



Bonshaw Solar Farm

Response to Submissions Report

27 March 2020

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Bonshaw Solar Farm

Response to Submissions Report



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1. BACKGROUND

The proposed development seeks approval to develop a large scale photovoltaic (PV) generation facility with a capacity of 200 megawatts (MW) and associated infrastructure, including a Lithium-ion Energy Storage System (ESS/Li-ion).

The Environmental Impact Statement (EIS) has been prepared for GAIA Australia Pty Ltd (GAIA) to assess the environmental matters relating to the proposed development of the Bonshaw Solar Farm (the 'Project') at Bonshaw, within the Inverell Local Government Area in New South Wales (NSW) (refer to Figure 1-1).

The Project follows the approvals process under Part 4 of the *Environmental Planning and Assessment Act 1979* as it meets the criteria of a State Significant Development (SSD) under clause 20, Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by GAIA to coordinate the technical assessments and prepare this EIS to support the SSD application. As such, the EIS underwent its public exhibition phase, providing the opportunity for the community, other stakeholders and relevant government agencies to submit and share knowledge and raise issues where appropriate via written submission.

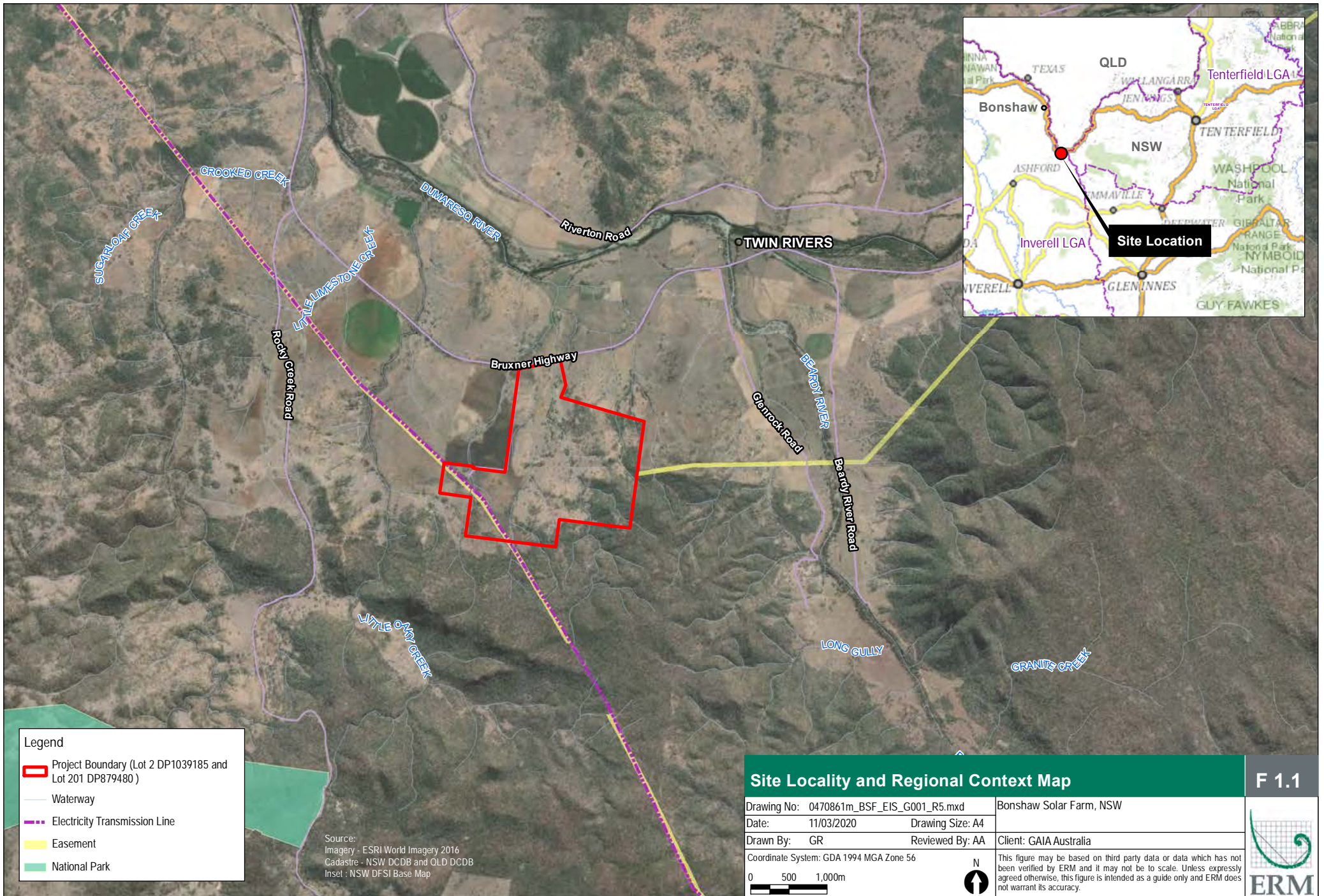
This Response to Submissions (RTS) addresses both agency and public comments received during public exhibition of the Bonshaw Solar Farm EIS.

1.1 Purpose of this Report

ERM has prepared this Response to Submissions (RTS) on behalf of GAIA Australia Pty Ltd in response to the Department of Planning, Industry and Environment's (DPIE) letter dated 6 December 2019 and to fulfil the requirements of Section 85A of the *Environmental Planning and Assessment Regulation 2000*.

The purpose of the Submissions Report is to:

- Consider and respond to the matters raised in the submissions for the proposal.
- Describe any changes to the proposal, including a revised set of proposed mitigation measures.



F 1.1

2. PROPOSAL SUMMARY

2.1 Site Context

The Project is located approximately 16 kilometres (km) south of Bonshaw and 66 km north of Inverell. The Project Site, as described in the Environmental Impact Statement (EIS), originally comprised of approximately 353 hectares (ha), of which the proposed development area originally occupied approximately 167 ha. Refinements to the Project Site are further discussed in Section 2.4 below.

The Project Site and broader region is predominately agricultural grazing land. An existing TransGrid-owned 330 kV transmission line runs through the Project Site.

2.2 Key Infrastructure

The key elements of the Project include the construction and operation of:

- a network of PV modules in a fixed tilt or single axis tracking arrangement;
- associated battery energy storage system (BESS) / battery storage;
- a switch yard to be connected to the 330 kV TransGrid Dumaresq Substation, on the boundary of the Project Site;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- operations and maintenance (O&M) infrastructure, including O&M buildings incorporating a control room, meeting facilities, a temperature controlled spare parts storage facility, supervisory control and data acquisition (SCADA) facilities, a workshop and associated infrastructure (e.g. kitchen, toilets and other facilities), and car parking facilities. These are proposed close to the substation in the south-west of the site;
- site access will be provided from the existing access road leading to the Dumaresq substation. A connecting road will join to the access road, connecting to the internal access road network at the north-western corner of the Project Site (refer to Figure 2-1);
- a new internal road network to enable access from surrounding local roads to the array areas during construction and operations including internal access tracks, creek crossing & perimeter security fencing;
- installation of an overhead grid connection to Dumaresq Substation; and
- temporary facilities during construction.

The refined concept layout is detailed in Figure 2-1 below.

2.3 Project Benefits and Justification

The Project would generate 420 GWh of electricity contributed to the National Electricity Market per annum, offering a multitude of benefits. The Project seeks to:

- provide a source of renewable energy to supplement NSW and National energy requirements and assist in reducing greenhouse gas (GHG) emissions;
- contribute to the additional generating capacity required to meet the growing energy demand in NSW;
- contribute to NSW and Commonwealth targets for renewable energy;
- provide economic benefits to the local and regional community provided directly and indirectly by the employments associated with the Project;
- provide additional income streams for the involved landholder;

- liaise and work with the community and all potentially affected stakeholders in the identification, mitigation and / or monitoring of any potential environmental effects;
- contribute to local community facilities and infrastructure through the Community Benefit Fund;
- ensure quality, safety and environmental standards are maintained;
- recycle and reuse material where practical and economically feasible; and
- minimise all potential and adverse environmental impacts and where practical, maximise all potential positive environmental effects.

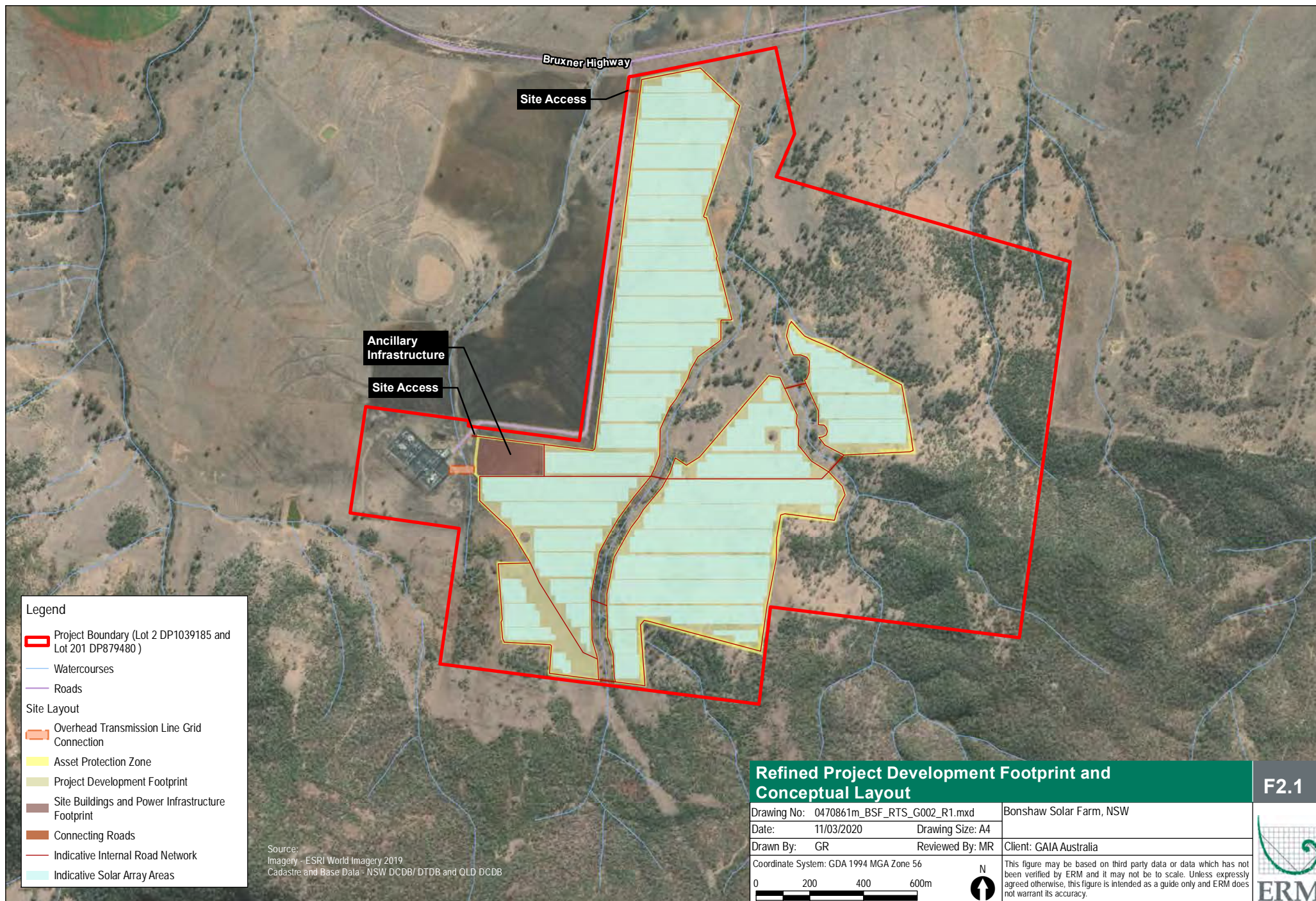
2.4 Project Design Amendments

A number of amendments have been made to the project design and layout. These have been made in response to Aboriginal Cultural Heritage and Biodiversity matters raised by the Biodiversity and Conservation Division (BCD). The amendments to the design have resulted in a reduction of the development footprint (to 149 ha) to avoid impacts to biodiversity and cultural values identified on the site, primarily relating to the avoidance of a hypothesised occupational site and further avoiding impacts to vegetation communities (refer to Figure 2-1). An overview of the Project Site and Development Footprint refinements are provided in Table 2-1 below.

