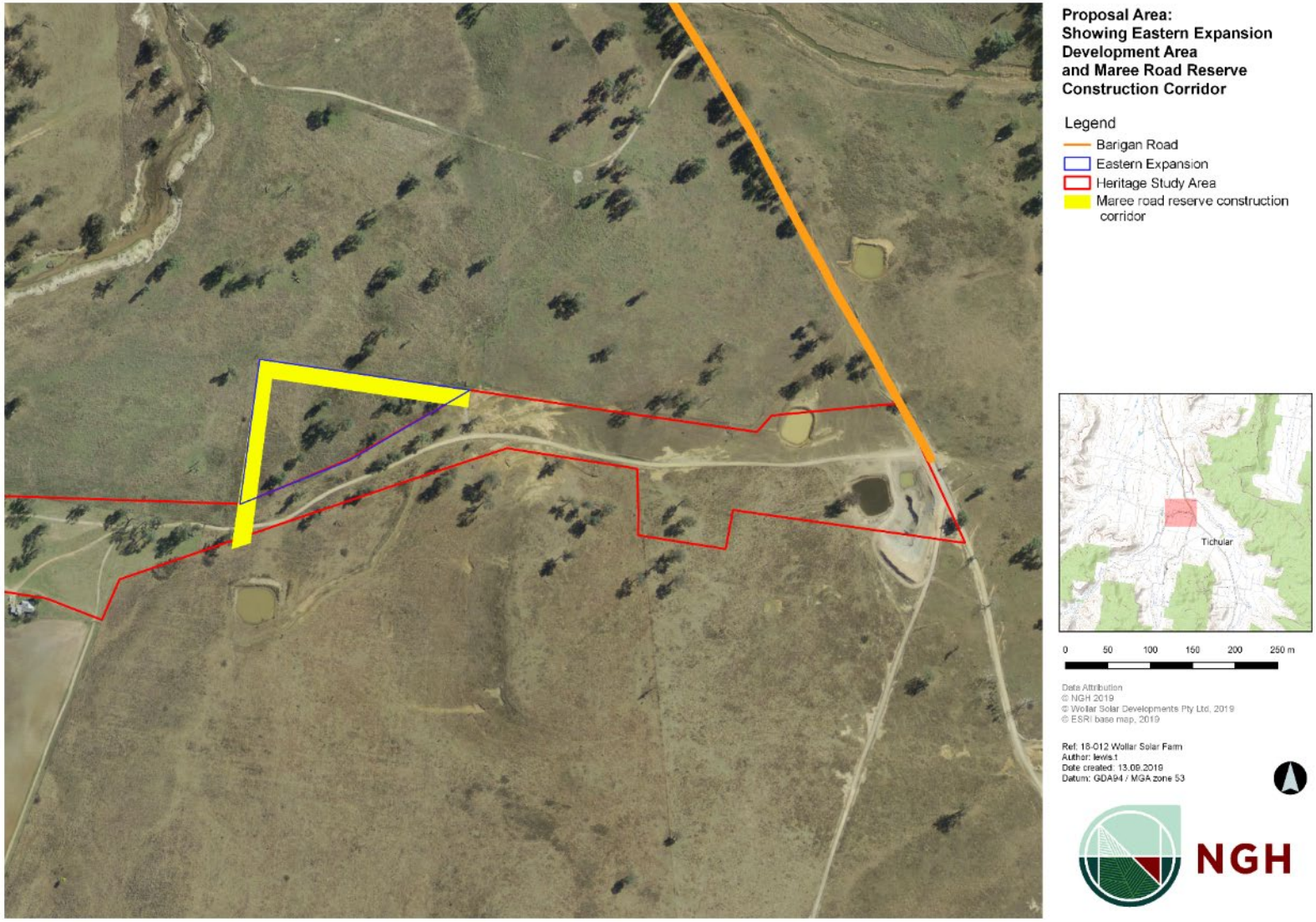


Figure 1-3 Proposal Area with Maree Road Reserve Construction Corridor

1.3 PROJECT PERSONNEL

The addendum assessment was undertaken by NGH Environmental archaeologists Kirsten Bradley and Ali Byrne, including research, Aboriginal community consultation, field survey and report preparation. Matthew Barber of NGH Environmental reviewed the report.

Consultation with the Aboriginal community was continuous from the initial project and followed the process outlined in OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010.* OEH was informed of this approach prior to the notifications being provided to the RAPs regarding the proposed expansion of the development footprint in April 2019, road upgrade in August 2019 and resulting addendum report.

Details regarding the consultation undertaken with reference to this addendum and additional surveys required at the Eastern Expansion and Barigan Road Upgrade areas are provided in Appendix A, including a consultation log and records of correspondence. A summary is also provided in Section 2.

This project has ten Aboriginal organisations and one individual recorded as RAPs.

These groups are:

- North West Wiradjuri Company LTD;
- Murong Gialinga Aboriginal & Torres Strait Islander;
- Buudang;
- Wellington Valley Wiradjuri Aboriginal Corporation;
- Gallaggabang Aboriginal Corporation;
- Mudgee LALC;
- Binjang Wellington Wiradjuri Heritage Survey;
- Barraby Cultural Services;
- Yulay Cultural Services; and
- Yurrandaali Cultural Services.

The individual who registered was:

- Paul Brydon

No other party registered their interest, including the entities and individuals recommended by OEH.

The fieldwork for the proposed Eastern Expansion area was arranged with the intention that the four registered parties who participated in the initial survey fieldwork in July 2018 would participate in the fieldwork. However due to a number of unforeseeable circumstances only two of the registered parties selected for fieldwork were able to participate in the survey conducted on the 9th of April 2019.

Representatives who participated in the fieldwork for the proposed Eastern Expansion area were:

- James Williams (representing Mudgee LALC); and
- Bradley Bliss (representing Wellington Valley Wiradjuri Aboriginal Corporation).

For the proposed Barigan Road upgrade works, the four RAPs who originally participated in the survey were again approached for sites officers to complete the field survey. Three representatives attended the field work undertaken on 29th August 2019, as follows:

- Tammy Peterson (representing Mudgee LALC);
- Steven Flick (representing Murong Gialinga); and
- Bradley Bliss (Wellington Valley Wiradjuri Aboriginal Corporation.

Further detail and an outline of the consultation process is provided in Section 2.

1.4 REPORT FORMAT

For the purposes of this addendum, we have prepared the report in line with the following:

- *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH 2011);
- *Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH 2010a), and
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (ACHCRP) (OEH 2010b) produced by the NSW OEH.

The purpose of this addendum ACHA report is to provide an assessment of the Aboriginal cultural values associated with the proposed Eastern Expansion area to the Wollar Solar Farm and the proposed Barigan Road upgrade area, and to assess the cultural and scientific significance of any identified Aboriginal heritage sites within the these areas in the context of the larger solar farm assessment. This conforms to the intention of the SEARs.

The objectives of the assessment were to:

- Continue Aboriginal consultation as specified in clause 80c of the *National Parks and Wildlife Regulation 2009*, using the consultation process outlined in the ACHCRP and in alignment with the OEH Guideline: *Applying for an Aboriginal Heritage Impact Permit: Guide for Applicants;*
- Undertake an assessment of the archaeological and cultural values of the proposed expansion areas and any Aboriginal sites therein;
- Assess the cultural and scientific significance of any archaeological material; and
- Provide management recommendations for any objects found.

2 ABORIGINAL CONSULTATION

The consultation with Aboriginal stakeholders has been undertaken in accordance with clause *80C of the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010* following the consultation steps outlined in the ACHCRP guide provided by OEH. All consultation undertaken for the Wollar Solar Farm ACHAR is clearly outlined and documented in the original report. Consultation about the proposed expansion area and road upgrades for the Wollar Solar Farm has been a continuation of this process in accordance with the advice previously provided by OEH.

The details of consultation steps undertaken, including names of groups and individuals that were contacted, and a consultation log, is provided in Appendix A. A summary of actions carried out for the current assessment is detailed below.

The RAPs were informed of the proposed changes to the development footprint in the area referred to as the Eastern Expansion area in April 2019 and about the proposed Barigan Road upgrade in August 2019. The methodology for the proposed survey of the Eastern Expansion area and Barigan Road upgrade area was noted to be in line with that proposed during the completion of the original Solar Farm assessment and would include survey with selected RAPs. The RAPs who participated in the initial ACHA survey were then asked to participate in the additional surveys of the Eastern Expansion area and Barigan Road upgrade area given that these were outside the area assessed in the original Wollar Solar Farm ACHA.

The fieldwork covering the Eastern Expansion area was carried out on the 9th of April 2019 by NGH archaeologist Kirsten Bradley with two representatives from the Aboriginal community. The representatives who participated in the fieldwork for the proposed Eastern Expansion area were:

- James Williams (representing Mudgee LALC) and
- Bradley Bliss (representing Wellington Valley Wiradjuri Aboriginal Corporation).

In April 2019 a draft version of this *Addendum Aboriginal Cultural Heritage Assessment Report* for the proposed Eastern Expansion area for the Wollar Solar Farm was forwarded to each registered Aboriginal party inviting comment on the results, the significance assessment and the recommendations. A response period of 28 days was allowed for responses to the document.

The fieldwork covering the proposed Barigan Road upgrade area was then completed on 29th August 2019 by NGH archaeologist Ali Byrne and three representatives from the RAPs:

- Tammy Peterson (representing Mudgee LALC);
- Steven Flick (representing Murong Gialinga); and
- Bradley Bliss (Wellington Valley Wiradjuri Aboriginal Corporation.

In September 2019 the addendum report was then updated to include the results of this survey. A draft version of the *Addendum Updated Aboriginal Cultural Heritage Assessment Report* for the proposed Eastern Expansion area and the Barigan Road upgrade for the Wollar Solar Farm (this document) was provided to the RAPs, for review and comment on 16 September 2019. A response period of 28 days was allowed for the receipt of comments.

2.1 ABORIGINAL COMMUNITY FEEDBACK

Community consultation occurred throughout the project. The draft addendum report and draft addendum updated report were provided to each of the RAPs and feedback was sought on the recommendations, the assessment and any other issues that may have been important.

Draft Addendum Report (April 2019)

Wellington Valley Wiradjuri Aboriginal Corporation and Gallaggabang Aboriginal Corporation provided a joint response to the draft addendum report (April 2019) in writing via a letter dated the 22 April 2019. Both groups noted that they agreed with the findings of the report and the recommendations. Barraby Cultural Services replied via email on the 23 April 2019 that they had received the document however no further comments were provided.

Report feedback was provided in writing via email from Murong Gialinga Aboriginal & Torres Strait Islander on the 20 May 2019 who did not raise any issues with the report or its recommendations.

Report feedback was provided in writing via email from Paul Brydon on the 22 May 2019 who did not raise any issues with the report or its recommendations.

No feedback was received from the North West Wiradjuri Company LTD, Buudang, Mudgee LALC, Binjang Wellington Wiradjuri Heritage Survey, Yulay Cultural Services and Yurrandaali Cultural Services.

Draft Addendum Updated Report (September 2019)

Comments received on the updated addendum report are provided in the table below for ease of reference, in addition to responses provided by NGH regarding the comments.

Table 2-1 RAP responses to Draft Addendum Updated Report September 2019

RAP Organisation	RAP Comment	NGH Response
Murong Gialinga Aboriginal and Torres Strait Islander	Agree with the recommendations but would like to see test excavation in addition to surface collection at Barigan AFT 1, 2, 3 and 4. Would also like a location or locations identified for the reburial of the artefacts within the road reserve following completion of works. Locations must be agreed upon by RAPs.	NGH notes the preference for subsurface testing at sites AFT 1, 2, 3 and 4. Due to the nature of the disturbances along the road, including modification of the verges and significant erosion cause by runoff, NGH believes that subsurface testing would not be required. It is noted that in the vicinity of AFT 3 and IF3, some topsoils remained present on the eastern side of the road, from approximately 1-2 metres away from the road, to the fenceline. NGH suggests that surface salvage be undertaken and, where proposed road upgrade works cannot avoid the identified topsoils in this area, a limited testing programme of test pits may be placed to determine the nature of the deposit. NGH has included the comments relating to reburial in the recommendations of this report.
Buudang	Refer to Murong Gialinga Aboriginal and Torres Strait Islander (comments supplied were joint).	See above.
Wellington Valley Wiradjuri Aboriginal Corporation	Agree with the recommendations but would like to see test excavation in addition to surface collection at Barigan AFT 1, 2, 3 and 4. Would also like locations identified for the reburial of the artefacts within the road reserve following completion of works. Locations must be agreed upon by RAPs.	NGH notes the preference for subsurface testing at sites AFT 1, 2, 3 and 4. Due to the nature of the disturbances along the road, including modification of the verges and significant erosion cause by runoff, NGH believes that subsurface testing would not be required. It is noted that in the vicinity of AFT 3 and IF3, some topsoils remained present on the eastern side of the road, from approximately 1-2 metres away from the road, to the fenceline. NGH suggests that surface salvage be undertaken and, where proposed road upgrade works cannot avoid the identified topsoils in this area, a limited testing programme of test pits may be placed to determine the nature of the deposit. NGH has included the comments relating to reburial in the recommendations of this report.
Gallaggabang Aboriginal Corporation	Refer to Wellington Valley Wiradjuri Aboriginal Corporation (comments supplied were joint).	See above.

Mudgee Local Aboriginal Land Council	No comment provided.	-
North West Wiradjuri Company Pty Ltd	No comment provided.	-
Yurrandaali Cultural Services	No comment provided.	-
Yulay Cultural Services	Indicated that they did not wish to comment as they had not been involved in the fieldwork.	Comment noted.
Barraby Cultural Services	No comment provided.	-
Binjang Wellington Wiradjuri Heritage Survey	Happy with report.	Comment noted.
Paul Brydon (Biran Ngurumbang Consulting)	Happy with report.	Comment noted.

3 REVIEW OF ABORIGINAL ARCHAEOLOGICAL CONTEXT

3.1.1 AHIMS Search

A search of relevant heritage registers for Aboriginal sites and places provides information regarding the presence of previously recorded sites. A register search is not conclusive however, as it requires that an area has been inspected and information about any sites identified provided to the relevant body to add to the register. However, as a starting point, the search will indicate whether any sites are known within or adjacent to the investigation area. The Aboriginal Heritage Information Management System (AHIMS) is maintained by BCD (formerly OEH) and provides a database of previously recorded Aboriginal heritage sites. A search provides basic information about any sites previously identified within a search area. The results of the search can be considered valid for 12 months.

An extensive search of AHIMS was undertaken for the Wollar Solar Farm ACHA on the 24th of May 2018 which identified a number of previously identified Aboriginal heritage sites. The AHIMS Client Service Number was: 347074. There were 94 Aboriginal sites and no declared Aboriginal Places recorded in the 16 km east-west x 16 km north-south search area which was centred on the proposal area.

At the time of the original AHIMS extensive search, two sites with artefacts (Wollar Creek 1/AHIMS #36-3-0335 and Wollar Creek 2/AHIMS #36-3-0336) were located within the Solar Farm proposal area along the proposed access track near the substation. Two additional artefact sites were located in close proximity to the proposal area with AHIMS#36-3-0075 located approximately 30 m south-east of the project area and AHIMS # 36-3-0077 located approximately 90 m east of the project area. In total there was eight recorded open artefact sites within a 2 km buffer of the proposal area. All other sites on AHIMS were over 5 km away from the assessment area.

During the field assessment of the Wollar Solar Farm proposal area, as assessed in the original ACHA (NGH 2018), 37 stone artefact sites were recorded within the boundary of the proposed Solar Farm. These archaeological features were recorded as 12 artefact scatters and 25 isolated finds. One grinding groove, one scarred tree, one possible scarred tree and a culturally significant site were also recorded. A site card for each location was submitted to AHIMS for registration with the exception of the possible scarred tree given its ambiguous origin (see Figure 3-1 and Figure 3-2).

Given the approaching expiration of the initial AHIMS search a new search of the database was conducted for the Wollar Solar Farm and the proposed Eastern Expansion Area assessed in this report on the 11th of April 2019. The updated search of the AHIMS database was conducted over an area approximately 7 km east-west x 7 km north-south centred on the proposal area. The recent AHIMS search area was notably smaller than the initial search area. The AHIMS Client Service Number was: 414128. There were 47 Aboriginal sites and no declared Aboriginal Places recorded in the search area. Of the 47 sites 40 of them had been recorded by NGH during the initial survey for the Wollar Solar Farm. The other seven sites had also been identified in the initial search with no other new sites recorded on AHIMS in close proximity to the proposal area beyond those previously noted. Figure 3-1 shows the registered sites in or near the Eastern Expansion Area.

A second additional AHIMS search was completed for the assessment of the proposed Barigan Road upgrade on 21st August 2019, which focussed specifically on the Barigan Road project area; the AHIMS Client Service Number was 443358. This search did not identify any previously unknown or new registered sites within 200 m of the proposed Barigan Road upgrade area. No registered sites have been recorded within the proposed upgrade area, however there are six sites located 200 m or less from the boundary of the upgrade area. Figure 3-2 shows the registered sites within or near the Barigan Road Upgrade Area.

3.1.2 Previous archaeological studies for the Wollar Solar Farm

In 2018 NGH Environmental undertook the survey for the proposed Wollar Solar Farm, located approximately 7 km south of the town of Wollar in NSW. The ACHA report for the Wollar Solar Farm was undertaken to investigate the presence of any Aboriginal sites and to assess the impacts and management strategies that may mitigate any impact for the proposed development and to address the DPE (now DPIE) issued SEARs relating to Aboriginal heritage for the project which were as follows:

> Include an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community (SEARs for Wollar Solar Farm 4/05/18).

The Wollar Solar Farm Heritage assessment area was approximately 680 ha and WSD proposed to develop approximately 461 ha. Survey transects were undertaken on foot across the proposal area to achieve maximum coverage. All mature native trees and outcrops within the proposal area were also inspected for evidence of Aboriginal use. Visibility within the proposal site was variable however as a whole the survey of Wollar Solar Farm proposal area had sufficient and effective survey coverage.

During the survey there were a number of stone artefacts found across the proposal site that were recorded as 37 separate site occurrences, including 12 artefact scatters and 25 isolated finds. One grinding groove, one scarred tree, one possible scarred tree and a culturally significant site were also recorded. The sites were identified across a range of landforms including slopes, flats, spurs, hill crests and along creeks/drainage lines. Of the two previously recorded Aboriginal sites within the proposal area, only artefacts from Wollar Creek 2/ AHIMS #36-3-0336 were identified during the ground truthing undertaken as part of the survey. Despite intensive survey around the coordinate location for Wollar Creek 1/AHIMS #36-3-0335 no objects could be identified.

Based on the land use history, an appraisal of the landscape, soil, level of disturbance and the results from the field survey, it was concluded that there was negligible potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the proposal area with the exception of the site Wollar SF AFT 11 recorded on the sandy raised western bank of Wollar Creek.