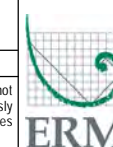
In addition, the grid connection component of the project has been included, increasing the Project area to approximately 368 ha. An Amendment Report has been prepared for the Project, which provides a description of changes and potential environmental impacts. The environmental matters are discussed in Table 5-1 further below.

Table 2-1 Changes to Project Site and Development Footprint

Project Stage	Project Site	Development Footprint	Comment
Environmental Impact Statement	353 ha	167 ha	Lot 2 DP 1039185.
Response To Submission Version 1	353 ha	148.99 ha	<i>Development Footprint</i> refined in response to Aboriginal Cultural Heritage and Biodiversity matters raised by the BCD submission.
Response to Submission Version 2 & Amendment Report	368 ha	149.24 ha	<i>Project Site</i> expanded to include Lot 201 DP 879480 (Dumaresq Substation) for grid connection, in response to TransGrid submission. This change required the preparation of an Amendment Report (Appendix F). <i>Amendment to the Development Footprint</i> to include the overhead grid connection and a 30 m easement.



F2.1



3. EXHIBITION PERIOD

The EIS for the Project was publically exhibited over a 29 day period, from the 6 November 2019 to 4 December 2019.

The EIS was available online through the DPIE Major Projects website at:

<https://www.planningportal.nsw.gov.au/major-projects/project/9936>

Additionally, hard copies of the EIS were made publically available at:

- Inverell Shire Council Chambers (144 Otho Street, Inverell);
- Department of Planning and Environment Office (320 Pitt Street, Sydney); and
- Bonshaw Store (10959 Bruxner Highway, Bonshaw).

3.1 Submissions Received

There were 13 submissions received from government agencies and two (2) public submissions during this period. No submissions were received from special interest groups.

Table 3-1 Submissions Received

Submissions	Number of Responses
Public	
■ Objections	1
■ Comments	1
Agency	
■ NSW Heritage	
■ NSW Geoscience	
■ NSW EPA	
■ Inverell Council	
■ NSW RMS	
■ NSW DPI	
■ NSW OEH	
■ NSW Fire and Rescue	
■ TransGrid	
■ NSW Health	
■ NSW Rural Fire Services	
■ NSW DPIE Water and NRAR	
■ NSW DPIE Crown Lands	
Total Submissions	15

Issues raised in each submission are discussed further in Section 4, with a response to each issue also provided.

4. RESPONSE TO SUBMISSIONS

Table 4-1 below outlines the submissions received during the exhibition period and provides a response to these submissions.

Table 4-1 Response to Submissions

Aspect	Issue	Response
Department of Planning, Industry and Environment		
Grid Connection	Based on TransGrid's advice, the grid connection should form part of this SSD application. As such, an Amendment Report (AR) is required to describe the connection of the project to the grid. The AR should also include relevant environmental assessments of this component of the project, as well as additional engagement and associated landowners' consents.	An Amendment Report has been prepared to address the connection of the project to the grid. Refer to Appendix F.
Hazards and Risks	<p>Given the scale of the project and BESS capacity, the Department considers the BESS is "potentially hazardous" under SEPP 33 and requests you to prepare a Preliminary Hazard Analysis in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011).</p> <p>Additionally, an assessment of potential hazards and risks should include, but not be limited to bushfires, spontaneous ignition, electromagnetic field of the proposed grid connection infrastructure against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.</p>	A Preliminary Hazard Assessment has been prepared to support the Project. Refer to Appendix A.
Traffic	Update the Traffic Impact Assessment (TIA) study to include the information requested by RMS.	The Traffic Impact Assessment has been updated to address comments raised by RMS. Refer to Appendix B.


Aspect	Issue	Response
DPIE – Division of Resources & Geosciences		
Biodiversity Offsets	Geosciences NSW want to be consulted regarding the proposed locations of any biodiversity offset areas both on site and off site – or any supplementary biodiversity measures	The Proponent will continue to engage DRG and provide updates throughout the process of investigating potential biodiversity offset areas.
DPIE – Biodiversity and Conservation Division (BCD)		
Biodiversity	<ul style="list-style-type: none"> ■ The BDAR should be reviewed, updated and certified to comply with the BC Act and resubmitted as part of the proposal. ■ The BDAR should ensure adequate consideration of the NVR mapping for the site. ■ Ensure the correct application of the Streamlined assessment module – clearing paddock trees. ■ The BDAR should be updated to include reference to existing threatened species habitat mapping. ■ The BDAR should provide further justification of the Masked Owl to ensure it has been adequately considered. ■ The BDAR should be updated to remove the recommendation to change the offset requirement for vegetation zone 11. ■ The future vegetation integrity scores for all vegetation zones is to be reduced to zero. ■ The BAM calculator is to be updated and finalised for review. ■ The mitigation measures as outlined in Table 7.1 of the BDAR should for part of any proposed development consent conditions. 	<p>The Biodiversity Development Assessment Report (BDAR) has been updated to address comments. Please refer to Appendix C.</p> <p>Specific amendments to the BDAR include:</p> <ul style="list-style-type: none"> ■ The BDAR has been updated to comply with the BC Act. ■ Figure 3.1 of the BDAR has included NVR mapping. Section 4 of the BDAR includes an assessment of the Project's impact on the Native Vegetation Regulatory mapping. ■ Further details of the streamlined assessment module applied to paddock trees is detailed in Section 4.1.4 of the BDAR. ■ Further details of the threatened species habitat impacts is provided in Section 6.3.1 and mapping updates to Figure 5.2. ■ Further justification to the exclusion of the Masked Owl has been detailed in Table 5.3 ■ The BDAR has been amended to remove the recommendation for vegetation zone 11 in regard to offset requirements.

Aspect	Issue	Response
		<ul style="list-style-type: none"> ■ Integrity score has been updated to zero. ■ An updated BAM calculation has been provided in Appendix K of the updated BDAR. ■ The commitment to mitigation measures will be reflected in the Conditions of Approval.
Cultural Heritage	<ul style="list-style-type: none"> ■ The inconsistencies within the EIS and CHA need to be addressed prior to final determination. ■ Further assessment, including sub-surface investigation, for a number of sites and locations within the project area to test the hypotheses proposed by the consultant that the project area constitutes a long-term, high density occupational complex. ■ Further assessment of the site should include a concerted effort to rediscover the previously recorded AHIMS 11-3-0083 which we consider highly important to the contextual understanding of the Aboriginal Cultural Heritage value of the project area. ■ Further amendments are required to the Unexpected Finds Procedure. ■ The demarcation of Aboriginal heritage sites should be clearly marked on the ground to avoid potential impacts. ■ All Aboriginal scar trees should be retained in-situ and the assessment of the significance relating to Aboriginal scar trees should be reviewed. 	<p>The Cultural Heritage Assessment (CHA) has been updated to address comments. Refer to Appendix D.</p> <ul style="list-style-type: none"> ■ Amendments to address comments made around inconsistencies have been addressed in the CHA as follows: <ul style="list-style-type: none"> - Table 10.1 of the CHA provides a column for addressing Management Measures of each identified Aboriginal Heritage Site. - Table 10.1 of the CHA has been updated to reflect the exclusion of BSF18, BSF19, BSF22 and BSF29 from the Development Footprint. Figure 9.1 has also been updated to reflect the 20m buffer zone around each scar tree within the Development Footprint, confirming avoidance of any impact. - Table 9.1 of the CHA has been amended to further quantify impact and provide recommendations for sites which have "potential impact". <p>Where any inconsistency persists between the EIS and the CHA, the updated CHA takes precedence (refer to Appendix D).</p>

Aspect	Issue	Response
		<ul style="list-style-type: none"> ■ The Development Footprint of the Project has been amended to avoid the area hypothesised to be a large occupational complex (refer to area marked as “High Archaeological Potential” in Figure 7.2 of CHA). ■ Further survey of AHIMS 11-3-0083 has not been undertaken, however additional details of the concerted effort previously undertaken with RAPs present has been added to the CHA (refer to Section 7.2.3 of CHA). ■ Additional information added to Section 10.2.1.1 of the CHA to further detail the Unexpected Finds Protocol. ■ Section 10.2.1.4 of the CHA has been added to include details for inclusion in a Cultural Heritage Management Plan, including the demarcation of sites prior to construction commencing. ■ Careful detailed design of the development footprint has successfully avoided scar trees. Scar trees have been omitted from the Development Footprint and a 20m buffer applied to retain these sites in situ (refer to Figure 7.2).
DPIE – Department of Primary Industries (DPI)		
Decommissioning and Rehabilitation	All infrastructure on the Bonshaw Solar Farm, including all below ground cabling, must be removed at the end of the project. This position is not reflected in the Bonshaw Solar Farm Environmental Impact Statement (EIS) and should be included as a condition of consent if approved.	<p>Section 2.5 of the EIS details that Project decommissioning would involve the removal of solar panels and all associated infrastructure.</p> <p>The Proponent will be responsible for ensuring all infrastructure (including underground cabling) will be removed during the decommissioning of the Site.</p>

Aspect	Issue	Response
		<p>The preparation of a Decommissioning and Rehabilitation Plan has been included in the Statement of Commitments in the EIS.</p> <p>It is acknowledged that this commitment will be reflected in the Conditions of Approval and a Decommissioning and Rehabilitation Plan.</p>
Infrastructure	There is no specific detail about the type of piers for the solar panel mounting structures. The type of piers significantly impacts the land, large concrete footings disturb and displace the soil profile and are significantly harder to rehabilitate, while driven or screw piers will have less disturbance. In the absence of detail DPI advises that as a condition of consent that all piers are to be completely removed on completion of the project and the soil profile be returned to its original sequence so as to minimise loss of future agricultural production post development.	<p>Piers for solar panel mounting will be ground screwed, allowing the piers to be removed and the ground restored to its original state.</p> <p>As reflected above, the Proponent will undertake removal of all infrastructure in accordance with the Decommissioning and Rehabilitation Plan.</p>
Infrastructure	The EIS does not stipulate what type of panel technology are going to be used. If Dual-Glass (Option 2) is used there is no investigation into the long term impacts to agricultural production rates and rehabilitation from the "ground condition improvement for better reflection purposes (i.e. white sand)".	<p>The project is likely to fixed tilt (25°) PV panels. However, flexibility in technology is required to ensure the project remains viable, this includes the potential use of bi-facial panels. Should the use of alternative technologies result in additional infrastructure or ground treatments (i.e. white sand to increase reflectivity), this will require a modification to the Development Consent and assessment of potential additional impacts.</p> <p>Figure 4-1 Fixed Tilt PV Array Configuration</p>

Aspect	Issue	Response
PIE – Water and the Natural Resources Access Regulator		
Water Supply	Clarification should be provided of the ability to obtain the necessary water volumes from the site or confirm a viable supply is available, via an indication of an agreement from a water supplier. Where the water is to be sourced from a currently unauthorised source, an impact assessment and confirmation that the necessary entitlement can be obtained and traded in accordance with the relevant Water Sharing Plan will be required.	Water supply for the project will be provided through a licenced water supplier. GAIA have identified three (3) potential suppliers for the project – Trident Water or Wade's Water in Warwick or Vital Water Service in Casino. These will be further reviewed once the project commits to a construction timeframe (post-approval).
Watercourse Buffers	Clarification should be provided of the proposed infrastructure layout to meet the buffer requirements from watercourses as defined in the <i>Guidelines for Controlled Activities on Waterfront Land</i> (NRAR 2018).	<p>The Project has been designed in accordance with the <i>Guidelines for Controlled Activities on Waterfront Land</i> (NRAR 2018). Appropriate buffers have been applied for all infrastructure in close proximity to watercourses within the Project Area.</p> <p>Section 6.8 of the EIS details that design of the development footprint includes the provision of a 40 m buffer from infrastructure to the top of creek banks. The riparian zone will be surveyed prior to detailed design to ensure the development footprint is offset and outside third order and higher riparian corridor (as detailed in Section 8.3.1 of the EIS).</p>

Aspect	Issue	Response
Flood Impacts	The proponent should confirm the impact of the security fencing on floodwaters and the resultant impact to adjacent watercourses. Where impacts are identified, mitigating measures will be required.	<p>The project boundary will be fenced using standard chain mesh fencing which will have no impact on overland flows in the event of flooding.</p> <p>Figure 4-2 Typical Chain Mesh Security</p> 
Post-Approvals	<ul style="list-style-type: none"> ■ The proponent must obtain relevant approvals and licences under the Water Management Act 2000 before commencing any works which intercept or extract groundwater or surface water (including from on-site dams where necessary) or for any works which have the potential to alter the flow of floodwaters. ■ The proponent should prepare a Construction Environmental Management Plan (incorporating an Erosion and Sediment Control Plan) prior to commencement of activities. ■ Works within waterfront land should be in accordance with the Guidelines for Controlled Activities on Waterfront Land (NRAR 2018). ■ Soil & Water Management Plan and Progressive Erosion & Sediment Control Plans (section 6.3.4) to be developed in consultation with DPIE Water. 	These requirements have been reflected in the revised Statement of Commitments included in Figure 5-1.

Aspect	Issue	Response
Transport for NSW		
	The Environmental Impact Statement (EIS) and Traffic Impact Assessment (TIA) have not assessed the impacts on all of the transport routes and key intersections, especially the proposed return route through Ashford, Inverell and Glen Innes.	Updated TIA to assess impacts on transport routes and key intersections.
	It was identified in the TIA that sight distance to the north along the New England Highway at the intersection of the Bruxner Highway is constrained for exiting right-turning traffic. It is unclear from the information provided whether all traffic such as workers and tradesmen exiting the site will have to use the same route as heavy vehicles via Inverell to return to the east.	<p>Assessment of intersection of Bruxner Hwy and New England Hwy in Section 2.2.1 of TIA.</p> <p>No right turn out of Bruxner Hwy for light or heavy vehicles associated with construction work. Light vehicles to use right turn out of Sunnyside Platform Road onto New England Highway.</p> <p>Detailed Construction Traffic Management Plan (forming Appendix E of TIA).</p>
	To reduce conflict points, access from the Bruxner Highway to the sub-station and solar farm should be consolidated to a single access. It is unclear why the existing sealed access to the sub-station is not being used.	<p>Site access has been consolidated. The Project proposes to utilise the existing access road that links to the Dumaresq Substation.</p> <p>Access to the Site will be in the north-west corner of the Project Site, as indicated on Figure 2-1.</p> <p>Note: southern access road is included as an emergency exit, not proposed for construction vehicles to access the site.</p>
	Any new access will require a Section 138 Application to be submitted to Inverell Council in accordance with the Roads Act 1993. This will require concurrence from Roads and Maritime and should include a strategic concept design for the road works.	<p>Project no longer proposes to construct a new access, rather utilising the existing access road immediately adjacent to the west.</p> <p>Refer to Figure 2-1.</p>

Aspect	Issue	Response
	There was no evidence that the proposed access was assessed in accordance with <i>Austroads Guide to Traffic Management Part 6</i> and <i>Austroads Guide to Road Design Part 4A</i> to identify the appropriate treatments for turning traffic. The minimum requirements for a non-residential rural access is a BAR and BAL. Any proposed road works should consider the long term safety of the access.	Project no longer proposes to construct a new access, rather utilising the existing access road immediately adjacent to the west. Refer to Figure 2-1.
	It is noted that a Construction Traffic Management Plan (CTMP), Dilapidation and Decommissioning Plans will be prepared. These should be included in the EIS.	A CTMP has been prepared and forms Appendix E of TIA.
	No swept paths for the largest vehicle that would use the transport routes and proposed access were provided.	Given the Project no longer proposes to construct a new access road to Bruxner Highway, the inclusion of vehicle swept paths is no longer required. Detail of the adequacy of the roads proposed to accommodate the swept path requirements for B double to access the site is included in the TIA. Refer to Section 4.1.
	Sight distance measurements at key intersections along the transport routes were only estimated and not measured.	Additional information has been provided around the sight distances at key intersections, including the provision of supporting photographs. Refer to Section 2.2.1 and Section 2.2.2.
	No crash data was provided for the transport routes.	Accident data has been included in the TIA. This data shows the vast majority of accidents along the proposed heavy vehicle route involved single vehicles (74%). Speeding was the contributing factor for over half of the recorded accidents. The TIA has not identified any inherent road safety issues. Refer to Section 2.3 and Appendix C of the TIA.
	No details of the onsite arrangements for parking and servicing were provided	Details of onsite parking area is included in Section 3 of the TIA.

Aspect	Issue	Response
	It was identified that glare from the solar farm would have an impact on the Bruxner Highway traffic. It was not indicated how long it would take for the vegetative screening to become effective or how the ongoing management of the plantings would be undertaken. This should be addressed.	As outlined in Table 6-9 of the EIS, monitoring of landscaping management measures will be managed through the Project CEMP and OEMP.
	Where road safety concerns are identified at a specific location along the identified haulage route/s, Roads and Maritime suggests that the TIA be supported by a targeted Road Safety Audit undertaken by suitably qualified persons.	<p>Section 2.2 of the TIA addresses road safety concerns. Alternative route options have adequately mitigated road safety concerns.</p> <p>The TIA has not identified any inherent road safety issues. Further assessment is not considered necessary for any locations highlighted.</p>
Inverell Shire Council		
Local infrastructure protection	Independent road dilapidation reporting prior to construction, for all local and state roads.	This commitment has been reflected in the revised Statement of Commitments included in Table 5-1.
	Ongoing and regular measures to restore and reinstate road damage resulting from construction of the project.	This commitment has been reflected in the revised Statement of Commitments included in Table 5-1 and will be managed through the Project's CEMP.
	After construction a subsequent report to assess the damage that may have resulted from construction.	This commitment has been reflected in the revised Statement of Commitments included in Table 5-1 and will be managed through the Project's CEMP.

Aspect	Issue	Response
	Council being involved in the design, assessment and approval of the site access of the Bruxner Way.	Project Site access has been amended to avoid the necessity of constructing a new access point adjacent to the existing site access that leads to the Dumaresq Substation. It is acknowledged that any upgrades required to facilitate site access will require Section 138 Application to be submitted to Inverell Council in accordance with the Roads Act 1993.
	Council being able to review and provide input into the Traffic Control Plan and the Construction Traffic Management Plan	A Construction Traffic Management Plan has been included in the updated Traffic Impact Assessment at the request of RMS. It is anticipated this will need to be updated and a Traffic Control Plan prepared prior to construction. The preparation of these documents was included in the Statement of Commitments included in the EIS. It is acknowledged that Council will be consulted during this process and is likely to be reflected in the Conditions of Approval.
Fire and Rescue NSW		
Fire Safety	<p>FRNSW reaffirm comments and recommendations previously submitted in preparation of the SEARs and maintain that they remain relevant in addressing fire and life safety considerations for the proposed development.</p> <p>Furthermore, it is recommended that should Development Consent be granted, a Condition of Consent be included that would require the Applicant to prepare a comprehensive fire safety study (FSS) for the Battery Energy Storage Systems (BESS) component of the development. The FSS should be developed in accordance with the requirements of Hazardous Industry Planning Advisory Paper No.2 (HIPAP No.2), and in consultation with and to the satisfaction of FRNSW.</p>	Preparation of a comprehensive fire safety study (FSS) for the Project has been added to the revised Statement of Commitments included in Table 5-1.