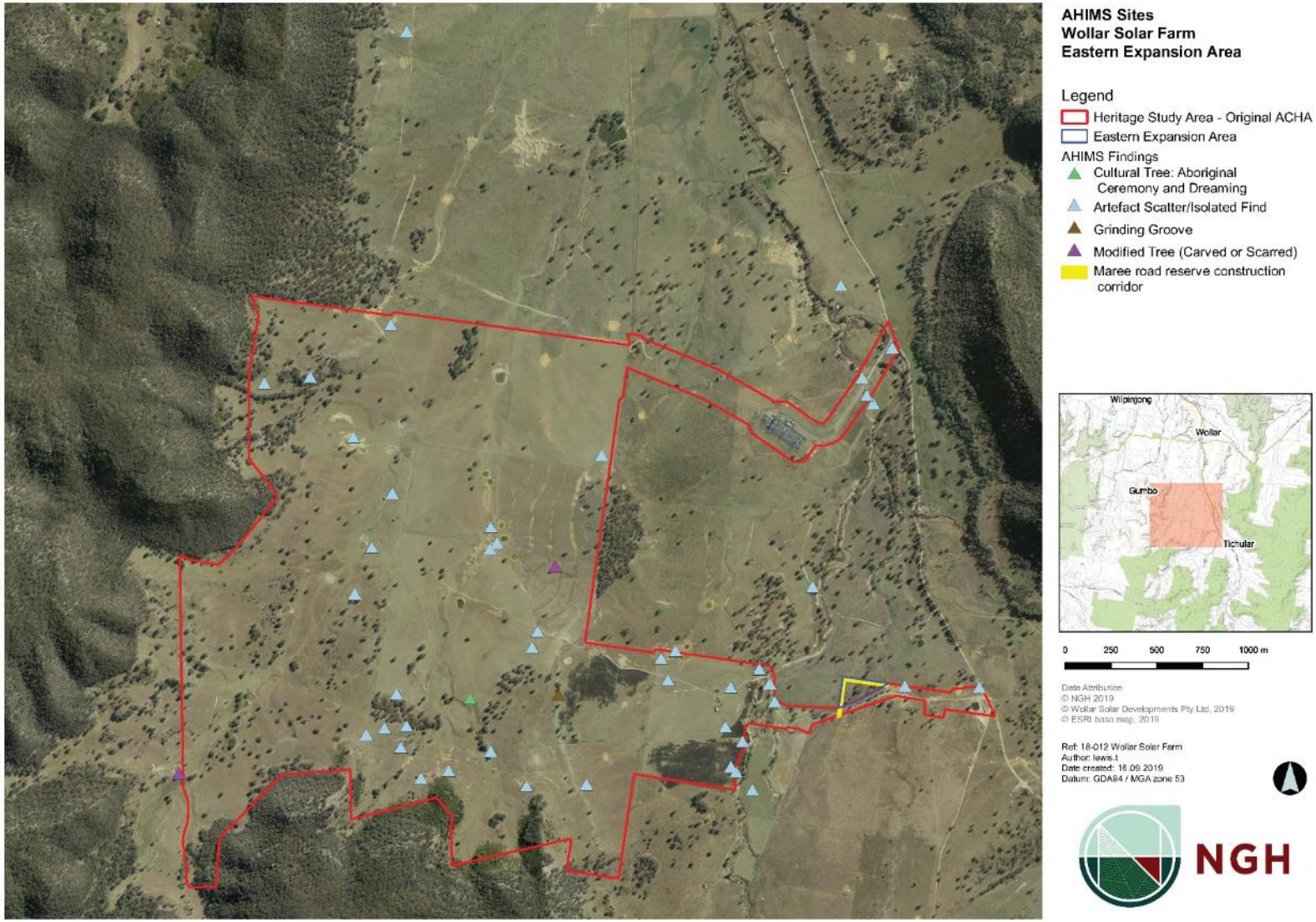


Figure 3-1. Wollar Solar Farm and Eastern Expansion Area AHIMS Sites

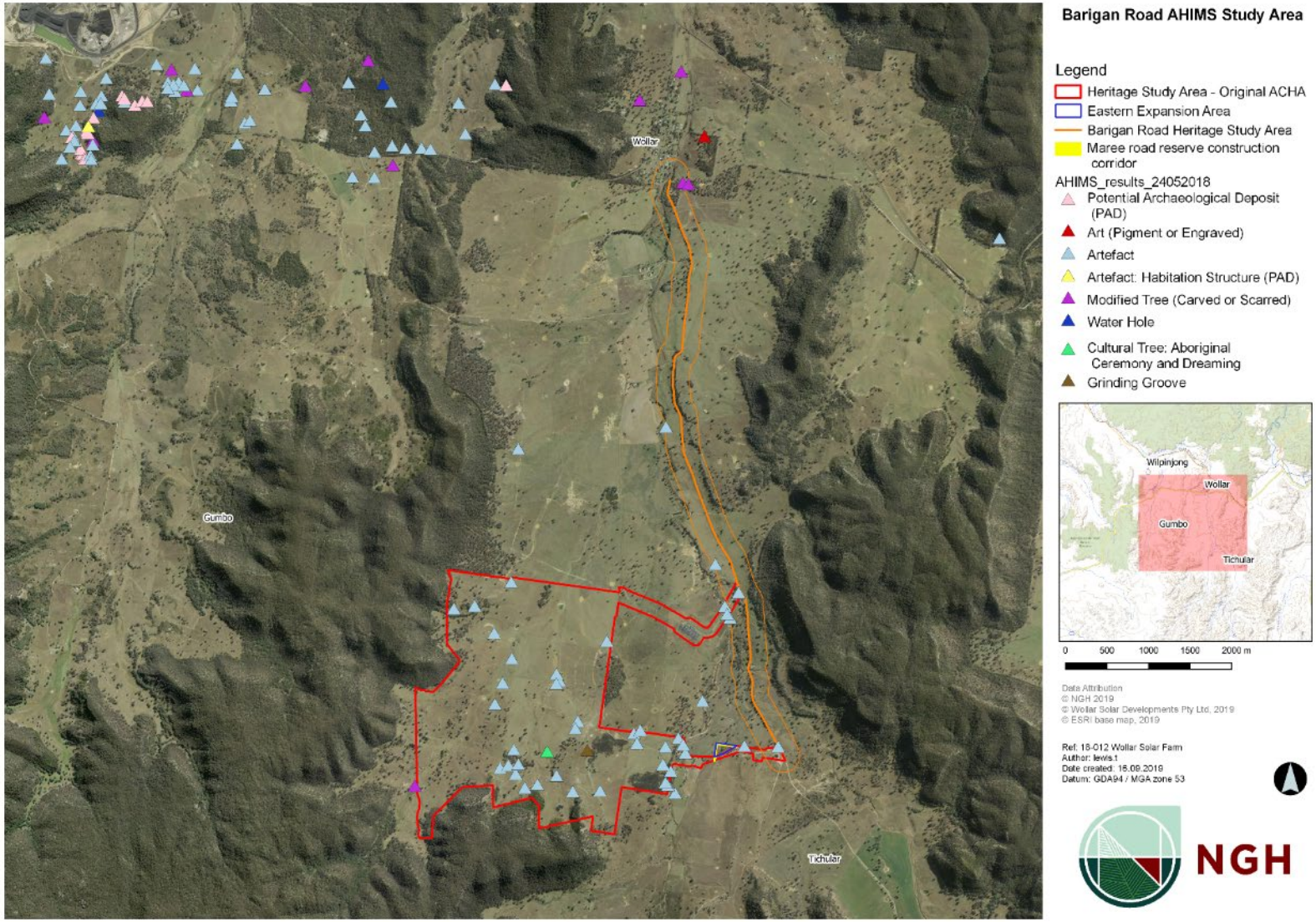


Figure 3-2. Barigan Road AHIMS Sites

Table 3-1 below provides a summary of site types noted to be impacted or avoided by the original proposed Wollar Solar Farm development footprint. The cultural site (Wollar SF Cultural Site 1), grinding groove (Wollar SF GDG 1), modified tree (Wollar SF ST1) and possible modified tree (Wollar SF ST2) would not be impacted by the proposed solar farm development as agreed by Wollar Development.

A number of mitigation measures were recommended in the Wollar Solar Farm ACHA. These recommendations included that further archaeological assessment would be required if the proposal activity extends beyond the original area assessed in the Wollar Solar Farm ACHA. The current assessment is being undertaken in line with the recommendations of the Wollar Solar Farm ACHA.

Table 3-1 Summary of site types noted with the initially proposed Wollar Solar Farm development footprint

Site Type	Type of Harm	Degree of Harm	Consequence of harm	No. of Sites	% of site type
Isolated Finds	Direct	Complete	Total loss of value	15	60
	Nil	Nil	Not Applicable	10	40
Artefact Scatters	Direct	Complete	Total loss of value	11	92
	Nil	Nil	Not Applicable	1	8
Grinding Groove	Nil	Nil	Not Applicable	1	100
Modified tree	Nil	Nil	Not Applicable	2	100
Cultural site	Nil	Nil	Not Applicable	1	100
Previously recorded AHIMS sites	Nil	Nil	Not Applicable	2	100

3.1.3 Archaeological Site Location Model

Based on the results of the previous archaeological investigations for the Wollar Solar Farm it is possible to provide the following model of site location in relation to the proposed Eastern Expansion of the development footprint for the Wollar Solar Farm and Barigan Road Upgrade.

Stone artefact scatters – representing camp sites can occur across the landscape, usually in association with some form of resource or landscape unit such as spur and ridge crests and creek lines. There is a tributary in close proximity to the proposed Eastern Expansion and therefore it is possible that artefact scatters may occur. The proposed Barigan Road upgrade comes within less than 20 m of Wollar Creek at its closest point, and runs parallel with this watercourse for most of the length of the proposed upgrade and therefore there is moderate to high potential for artefact scatters to be present.

Scarred Trees – these require the presence of mature trees and are likely to be concentrated along major waterways and around swamp areas. There are patches of remnant vegetation across the proposed Eastern Expansion area and adjacent to the Barigan Road upgrade area, therefore, it is possible that this feature could occur.

Isolated Artefacts – are present across the entire landscape, in varying densities. As Aboriginal people traversed the entire landscape for thousands of years, such finds can occur anywhere and indicate the presence of isolated activity, dropped or discarded artefacts from hunting or gathering expeditions or the ephemeral presence of short-term camps.

Given that Aboriginal people have lived in the region for tens of thousands of years, there is potential for archaeological evidence to occur throughout the proposed Eastern Expansion area and along the proposed Barigan Road upgrade area for the Wollar Solar Farm, this is most likely to be in the form of stone artefacts or as scarred trees.

4 ARCHAEOLOGICAL INVESTIGATION RESULTS

4.1 EASTERN EXPANSION AREA

4.1.1 Survey strategy

The intention of the survey was to cover as much ground surface as possible within the proposed Eastern Expansion area given it had not been assessed in the original survey conducted for the Wollar Solar Farm. The strategy therefore was to walk a series of transects across the proposed Eastern Expansion area to achieve maximum coverage. Transects were spaced evenly with the survey team spread apart at 15 m intervals, walking in parallel lines. The small size of the proposed Eastern Expansion area made this an ideal survey strategy. The team were able to walk in parallel lines, at a similar pace, allowing for maximum survey coverage and maximum opportunity to identify any heritage features. The survey team consisted of three people which allowed a 45 m wide tract of the proposal site to be surveyed with each transect.

Any mature trees with the proposed Eastern Expansion area were also inspected for any evidence of Aboriginal scarring (Long 2005).

NGH believes that the survey strategy was comprehensive and the most effective way to identify the presence of Aboriginal heritage sites within the Eastern Expansion area. Discussions were held in the field between the archaeologist and two Aboriginal community representatives present to ensure all were satisfied and agreed with the spacing and survey methodology.

The proposed Eastern Expansion area was identified to be with in the broad open valleys and floodplain with creeks and drainage lines landform as previously identified in the Wollar Solar Farm ACHA.

The survey was undertaken by the team on the 9th of April 2019. Notes were made about visibility, photos taken and any possible Aboriginal features were inspected, assessed and recorded if deemed to be Aboriginal in origin.

4.1.2 Survey Coverage

Survey transects were undertaken on foot and traversed the entire proposed Eastern Expansion area. Visibility within the proposal area was variable however as a whole it generally had low visibility averaging 5% overall. The effective visibility in the area ranged from 95% in exposures to less than 5% in areas with a dense grass cover. Between the survey participants, over the course of the field survey, approximately, 3.3 km of transects were walked across the proposed Eastern Expansion area.

Table 4-1 below shows the calculations of effective survey coverage and Plate 1, Plate 2, Plate 3 and Plate 4, show examples of the landforms and visibility within the proposed Eastern Expansion area.

Allowing for an effective view width of 5 m for each person and given the variability in the ground visibility across the proposal site overall the survey effectively examined 3.59% of the proposed Eastern Expansion area. It is considered that the survey of the Wollar Solar Farm proposed Eastern Expansion area had

sufficient and effective survey coverage. The results of the survey are considered a true reflection of the nature of the Aboriginal archaeological record present within the proposed Eastern Expansion area.

Table 4-1 Transect information.

Landform	Number of Survey Transects	Exposure type	Project area (ha)	Surveyed area (length m x width m)	Survey area (m2)	Average Visibility %	Effective coverage (area x visibility) m2	Project area surveyed (ha)	Percentage of Project area effectively surveyed	Archaeological result
Broad open valleys and floodplain with creeks and drainage lines	4	Bare ground, gate entrance, fence line, eroding deposits.	2.3	1,100 x 15	16,500	5	825	0.0825	3.59	Nil

Plate 1 View west along the exposure cut on the northern boundary of the proposed Eastern Expansion area.

Plate 2 View south across area with poor surface visibility in the proposed Eastern Expansion area.

Plate 3 View west along the fence line of the southern boundary, not the exposure in the foreground.	Plate 4 View east across the proposed Eastern Expansion area from the centre of the area being assessed, note the poor surface visibility.

4.1.3 Survey Results

While the survey was impeded by poor visibility across the majority of the proposed Eastern Expansion area a number of exposures were present that were inspected. However, no surface Aboriginal objects or culturally modified trees were recorded.

Discussions were held in the field with the representatives present to assess the potential for subsurface deposits across the proposed Eastern Expansion area. Based on the land use history, an appraisal of the landscape, soil, level of disturbance and the results from the field survey, it was concluded that there was negligible potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the proposed Eastern Expansion area. Consequently, subsurface testing is not warranted in the proposed Eastern Expansion area.

The Aboriginal representative present during the fieldwork noted that if any further development or ground disturbance works were proposed outside the proposed Eastern Expansion area and the area accessed in the original Wollar Solar Farm survey that additional assessment would be required.

4.2 BARIGAN ROAD UPGRADE AREA

4.2.1 Survey Strategy

As with the Eastern Expansion area, the intention of the survey of the proposed Barigan Road upgrade area was to cover as much ground surface as possible to achieve adequate coverage for assessment. The strategy therefore was to walk a transect along the proposed road upgrade impact area. Transects were spaced evenly, focussing on the road reserve between the existing graded road and the boundary fences on both sides, with the survey team spread at appropriate intervals based on the width of the reserve, walking in parallel lines. In general, there were two people on each side of the road at any given time, however in some instances, the road reserve was significantly narrower on one side than the other, and in that case the walkers were three on the wider side, one on the narrow side.

The survey strategy was highly effective given the narrow nature of the proposal area. The team were able to walk in parallel lines, at a similar pace, allowing for maximum survey coverage and maximum opportunity to identify any heritage features. The survey team consisted of four people which allowed a distance of five metres or less between each person during the survey.

Any mature trees with the proposed road upgrade area were also inspected for any evidence of Aboriginal scarring (Long 2005).

NGH believes that the survey strategy was comprehensive and the most effective way to identify the presence of Aboriginal heritage sites within the Barigan Road upgrade area. Discussions were held in the field between the archaeologist and three Aboriginal community representatives present to ensure all were satisfied and agreed with the spacing and survey methodology.

The proposed Barigan Road upgrade area was identified to be with in the broad open valleys and floodplain with creeks and drainage lines landform as previously identified in the Wollar Solar Farm ACHA. The road runs generally parallel to Wollar Creek and Barigan Creek.

The survey was undertaken by the team on the 29th of August 2019. Notes were made about visibility, photos taken and any Aboriginal objects were inspected, assessed and recorded.

4.2.2 Survey Coverage

A survey transect was undertaken on foot and covered the road reserve on both sides of the graded road. Due to the linear nature of the Barigan Road assessment area and its location within a single landform, the survey was not separated into survey units. Furthermore, while the proposed impact area for the upgrade of the road covers an area of approximately 8.8 ha, the survey assessed the entire road reserve in order to ensure that coverage for all possible impacts, including movement of vehicles and plant which may need to manoeuvre within the road reserve, was achieved. As such, an area of 14.5 ha was assessed.

Visibility within the proposal area was variable however as a whole it generally had moderate to high visibility, averaging 50% overall. The effective visibility in the area ranged from 100% in exposures to less than 5% in areas with a dense grass cover. Between the survey participants, over the course of the field survey, approximately 7.2 km of road reserve was covered on Barigan Road between Wollar and Maree Road.

Allowing for an effective view width of 5 m for each person and given the variability in the ground visibility across the proposal site overall the survey effectively examined 49.92% of the proposed Barigan Road upgrade area. It is considered that the survey of the Wollar Solar Farm proposed road upgrade area achieved sufficient and effective survey coverage. The results of the survey are considered a true reflection of the nature of the Aboriginal archaeological record present within the proposed road upgrade area.

Table 4-2 below shows the calculations of effective survey coverage and Plate 5, Plate 6, Plate 7 and Plate 8, show examples of the landforms and visibility within the proposed Barigan Road upgrade area.

Table 4-2 Survey information.

Landform	Number of Survey Units	Exposure type	Project area (ha)	Surveyed area (length m x width m)	Survey area (m^2)	Average Visibility %	Effective coverage (area x visibility) m^2	Project area surveyed (ha)	Percentage of Project area effectively surveyed	Archaeological result
Broad open valleys and floodplain with creeks and drainage lines	1	Bare ground, gate entrances, fence line, eroding sediment.	14.5	7,239 x 20	144,780	50	72,390	7.239	49.92	4 artefact scatters 5 isolated finds

	
Plate 5 View north along the road, showing nearly 100% exposure on both sides, near northern end of project area.	Plate 6 Sandstone boulder in road reserve
	
Plate 7 View north along the fence line of the road reserve, showing less than 5% visibility due to grass cover.	Plate 8 View north along Barigan Road showing variable visibility

4.2.3 Survey Results

There majority of the road verges contained patchy vegetation nor no vegetation at all providing high visibility across the survey area, though some areas were covered in dense ground covering grasses which reduced the visibility to zero in small parts.

Four artefact scatters and five isolated finds were recorded during the survey, with a total of 44 artefacts identified. There were a number of mature trees located along the road survey area and these were inspected for evidence of cultural modification. No scars or other markings indicating anthropogenic origins were observed. In general, grey-brown to red brown compacted silty clay with shallow redeposited A horizon silty sands present where erosion had moved topsoils. The road had been graded in the interim between the archaeological surveys taken for the Wollar Solar Farm development, and the completion of this survey of Barigan Road.

As with the above outlined results of the Eastern Expansion area, the team noted that there was also potential for additional sites outside of the road reserve, and as such any ground surface disturbance works outside the area surveyed would require further assessment.

Artefact scatters

The raw artefact data for each scatter is provided in Appendix C.

NGH Barigan AFT 1

This site comprises a low density artefact scatter measuring 165 m (north/south) by 14 m (east/west). It is possible this scatter extends further east, however the extent of the site could not be assessed as this would have required crossing the boundary fence of the road reserve, into private property. A total of 19 artefacts were recorded scattered along the eastern road verge starting from near the intersection with Wollar Road. These artefacts were likely to have been moved as a result of the construction and maintenance of the road but would likely have originally formed a part of a deposit associated with Wollar Creek. It was noted by Bradley Bliss of Wellington Valley Wiradjuri Aboriginal Corporation that the church and grounds located adjacent to this artefact scatter was a place to which Aboriginal people had been invited to camp by the government in the early twentieth century, before being moved to other regions in NSW. As such, artefacts associated with this event may also be present in and near the church property.

The raw materials recorded included quartz (n=10; 52.6%), chert (n=4; 21.1%), quartzite (n=3; 15.8%) and tuff (n=2; 10.5%). The typologies identified included flakes (n=12; 63.2%), cores (n=2; 10.5%), medial fragments (n=2; 10.5%), a broken flakes (n=1; 5.3%), flaked piece (n=1; 5.3%) and a proximal fragment (n=1; 5.3%).

Only one of the artefacts contained any cortex, a quartz flake with cortex platform indicating it was flaked from a pebble. The near-absence of cortex within the assemblage suggests that the artefacts were generally from the tertiary and secondary stages of reduction. Many of the artefacts exhibited recent damage, probably resulting from vehicle movement during maintenance of the road, or where cars have pulled off the road onto the verges. The artefacts were located on a grey-brown compacted silty clay and visibility ranged between nearly 100% in exposures to 50% where clumps of grass were present. No retouched artefacts were identified and no evidence of usewear could be observed in the field.

Plate 9 View north along the eastern side of Barigan Road with exposure containing artefacts from NGH Barigan AFT1.