Aspect	Issue	Response
NSW Rural Fire Service		
Bushfire	<p>The subject land is partly mapped as bushfire prone land by Inverell Shire Council. Further, the NSW RFS is the primary response agency for all structural fires on the land.</p> <p>It is noted that the Bushfire Hazard Assessment report includes broad scale vegetation, slope and bush fire hazard mapping. Based on this mapping, a 10 metre asset protection zone (APZ) is recommended around the perimeter of the development. It appears that in some locations around the site, a 10 metre APZ may be insufficient to ensure that the development is not subject to flame contact from a bush fire, due to the prevailing slope and vegetation classes. Accordingly, the NSW RFS recommends that a more detailed assessment of the development site perimeter be undertaken to determine appropriate APZs. While a metre APZ is supported for the grassland vegetation, a larger APZ may be required where the development is adjacent to woodland and/or forest vegetation. It is further recommended that minimum APZs be based on Table A2.5 of 'Planning for Bush Fire Protection 2006'.</p>	<p>The Bushfire Impact Assessment has been updated to reflect the revised Asset Protection Zones (APZ) in accordance with Table A2.5 of 'Planning for Bush Fire Protection 2006'. This is reflected in Figure 2-1 above.</p>
Bushfire	<p>A Fire Management Plan (FMP) shall be prepared in consultation with NSW RFS Northern Tablelands Fire Control Centre. The FMP shall include:</p> <ul style="list-style-type: none"> ■ 24 hour emergency contact details including alternative telephone contact; ■ site infrastructure plan; ■ firefighting water supply plan; ■ site access and internal road plan; ■ construction of APZ and their continued maintenance; ■ location of hazards (physical, chemical and electrical) that will impact on firefighting operations and procedures to manage identified hazards during firefighting operations; 	<p>This requirement has been reflected in the revised Statement of Commitments included in Figure 5-1.</p>

Aspect	Issue	Response
	<ul style="list-style-type: none"> ■ fire mitigation strategies as outlined in Section 4 of the Bushfire Hazard Assessment report prepared by ERM (ref: Project No. 0470861), dated 26 July 2019; and ■ such additional matters as required by the NSW RFS District Office (PMP review and updates). 	
Bushfire	<p>The entire solar array development and associated infrastructure footprint is to be managed as an Asset Protection Zone as outlined within section 4.1.3 and Appendix 5 of 'Planning for Bush Fire Protection 2006' and the NSW Rural Fire Service's document 'Standards for Asset Protection Zones'.</p> <p>A 50,000 litre water supply (tank) fitted with a 65mm storz fitting shall be located adjoining the internal property access road within the required APZ.</p> <p>To allow for emergency service personnel to undertake property protection activities, a defensible space (APZ) that permits unobstructed vehicle access is to be provided around the perimeter of each of the solar array areas and associated infrastructure.</p>	<p>These requirements have been reflected in the revised Statement of Commitments included in Figure 5-1.</p> <p>The Bushfire Impact Assessment has been updated to reflect the revised Asset Protection Zones (APZ) in accordance with Table A2.5 of 'Planning for Bush Fire Protection 2006'. This is reflected in Figure 2-1 above.</p>
Transgrid		
Grid Connection	<p>The EIS states that the grid connection would be obtained separately, in accordance with Part 5 of the EP&A Act 1979. Transgrid will not be seeking approval for any grid connection works. It is the responsibility of the proponent to ensure that all works associated with their project included all grid connection works, are included in the development approval for the overall solar farm project.</p>	<p>Grid connection will be obtained through a proposed overhead transmission connection. The overhead connection will connect from a pylon in the 'Ancillary Infrastructure' area, extending approximately 150 m directly into the Dumaresq Substation (refer to Figure 2-1).</p> <p>An Amendment Report has been prepared to address the connection of the project to the grid. Refer to Appendix F.</p>

Aspect	Issue	Response
Hunter New England Local Health District		
Water Supply	<p>It is noted that the nearest reticulated water supply is located at Bonshaw, and there is no mention of potable water onsite during construction or operations. There is mention that water management measures including alternative sources of water that will be implemented for the Project. There is however no stipulation about the source of potable water onsite during construction or operations for staff.</p> <p>This office would suggest that should there not be a connection to a potable water supply then the applicant must demonstrate that the drinking water supplied to the premises will consistently meet the Australian Drinking Water Guidelines 2011 and any subsequent amendments of the Guidelines.” This includes “an appropriate drinking water quality assurance program, in compliance with NSW Health requirements and the Public Health Act 2010 and the Public Health Regulation 2012 is to be provided.”</p> <p>The selected option for the provision of a private potable water supply is likely to require a quality assurance program in accordance with the provisions of the Public Health Act 2010. The proponent is encouraged to contact Hunter New England Local Health District with respect to developing a quality assurance program.</p>	<p>Water supply for the project will be provided through a licenced water supplier. GAIA have identified three (3) potential suppliers for the project – Trident Water or Wade’s Water in Warwick or Vital Water Service in Casino. These will be further reviewed once the project commits to a construction timeframe (post-approval).</p>
Heritage Council of NSW		
Heritage	<p>The subject site is not listed on the State Heritage Register (SHR), nor is it in the immediate vicinity of any SHR items. It is noted that although the historical archaeological assessment (<i>Bonshaw Solar Farm, Cultural Heritage Assessment</i>, prepared by ERM, dated 18 April 2019) identified scattered artefacts, these were not assessed as being significant or requiring management. Accordingly, no further comments are required from the Heritage Council of NSW. The Department does not need to refer subsequent stages of this proposal to the Heritage Council of NSW.</p>	<p>Comments have been noted – no action required.</p>

Aspect	Issue	Response
Environmental Protection Agency NSW		
Environmental Protection	The EPA has briefly reviewed the document titled 'Bonshaw Solar Farm – Environmental Impact Statement' dated 18 October 2019 and advise that the proposal will not need an Environmental Protection Licence if consent is granted. Accordingly, the EPA will not be providing any recommended conditions of approval for this project.	Comments have been noted – no action required.
Public Submissions		
Visual Impacts	My wife Lyn and I, (Neville Heywood) are strongly opposed to the establishment of a solar farm on the Bruxner Highway Bonshaw. We see it as a despoiling of the beautiful landscape around Bonshaw between Tenterfield and Goondiwindi and Bonshaw and Inverell. This is a particularly scenic area and a solar farm completely incongruous in the environment. I am presently preparing a submission for a doctorate and Bonshaw is a central area for my study of the bush there. A Solar farm does not fit the unity and harmony of the environment and will be a form of visual vandalism totally out of character with this area. While at this point it appears to be solar alone and not wind turbine technology, a large capacity solar farm is completely out of character nevertheless. Such a project as the wind turbines totally destroy the visual beauty of the landscape between Inverell and Glen Innes and such a solar farm introduction will do the same out here – mega acres of unnatural black shiny panels.	<p>In accordance with the SEARs, a Visual Impact Assessment (VIA) has been prepared for the Project to assess the potential for visual impacts that may result from the Project.</p> <p>The assessment determined that views to the Project are limited to a short section of the Bruxner Highway immediately north of the Site. Limited views of the site are achieved from neighbouring properties due to topographic features or vegetation.</p>

Aspect	Issue	Response
	<p>We consider these projects in large-scale solar farms a second rate method of generating electricity where the environment pays the price. This is not green technology – but black technology – and ugly and disregards the appearance of beautiful rural landscapes like that in the Bonshaw district. I firmly believe that the best form of solar energy is that located in urban areas, not as solar farms but on the roofs of dwellings, commercial buildings and factory buildings. In those contexts they are not incongruous or unattractive. It's a visual win for all. Urban areas with buildings relate to the panels on their rooves – especially if they were placed on every user's roof. Those areas then can use some of the electricity generated and feed it into the grid. For those connected to the grid at present as users of electricity they could pay a small levy in their bill that over time the electricity retailer could return the value of the subsidies these new industries receive back to the federal government. At the moment its taxpayer money gifted in subsidy with no pay back – just a lucrative money spin for those taking advantage of this windfall. It's not an unrealistic approach in the sense that poles and wires are passed onto consumers, so why not solar panels for users as well.</p> <p>We urge that this project does not go ahead and that the Bonshaw landscape will keep its unified, natural aesthetic appeal for all who live there. My family ancestors have lived in the Bonshaw area since before the 1850's. We therefore have great attachment to this area and extremely concerned that such an industry is intending to locate here.</p>	
Visual Impacts	<p>I bought my property approximately 10 years ago as an investment for part of my superannuation/ retirement fund and somewhere I can take my family and friends to escape on holidays or weekends. So far I have spent money on it by making tracks around the property for motor bike riding, 4x4 driving, horse riding, bush walking, bird watching and shooting. When it rains the creek is a serene spot for a picnic and also has yabbies' in it as well as in the dams. Where the shed is situated on top of the hill, it offers spectacular views of storms rolling in over the mountains. The existing substation and power lines where established prior to us purchasing the property and has only a small impact on our view of the surrounding vegetation however, the 1 million solar panels will have major impact in the scenery and value of our property and will greatly impact our superannuation fund for our future. We are not against this project for a cleaner future however, we feel it will be at a huge financial loss to us.</p>	<p>In accordance with the SEARs, a Visual Impact Assessment (VIA) has been prepared for the Project to assess the potential for visual impacts that may result from the Project.</p> <p>The assessment determined that views to the Project are limited to a short section of the Bruxner Highway immediately north of the Site. Limited views of the site are achieved from neighbouring properties due to topographic features or vegetation.</p>

5. PROJECT UPDATES

In responding to the submissions raised, the Project has been updated to include the following changes:

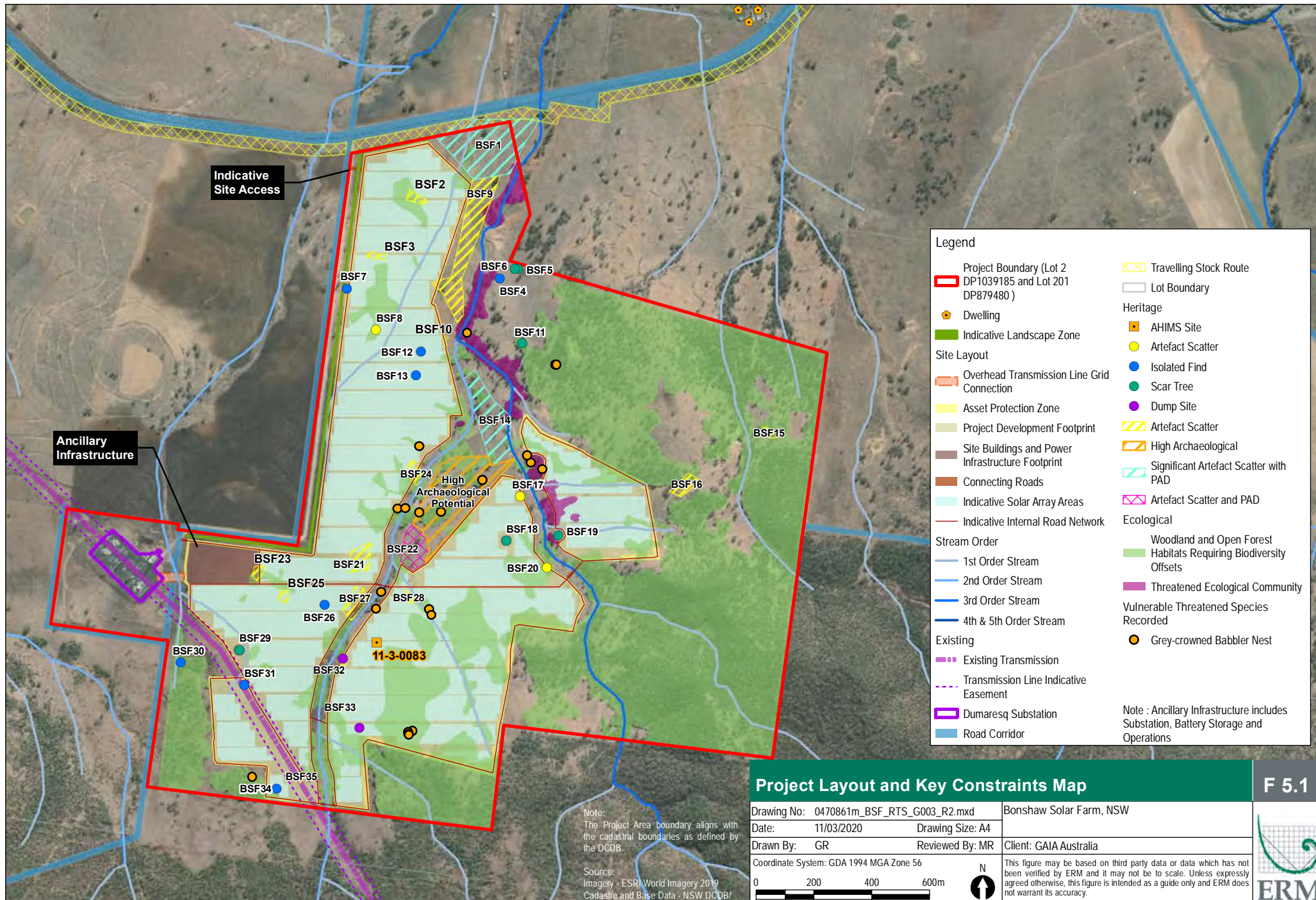
Table 5-1 Summary of Project Updates

Aspect	Project Response
Grid Connection	<p>Grid connection will be obtained through a proposed overhead transmission connection. The overhead connection will connect from a pylon in the 'Ancillary Infrastructure' area, extending approximately 150 m directly into the Dumaresq Substation (refer to Figure 2-1). The overhead connection is considered as an amendment to the original project description in the EIS.</p> <p>This response has triggered the need to develop an Amendment Report that details the description of the proposed project amendment, including an assessment of the relevant environmental impacts (refer to Appendix F).</p> <p>Furthermore, the addition of the Dumaresq Substation requires landowner consent for the inclusion of Lot 201 DP 879480 and the Crown Land corridor. Evidence of engagement to obtain landowner consent is provided in Appendix F below.</p>
Water Supply	<p>Water supply for the project will be provided through a licenced water supplier. GAIA have identified three (3) potential suppliers for the project – Trident Water or Wade's Water in Warwick or Vital Water Service in Casino. These will be further reviewed once the project commits to a construction timeframe (post-approval).</p>
Infrastructure	<p>The project is likely to fixed tilt (25°) PV panels. However, flexibility in technology is required to ensure the project remains viable, this includes the potential use of bi-facial panels. Piers for solar panel mounting will be ground screwed, allowing the piers to be removed and the ground restored to its original state.</p> <p>Should the use of alternative technologies result in additional infrastructure or ground treatments (i.e. white sand to increase reflectivity), this will require a modification to the Development Consent and assessment of potential additional impacts.</p>
Biodiversity	<p>The BDAR has been updated to address comments raised by BCD (as detailed above).</p> <p>The BDAR has included an assessment of the grid connection component, including Dumaresq Substation. This change to the Project Area has resulted in the need to update the calculations recorded in the BDAR and the final BAM calculation.</p>
Cultural Heritage	<p>All amended sections refer to the Cultural Heritage Assessment Report.</p> <ul style="list-style-type: none"> ■ Inclusion of Section 5.3.2.1 of the CHA to describe the AHIMS Site #11-3-0083; ■ Inclusion of Figure 5.2 – Reference Map to location of AHIMS #11-3-0083; ■ Inclusion of discussion of AHIMS #11-3-0083 in the survey results (Section 7.2.3); ■ Inclusion of AHIMS #11-3-0083 in Aboriginal Heritage Statement of Significance; ■ Minor amendment to entry for AHIMS #11-3-0083 in Table 8.1; ■ Addition of AHIMS #11-3-0083 to Impact Assessment (Section 9); ■ Section 9 – clarification of impact metric utilised and reasoning for use;

Aspect	Project Response
	<ul style="list-style-type: none"> ■ Amendments to Table 9.1 to remove usage of 'Possible Impact'; ■ Revision of Aboriginal Heritage recommendations and unexpected finds procedure, in line with comments received from DPIE; and ■ Addition of Section 10.2.1.4 'Cultural Heritage Management Plan' to outline requirements for preparation of a CHMP.
Traffic	The Traffic Impact Assessment has been updated to include an assessment of all transport routes and key intersections associated with the project. The site access has been consolidated with the existing access to the Dumaresq Substation access road, with site access to be provided off this road rather than directly onto the Bruxner Highway.
Bushfire	The Bushfire Hazard Assessment has been updated to reflect the revised Asset Protection Zones (APZ) which has also been reflected in the updated Project Layout provided as Figure 5-1.
Hazards	<p>Preparation of a Preliminary Hazard Assessment (PHA) which details the Project's potential risks and hazards and suitable controls.</p> <p>In response to <i>State Environmental Planning Policy No.33 – Hazardous and Offensive Development</i> (SEPP33).</p> <p>This is primarily related to the lithium-ion batteries being new technology that may not have been taken into account during the initial process determined for SEPP33.</p> <p>The outcome of the PHA concludes that It has been recognised that the Project is to include small quantities of hazardous materials which do not trigger the threshold. With consideration of the insignificant quantity of materials stored on site, along with the significant distance to neighbouring properties, it can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety.</p> <p>The PHA has also revised a level 1 hazard analysis on the Project Battery and Energy Storage System (BESS) within the PHA. The following condensed assessment was concluded as a result of the assessment:</p> <ul style="list-style-type: none"> ■ That the BESS is located in the most appropriate location regarding the surrounding bushfire hazards and bushfire prone land. ■ That the Energy Storage System (ESS) supplier will maintain the most up to date global standards that commit to negating the possibility of fire propagation to additional units in the event of a thermal runaway. ■ That the preferred ESS supplier only supplies BESS units that contain a fire extinguishing system. ■ That the ESS and installation comply with the relevant Australian Standards on Energy Storage Systems (outlined in the PHA)

Aspect	Project Response
Statement of Commitments	<p>The following Statement of Commitments are provided in addition to the commitments made in the EIS and are a direct response to the submissions:</p> <ul style="list-style-type: none">■ Prepare a comprehensive fire safety study (FSS) for the Battery Energy Storage Systems (BESS) component of the development. The FSS should be developed in accordance with the requirements of Hazardous Industry Planning Advisory Paper No.2 (HIPAP No.2), and in consultation with and to the satisfaction of FRNSW;■ Preparation of a Fire Management Plan (FMP) in consultation with NSW RFS Northern Tablelands Fire Control Centre;■ Preparation of a Decommissioning and Rehabilitation Plan prior to decommissioning the Project which will detail how the site will be rehabilitated to the pre-development state; and■ Undertake a pre and post construction road dilapidation report for the local transport route and restore any road damage resulting from construction of the project.

The implications of these updates to the project on the layout is provided in Figure 5-1 below.



6. SUMMARY

This report has been prepared in response to the submissions received on the Bonshaw Solar Farm (SSD 9438) during the exhibition period. There were a total of 15 submissions received, 13 were from government agencies and two (2) public submissions.

In response to the submissions, there are a number of aspects of the project which have been updated, including:

- Revised Development Footprint taking into consideration additional biodiversity, cultural heritage and bushfire mitigation constraints;
- Revised access location with site access to be provided to Bruxner Highway via the Dumaresq Substation access road; and
- Amendment of the Project Area to include the Dumaresq substation. Details of the project change is provided in the Amendment Report prepared, including evidence of engagement to obtain landowner consent.

In order to reflect these changes to the project, the proponent has revised a number of supporting documents associated with EIS, as well as prepared additional supporting information, including:

- Biodiversity Development Assessment Report (Updated);
- Traffic Impact Assessment (Updated);
- Cultural Heritage Assessment (Updated);
- Bushfire Hazard Assessment (Updated);
- Preliminary Hazard Analysis (New); and
- Amendment Report (New).

It is considered that the key of the issues raised in the submissions have now been adequately addressed in this submission to allow consideration by the Minister for approval of this project.

APPENDIX A PRELIMINARY HAZARD ASSESSMENT



GAIA Australia Pty Ltd

Preliminary Hazard Analysis

Bonshaw SEPP 33 Assessment

20 March 2020

Project No.: 0470861

Document details	
Document title	Preliminary Hazard Analysis
Document subtitle	Bonshaw SEPP 33 Assessment
Project No.	0470861
Date	20 March 2020
Version	2.0
Author	Ned Bowden
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Document history

Version	Revision	Author	Reviewed by	ERM approval to issue		Comments
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Signature Page

20 March 2020

Preliminary Hazard Analysis

Bonshaw SEPP 33 Assessment



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Acronyms and Abbreviations

Name	Description
AC	Alternate Current
APZ	Asset Protection Zone
AS	Australian Standard
BESS	Battery Energy Storage System
CEMP	Construction Environmental Management Plan
the Department	NSW Government Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
ESS	Energy Storage System
EIS	Environmental Impact Statement
EMF	Electro-Magnetic Field
ERM	Environmental Resources Management Pty Ltd
GAIA	GAIA Australia Pty Ltd
ha	hectare
ICNIRP	International Commission on Non-Ionizing Radiation Protection
km	kilometre
kV	kilovolt
kWh	kilowatt hour
m	metre
MW	megawatts
NEM	National Electricity Market
O&M	operations and maintenance
PHA	Preliminary Hazard Analysis
Project	Bonshaw Solar Farm
PPE	Personal Protective Equipment
PV	Photo-Voltaic
RFS	Rural Fire Service
RTS	Response to Submission
SDS	Safety Data Sheet
SEARs	Secretary's Environmental Assessment Requirements
SEPP 33	<i>State Environmental Planning Policy No. 33 – Hazardous and Offensive Development</i>
T	tonne
T	Tesla (where mentioned in the EMF section)
TIA	Transport Impact Assessment
WHS	Workplace Health and Safety

1. INTRODUCTION

1.1 Project Overview

GAIA Australia Pty Ltd (GAIA) is seeking to develop the Bonshaw Solar Farm (the 'Project') at Bonshaw in the Inverell Shire Council in New South Wales (NSW). Environmental Resources Management Australia Pty Ltd (ERM) has been engaged to address the 'Hazards and Risks' component of the Secretary's Environmental Assessment Requirements (SEARs) which includes:

1. A preliminary screening assessment to identify risks and hazards associated with the Project. This is in accordance with the *State Environmental Planning Policy No.33 – Hazardous and Offensive Development* (SEPP33). The preliminary risk screening, while not exceeding any identifiable thresholds that trigger the determination of a the Project being a 'potentially hazardous industry', will still require a Preliminary Hazard Analysis following the guidelines in the *Hazardous Industry Planning Advisory Paper No 6 – Hazard Analysis (HIPAP 6)* and upon a post-lodgement discussion with DPIE due to the inclusion of a battery energy storage system (BESS) on site. This is primarily related to the lithium-ion batteries being new technology that may not have been taken into account during the initial process determined for SEPP33.
2. An assessment of potential hazards and risks that could include, but is not limited to, bushfires, spontaneous combustion, electromagnetic fields (EMF), electrocution and toxic gases.

1.2 Project Description

The proposed developed area is approximately 165 ha on part of Lot 2 on DP1039185. Connection of the Bonshaw Solar Farm will be to the 330 kilovolt (kV) TransGrid Dumaresq Substation located on the adjoining Lot 210 on DP 879480. Access to the site is proposed via the existing access from the Bruxner Highway.