Plate 10 Sample of artefacts identified at NGH Baring AFT 1

NGH Barigan AFT 2

The site is a low density artefact scatter measuring 340 m (north/south) by 30 m (east/west). A total of 15 artefacts were recorded scattered along the road verge, will all but one occurring on the eastern side of the road.

The artefact lithologies were quartz (n=6; 40%), chert (n=6; 40%), quartzite (n=2; 13.3%) and tuff (n=1; 6.7%) and the typologies included flakes (n=8; 53.3%), broken flakes (n=2; 13.3%), cores (n=2; 13.3%), medial fragments (n=2; 13.3%) and a distal fragment (n=1; 6.7%).

No artefacts within this scatter contained any cortex. The absence of cortex within the assemblage demonstrates that the artefacts were generally from the tertiary and secondary stages of reduction. Many of the artefacts exhibited recent damage, probably resulting from vehicle movement during maintenance of the road, or where cars have pulled off the road onto the verges. The artefacts were located on a grey-brown compacted silty clay and visibility ranged between nearly 100% in exposures to 50% where clumps of grass were present. No retouched artefacts were identified and no evidence of usewear could be observed in the field.

Plate 11 View south along the eastern side of Barigan Road with exposure containing artefacts from NGH Barigan AFT2

Plate 12 Sample of artefacts identified at NGH Barigan AFT 2

NGH Barigan AFT 3

This site is a low density scatter comprising two artefacts located within a one by one metre area on bunded earth on the eastern side of the road.

The artefact lithologies were chert (n=1; 50%) and quartz (n=1; 50%) and both artefacts were flakes (n=2; 100%). Neither of the artefacts within this scatter contained any cortex. The absence of cortex within the assemblage demonstrates that the artefacts were likely a result of the tertiary and secondary stages of reduction. The artefacts were located on a grey-brown sandy silt sediment and visibility was approximately 70%, with some patchy grass partially obscuring the ground surface. No retouched artefacts were identified and no evidence of usewear could be observed in the field.

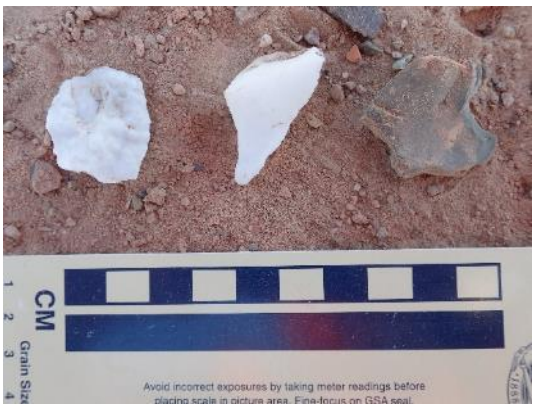
Within one to two metres of the gravel road, A horizon soil had been eroded and damaged as a result of vehicle movement. However, between AFT 3 and IF 3, and more than one to two metres from the road, up to 20 centimetres of topsoil were observed.

	
Plate 13 View north along the eastern side of Barigan Road with exposure containing artefacts from NGH Barigan AFT3	Plate 14 Artefacts identified at NGH Barigan AFT 3

NGH Barigan AFT 4

This site is a low density scatter comprising three artefacts located within an area of two by two metres on bunded earth on the western side of the road.

The artefact lithologies were quartz (n=2; 66.6%) and basalt (n=1; 33.3%) and typologies included flakes (n=2; 66.6%) and a broken flake (n=1; 33.3%). Neither of the artefacts within this scatter contained any cortex. The absence of cortex within the assemblage demonstrates that the artefacts were likely a result of the tertiary and secondary stages of reduction. The artefacts were located on a very compact red-brown silty clay and visibility was approximately 70%, with some patchy grass partially obscuring the ground surface. No retouched artefacts were identified and no evidence of usewear could be observed in the field.

	
Plate 15 View west from western side of Barigan Road with exposure containing artefacts from NGH Barigan AFT 4 and Wollar Creek in mid ground	Plate 16 Artefacts identified at NGH Barigan AFT 4

Isolated Finds

A total of five isolated finds were recorded along the Barigan Road upgrade area. The raw artefact data for each isolated find is provided in Appendix C.

The isolated find artefact lithologies include quartz (n=2; 40%), chert (n=2; 40%) and quartzite (n=1; 20%). Typologies recorded included flakes (n=3; 60%), a broken flake (n=1; 20%) and a core (n=1; 20%). Field observations indicated that these artefacts, as with the majority of those identified in the artefact scatters,

were from the tertiary and secondary stages of reduction, with only one artefact, a quartzite pebble core, containing terrestrial cortex. The core had only one possible negative flake scar present and the remaining 70% of the pebble was cortex. No retouched artefacts were identified and no evidence of usewear could be observed in the field.

The isolated finds occurred all along the road and were generally present on exposures formed on bunding associated with the construction and maintenance of the road. It is possible that some or all of these isolated artefacts may form part of artefact scatters that were formerly present at the location prior to disturbance from the road. Furthermore, artefact scatters with which these isolated finds may be associated may extend into the paddocks outside the road reserve, which could not be accessed and did not form part of this assessment. Visibility outside the road reserve was significantly lower in most places along the route, reduced as a result of pasture grasses, however some possible artefacts were noted from the fence line in exposures. These could not be confirmed.

4.2.4 Consideration of potential for subsurface material

The Barigan Road upgrade area comprised a modified portion of the Wollar and Barigan Creek banks and associated foot slopes. The road has recently been graded and the road verges are characterised primarily by disturbed sediments which have been pushed up and bunded on the roadside during the creation and maintenance of the road. It was noted that where natural soils were present they comprise heavily eroded silty clay B horizon layers. Based on the land use history, an appraisal of the landscape, soil, level of disturbance and the results from the field survey, it was concluded that there was nil to low potential for the presence of intact subsurface deposits with high densities of objects or cultural material within the proposed Barigan Road upgrade area. As such it has been assessed that subsurface testing or salvage excavation would not be required within the proposed Barigan Road upgrade area, which is contained within the existing road reserve.

4.3 DISCUSSION

The results of previous archaeological surveys in the Wollar region show that there are sites and artefacts present across the landscape.

The predictions based on the modelling for the proposed Eastern Expansion area were that stone artefacts and scarred trees were the most likely manifestation of Aboriginal occupation of the area. The lack of sites identified within the proposed Eastern Expansion area is not surprising given the poor surface visibility and previous disturbance of the area. The result of the survey of the Eastern Expansion area does not negate the need for further survey to occur in any other areas of proposed activity for the Wollar Solar Farm that extend beyond the areas assessed in this report and the original Wollar Solar Farm ACHA.

The predictions based on the modelling for the proposed Barigan Road upgrade area, were that the most likely site types to occur would be stone artefact sites and scarred trees. While there were a number of mature trees within the upgrade area, no cultural modifications were observed on any of the trees. A total of four surface artefact scatters and five isolated finds were recorded during the completion of the archaeological survey for the proposed Barigan Road upgrade area. The narrow and linear nature of the Barigan Road assessment area limits the extent to which analysis can be undertaken, however in context of the findings of the ACHA, some conclusions can be reached.

The artefacts recorded were manufactured primarily from quartz (n=21; 47.7%) and chert (n=13; 29.5%), with smaller percentages of quartzite (n=6; 13.6%), tuff (n=3; 6.8%) and basalt (n=1; 2.3%), all of which are common raw materials for the area, and much of which could have been sourced as cobbles from the

nearby Wollar Creek. As with the assemblages identified during the original Wollar Solar Farm ACHA, the presence of flakes, cores, broken flakes, medial and proximal fragments and a flaked piece, may indicate that tool manufacture was occurring on site, in particular at the northern end of the assessment area where Barigan Road intersects with Wollar Creek – this is also consistent with the findings of the original ACHA and indicate that the banks of Wollar Creek were suitable for such activities.

The artefacts identified in the southern two-thirds of the Barigan Road upgrade area comprised very small scatters or isolated finds, indicating that these were likely to have been a result of more transient use of the area. As noted in the ACHA, the area was likely used intermittently over a period of time for camping, hunting and gathering resources.

The distribution of cultural material across the landscape including the presence of artefact scatters provides an indication that the area was likely to have been revisited repeatedly. The artefact types and raw materials are common for the region. During the preparation of the ACHA it was noted that the results had increased the number of known sites in the local area significantly and it was concluded that the dominance of artefacts as the most common site type was further supported by the ACHA. The findings of the Barigan Road survey are consistent with this assessment.

The implications of this relate to significance assessments and the related assessments by site representatives. It is likely that there are many hundreds of such sites in the local area which have simply not yet been recorded and registered – the AHIMS data is merely a reflection of the limited number of archaeological surveys which have been undertaken in the area.

In terms of the proposed Barigan Road upgrade, extrapolating results from this survey in addition to that undertaken as part of the original ACHA, it is assessed to be unlikely that subsurface deposits would be present within the proposed road upgrade area, and with reference to the level of disturbance within the road reserve, the surface artefacts identified are likely to have been moved from their original location during the creation and maintenance of the road. However, it should be noted that shallow topsoils (approximately 20 centimetres in depth) were observed between one to two metres from the existing road on the eastern side of Barigan Road between NGH Barigan Rd AFT 3 and NGH Barigan Rd IF 3. There is low potential for subsurface artefacts to be present within this sediment.

5 CULTURAL HERITAGE VALUES AND STATEMENT OF SIGNIFICANCE

The assessment of the significance of Aboriginal archaeological sites is currently undertaken largely with reference to criteria outlined in the ICOMOS Burra Charter (Marquis-Kyle & Walker 1994). Criteria used for assessment are:

- *Social or Cultural Value*: In the context of an Aboriginal heritage assessment, this value refers to the significance placed on a site or place by the local Aboriginal community – either in a contemporary or traditional setting.
- *Scientific Value*: Scientific value is the term employed to describe the potential of a site or place to answer research questions. In making an assessment of Scientific Value issues such as representativeness, rarity and integrity are addressed. All archaeological places possess a degree of scientific value in that they contribute to understanding the distribution of evidence of past activities of people in the landscape. In the case of flaked stone artefact scatters, larger sites or those with more complex assemblages are more likely to be able to

address questions about past economy and technology, giving them greater significance than smaller, less complex sites. Sites with stratified and potentially in situ sub-surface deposits, such as those found within rock shelters or depositional open environments, could address questions about the sequence and timing of past Aboriginal activity, and will be more significant than disturbed or deflated sites. Groups or complexes of sites that can be related to each other spatially or through time are generally of higher value than single sites.

- *Aesthetic Value*: Aesthetic values include those related to sensory perception and are not commonly identified as a principal value contributing to management priorities for Aboriginal archaeological sites, except for art sites.
- *Historic Value*: Historic value refers to a site or place's ability to contribute information on an important historic event, phase or person.
- *Other Values*: The Burra Charter makes allowance for the incorporation of other values into an assessment where such values are not covered by those listed above. Such values might include Educational Value.

All sites or places have some degree of value, but of course, some have more than others. In addition, where a site is deemed to be significant, it may be so on different levels or contexts ranging from local to regional to national, or in very rare cases, international. Further, sites may either be assessed individually, or where they occur in association with other sites the value of the complex should be considered.

The assessments below are provided with direct reference to the significance assessment in the original Wollar Solar Farm ACHA (NGH 2018).

Social or cultural value

While the true cultural and social value of Aboriginal sites can only be determined by local Aboriginal people, as a general concept, all sites hold cultural value to the local Aboriginal community.

Cultural significance can be determined only by the local Aboriginal community.

EASTERN EXPANSION AREA

No Aboriginal sites were identified during the survey for the proposed Eastern Expansion area of the Wollar Solar Farm and no known cultural sites or places of value within or in close proximity to the proposal area have been identified during the consultation process for the project.

BARIGAN ROAD UPGRADE AREA

Four artefact scatters and 5 isolated finds, containing a total of 44 artefacts were identified along the proposed Barigan Road Upgrade Area.

Feedback received from Aboriginal representatives during the field survey indicated that all sites hold cultural value to the local Aboriginal community. This includes stone artefacts, which should be collected before any damage or development occurs. Furthermore, placement of collected artefacts in a location which will be safe in the long term was noted as an important aspect of the impact mitigation process.

Scientific (archaeological) value.

EASTERN EXPANSION AREA

Given that no Aboriginal sites were identified during the survey for the proposed Eastern Expansion area of the Wollar Solar Farm there are limited scientific values to evaluate for this area. While the absence of

sites can be used to assist in the development of site modelling for the local landscape, the scientific value for further research is nil.

BARIGAN ROAD UPGRADE AREA

The research potential of the artefact sites identified within the Barigan Road Upgrade Area is considered to be low, in context of the sites identified during the Wollar Solar Farm ACHA. While the presence of the sites can be used to assist in the development of site modelling for the local landscape, their scientific value for further research is limited.

While the artefacts identified are intrinsically valuable for their base technical information and expansion of data sets, their lack of temporal context and the absence of information about local resources makes further conclusions about land and resource use difficult. Their scientific value for further research is also limited due to the sparse distribution of artefacts, disturbed nature of the landscape and the subsequent movement of objects as a result of the construction and maintenance of the road.

As noted in Section 4.3, the findings of the Wollar Solar Farm ACHA, and this addendum, have substantially increased the number of sites listed in the AHIMS database for the area, with 40 new archaeological sites and one new cultural site recorded during the original ACHA, plus nine new artefact sites (artefacts and isolated finds) identified during the survey of the Barigan Road Upgrade Area. In terms of rarity, the artefact sites identified in the proposed Barigan Road Upgrade Area are not considered to be rare.

Aesthetic value.

EASTERN EXPANSION AREA

Given that no sites were identified in the proposed Eastern Expansion area there are no aesthetic values associated with archaeological sites per se.

BARIGAN ROAD UPGRADE AREA

There are no intrinsic aesthetic values associated with the archaeological sites recorded within the proposed Barigan Road Upgrade Area, apart from the possible aesthetic value associated with the setting of Wollar Creek on which the majority of artefacts were identified, however this has been altered as a result of the construction and maintenance of Barigan Road which detracts significantly from this aesthetic setting.

Historic Values

EASTERN EXPANSION AREA

Given that no sites were identified in the proposed Eastern Expansion area there are no historic values associated with archaeological sites per se.

BARIGAN ROAD UPGRADE AREA

It was noted by Bradley Bliss during the survey that St Luke's Church and grounds had historically been the site of a gathering of local Aboriginal people who had been invited by the government to camp there, before they were forcibly removed to other regions in NSW. No research into this event has been undertaken as part of this assessment, however the site holds historical significance for the local Aboriginal community for this reason, as noted by Bradley Bliss of the Wellington Valley Wiradjuri Aboriginal Corporation.

Other Values

There are no other known heritage values associated with the proposed Eastern Expansion area or the proposed Barigan Road Upgrade Area.

6 PROPOSED ACTIVITY

6.1 PROPOSED DEVELOPMENT ACTIVITY

The proposed Eastern Expansion of the Wollar Solar Farm development footprint which was assessed in April 2019 includes a portion of Lot 84 DP 755430, Lot 46 DP 755430 and unused road reserve Lot extending north from the existing Maree Road alignment that encompasses an area of approximately 2.3 ha. This area was assessed in April 2019.

Subsequent to the completion of the assessment covering the 2.3 ha, the proposed development footprint was refined to a 0.8 ha portion of the unused road reserve which is wholly within the assessed area, and is known as the Maree Road reserve construction corridor. While specific design details are currently not available, construction of a new road is proposed in this area will include ground disturbances.

In addition to this, the upgrade of Barigan Road between Wollar township and Maree Road will require the widening of the road to achieve a 7m wide pavement to allow for simultaneous two-way traffic movement. Some curves along Barigan Road will require a slightly wider pavement to achieve simultaneous two way traffic movement. All road upgrade works would occur within a 12 m corridor of Barigan Road. The route is approximately 7.2 km in length and is located entirely within existing road reserve.

These works will include ground surface disturbance as well as the movement of vehicles and plant along the road and road verges during the construction works. While the proposed impact area for the road upgrade covers an area of approximately 8.8 ha, the survey assessed the entire road reserve, an area of 14.5 ha, in order to achieve coverage for all possible impacts, including movement of vehicles and plant during construction.

6.2 ASSESSMENT OF HARM

6.2.1 Proposed Eastern Expansion Area

As described in this report, no Aboriginal archaeological sites were located within the proposed Eastern Expansion area of the Wollar Solar Farm. Therefore, the assessment of harm for the Eastern Expansion area is nil.

6.2.2 Proposed Barigan Road Upgrade Area

As described in this report, a total of nine sites, including four artefact scatters and five isolated finds were identified within the Proposed Barigan Road Upgrade Area. All of these sites will likely be subject to impacts as a result of the proposed upgrade works due to the movement of plant and vehicles within the road reserve and the ground surface disturbance required for the road widening. Table 6-1 provides a summary of the impacts.

Table 6-1 Summary of the degree of harm and consequence of harm for sites

AHIMS ID	Site Name	Type of Harm	Degree of Harm	Consequence of Harm
TBC	NGH Barigan AFT 1	Direct	Complete (for known extent of site)	Total loss of value (for known extent of site)
TBC	NGH Barigan AFT 2	Direct	Complete	Total loss of value
TBC	NGH Barigan AFT 3	Direct	Complete	Total loss of value
TBC	NGH Barigan AFT 4	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 1	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 2	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 3	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 4	Direct	Complete	Total loss of value
TBC	NGH Barigan IF 5	Direct	Complete	Total loss of value

The impacts are considered to be direct impacts to the Aboriginal objects as the movement of plant and vehicles and ground surface disturbance for the widening of roads may result in the removal, breakage or displacement of the artefacts.

While the assessment of harm for the proposed Barigan Road Upgrade Area is high as a standalone project, in context of the original Wollar Solar Farm ACHA, the assessment of harm overall is assessed to be moderate (refer to NGH 2018:53).

6.3 IMPACTS TO VALUES

6.3.1 Proposed Eastern Expansion Area

The values potentially impacted by the development of the proposed Eastern Expansion area of the Wollar Solar Farm are any social and cultural values attributed to the area by the local Aboriginal community. As described in this report, no Aboriginal archaeological sites were located within the proposed Eastern Expansion area and no cultural values within the project area have been identified by local Aboriginal community. Therefore, the impact to the Aboriginal Heritage values for this development are nil.

No values have been identified that would be affected by the development of the proposed Eastern Expansion area of the Wollar Solar Farm.

6.3.2 Proposed Barigan Road Upgrade Area

The values which will be impacted by the proposed road upgrade to Barigan Road are any social and cultural values attributed to the artefacts by the local Aboriginal community. The extent to which the loss of the sites would impact on the community is only something that can be assessed by the local Aboriginal community.

The impact to scientific values for this proposal is summarised in Table 6-2. While all the identified stone artefact sites recorded within the proposal area will be impacted as a result of the road upgrade, it is argued that there are likely to be a large number of similar site types, with greater intactness and integrity, present within the local area and therefore the impact to the overall archaeological record is assessed to be low. It is also likely that the sites extend outside the road corridor into private property beyond the proposed impact area for the road upgrade.

The stone artefacts have little research value apart from what has already been gained from the information obtained during the present assessment. This information relates more to the presence of the artefacts in the development of Aboriginal site modelling, which has largely now been realised by the recording.

The proposed Barigan Road Upgrade Area and the locations of the sites assessed in this report are shown in Figure 6-1 Figure 6-2 and Figure 6-3.