The Project incorporates arrays of Photo-Voltaic (PV) modules (commonly referred to as "solar panels"), transmission infrastructure and switch yard to enable connection into the existing electricity transmission network via the 330 kV Dumaresq Substation. The project will have a targeted 'sent out' electricity generating capacity of up to 200 megawatts (MW, AC) and a BESS/battery storage with up to 300 MW (AC) . The exact method and point of connection is being developed in conjunction with TransGrid in parallel with this planning application and the detailed infrastructure layout developed during detailed design will confirm the generating capacity of the Bonshaw Solar Farm.

The key elements of the project include the construction and operation of:

- a network of PV modules in a fixed tilt or single axis tracking arrangement;
- associated battery energy storage system (BESS) / battery storage;
- a switch yard to be connected to the 330 kV TransGrid Dumaresq Substation, on the boundary of the Project Area;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- operations and maintenance (O&M) infrastructure, including O&M buildings incorporating a control room, meeting facilities, a temperature controlled spare parts storage facility, supervisory control and data acquisition facilities, a workshop and associated infrastructure (e.g. kitchen, toilets and other facilities), and car parking facilities;
- Access point to the site via the Bruxner Highway;
- a new internal road network to enable access from surrounding local roads to the array areas during construction and operations including internal access tracks, creek crossing & perimeter security fencing; and
- Temporary facilities during construction.

The Proposed Site Layout is outlined in **Figure 1-3** in concept form.

The Project will adopt lithium-ion based batteries for the battery energy storage system (BESS). Any alternative battery types are considerations and will be consulted with the relevant administering authority for approval and hazard assessment.

The location of battery components and the relative distance to neighbours is provided in **Section 1.3** and outlined in **Figure 1-2**. The closest neighbouring dwelling to the battery components is approximately 2.1 km, which highlights the unlikely potential for any significant impacts to be experienced by neighbouring landowners.

1.2.1 Battery and Energy Storage System

The Project includes the addition of a battery energy storage system (BESS). A 1.5 ha footprint area has been set aside for the installation of the BESS. Given the substantive advances in storage technologies over time, the exact storage capacity cannot be confirmed at this time, however it is anticipated that a 100MW facility, expandable by a further 200MW would allow the optimisation of the Bonshaw Solar Farm in the National Electricity Market (NEM) and potentially aid as a frequency stabilizer and safety net for the nearby transmission and distribution system. The function of the increased 200MW BESS network as a safety net, as mentioned above, is currently under discussion with Transgrid as a part of 'Expanding NSW-QLD Transmission Transfer Capacity' program.

The BESS will be located on the western side of the site within the ancillary infrastructure boundary (**Figure 1-3**). The battery banks and transformers will sit to the eastern side of the ancillary infrastructure boundary and orientate in east-west direction (**Figure 1-5 & Figure 1-6**)

The major components for each BESS include batteries, inverters, transformers, heating ventilation air conditioning and fire protection. The specific design details for the BESS will not be finalised until the completion of the detailed design stage of the project. The general description of the alternatives that are under consideration for the BESS are as follows:

- **Multiple individual cubicles** each of between 130kWh and 160kWh. These would be skid mounted and pre-commissioned in packs of 8 to 10 battery cubicles with 2 inverters. The cubicle system manages fire risk via containment; each cubicle is a fire-rated and sealed system which prevents the spread of fire from one cubicle to another and the fire can quickly burn out without a material loss of battery capacity or capital value across the system as a whole; or
- **A containerised system** of approximately 10MW capacity per container. A containerised system has a fire suppression system (typically inert gas or water deluge) to prevent the spread of fire within the container.

Both options would have a similar appearance, as the individual cubicles would be arranged in such a way as to appear as a single container. The BESS facility will encompass a surface area of up to 15,000m² and include a series of concrete pads, suitably spaced for optimum operations and maintenance and separated by gravel/road-base to assist in fire management. The final decision on the preferred technology provider and detailed technology specification would be confirmed during the detailed design phase of the Project, and would comply with applicable Australian standards, licences and codes.

Indicative battery modules would be of the order of 2.5 metres in height. An example battery pack is shown in **Figure 1-1**.

Figure 1-1 Example Battery Module

1.3 Proximity to Neighbours

The PHA recognises the relative proximity of neighbouring properties to consider the likely significance of impacts upon neighbours of the Project. Given the rural setting of the area, neighbouring landowner dwellings are scattered over a vast area, with the closest being located just over 2 km from the BESS. The substantial distance, in regards to proximity, provides a sufficient buffer, rendering the potential for impacts insignificant. The proximity to neighbouring landowner dwellings are outlined in Table 1-1 and displayed in **Figure 1-4** below.

Table 1-1 Proximity of Neighbours to Battery Components

Landowner	Direction from Site	Approximate Distance to Dwelling
Lot 200 DP 879480	West	3.2 km (<i>Dwelling of property owner located in Lot 1 DP 77438</i>)
Lot 201 DP 879480	West	N/A – Dumaresq Substation
Lot 46 DP 750075	West, South and East	N/A – Unoccupied Land
Lot 29 DP 750075	East	3.7 km (<i>Dwelling of property owner located in Lot 52 DP 750075</i>)
Lot 16 DP 750075	North	2.3 km (<i>Dwelling of property owner located in Lot 18 DP 750075</i>)
Lot 1 DP 1039185	North	2.1 km
Lot 1 DP 777438	North-west	3.2 km

1.4 Scope

The scope of the PHA includes the following project infrastructure:

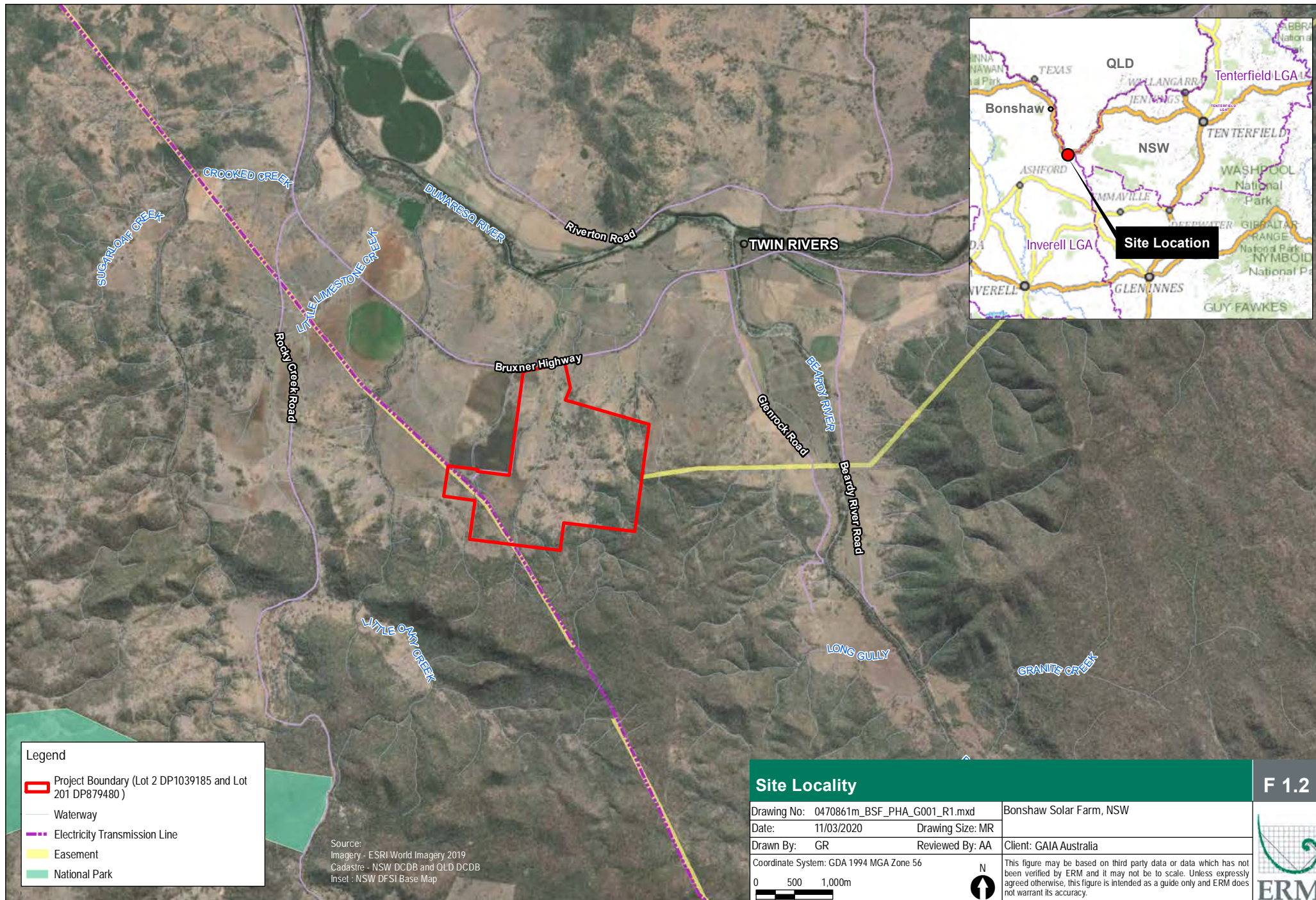
- Solar arrays and PV modules
- Collector network (overhead transmission lines) and grid substation
- Battery Energy Storage System (BESS)
- Supporting infrastructure, including:

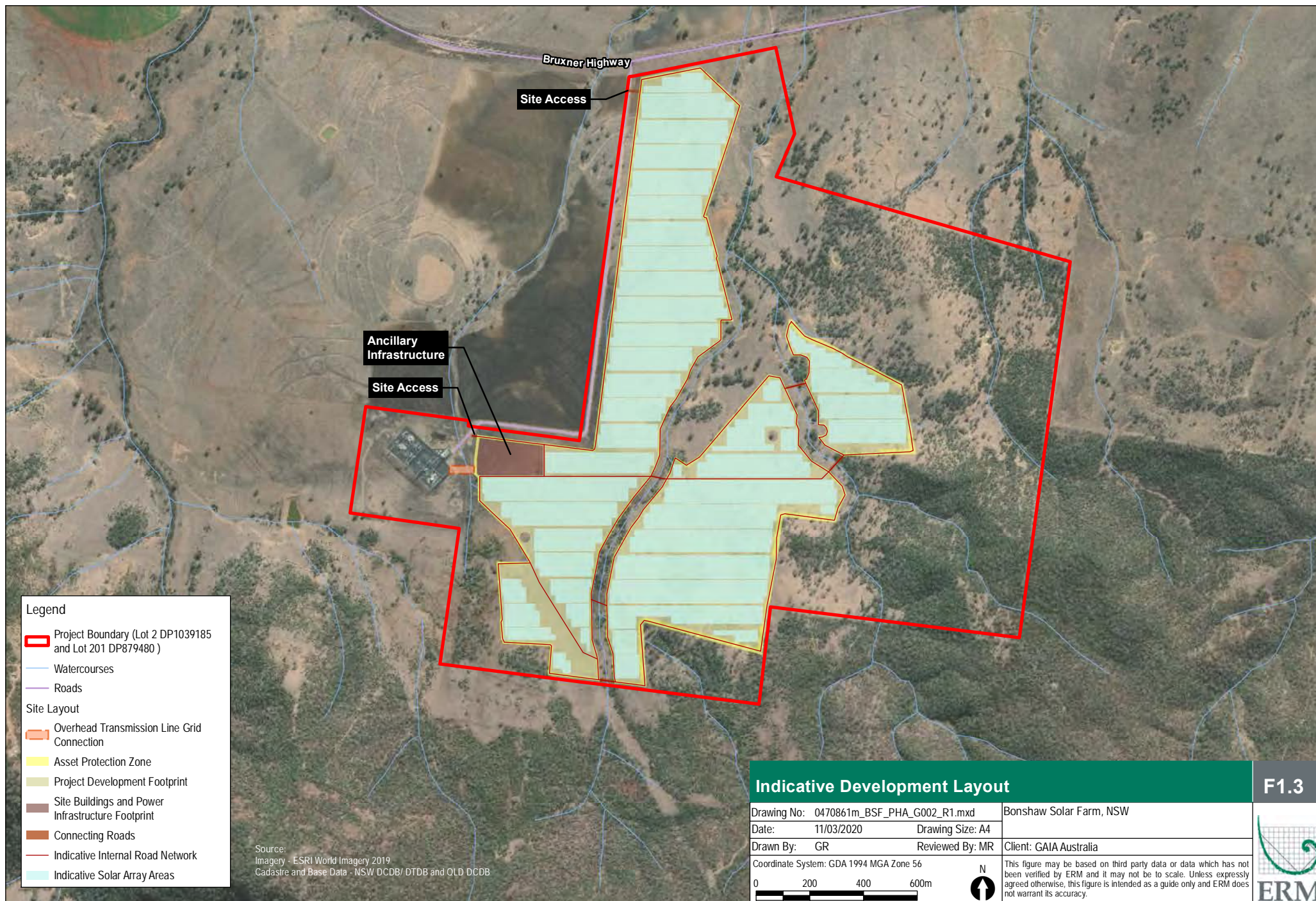
- Operational buildings
- Access roads and internal roads on site, as well as emergency access points
- Fencing and landscaping surrounding the arrays, substations and BESSs.

1.5 Limitations

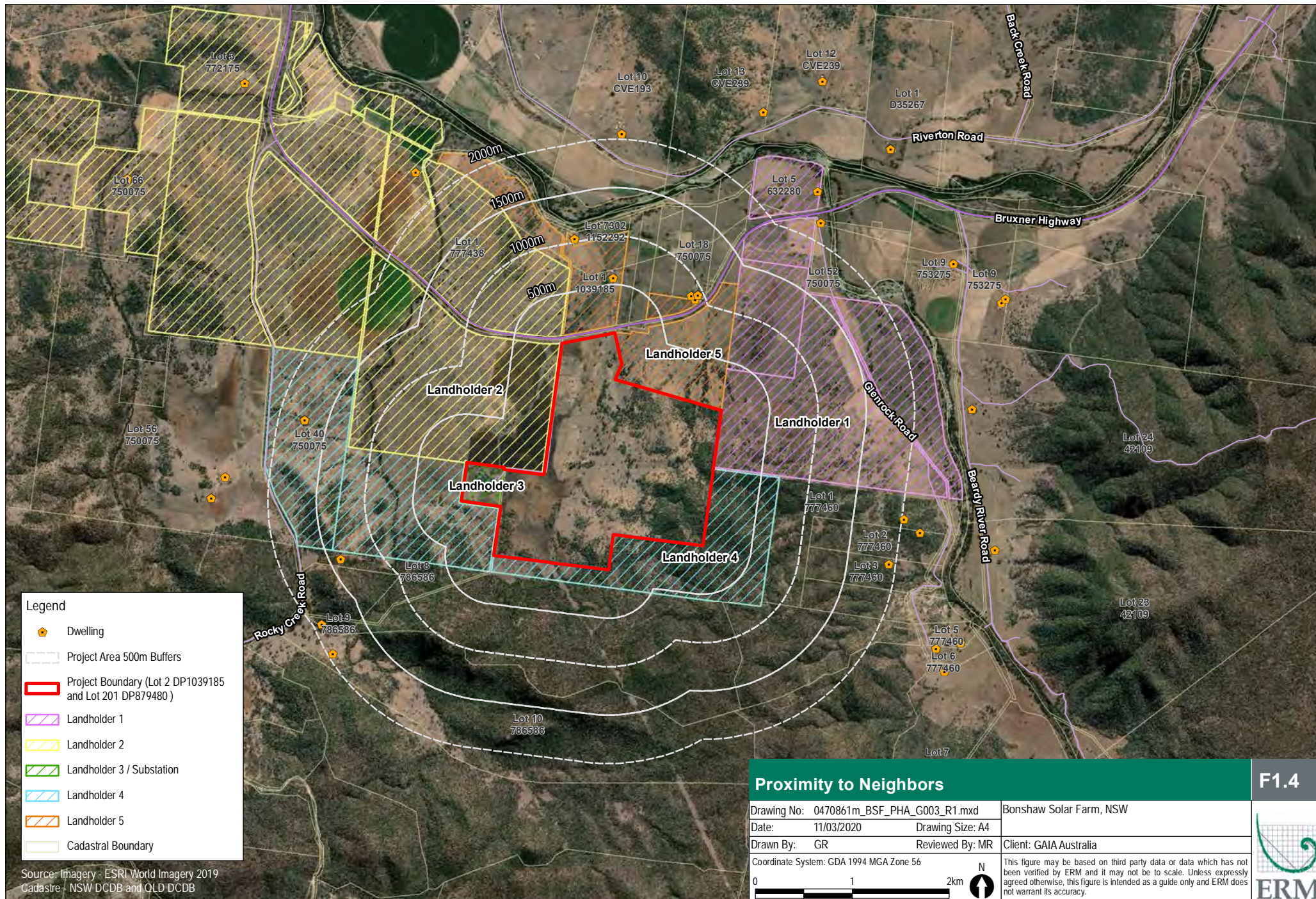
The scope of work is limited to the requirements of the SEPP33 and works already undertaken that address the hazards and risks component of the SEARs. The limitations for the following scopes of hazards and risks are presented as limitations as detailed descriptions and management strategies are presented in their relevant study sections. The study limitations are:

- Bushfire hazard assessment. Risks and hazards associated with bushfire are detailed in the bushfire management plan produced as a requirement for the Project EIS and Post-lodgement RTS. Where applicable, identified controls have been referenced in this study (such as the bushfire management plan).
- Hazards and risks associated with traffic and traffic management. A Traffic Impact Assessment (TIA) has been produced as a requirement of site access and construction under the Project EIS process. Where relevant, identified controls will be referenced in this study (i.e. the Project TIA).
- Hazards and risks associated with construction. Construction associated hazards and risk will be addressed in the Construction Environmental Management Plan (CEMP) for the Project's construction phase, as well as a site Work Health and Safety Plan (WHS).





F1.3



F1.4

Source: Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB

Figure 1-5 BESS layout

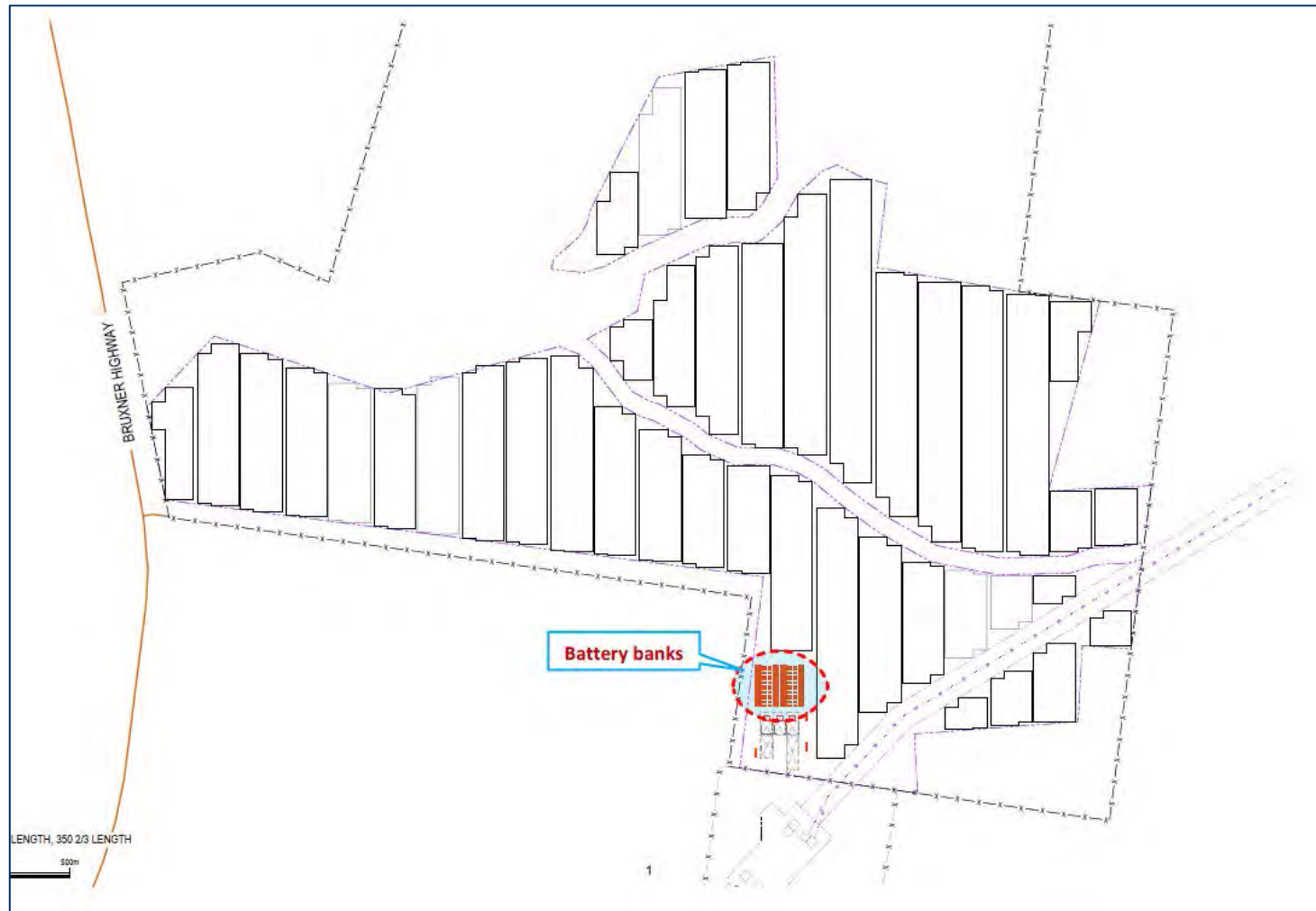
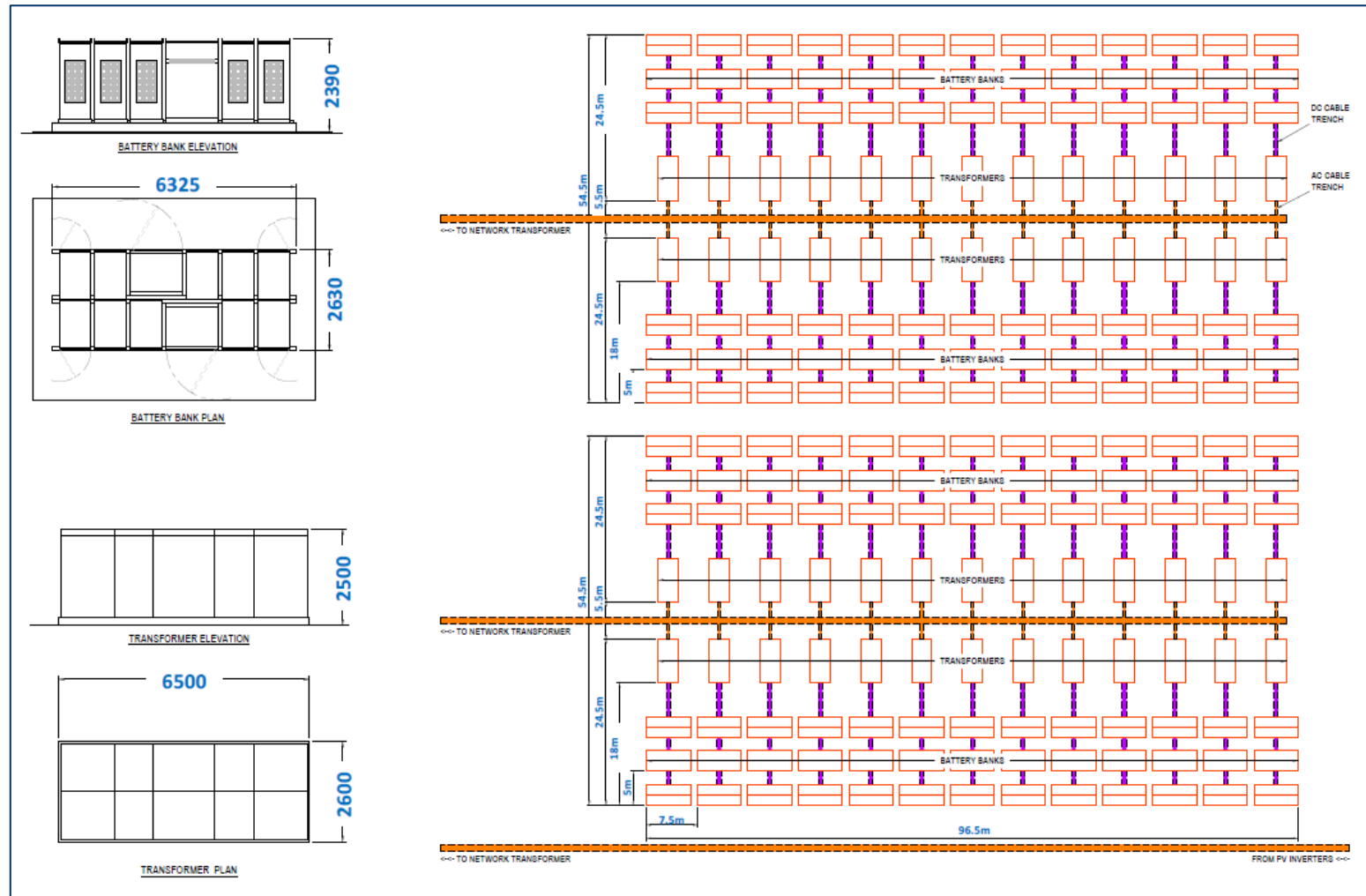