Table 6-2 Assessment of harm to scientific values

AHIMS ID	Site Name	Site Integrity	Scientific Significance	Recommendation
TBC	NGH Barigan AFT 1	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan AFT 2	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan AFT 3	Poor – modified landform as a result of road construction and maintenance. Some possible extant topsoils 1-2 m east of gravel road which have low potential to contain Aboriginal objects.	Low	Salvage objects prior to commencement of proposed road upgrade works. Avoid impact to extant topsoils on eastern side of road between AFT 3 and IF 3
TBC	NGH Barigan AFT 4	Poor – modified landform as a result of	Low	Salvage objects prior to commencement of

		road construction and maintenance		proposed road upgrade works
TBC	NGH Barigan IF 1	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan IF 2	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan IF 3	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan IF 4	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works
TBC	NGH Barigan IF 5	Poor – modified landform as a result of road construction and maintenance	Low	Salvage objects prior to commencement of proposed road upgrade works

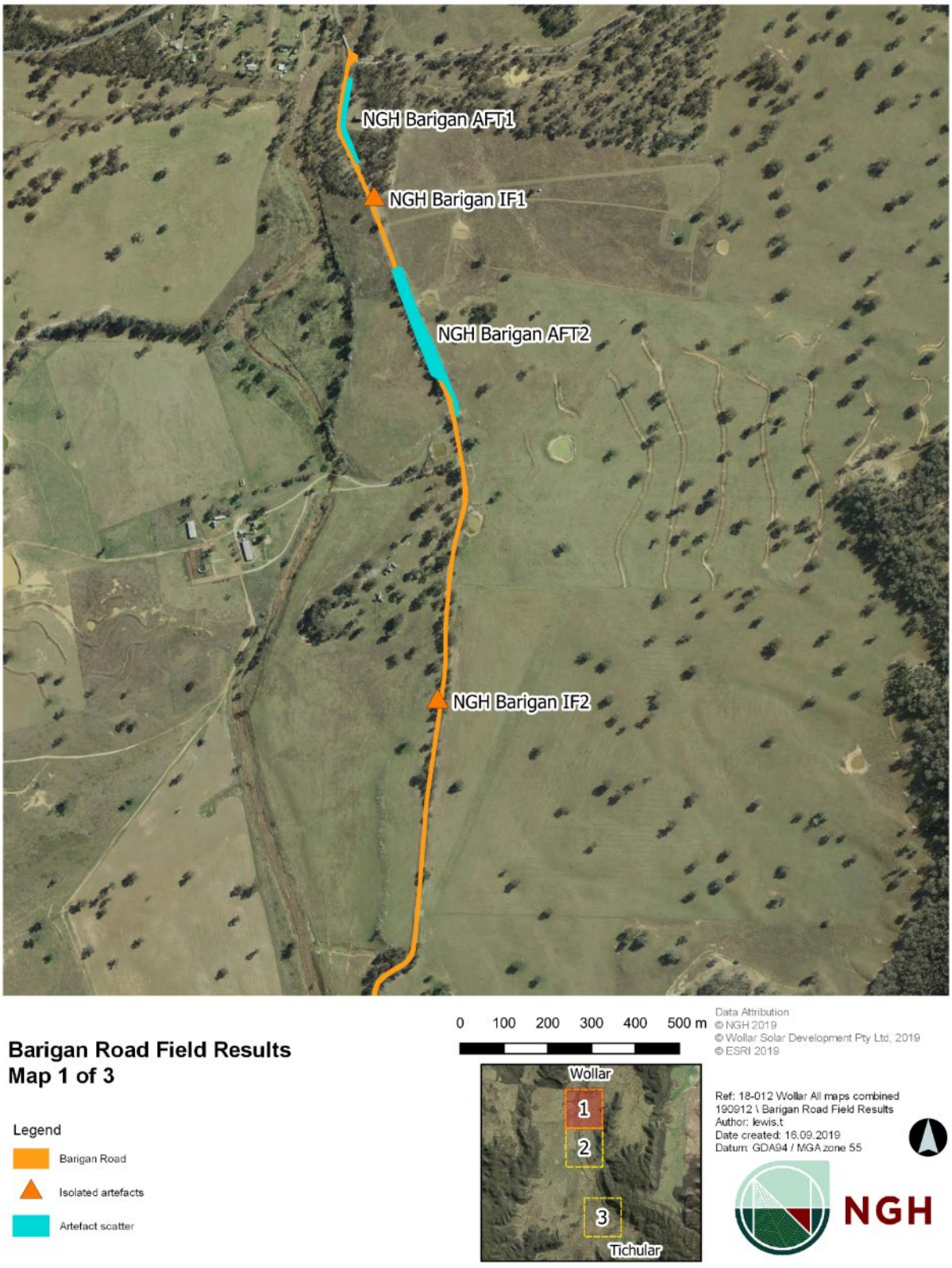


Figure 6-1 Field Results (map 1)

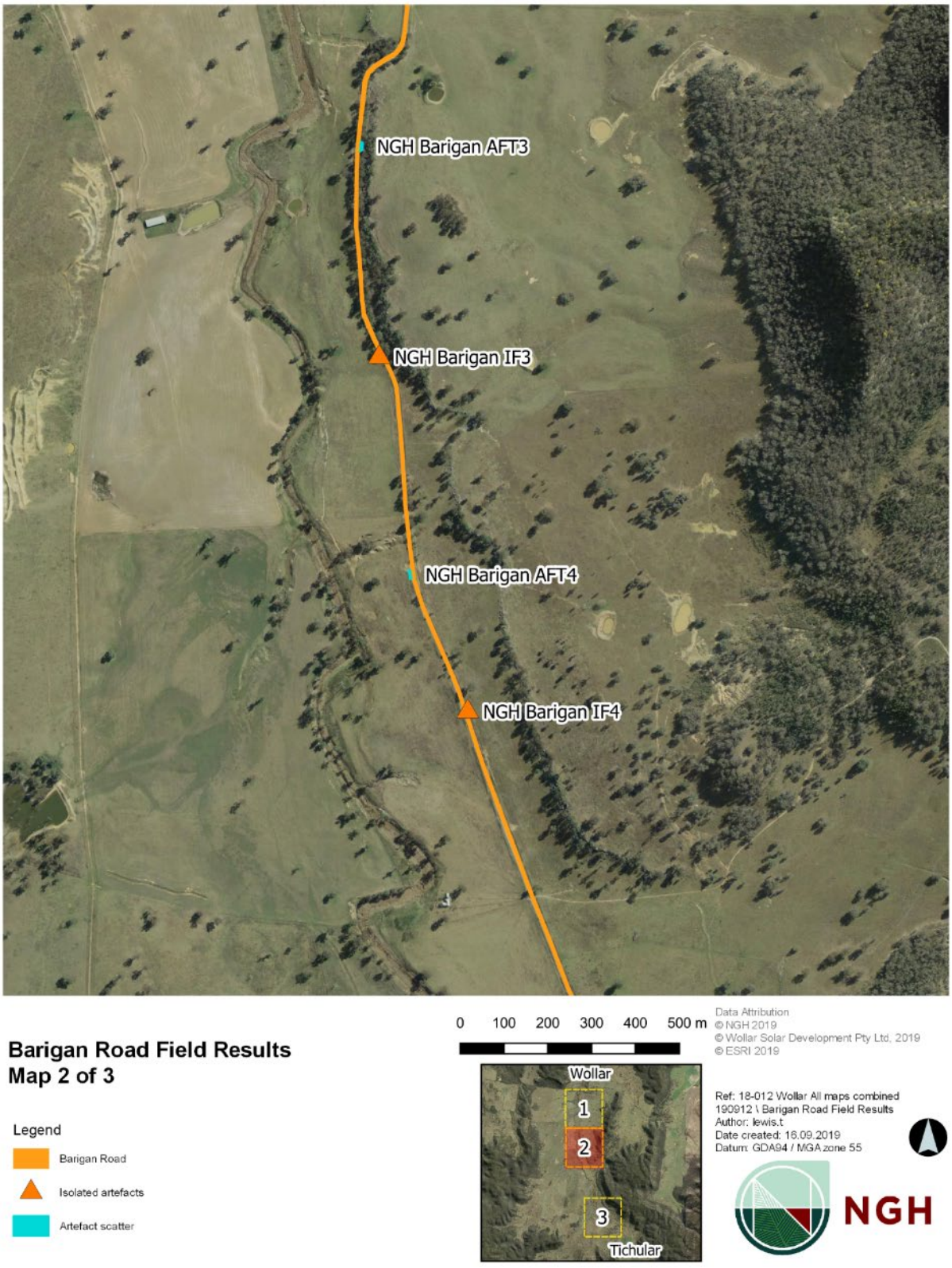


Figure 6-2 Field Results (map 2)

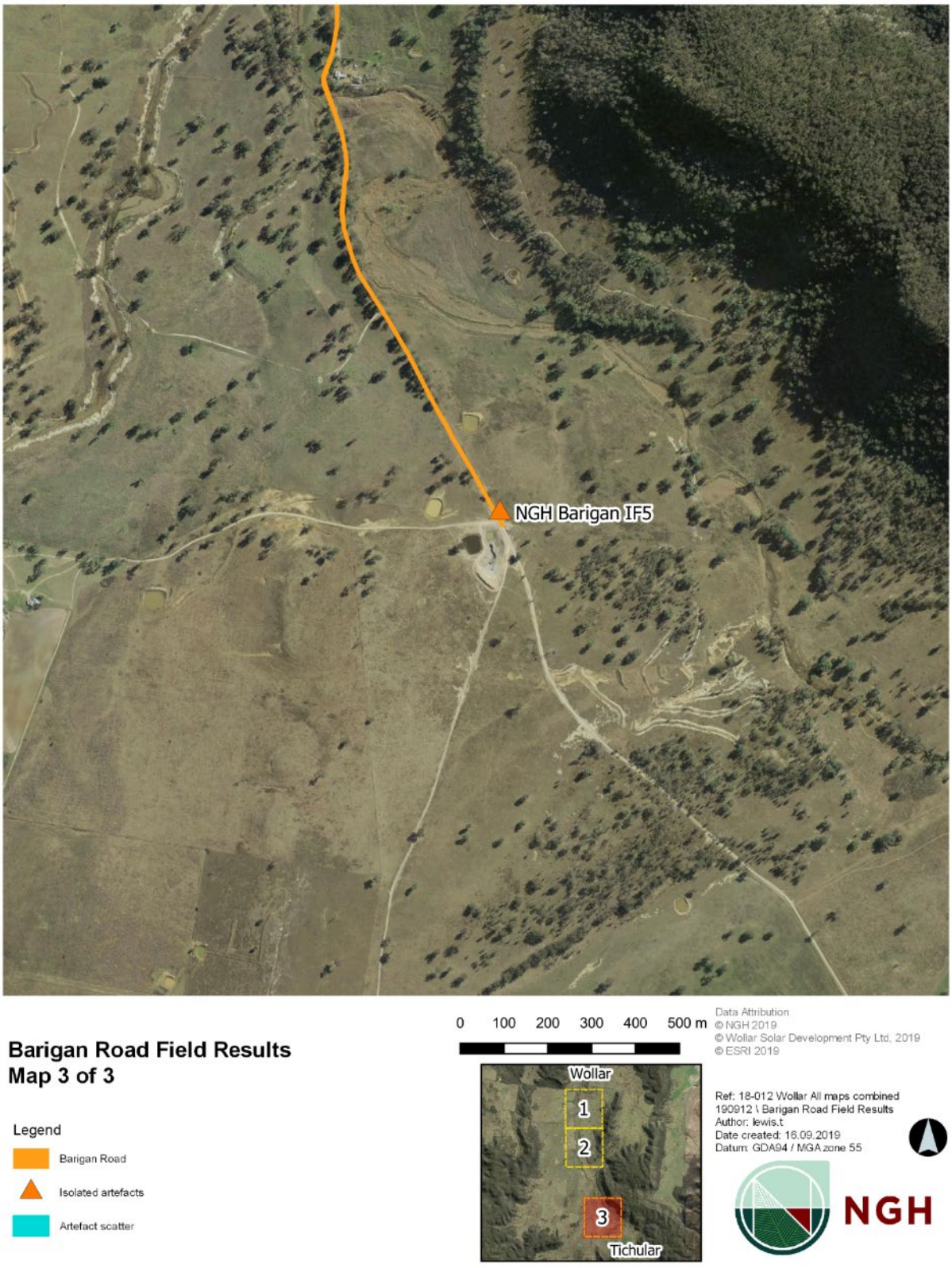


Figure 6-3 Field Results (page 3)

7 AVOIDING OR MITIGATING HARM

7.1 CONSIDERATION OF ESD PRINCIPLES

7.1.1 Proposed Eastern Expansion Area

The consideration of the principles of Ecologically Sustainable Development (ESD) and the use of the precautionary principle was not required to be undertaken when assessing the harm to sites and the potential for mitigating impacts on Aboriginal heritage within the proposed Eastern Expansion area of the Wollar Solar Farm given that no sites or cultural values were identified.

We therefore argue that the overall cumulative impact on the archaeological record for the region is likely to be nil given that no sites or cultural values were identified with the proposed Eastern Expansion area of the Wollar Solar Farm.

7.1.2 Proposed Barigan Road Upgrade Area

Consideration of the principles of Ecologically Sustainable (ESD) and the use of the precautionary principle was undertaken when assessing the harm to sites and potential for mitigating impacts to the sites recorded within the proposed Barigan Road Upgrade Area as part of the wider Wollar Solar Farm proposal area. The main consideration was the cumulative effect of the proposed impact to the sites and the wider archaeological record. The precautionary principle in relation to Aboriginal heritage implies that development proposals should be carefully evaluated to identify potential impacts and assess the risk of potential consequences.

In broad terms, the archaeological material located during this investigation is similar to what has been found previously within the Wollar region. Currently there is no clear regional synthesis of the nature, number, extent and content for archaeological sites within the Mid-Western Regional LGA. Nevertheless, given the size of the geographical area, it is certain that there would be similar artefacts present within the region.

The result of this addendum to the Wollar Solar Farm ACHA has confirmed the proposed model of site location and site distribution, where sites could be expected to occur across the landscape and in particular in proximity to a water source, even in disturbed areas.

The implications for ESD principles are that in fact more sites are likely to be present in the region than previously thought, which reduces the individual value of the particular sites within the proposed upgrade area, particularly with reference to the condition in which the nine sites within the proposed Barigan Road Upgrade Area have been found. Better representations of artefact sites are likely to be present elsewhere within the local area. It must be recognised that large parts of the region have been heavily cleared, mined, farmed, and developed through the construction and maintenance of roads and residential structures and therefore other sites are likely to also have been disturbed. However, it is also likely that more intact sites are present. The conclusion that similar sites exist reduces the representative values of the sites within the proposed upgrade area.

It should be noted that while all nine sites identified within the proposed upgrade area will likely be subject to impacts as a result of the upgrade, within the wider Wollar Solar Farm development, there are a number of sites around which the design of the proposal has been amended to ensure that impacts do not occur.

The archaeological value of the sites within the upgrade area has been assessed to be low and therefore the proposed impacts to the sites would not adversely affect the archaeological record for the local area or region significantly.

The principle of intergenerational equity requires the present generation to ensure that the sites and diversity of the archaeological record is maintained or enhanced for the benefit of future generations. This assessment concludes that the diversity of the archaeological record will not be compromised by the proposed upgrade of the road.

The overall cumulative impact on the archaeological record for the region is likely to be minimal, assuming a density of artefact sites remain across the wider region.

7.2 CONSIDERATION OF HARM

7.2.1 Proposed Eastern Expansion Area

As described in this report, no Aboriginal archaeological sites were located within the proposed Eastern Expansion area of the Wollar Solar Farm and no cultural values within the project area have been identified by local Aboriginal community. Given the absence Aboriginal archaeological sites and cultural values within the proposed Eastern Expansion area of the Wollar Solar Farm no mitigation methods are required.

7.2.2 Proposed Barigan Road Upgrade Area

Avoidance of sites in this case is unlikely to be possible due to the existing route of the road reserve. It is likely that the surface artefacts identified during the archaeological survey for the proposed Barigan Road Upgrade have been subject to disturbance as a result of the construction and maintenance of the graded road previously. Relocating the road would likely have a significantly greater impact on the archaeological record than the widening and upgrading of the existing roadway. Furthermore, as outlined in this document, the archaeological material identified in the survey is not of sufficient value to reject the proposal. Avoidance may be possible of one area identified to contain topsoils, approximately one to two metres to the east of Barigan Road, between NGH Barigan Rd AFT 3 and NGH Barigan Rd IF 3.

Mitigation of harm to cultural heritage sites generally involves some level of detailed recording to preserve the information contained within the site. Mitigation can be in the form of minimising harm, through direct management measures applied to Aboriginal archaeological sites.

While mitigation in the form of avoidance is not feasible in this case, salvage (surface collection) is a suitable mitigation strategy which has been considered with the registered Aboriginal party representatives on site as an appropriate action.

As there were no areas of potential subsurface deposit, and no other site types identified, no additional forms of mitigation would be required for the proposed Barigan Road Upgrade Area. Salvage in the form of surface collection should be undertaken by a qualified archaeologist and with representatives from the registered Aboriginal parties prior to the commencement of any proposed upgrade works. The artefacts should be collected and moved to a safe area within the Wollar Solar Farm project area that will not be subject to any ground disturbance in the long term as per the recommendations for the artefact sites

identified in the original Wollar Solar Farm ACHA (NGH 2018). It is noted that during the completion of the original assessment, the registered Aboriginal parties had requested the opportunity to perform a smoking ceremony to cleanse the salvaged artefacts and the reburial location.

8 LEGISLATIVE CONTEXT

Aboriginal heritage is primarily protected under the NPW Act and as subsequently amended in 2010 with the introduction of the *National Parks and Wildlife Amendment (Aboriginal Objects and Places) Regulation 2010*. The aim of the NPW Act includes:

> The conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including but not limited to: places, objects and features of significance to Aboriginal people.

An Aboriginal object is defined as:

> Any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains.

Part 6 of the NPW Act concerns Aboriginal objects and places and various sections describe the offences, defences and requirements to harm an Aboriginal object or place. The main offences under section 86 of the NPW Act are:

- A person must not harm or desecrate an object that the person knows is an Aboriginal object.
- A person must not harm an Aboriginal object.
- For the purposes of this section, "circumstances of aggravation" are:
    - that the offence was committed in the course of carrying out a commercial activity, or
    - that the offence was the second or subsequent occasion on which the offender was convicted of an offence under this section.
- A person must not harm or desecrate an Aboriginal place.

Under section 87 of the NPW Act, there are specified defences to prosecution including authorisation through an Aboriginal Heritage Impact Permit (AHIP) or through exercising due diligence or compliance through the regulation.

Section 89A of the Act also requires that a person who is aware of an Aboriginal object, must notify the Director-General in a prescribed manner. In effect this section requires the completion of AHIMS site cards for all sites located during heritage surveys.

Section 90 of the NPW Act deals with the issuing of an AHIP, including that the permit may be subject to certain conditions.

The EP&A Act is legislation for the management of development in NSW. It sets up a planning structure that requires developers (individuals or companies) to consider the environmental impacts of new projects. Under this Act, cultural heritage is considered to be a part of the environment. This Act requires that Aboriginal cultural heritage and the possible impacts to Aboriginal heritage that development may have are formally considered in land-use planning and development approval processes.

Proposals classified as State Significant Development or State Significant Infrastructure under the EP&A Act have a different assessment regime. As part of this process, Section 90 harm provisions under the NPW Act are not required, that is, an AHIP is not required to impact Aboriginal objects. However, the NSW DPIE is required to ensure that Aboriginal heritage is considered in the environmental impact assessment process. The DPIE will consult with internal departments, including BCD (formerly OEH) prior to development consent being approved.

The Wollar Solar Farm proposal is a State Significant Development and will therefore be assessed via this pathway, which does not negate the need to carry out an appropriate level of Aboriginal heritage assessment or the need to conduct Aboriginal consultation in line with the requirements outlined by the *Aboriginal cultural heritage consultation requirements for proponents 2010* (OEH 2010b).

9 RECOMMENDATIONS

The recommendations are based on the following information and considerations:

- Results of the archaeological survey;
- Consideration of results from the original Wollar Solar Farm survey;
- Results of consultation with the registered Aboriginal parties;
- Appraisal of the proposed development, and
- Legislative context for the development proposal.

It is recommended that:

1. The proposed Eastern Expansion of the Wollar Solar Farm development footprint as detailed in this addendum report has negligible potential to impact Aboriginal objects.
2. The proposed Eastern Expansion of the Wollar Solar Farm development footprint should now be able to proceed without any additional Aboriginal archaeological investigation.
3. The proposed Barigan Road Upgrade as detailed in this addendum report will impact nine artefact sites recorded as part of this assessment.
4. The artefacts identified at NGH Barigan AFT 1, 2, 3 and 4; and NGH Barigan IF 1, 2, 3, 4 and 5, must be salvaged prior to the proposed work commencing and moved to a safe area within the Wollar Solar Farm development footprint. Note that this in addition to artefacts referenced in Recommendation 4 of the Wollar Solar Farm ACHA (NGH 2018) which are to be salvaged prior to construction.
5. The surface collection and relocation of the artefacts must be undertaken by an archaeologist and representatives of the registered Aboriginal parties. The salvage should be consistent with the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* A new site card must be completed once the artefacts are moved to record their new location on the AHIMS database. Note that RAP comments include a request for the option to test excavate where topsoils are present within the impact zone. This will be determined by the proposed road upgrade design (refer to Section 2.1 Table 2-1).
6. It is recommended that the proposed upgrade works be designed to avoid subsurface disturbance further than one metre from the edge of the gravel road on the eastern side of Barigan Road between NGH Barigan Rd AFT 3 and NGH Barigan Rd IF3. This relates to the presence of topsoils which are present along the side of the road in this location, which have some potential to contain Aboriginal objects.
7. With reference to the Wollar Solar Farm ACHA (NGH 2018), reburial of artefacts is the preferred option for the management of Aboriginal objects recovered during salvage works. Artefacts recovered from Barigan Road should be reburied within the road reserve and as close to their original location/s as possible. The Aboriginal community requests that a Cultural Smoking Ceremony be accommodated to cleanse the salvaged artefacts and the reburial location.
8. WSD should prepare a Cultural Heritage Management Plan (CHMP) which includes an unexpected finds procedure. Preparation of the CHMP should be undertaken in consultation with the registered Aboriginal parties and be incorporated into the overall management plan for the solar farm.
9. In the unlikely event that human remains are discovered during the construction, all work must cease in the immediate vicinity. OEH, the local police and the registered Aboriginal parties should be notified. Further assessment would be undertaken to determine if the remains were Aboriginal or non-Aboriginal.
10. .

10 REFERENCES

NGH Environmental (2018), *Wollar Solar Farm Aboriginal Cultural Heritage Assessment Report*, report prepared for Wollar Solar Development Pty Ltd.

OEH 2010a, *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*.

OEH 2010b, *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.

OEH 2011, *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW*.

APPENDIX A ABORIGINAL CONSULTATION

Consultation Log of the Proposed Wollar Solar Farm and proposed Eastern Expansion area

Organisation	Action	Date Sent	Reply Date	Replied by	Response
OEH	letter to OEH via email	27/04/2018	7/05/2018	letter via email	supplies list of additional possible stakeholders and postal contacts
NTScorp	Letter to NTSCorp via email	27/04/2018			
National Native Title Tribunal	online search	27/04/2018			No determinations on land
Office of Registrar Aboriginal Land Rights Act	Letter to Office of the Registrar via email	27/04/2018	30/04/2018	letter via email	I have searched the Register of Aboriginal Owners and the project area described does not have Registered Aboriginal Owners pursuant to Division 3 of the Aboriginal Land Rights Act 1983. I suggest that you contact the Mudgee Local Aboriginal Land Council
Mudgee LALC	Letter to LALC via email	27/04/2018	14/05/2018	email	registered via email, KB acknowledge registration for project on 14/05/2018
Central Table lands Local Land Services	Letter to LLS via email	27/04/2018			
Mid-Western Regional Council	Letter sent via email	27/04/2018			
Local Newspapers	Mudgee Guardian	1/05/2018			
Registered after advert					
Murong Gialinga Aboriginal & Torres Strait Islander		2/05/2018	7/05/2018	NGH acknowledged registration	registered via email from seeing local advert
Buudang		2/05/2018	7/05/2018	NGH acknowledged registration	registered via email from seeing local advert
Wellington Valley Wiradjuri Aboriginal Corporation		8/05/2018	8/05/2018	NGH acknowledged registration	registered via email from seeing local advert
Gallaggabang Aboriginal Corporation		8/05/2018	8/05/2018	NGH acknowledged registration	registered via email from seeing local advert
OEH list of possible stakeholders					Due 29th May
Bill Allen	letter sent via post	15/05/2018			

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Binjang Wellington Wiradjuri heritage Survey	letter sent via post	15/05/2018	29/05/2018	registered via email	KB sent acknowledgement of interest email on 29/05/2018
Darlina Verrills	letter sent via post	15/05/2018			
David Maynard	letter sent via post	15/05/2018			
Deborah Foley	already registered from newspaper ad				
Dhuuluu-Yala Aboriginal corporation	letter sent via post	15/05/2018	29/05/2018	returned to sender	
Jean Thornton	letter sent via post	15/05/2018			
Jodie Mckinnon	letter sent via post	15/05/2018	29/05/2018	returned to sender	
Katrina Mckinnon	letter sent via post	15/05/2018			
Larry Foley	already registered from newspaper ad				
Lyn Syme	letter sent via post	15/05/2018	28/05/2018	registered via email letter	KB sent acknowledgement of interest email on 29/05/2018
Mingaan Aboriginal Corporation	letter sent via post	15/05/2018			
Mooka	letter sent via post	15/05/2018			
Mudgee LALC	already written to	15/05/2018			
Murong Gialinga Aboriginal & Torres Strait Islander corporation	letter sent via post	15/05/2018			
Natasha Rodgers	letter sent via post	15/05/2018			
North- Eastern Wiradjuri	letter sent via post	15/05/2018			
Paul (midnight) Brydon	letter sent via post	15/05/2018	21/05/2018	registered via email	KB sent acknowledgement of interest email on 22/05/2018
Trevor Robinson	letter sent via post	15/05/2018	10/07/2018	returned to sender	

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Wamarr Cutural Consultants	letter sent via post	15/05/2018			
Warrabinga Native Tittle Claimants Aboriginal	letter sent via post	15/05/2018	10/07/2018	returned to sender	
Wellington Valley Wiradjuri Aboriginal Corporation	already registered from newspaper ad				
Wiradjuri Council of Elders	letter sent via post	15/05/2018	10/07/2018	returned to sender	
Wiradjuri Interim Working Party	letter sent via post	15/05/2018	22/05/2018	returned to sender	
Wiradjuri traditional Owners Central West Aboriginal	letter sent via post	15/05/2018			
Wurrumay Consultants	letter sent via post	15/05/2018	22/05/2018	returned to sender noted that box is closed	
OEH emailed re restricted sites and change is site numbers during AHIMS search	via email	24/05/2018	25/05/2018	via email	I can confirm that Restricted Aboriginal Sites are nowhere the Wollar Windfarm Study Area and will not be impacted by any works within the proposed Works Boundary.
Barraby Cultural Services	letter via email registering for project	30/05/2018	30/05/2018	via email	KB sent acknowledgement of interest
Yulay Cultural Services	letter via email registering for project	30/05/2018	30/05/2018	via email	KB sent acknowledgement of interest
Yurrandaali Cultural Services	letter via email registering for project	30/05/2018	30/05/2018	via email	KB sent acknowledgement of interest
Methodology					
North West Wiradjuri Company LTD	via email	7/06/2018			
Paul (midnight) Brydon	via email	7/06/2018			
Murong Gialinga Aboriginal & Torres Strait Islander	via email	7/06/2018	7/06/2018	via email	provided rates, insurances and work history
Buudang	via email	7/06/2018	12/06/2018	via email	we would like to ask that the survey transect be reduced to 10m to 15m apart as it being 20m to 30m a lot of the area will not be covered properly we agree with everything else

Organisation	Action	Date Sent	Reply Date	Replied by	Response
					in the Methodology. Also provided rates, insurances and work history
Wellington Valley Wiradjuri Aboriginal Corporation	via email	7/06/2018	13/06/2018	via email	Agree in principle to methodology, would like spacing no greater then 30m with 20m being optimal. Request to be involved in enviro surveys
Gallaggabang Aboriginal Corporation	via email	7/06/2018	13/06/2018	via email	Agree in principle to methodology, would like spacing no greater then 30m with 20m being optimal. Request to be involved in enviro surveys
Mudgee LALC	via email	7/06/2018			
Binjang Wellington Wiradjuri heritage Survey	via email	7/06/2018			
Barraby Cultural Services	via email	7/06/2018	8/06/2018	via email	supports the methodology for this project, supplied rates and insurances
Yulay Cultural Services	via email	7/06/2018			
Yurrandaali Cultural Services	via email	7/06/2018	7/06/2018	via email	supports the methodology for this project, supplied rates and insurances
OEH informed on RAPS	via email	7/06/2018			Please note for OEH records that there are 11 registered Aboriginal parties for the proposed Wollar Solar Farm as listed below. • North West Wiradjuri Company LTD • Paul Brydon • Murong Gialinga Aboriginal & Torres Strait Islander • Buudang • Wellington Valley Wiradjuri Aboriginal Corporation • Gallaggabang Aboriginal Corporation • Mudgee LALC • Binjang Wellington Wiradjuri heritage Survey • Barraby Cultural Services • YULAY CULTURAL SERVICES • Yurrandaali Cultural Services No other party registered their interest, including the entities and individuals recommended by OEH.
Murong Gialinga Aboriginal & Torres Strait Islander	via email	12/06/2018			we would like to ask that the survey transect be reduced to 10m to 15m apart as it being 20m to 30m a lot of the area will not be covered properly we agree with everything else in the Methodology
Reminder emails sent re comments due next week					

Organisation	Action	Date Sent	Reply Date	Replied by	Response
North West Wiradjuri Company LTD	via email	27/06/2018			
Paul (midnight) Brydon	via email	27/06/2018	27/06/2018	via email	Noted that "All appears to be in order, no bad comments from this end. “and that he won't be able to participate in any field work at this time but would still like to be kept in the loop.
Mudgee LALC	via email	27/06/2018	3/07/2018	via email	supplies rates and insurances, no comments on the methodology noted.
Binjang Wellington Wiradjuri heritage Survey	via email	27/06/2018			
Yulay Cultural Services	via email	27/06/2018			
reminder emails as comments due COB today					
North West Wiradjuri Company LTD	remainder comments due COB today sent via email	5/07/2018			No response received
Binjang Wellington Wiradjuri heritage Survey	remainder comments due COB today sent via email	5/07/2018			No response received
Yulay Cultural Services	remainder comments due COB today sent via email	5/07/2018			No response received
NGH response to methodology re spacing					
Murong Gialinga Aboriginal & Torres Strait Islander	letter via email	6/07/2018			NGH responded that spacing will be reduced to 20-25m
Buudang	letter via email	6/07/2018			NGH responded that spacing will be reduced to 20-25m
Wellington Valley Wiradjuri Aboriginal Corporation	letter via email	6/07/2018	6/07/2018	via email- happy with NGH response	NGH responded that spacing will be reduced to 20-25m
Gallaggabang Aboriginal Corporation	letter via email	6/07/2018	6/07/2018	via email- happy with NGH response	NGH responded that spacing will be reduced to 20-25m
Draft ACHA					**comments due 15 Nov**
Mudgee LALC	sent via email	18/10/2018			

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Murong Gialinga Aboriginal & Torres Strait Islander	sent via email	18/10/2018			
Buudang	sent via email	18/10/2018			
Wellington Valley Wiradjuri Aboriginal Corporation	sent via email	18/10/2018	23/10/2018	via email	provided informal response -still reading draft but so far looks ok, will provide formal response after comms from Elders and field officers.
Gallaggabang Aboriginal Corporation	sent via email	18/10/2018			
North West Wiradjuri Company LTD	sent via email	18/10/2018			
Paul (midnight) Brydon	sent via email	18/10/2018	22/10/2018	via email	issue downloading document requested resent
Binjang Wellington Wiradjuri heritage Survey	sent via email	18/10/2018			
Barraby Cultural Services	sent via email	18/10/2018			
Yulay Cultural Services	sent via email	18/10/2018			
Yurrandaali Cultural Services	sent via email	18/10/2018			
Paul (midnight) Brydon	KB sent via email reduced PDF version as requested	24/10/2018			
Project updated re reduction in development footprint					
Mudgee LALC	NGH sent update via email	14/11/2018			
Murong Gialinga Aboriginal & Torres Strait Islander	NGH sent update via email	14/11/2018	15/11/2018	Debbie called KB	provided over phone comments -noted happy with report and recommendations and updated to footprint, no additional comments provided
Buudang	NGH sent update via email	14/11/2018	15/11/2018	Debbie called KB	provided over phone comments -noted happy with report and recommendations and updated to footprint, no additional comments provided
Wellington Valley Wiradjuri Aboriginal Corporation	NGH sent update via email	14/11/2018	14/11/2018	Brad replied via email	We agreed with the recommendations in the report and asked for the birthing tree to be recorded. No changes.
Gallaggabang Aboriginal Corporation	NGH sent update via email	14/11/2018	14/11/2018	Brad replied via email	Thank you for the update project advice. Yes WVWAC response comments is also that of Gallanggabang as a RAP.
North West Wiradjuri Company LTD	NGH sent update via email	14/11/2018			

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Paul (midnight) Brydon	NGH sent update via email	14/11/2018	14/11/2018	Midnight replied via email	I have no problems with this but would still like to be kept in the loop and Happy to go cheers midnight
Binjang Wellington Wiradjuri heritage Survey	NGH sent update via email	14/11/2018			
Barraby Cultural Services	NGH sent update via email	14/11/2018			
Yulay Cultural Services	NGH sent update via email	14/11/2018			
Yurrandaali Cultural Services	NGH sent update via email	14/11/2018			
Reminder sent re comments as timeframe now lapsed					
North West Wiradjuri Company LTD	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Binjang Wellington Wiradjuri heritage Survey	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Barraby Cultural Services	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Yulay Cultural Services	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Yurrandaali Cultural Services	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Mudgee LALC	Via email	20/11/2018			NGH sent reminder re comments as timeframe now lapsed
Final Reminder sent re comments as timeframe now lapsed and finalising report					
North West Wiradjuri Company LTD	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Binjang Wellington Wiradjuri heritage Survey	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Barraby Cultural Services	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Yulay Cultural Services	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Yurrandaali Cultural Services	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Mudgee LALC	Via email	23/11/2018			NGH sent reminder re comments as timeframe now lapsed
Mudgee LALC	replied via email	3/12/2018			The Mudgee LALC agrees with the recommendations for the management of Aboriginal Cultural Heritage within the report. In particular we are supportive of the buffer zones and avoiding disturbance to sites wherever possible and

Organisation	Action	Date Sent	Reply Date	Replied by	Response
					that when this is not possible that objects remain on site in a safe and suitable location.
Project updated development footprint					
Mudgee LALC	via email	15/03/2019			
Murong Gialinga Aboriginal & Torres Strait Islander	via email	15/03/2019			
Buudang	via email	15/03/2019			
Wellington Valley Wiradjuri Aboriginal Corporation	via email	15/03/2019	15/03/2019	via email	Thanks for the project update.
Gallaggabang Aboriginal Corporation	via email	15/03/2019			
North West Wiradjuri Company LTD	via email	15/03/2019			
Paul (midnight) Brydon	via email	15/03/2019			
Binjang Wellington Wiradjuri heritage Survey	via email	15/03/2019			
Barraby Cultural Services	via email	15/03/2019			
Yulay Cultural Services	via email	15/03/2019			
Yurrandaali Cultural Services	via email	15/03/2019			
OEH	via email	19/03/2019			I just wanted to quickly touch base with you in regard to the further field survey that will occur for a 2.3 ha area for the State Significant Development (SSD) for the proposed Wollar Solar Farm. As per past correspondence with yourself and OEH regarding similar SSD projects and the need for additional survey that is considered a continuation of the main Solar Farm assessment where consultation with the RAPs has been continuous (within 6 months) NGH proposed to undertake further field assessment of a 2.3 ha area that will be surveyed and assessed as an addendum report to the Wollar Solar Farm ACHA. Given the addendum report approach as noted above is consistent with previous advice provided by yourself and OEH on similar SSD projects we would consult with the RAPs that are registered for the Wollar Solar Farm project. Should there be any change to the advice previously

Organisation	Action	Date Sent	Reply Date	Replied by	Response
					provided for similar projects please contact me ASAP so we can advise the proponent and respond accordingly.
Letter sent re Additional survey and addendum report and Final ACHA sent also to all RAPs					
Mudgee LALC	via email	22/03/2019	25/03/2019	via email	noted available for fieldwork and provided updated insurances
Murong Gialinga Aboriginal & Torres Strait Islander	via email	22/03/2019	25/03/2019	via email	noted available for fieldwork and provided updated insurances
Buudang	via email	22/03/2019	25/03/2019	via email	noted available for fieldwork and provided updated insurances
Wellington Valley Wiradjuri Aboriginal Corporation	via email	22/03/2019	22/03/2019	via email	noted available for fieldwork and provided updated insurances
Gallaggabang Aboriginal Corporation	via email	22/03/2019			
North West Wiradjuri Company LTD	via email	22/03/2019			
Paul (midnight) Brydon	via email	22/03/2019			
Binjang Wellington Wiradjuri heritage Survey	via email	22/03/2019			
Barraby Cultural Services	via email	22/03/2019			
Yulay Cultural Services	via email	22/03/2019			
Yurrandaali Cultural Services	via email				
Murong Gialinga Aboriginal & Torres Strait Islander	via email	2/04/2019			due to other commitments will no longer be able to participate in fieldwork
Buudang	via email	2/04/2019			due to other commitments will no longer be able to participate in fieldwork
Draft addendum sent to all RAPs					
Mudgee LALC	via email	16/04/2019			
Murong Gialinga Aboriginal & Torres Stait Islander	via email	16/04/2019			
Buudang	via email	16/04/2019			
Wellington Valley Wiradjuri Aboriginal Corporation	via email	16/04/2019	22/04/2019	Letter via email	Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) and Gallanggabang Aboriginal Corporation (GAC) jointly respond to the Addendum Aboriginal Cultural Heritage Assessment:

Organisation	Action	Date Sent	Reply Date	Replied by	Response
					Eastern Expansion Area – Wollar Solar Farm report dated April 2019. WVWAC & GAC agree to the findings of this report and the recommendations as set out within it.
Gallaggabang Aboriginal Corporation	via email	16/04/2019	22/04/2019	Letter via email	Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) and Gallanggabang Aboriginal Corporation (GAC) jointly respond to the Addendum Aboriginal Cultural Heritage Assessment: Eastern Expansion Area – Wollar Solar Farm report dated April 2019. WVWAC & GAC agree to the findings of this report and the recommendations as set out within it.
North West Wiradjuri Company LTD	via email	16/04/2019			
Paul (midnight) Brydon	via email	16/04/2019			
Binjang Wellington Wiradjuri heritage Survey	via email	16/04/2019			
Barraby Cultural Services	via email	16/04/2019	23/04/2019	via email	Received, thank you.
Yulay Cultural Services	via email	16/04/2019			
Yurrandaali Cultural Services	via email	16/04/2019			
Reminders sent re comments					
Mudgee LALC	reminder sent via email	13/05/2019			
Murong Gialinga Aboriginal & Torres Stait Islander	reminder sent via email	13/05/2019	20/05/2019	Via email	We have no comments
Buudang	reminder sent via email	13/05/2019			
North West Wiradjuri Company LTD	reminder sent via email	13/05/2019			
Paul (midnight) Brydon	reminder sent via email	13/05/2019			
Binjang Wellington Wiradjuri heritage Survey	reminder sent via email	13/05/2019			
Barraby Cultural Services	reminder sent via email	13/05/2019			
Yulay Cultural Services	reminder sent via email	13/05/2019			

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Yurrandaali Cultural Services	reminder sent via email	13/05/2019			
Reminder sent re comments now lapsed and will finalise report this week please send any comments ASAP.					
Mudgee LALC	reminder sent via email	22/05/2019			
Buudang	reminder sent via email	22/05/2019			
North West Wiradjuri Company LTD	reminder sent via email	22/05/2019			
Paul (midnight) Brydon	reminder sent via email	22/05/2019	22/05/2019	Via email	All ok with me
Binjang Wellington Wiradjuri heritage Survey	reminder sent via email	22/05/2019			
Barraby Cultural Services	reminder sent via email	22/05/2019			
Yulay Cultural Services	reminder sent via email	22/05/2019			
Yurrandaali Cultural Services	reminder sent via email	22/05/2019			
Letter sent re another additional survey and addendum report sent to all RAPs					
Mudgee LALC	via email	21 and 28/08/2019	21/08/2019	via email	noted available for fieldwork and provided updated insurances
Murong Gialinga Aboriginal & Torres Stait Islander	via email	21 and 28/08/2019	22/08/2019	via email	noted available for fieldwork and provided updated insurances
Buudang	via email	21 and 28/08/2019	22/08/2019	via email	noted NOT available for fieldwork
Wellington Valley Wiradjuri Aboriginal Corporation	via email	21 and 28/08/2019	21/08/2019	via email	noted available for fieldwork and provided updated insurances
Gallaggabang Aboriginal Corporation	via email	28/08/2019			
North West Wiradjuri Company LTD	via email	28/08/2019			

Organisation	Action	Date Sent	Reply Date	Replied by	Response
Paul (midnight) Brydon	via email	28/08/2019			
Binjang Wellington Wiradjuri heritage Survey	via email	28/08/2019			
Barraby Cultural Services	via email	28/08/2019			
Yulay Cultural Services	via email	28/08/2019			
Yurrandaali Cultural Services	via email	28/08/2019			
Draft UPDATED Addendum Report Regarding Additional Works Provided					
Mudgee LALC	via email	16/09/2019	14/10/2019	-	
Murong Gialinga Aboriginal & Torres Stait Islander	via email	16/09/2019	14/10/2019	30/09/2019	Agreed with report but would like to see test excavation at AFT 1, 2, 3, and 4. Also requested that artefacts be reburied in a location or locations was near to the sites as possible and in agreement with RAPs.
Buudang	via email	16/09/2019	14/10/2019	30/09/2019	As above
Wellington Valley Wiradjuri Aboriginal Corporation	via email	16/09/2019	14/10/2019	24/09/2019	Agreed with report but would like to see test excavation at locations with topsoil. Also requested that artefacts be reburied in a location or locations was near to the sites as possible and in agreement with RAPs.
Gallaggabang Aboriginal Corporation	via email	16/09/2019	14/10/2019	24/09/2019	As above
North West Wiradjuri Company LTD	via email	16/09/2019	14/10/2019	-	
Paul (midnight) Brydon	via email	16/09/2019	14/10/2019	18/09/2019	Happy with report
Binjang Wellington Wiradjuri heritage Survey	via email	16/09/2019	14/10/2019	18/09/2019	Happy with report
Barraby Cultural Services	via email	16/09/2019	14/10/2019	-	
Yulay Cultural Services	via email	16/09/2019	14/10/2019	01/10/2019	Did not wish to comment
Yurrandaali Cultural Services	via email	16/09/2019	14/10/2019	-	

NGH letter to all RAPs regarding additional survey and update to the development footprint sent out on the 22nd March 2019

ngh environmental

22 March 2019

canberra
unit 8, 27 yallourn st
(po box 62)
fyshwick act 2609
t 02 6280 5053

bega
89-91 auckland st
(po box 470)
bega nsw 2550
t 02 6492 8333

brisbane
suite 4, level 5
87 wickham terrace
spring hill qld 4000
t 07 3129 7633

newcastle
2/54 hudson st
hamilton nsw 2303
t 02 4929 2301

sydney
unit 18, level 3
21 mary st
surry hills nsw 2010
t 02 8202 8333

wagga wagga
suite 1, 39 fitzmaurice st
(po box 5464)
wagga wagga nsw 2650
t 02 6971 9696
f 02 6971 9693

ngh@nghenvironmental.com.au
www.nghenvironmental.com.au

To whom it may concern,

RE – Wollar Solar Farm Notice of additional survey and development footprint update- 22 March 2019

As you would be aware, you registered an interest in the Wollar Solar Farm project. Recently NGH Environmental was informed that Wollar Solar Development Pty Ltd have updated the Wollar Solar Farm development footprint. This update is in addition to the letter recently sent to you dated the 15th of March 2019.

The current development footprint update relates specifically to the extension of the development footprint for 59.3 ha in the western portion of the proposal area within an area previously surveyed and assessed in the ACHA as shown in Figure 1. This update to the development footprint is entirely within the area that was surveyed as part of the Wollar Solar Farm ACHA. No heritage sites or areas of potential archaeological deposits with high densities for subsurface objects were identified within this western expansion area during the initial ACHA fieldwork. Therefore, this update to the development footprint in no way alters or affects the assessment or recommendations in the ACHA report and no further heritage assessment is required. The development footprint would however increase by 59.3 ha.

Another area has also been identified for the expansion of the development footprint which is outside the area assessed in the ACHA report. This 2.3 ha area referred to as the eastern expansion area, as shown in Figure 1, requires field survey and assessment. As the survey for the 2.3 ha eastern expansion area is considered a continuation of the main Solar Farm assessment, and the consultation with the RAPs has been continuous, the area will be surveyed and assessed as an addendum to the ACHA. The methodology for the proposed survey of the 2.3 ha will be in line with that of the main Solar Farm assessment and will include survey with selected RAPs. An addendum to the ACHA report will be written and provided to the Registered Aboriginal Parties (RAPs) for review and comment prior to finalisation.

This letter is provided to ensure you are informed about the proposed changes to the development footprint. Should you have any questions or concerns regarding this update please don't hesitate to contact me.

Yours Sincerely,

Kirsten Bradley
Senior Heritage Consultant
NGH Environmental

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622) ABN: 62 603 938 549)

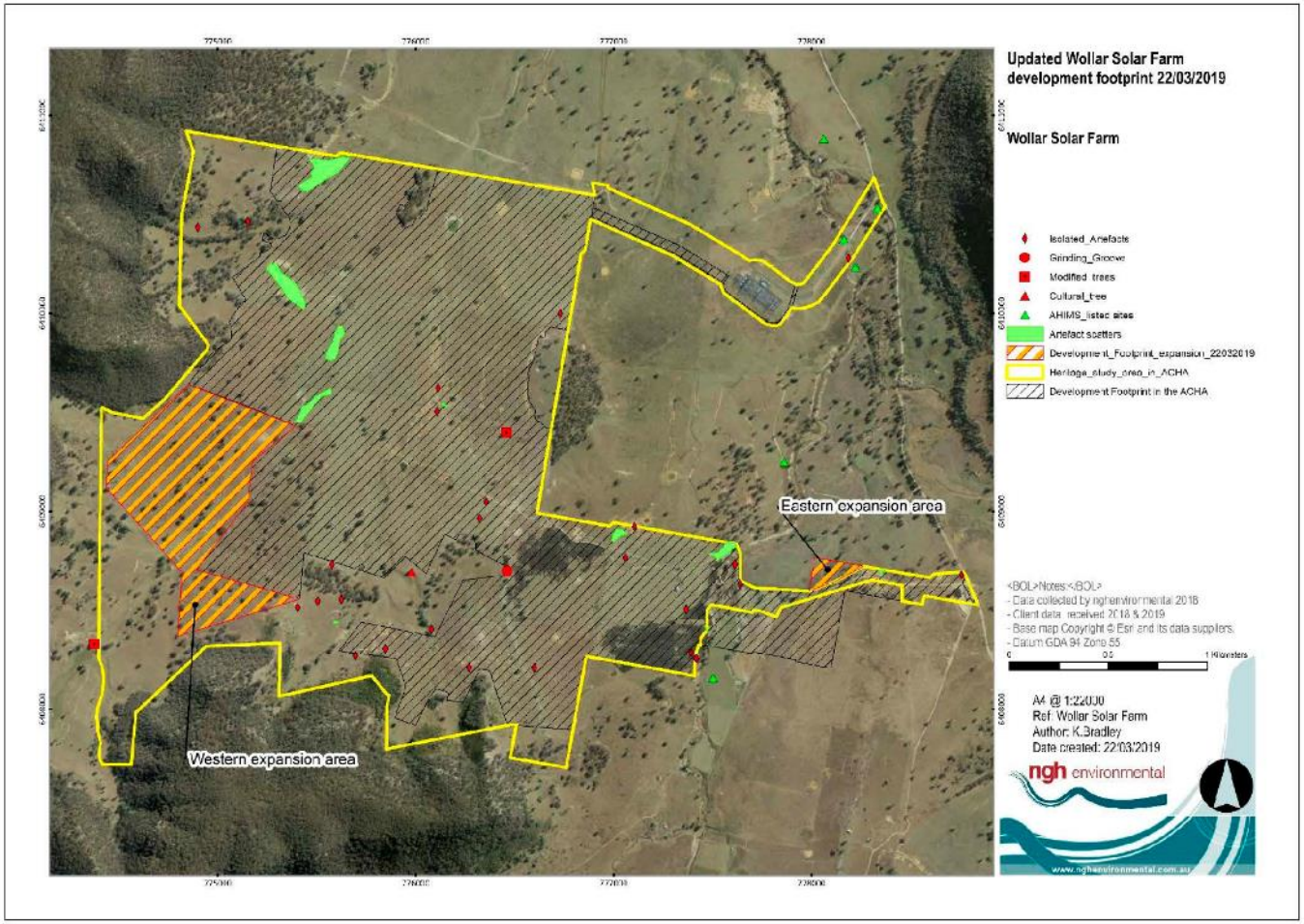


Figure 1.Updated Wollar Solar Farm development footprint including the eastern expansions area that will require additional survey.

28 August 2019

SAMPLE ONLY

Dear

Re: Wollar Solar Farm: Notice of project update – August 2019

As you would be aware, your organisation registered an interest in the Wollar Solar Farm project. Recently NGH was informed that Wollar Solar Development Pty Ltd have updated the project works to include the upgrade of an approximately eight (8) kilometre stretch of Barigan Road, as shown in Figure 1. The proposal description provided in the original ACHA included the following:

Two options for access are being considered:

- *Access via the existing Transgrid Road leading to the TransGrid Wollar substation. Access to this road is via Barigan Road and is unsealed.*
- *Maintain current access to the proposal site via Maree Road. Access to Maree Road is via Barigan Road. Both of which are unsealed.*

At this stage in the assessment, access via Maree Road is the preferred route, and as such, upgrades to Barigan Road are required, including widening. The purpose of the road widening is to improve safety and to accommodate heavy vehicles accessing the Solar Farm during construction. The works will include the widening of the road at a minimum of one metre on either side of the road, and up to five metres where required.

As the upgrade of the road is considered to be a continuation of the of main Solar Farm assessment, and the consultation with the registered Aboriginal parties (RAPs) has been continuous, the area will be assessed as an addendum to the ACHA. There are no registered Aboriginal objects or sites within the boundary of the proposed road upgrade; the closest site is approximately 40 metres from the impact area. As such, the area will be surveyed and assessed as an addendum to the ACHA. The methodology for the proposed survey will be in line with the main Solar Farm assessment and will include survey with selected RAPs. An addendum to the ACHA report will be prepared and provided as a draft to the RAPs for review and comment prior to finalisation.

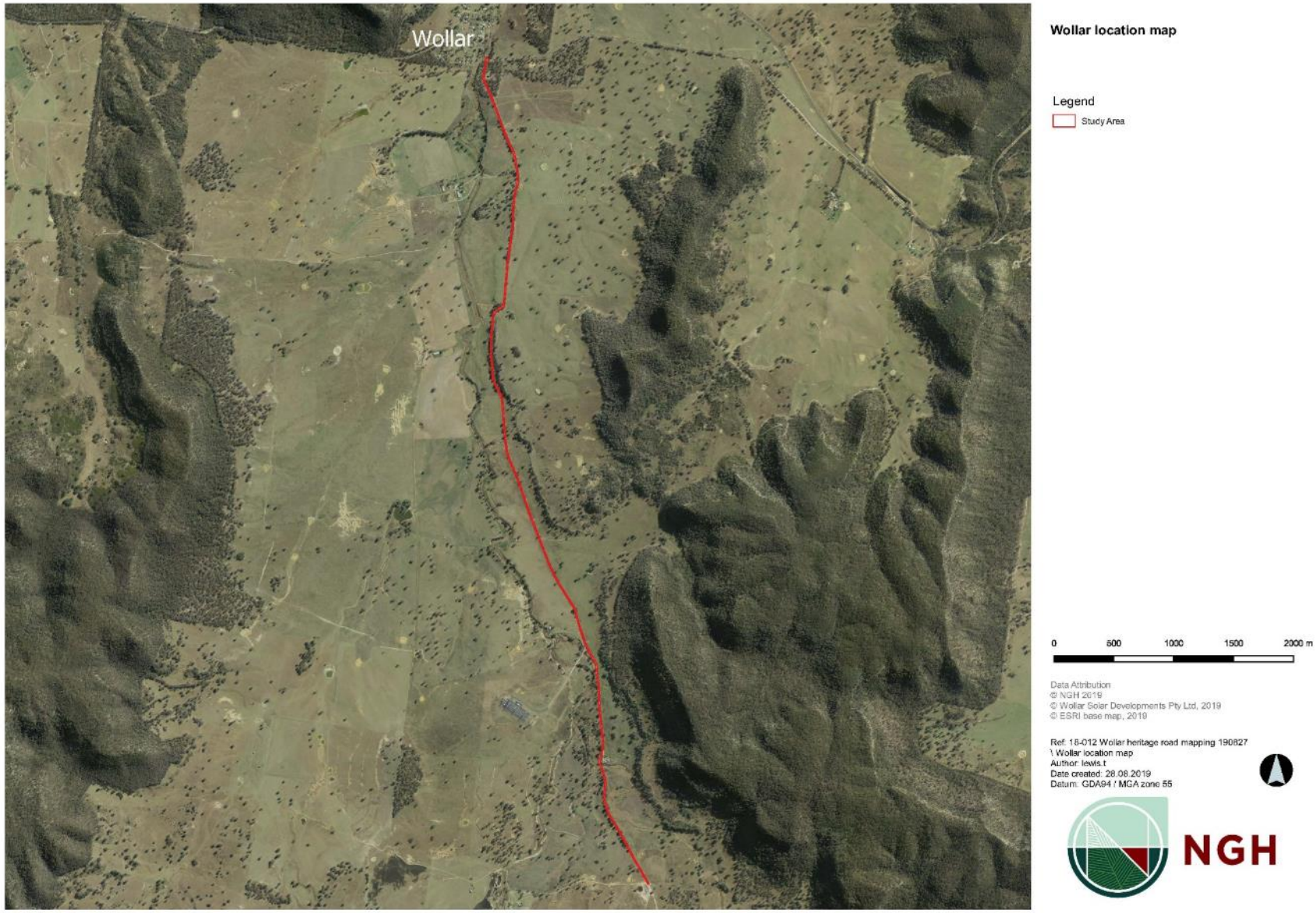
NEWCASTLE
Unit 2, 54 Hudson Street Hamilton NSW 2303
T. (02) 4929 2301 **E.** ngh@nghconsulting.com.au **W.** www.nghconsulting.com.au
BEGA • BRISBANE • CANBERRA • GOLD COAST • NEWCASTLE • SYDNEY • WAGGA WAGGA
ABN 31 124 444 622 ACN 124 444 622

This letter is to ensure you are informed about the proposed changes. Should you have any questions or concerns regarding this project please don't hesitate to contact me at ali.b@nghconsulting.com.au or 0428 747 615.

Yours sincerely,

Ali Byrne

Senior Heritage Consultant
ali.b@nghconsulting.com.au
(02) 4917 3971 / 0428 747 615.
NGH


Wollar
Wollar location map
Legend
Study Area
0
500
1000
1500
2000 m
Data Attribution
© NGH 2019
© Wollar Solar Developments Pty Ltd, 2019
© ESRI base map, 2019
Ref: 18-012 Wollar heritage road mapping 190827
\ Wollar location map
Author: lewis.t
Date created: 28.08.2019
Datum: GDA94 / MGA zone 55
NGH

Ali Byrne
To [redacted]

Reply | Reply All | Forward | ...
Mon 16/09/2019 12:38 PM

Addendum Updated Wollar Solar Farm ACHA_Draft 20190916v1r.pdf
.pdf File

H[redacted]

Please find attached the updated draft addendum report which is associated with the original ACHA completed in 2018 for the Wollar Solar Farm. Please note that we have incorporated the results of the Barigan Road assessment undertaken in August 2019 into the addendum report prepared for the additional fieldwork which was previously undertaken in April/May 2019 (which was provided to you at the time). So, the order of events for this project is as follows:

- 2018: ACHA for Wollar Solar Farm development footprint finalised;
- April/May 2019: Additional fieldwork (Eastern Expansion Area) completed and addendum report prepared and draft provided to RAPs;
- August/September 2019: More additional fieldwork (Barigan Road Upgrade) and addendum report updated to include these results (this is the document attached).

We'd appreciate your comments back as soon as possible, and no later than Monday 14 October 2019.

Please give me a call at any time if there is anything you would like to discuss – my contact details are provided below.

Kind regards,
Ali

ALEXANDRA BYRNE
SENIOR HERITAGE CONSULTANT
BA(Archaeology)

T. 02 4929 2301 **D.** 4917 3971 **M.** 0428 747 615
E. ali.b@nghconsulting.com.au
Unit 2, 54 Hudson St
Hamilton NSW 2303

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WWW.NGHCONSULTING.COM.AU

WELLINGTON VALLEY WIRADJURI
ABORIGINAL CORPORATION
www.wvwac.com

C/- 1 Golden Place
Orange NSW 2800
ABN: 77 548 143 187
ICN: 7398
WVWAC@hotmail.com

24th September 2019

Kirsten Bradley
NGH Environmental
Unit 8, 27 Yallourn Street
Fyshwick ACT 2609

Re: Addendum Updated Wollar Solar Farm ACHA Draft Dated 16 September 2019

Dear Kirsten,

Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) would like to thank you for your invitation to provide a response for This Aboriginal Cultural Heritage issue relevant to obligations to protect our Heritage within our Traditional Lands. Wellington Valley Wiradjuri represent the fourteen traditional families with identified apical ancestry pre European occupation with our known Traditional Lands. We know our culture, country and continue with our association with our traditional lands (Ngurangbang).

WVWAC object to any other non-traditional aboriginal organizations or people taking part in site surveys, consultation and assessments within our defined Traditional Lands. These non-traditional people and groups are outsiders under Traditional Lore and have no right to advise on or to be present during consultation or site visits as they do not possess the specific traditional knowledge in relation to these lands or sites. These participants may be indigenous and may live locally within the region however, this still does not give them the right to disregard Traditional Lore and values.

Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) have through consultation with Elders and Traditional Community with cultural knowledge have the following comments and or recommendations:

PROPOSED BARIGAN ROAD UPGRADE AREA

- The Barigan Road Upgrade Area, a total of nine sites, including four artefact scatters and five isolated finds were identified within this Proposed Barigan Road Upgrade Area. All of these sites will likely be subject to impacts as a result of the proposed upgrade works due to the movement of plant and vehicles within the road reserve and the ground surface disturbance required for the road widening.
    - WVWAC recommends surface collection and possible sub surface investigations at sites NGH Barigan AFT 1, 2, 3 and 4;
    - WVWAC recommends surface collection of sites NGH Barigan IF 1, 2, 3, 4 and 5
    - WVWAC recommends that several suitable sites along this 7km road be selected to rebury the returned artefacts post road upgrade disturbance.

- WVWAC agree to the **Addendum Updated Wollar Solar Farm ACHA Draft Dated 16 September 2019** recommendations as outlined in the report and seek additional detail be added as per the above comments and or recommendations by our Community.

WVWAC look forward to further participating in the above project, sharing our knowledge of county and to ensure our Heritage is protected. We trust our response meets your requirements. Please contact WVWAC Directors should you require our assistance to address any Aboriginal issues to support your future plans.

Yours sincerely,

Bradley R. Bliss J.P.
WVWAC CEO and Contact Officer
Gallanggabang Aboriginal Corporation Director
Northern and Eastern Wiradjuri Cultural Council Member (NEWCC)
Senior Aboriginal Cultural Heritage Field Officer
Senior Aboriginal Cultural Mentor and Educator
Mobile: 0427321016

GALLANGGABANG ABORIGINAL CORPORATION
"Traditional Families of the Wellington Valley & District"
(ABN 21 623 626 328)
(ICN 3477)

PO Box 508
Wellington NSW 2820

24th September 2019

Kirsten Bradley
NGH Environmental
Unit 8, 27 Yallourn Street
Fyshwick ACT 2609

Re: Addendum Updated Wollar Solar Farm ACHA Draft Dated 16 September 2019

Dear Kirsten,

Gallanggabang Aboriginal Corporation (GAC) would like to thank you for your invitation to provide a response for This Aboriginal Cultural Heritage issue relevant to obligations to protect our Heritage within our Traditional Lands. Gallanngabang represent the fourteen traditional families with identified apical ancestry pre European occupation with our known Traditional Lands. We know our culture, country and continue with our association with our traditional lands (Ngurangbang).

GAC object to any other non-traditional aboriginal organizations or people taking part in site surveys, consultation and assessments within our defined Traditional Lands. These non-traditional people and groups are outsiders under Traditional Lore and have no right to advise on or to be present during consultation or site visits as they do not possess the specific traditional knowledge in relation to these lands or sites. These participants may be indigenous and may live locally within the region however, this still does not give them the right to disregard Traditional Lore and values.

Gallanggabang Aboriginal Corporation (GAC) have through consultation with Elders and Traditional Community with cultural knowledge have the following comments and or recommendations:

PROPOSED BARIGAN ROAD UPGRADE AREA

- The Barigan Road Upgrade Area, a total of nine sites, including four artefact scatters and five isolated finds were identified within this Proposed Barigan Road Upgrade Area. All of these sites will likely be subject to impacts as a result of the proposed upgrade works due to the movement of plant and vehicles within the road reserve and the ground surface disturbance required for the road widening.
    - WWAC recommends surface collection and possible sub surface investigations at sites NGH Barigan AFT 1, 2, 3 and 4;
    - WWAC recommends surface collection of sites NGH Barigan IF 1, 2, 3, 4 and 5
    - WWAC recommends that several suitable sites along this 7km road be selected to rebury the returned artefacts post road upgrade disturbance.

- WWAC agree to the **Addendum Updated Wollar Solar Farm ACHA Draft Dated 16 September 2019** recommendations as outlined in the report and seek additional detail be added as per the above comments and or recommendations by our Community.

GAC look forward to further participating in the above project, sharing our knowledge of county and to ensure our Heritage is protected.

GALLANGGABANG ABORIGINAL CORPORATION

"Traditional Families of the Wellington Valley & District"

(ABN 21 623 626 328)

(ICN 3477)

PO Box 508
Wellington NSW 2820

We trust our response meets your requirements. Please contact GAC Directors should you require our assistance to address any Aboriginal issues to support your future plans.

Regards,

Bradley R. Bliss J.P.
Gallanggabang Aboriginal Corporation Director
WWWAC CEO and Contact Officer
Northern and Eastern Wiradjuri Cultural Council (NEWCC)
Senior Aboriginal Cultural Heritage Field Officer
Senior Aboriginal Cultural Mentor and Educator
Traditional Owner Clan Descendant
Mobile: 0427321016

From: Murong Gialinga
To: Ali Byrne
Subject: Re: Attn: Murong Gialinga - Wollar Solar Farm road upgrade
Date: Monday, 30 September 2019 5:11:16 PM
Attachments: image001.png

Good Afternoon Ali thank you for letting Murong Gialinga give feed back on this Draft.We would also like to thank you for being a pleasure and professional to work along side giving the time to listen to our Rap. Our raps have many years experience and have a vast knowledge of our local area.We look forward to working with you in this project. After reading and discussing this with community here are Murong Gilaingas recommendations & comments for the RE Addendum Updated Wollar Solar Farm ACHA Draft Dated 16th September 2019. .The Barigan Road upgrade area there was a total of Nine Sites identified they were Four artefact scatters and Five isolated finds these were within the Proposed Barigan Road Upgrade Area .These sites will could be subject to impacts as a result to the proposed upgrade due to the movement of plant and the traffic within the road reserve also the ground surface disturbance required for the road widening. Murong Gialinga would like to recommend a surface collection at Site NGH Barigan I F 1, 2 ,3 4 ,& 5 also we recommend a sub surface investigation at Sites Barigan AFT 1,2,3,&4.We would also like to see the returned Artefacts post road upgrade and disturbance buried in a appropriate area along the 7km road and all the raps agree on the reburial area. We hope our recommendations are head and accepted . We agree to the Addendum Updated Wollar Solar Farm A C H A Draft Dated 16th September 2019 our recommendations are outlined in the report . Kind Regards Debbie Foley on behalf of Murong Gialinga

---

From: Ali Byrne <ali.b@nghconsulting.com.au>
Sent: Thursday, 19 September 2019 11:20 AM
To: Murong Gialinga <muronggialinga@hotmail.com>
Subject: RE: Attn: Murong Gialinga - Wollar Solar Farm road upgrade

Thanks! The hard copies were sent in the mail yesterday so hopefully they arrive today or tomorrow

ALEXANDRA BYRNE
SENIOR HERITAGE CONSULTANT
BA(Archaeology)
T. 02 4929 2301 **D.** 4917 3971 **M.** 0428 747 615
E. ali.b@nghconsulting.com.au
Unit 2, 54 Hudson St
Hamilton NSW 2303

NGH

BEGA · BRISBANE · CANBERRA · GOLD COAST · NEWCASTLE · SYDNEY · WAGGA WAGGA
WWW.NGHCONSULTING.COM.AU

From: Murong Gialinga <muronggialinga@hotmail.com>
Sent: Thursday, 19 September 2019 11:10 AM
To: Ali Byrne <ali.b@nghconsulting.com.au>
Subject: Re: Attn: Murong Gialinga - Wollar Solar Farm road upgrade

Hi Ali i received your email and will get back to you with comments Take care Regards Deb

APPENDIX B AHIMS SEARCH

Information withheld due to cultural sensitivity.

APPENDIX D NOISE TECHNICAL NOTE

Renzo Tonin & Associates

23 October 2019
TK161-03F01 (r1) Technical Memo.docx

NGH Environmental
MS LOUIZA ROMANE
louiza.r@nghconsulting.com.au

From: Michael Chung [Michael.Chung@renzotonin.com.au]

Wollar Solar Farm - Reassessment of Road Traffic Noise Impacts

1 Introduction

Renzo Tonin & Associates was previously engaged to undertake a construction and operational noise and vibration assessment as part of the Environmental Impact Statement (EIS) for the proposed Wollar Solar Farm in NSW. The EIS noise and vibration assessment was presented in a previous report (ref. TK161-01F01 Report (r4), dated 22 March 2019) prepared by Renzo Tonin & Associates.

Since the preparation and submission of the noise and vibration assessment report, updates to the traffic access plan associated with the construction phase of the project has been amended. This technical memo addresses the potential noise impacts due to the updated traffic access plan and presents an updated road traffic noise assessment accordingly.

2 Project Update Description

The updated traffic access plan includes an increase in traffic generation during the construction phase of the solar farm, compared to the traffic generation presented in the previous Renzo Tonin & Associates report.

Furthermore, an option for traffic to enter the site via Maree Road on the southern end of the solar farm site is also being considered as part of the project and updated traffic access plan. Due to the implementation of the southern access option, 7km of Barigan Road from Wollar Road to the north and Maree Road to the south will be widened and sealed to accommodate the additional traffic generated by the construction of the project. The road upgrade would involve widening the existing road from 6m (in some areas) to 7m, to accommodate the larger construction type vehicles.

3 Road Traffic Noise Assessment

3.1 Construction Traffic Movements

An assessment of traffic noise impacts associated with traffic generated by the construction of the proposed solar farm was presented in Section 7 of the previous Renzo Tonin & Associates report.

The proposed construction generated daily traffic volumes presented in Table 7.1 of the previous Renzo Tonin & Associates have been revised as part of the updated traffic access plan. Table 1 presents the revised estimated daily vehicle movements during the construction phase of the solar farm.

Table 1 – Revised Estimated Traffic Movements During Construction

Vehicle Type	Movements per Day	Average Hourly Movements[1]
Light Vehicles (eg. cars, shuttle buses)	80 (40 in / 40 out)	8
Medium Trucks	40 (20 in / 20 out)	4
Heavy Trucks (eg. semi-trailer, B-double)	14 (7 in / 7 out)	2

Notes: 1. Average hourly movements based on movements per day ÷ 11, representing construction hours from 7am to 6pm

For a conservative assessment, it has been assumed that all the construction traffic will access the site via the southern access option on Maree Road. Therefore, based on the above revised estimated traffic movements, the predicted construction traffic noise levels at the nearest affected residences along the proposed route are presented in the following table.

It is noted that the predicted noise levels represent the traffic noise contribution from the vehicle movements associated with the construction works only and does not take into account existing traffic noise levels as existing traffic volumes along Wollar Road, Phillip Street, Maitland Street and Barigan Road are unknown.

Table 2 – Predicted Road Traffic Noise Levels Along Public Roads, dB(A)

Receiver	Criteria (external)	Average Traffic Movements			Speed (km/h)	Approx. Distance to Road	Predicted Noise Level dB(A)	Exceed?
		Light Vehicle	Medium Trucks	Heavy Trucks				
Nearest Residence on Wollar Road, Phillip Street, Maitland Street	$L_{Aeq,,15hr}$ 60	80 / per 15 hours	40 / per 15 hours	14 / per 15 hours	50	13m	55	No
Nearest Residence on Barigan Road	$L_{Aeq,,1hr}$ 55	8 / per one (1) hour	4 / per one (1) hour	2 / per one (1) hour	50	25m[1]	54	No

Note: 1. Approximate distance of nearest residence to Barigan Road located at 609 Barigan Road, Wollar
2. Only the day period assessed as construction will only occur during the day

From the above table, it can be seen that predicted road traffic noise level contributions from the vehicle movements associated with the construction works comply with the applicable noise criteria at the nearest affected receivers along Wollar Road, Phillip Street, Maitland Street and Barigan Road.

As the construction traffic noise levels are temporary and comply with the RNP criteria set above, it indicates that the traffic noise levels due to the construction works for the solar farm would not adversely affect the existing residences along Wollar Road, Phillip Street, Maitland Street and Barigan Road during construction of the proposed solar farm.

3.2 Barigan Road Upgrade

As mentioned previously, to accommodate the additional traffic generated during the construction of the proposed solar farm, Barigan Road would be widened from approximately 6m to 7m and sealed.

3.2.1 Applicable Traffic Noise Criteria

The EPA's 'Road Noise Policy' (RNP) sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for developments that are potentially affected by road traffic noise, with the aim of preserving the amenity appropriate to the land use. However, the RNP states the following on page 5 of the policy:

> *"Some works that are either minor or required to improve safety are not covered by this RNP."*

The upgrade of Berigan Road involves minor widening and sealing of the existing road to improve safety. Therefore, the project is not specifically assessed against the RNP.

The RMS's 'Noise Criteria Guideline' (NCG) further states the following;

> *"Some works may be primarily to improve safety. This may include minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road realignments.*
>
> *These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic"*

In accordance with the above statement from the NCG, the project is considered to be minor works. For minor works, the NCG states the following regarding noise level targets:

> *"Roads and Maritime applies the existing road criteria (RNP Table 8) where the minor works increase noise levels by more than 2.0dBA relative to the existing noise levels at the worst affected receiver."*

Table 8 of the RNP (Section 4.4) has the following target noise abatement levels for existing local roads not subject to redevelopment.

- **$L_{Aeq,1hr}$ 55dB(A) Day**
- **$L_{Aeq,1hr}$ 50dB(A) Night**

Therefore, based on statement in the NCG and the noise abatement levels for existing roads in the RNP, traffic noise along Barigan Road should not increase by more than 2dB(A) due to the widening of the road.

3.2.2 Traffic Noise Assessment

Based on the estimated construction traffic movements presented in Table 1 and Barigan Road proposed to be widened by up to 1m, the predicted traffic noise levels for the 'No Build' (ie. existing road) and 'Build' (ie. widened road) scenarios have been predicted and are presented in Table 3 below.

Table 3 – Predicted $L_{Aeq,1hr}$ Traffic Noise Levels for Barigan Road Widening

'No Build' Scenario (existing road)		'Build' Scenario (widened road)		Difference ('Build' – 'No Build')	Comply?
Approx. Distance to road[1]	Predicted Traffic Noise Level	Approx. Distance to road[1]	Predicted Traffic Noise Level		
25m	54	24m	54	0	Yes

Note: 1. Approximate distance of nearest residence located at 609 Barigan Road, Wollar

The results presented in the table above indicate that the widening of Barigan Road will not increase traffic noise levels compared to the existing road. Therefore, compliance with the RNP and NCG have been predicted.

Document Control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
23/10/2019	Prepare draft tech memo	-	0	M Chung	-	-
23/10/2019	Final tech memo	-	1	M Chung	-	M Chung

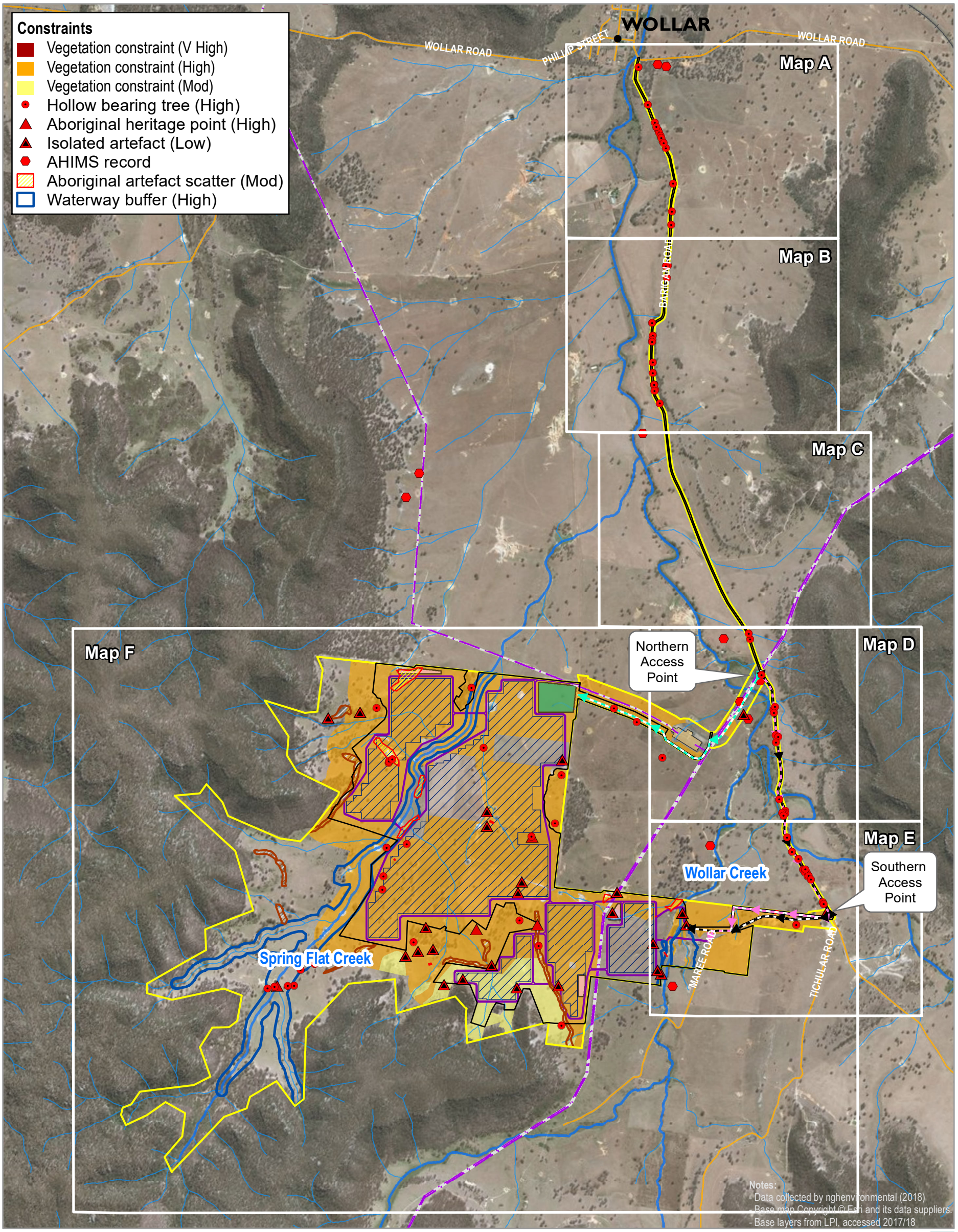
APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX E UPDATED CONSTRAINTS MAP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Vegetation constraint (High)
Vegetation constraint (Mod)
Hollow bearing tree (High)
Aboriginal heritage point (High)
Isolated artefact (Low)
AHIMS record
Aboriginal artefact scatter (Mod)
Waterway buffer (High)
WOLLAR
WOLLAR ROAD
PHILLIP STREET
WOLLAR ROAD
Map A
Map B
Map C
Map D
Map E
Map F
BARIGAN ROAD
Northern Access Point
Southern Access Point
Wollar Creek
Spring Flat Creek
MAREE ROAD
TICHULAR ROAD
Notes:
- Data collected by nghenvironmental (2018)
- Base map Copyright © Esri and its data suppliers.
- Base layers from LPI, accessed 2017/18
Local road
Existing transmission lines
Minor drainage feature
Drainage line
Farm dam / other water body
Existing Wollar substation
Amended proposal site
Amended development footprint
Proposed infrastructure
Site laydown areas
Battery Storage/Laydown/Substation
Solar arrays
Internal access tracks
Northern access
Southern access option 1
Southern access option 2
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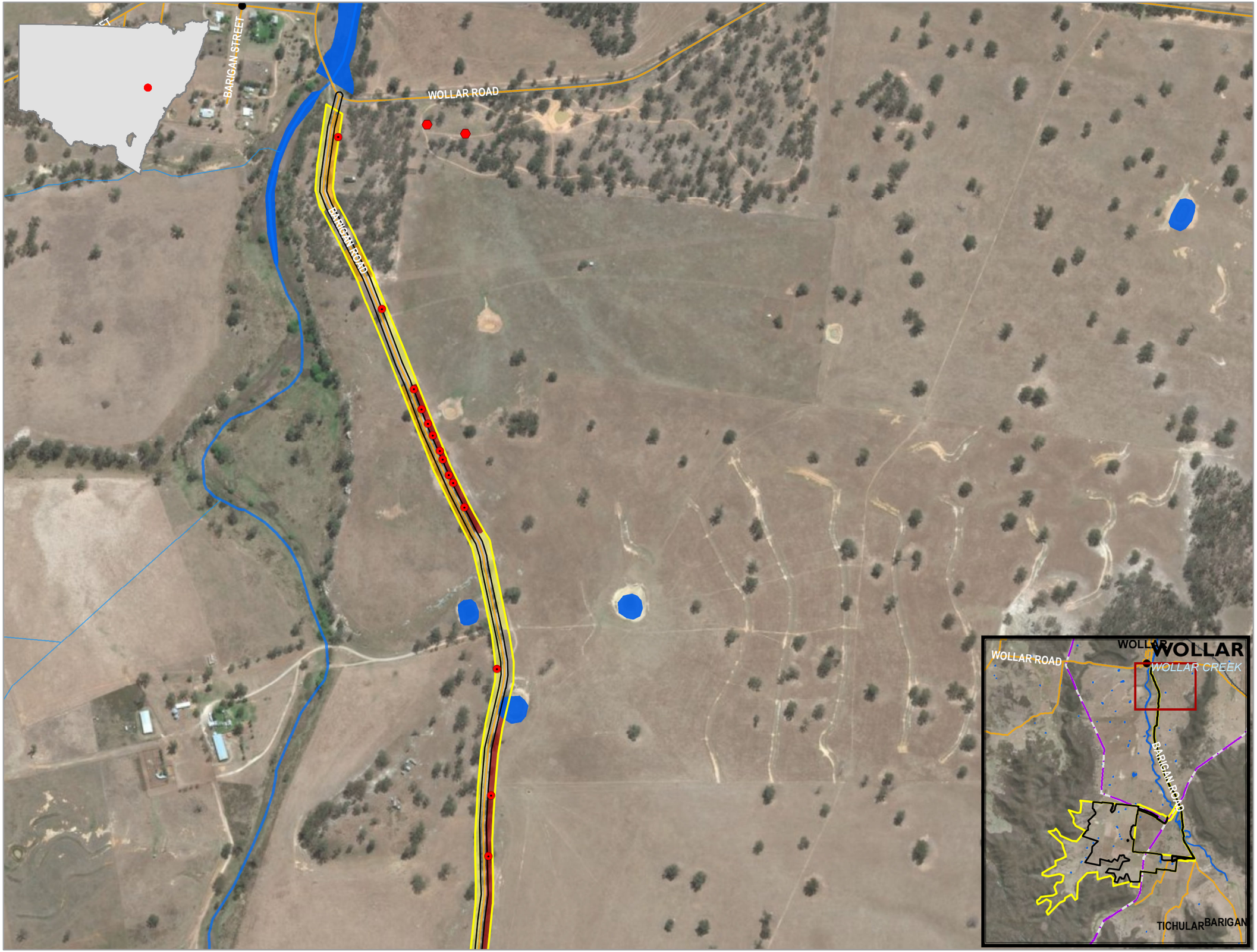

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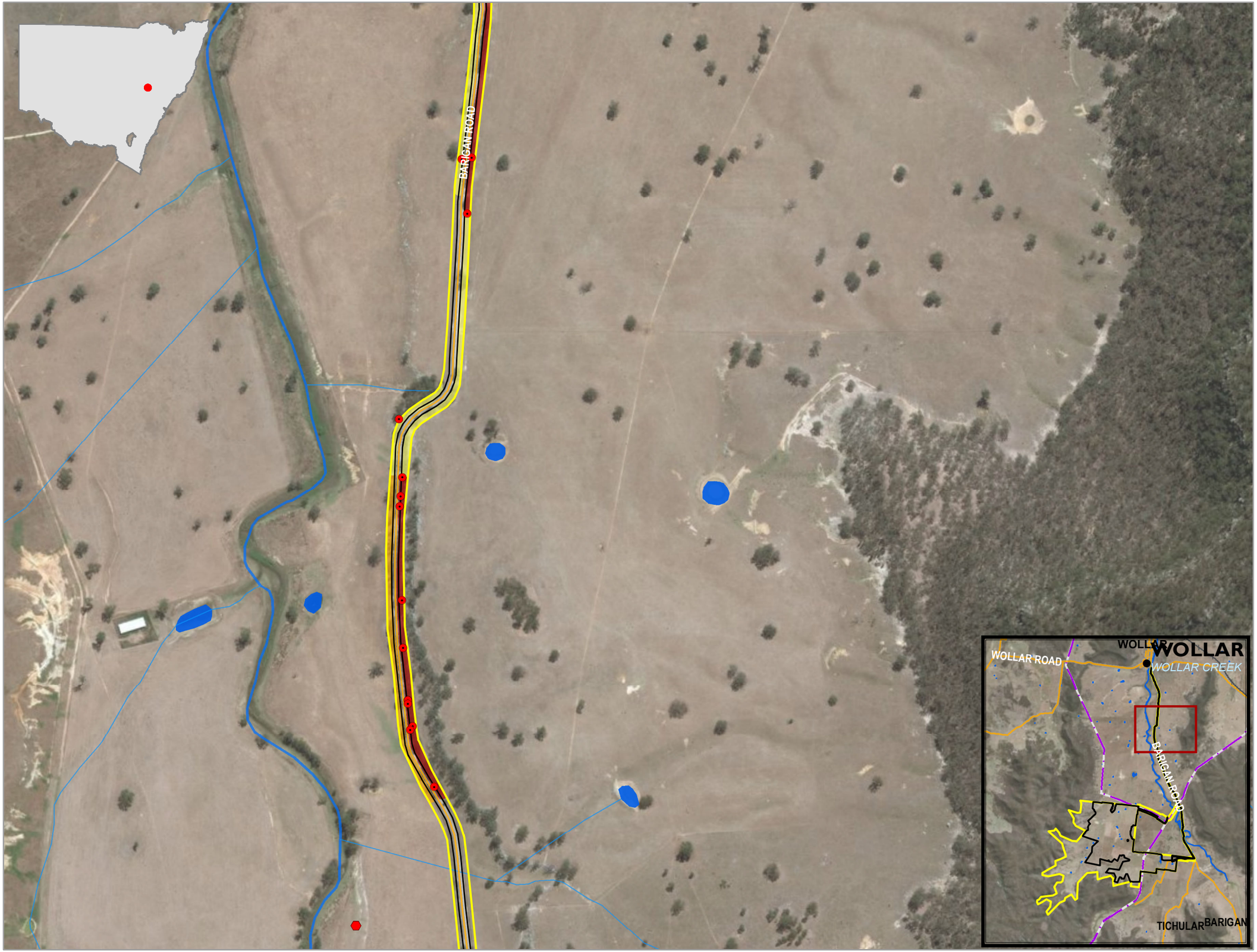

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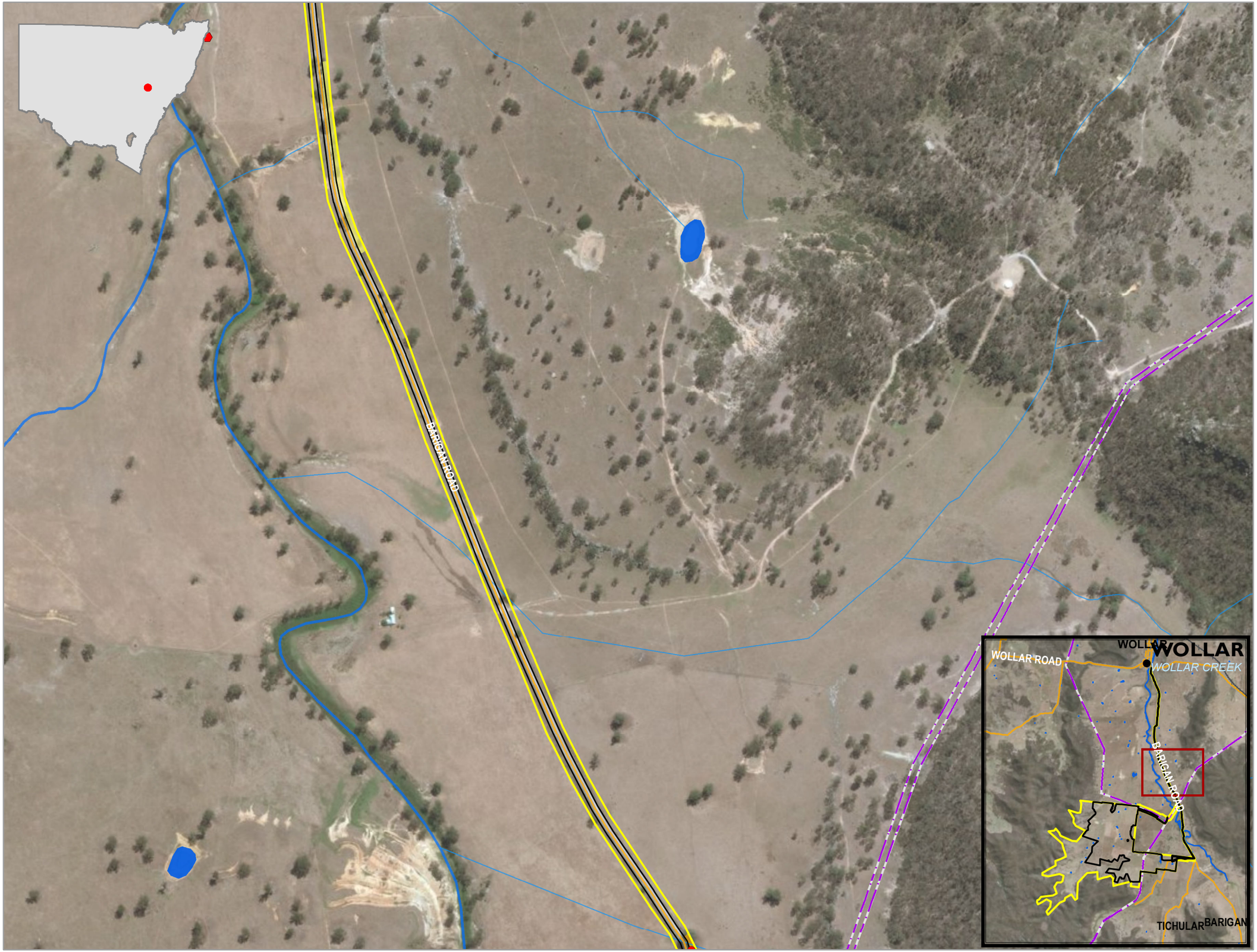

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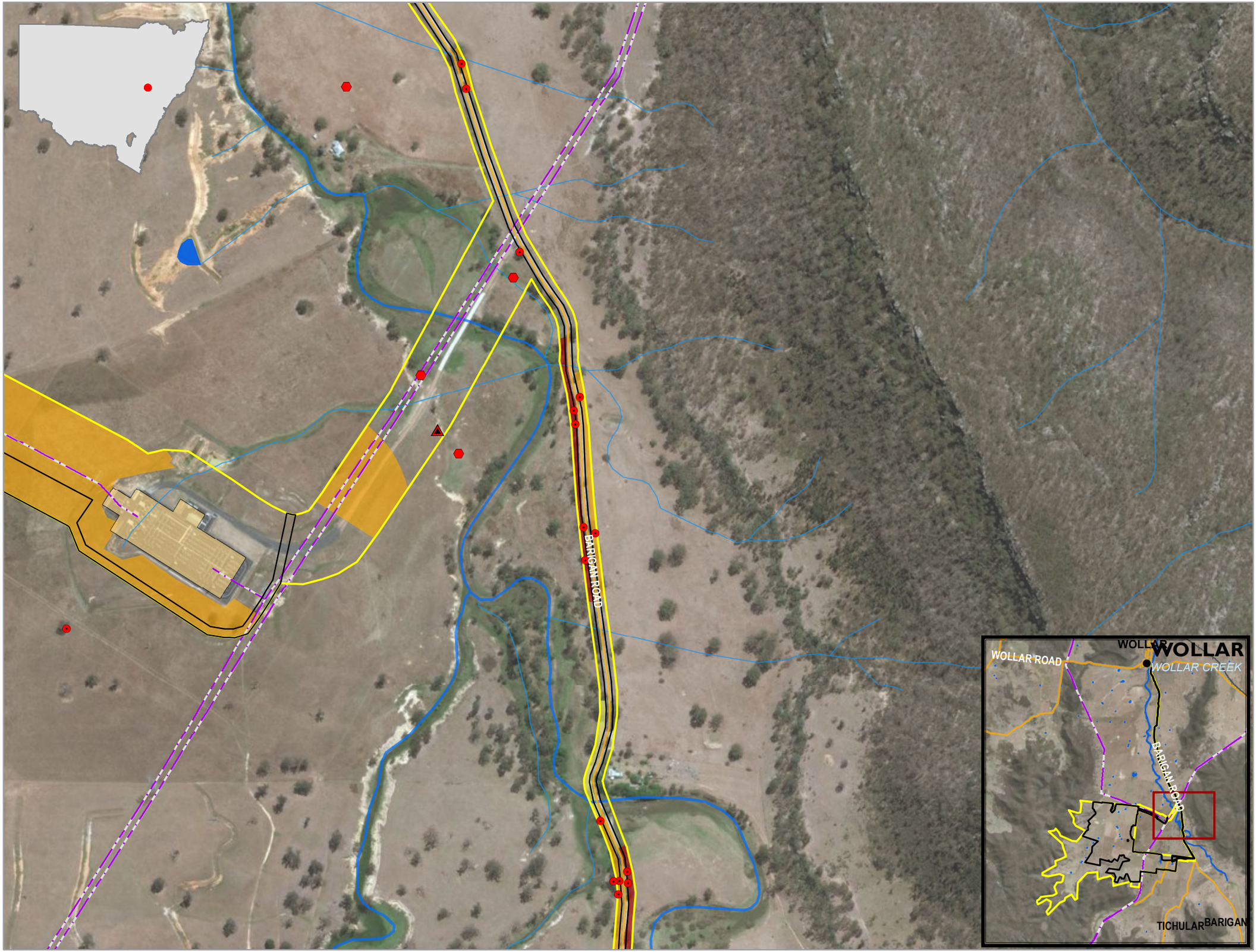

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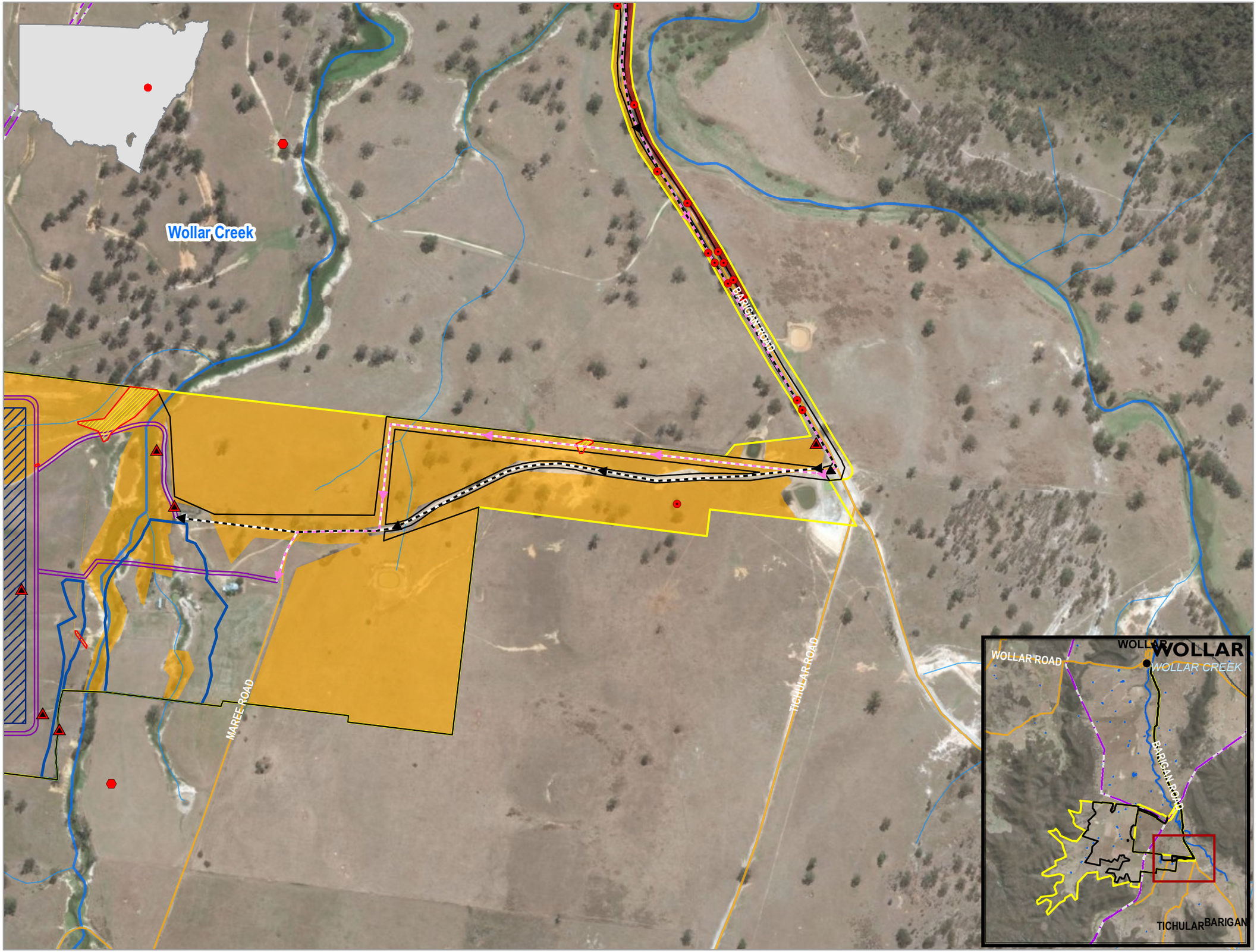

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- Southern access option 2

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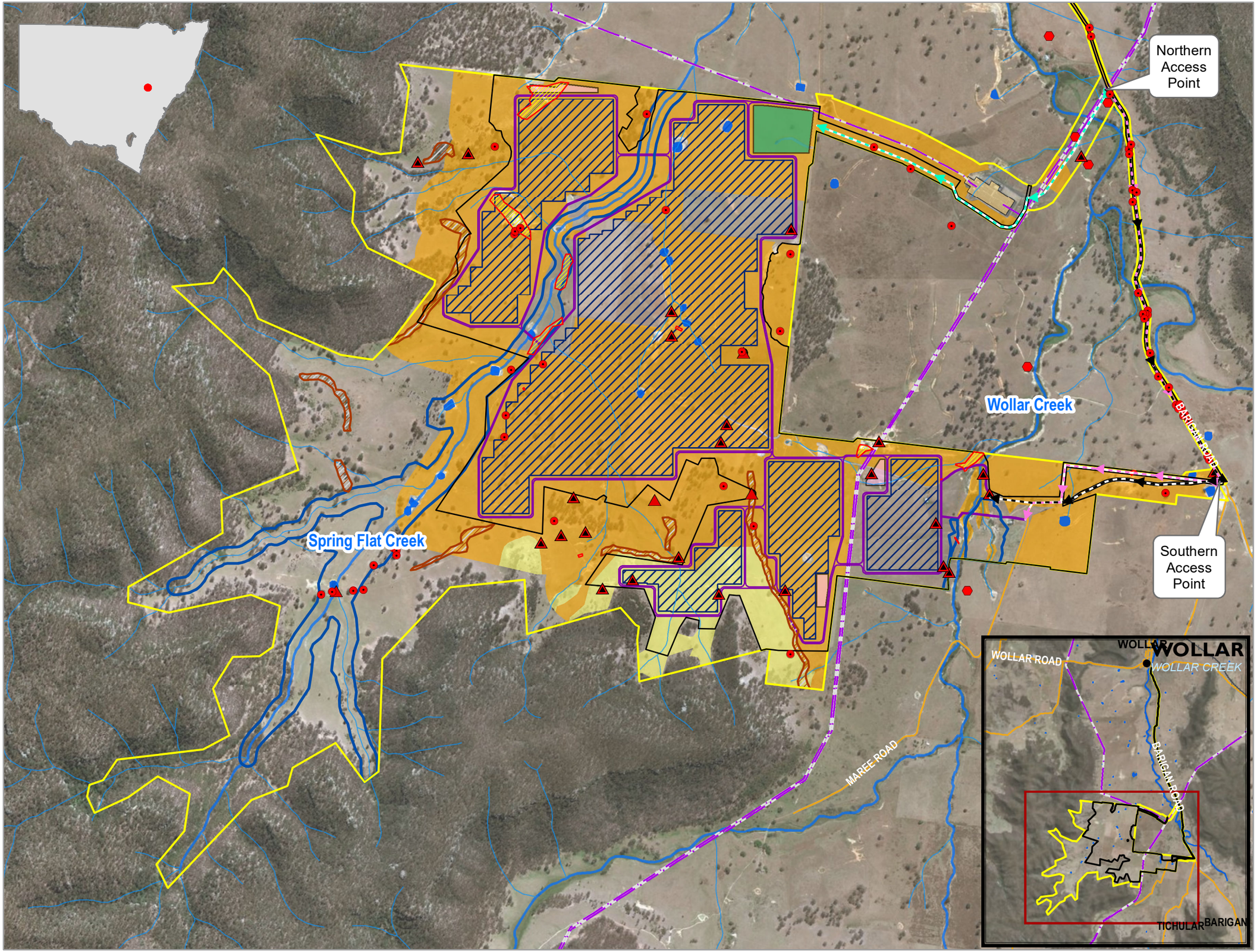

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