Figure 1-6 BESS Battery Bank layout



2. ASSESSMENT METHODOLOGY

2.1 Screening Assessment

A desktop assessment was carried out to identify environmental hazards and risks that could arise during the construction and operation of the Project, as well as mitigation measures to address such issues.

The assessment focused on those hazards and risks with the potential to adversely affect the quality of the surrounding environment, land uses and communities, with consideration of the following relevant policies and guidelines:

- *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (SEPP 33);
- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, 2011);
- *Hazardous Industry Planning Advisory Paper No 6: Hazard Analyses* (Department of Planning, 2011);
- *Multi-level Risk Assessment* (Department of Planning, 2011);
- *Australian Standard 1940: The storage and handling of flammable and combustible liquids* (AS 1940:2017);
- *Australian Standard 4332: The storage and handling of gases in cylinders and welding gases* (AS 4332:2004);
- *Australian Standard 4839: The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes* (AS 4839:2001);
- *International Standard (ISO / IEC 31010) Risk Management – Risk Assessment Technique*;
- *Australian Code for the Transport of Dangerous Goods by Road and Rail (7.5th edition)* (National Transport Commission, 2007); and
- *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005).

There may be additional health and safety hazards that are not specifically considered in this assessment and would be addressed by the construction contractor.

The screening assessment focuses on specific dangerous goods classes that have the potential for significant offsite effects. The assessment involves the identification of classes and quantities of all dangerous goods to be used, stored or produced on site. Details of the methodology of the screening assessment is outlined in SEP33 with particular reference to **Figure 2-1**

2.2 Hazard Identification

Hazard identification aims to highlight any risks associated with the interaction of the Project with the surrounding environment. This is to enable the identification of any potential offsite impacts.

Hazard identification is a desktop qualitative risk assessment and involves documenting possible events that could lead to a hazardous incident. It is a systematic process to list potential causes and healthy, safety and environmental consequences, in qualitative terms. Operational and organisational safeguards were developed to prevent hazardous events from occurring, or if they should occur, to mitigate the impact on the Project, equipment, people and the surrounding environment.

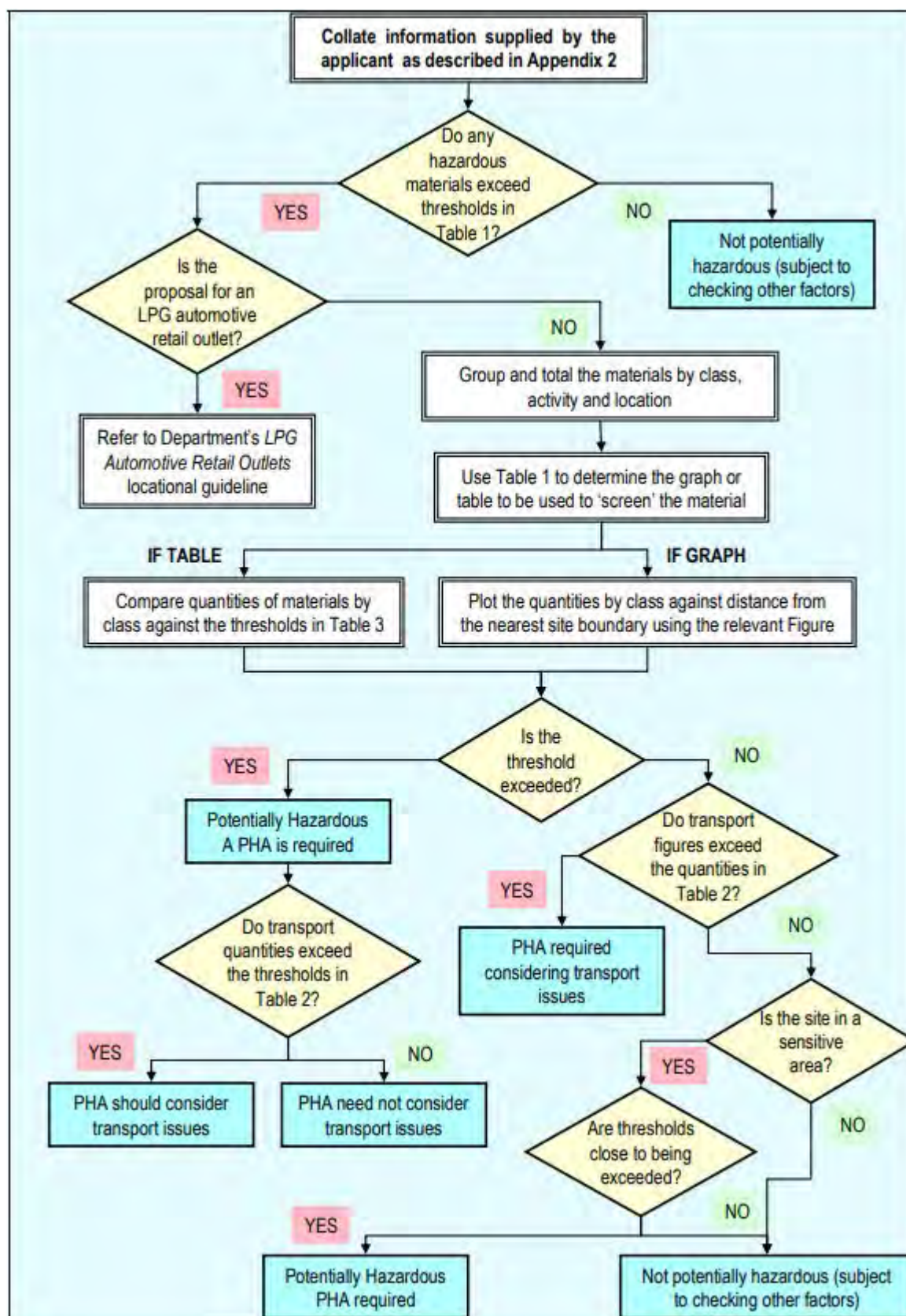


Figure 2-1 SEPP33 Risk Screening Process

3. PRELIMINARY RISK ASSESSMENT AND SCREENING

3.1 Definitions

Industries or projects determined by the risk screening process to be hazardous or potentially hazardous require the preparation of a Preliminary Hazard Analysis (PHA) in accordance with Clause 12 of SEPP 33.

Definitions of 'potentially hazardous industry' and 'potentially offensive industry' are provided in SEPP 33:

'potentially hazardous industry' means a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

- a. To human health, life or property, or
- b. To the biophysical environment, and includes a hazardous industry and a hazardous storage establishment.

'potentially offensive industry' means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

3.2 Assessment

3.2.1 Hazard Screening

In assessing the proposed Project, the emphasis is on preventing hazardous incidents on-site or offsite, such as spontaneous combustion and fire, or the contamination of land by the use of significant quantities of toxic or biologically harmful materials that could result in substantial effects.

3.2.2 Potential Impacts During Construction and Operation

Potential hazards and risks during construction and operation include (but are not limited to):

- The on-site storage, use and transport of dangerous goods and hazardous substances; and
- Risk of damage to existing infrastructure due to ground movement and geotechnical instability.

These hazards and risks are described further in the following sections. An indicative list of the types of potentially hazardous materials anticipated to be used, stored and transported during construction and operation of the Project is provided in **Table 3-1** along with the relevant storage and transport thresholds established under Applying SEPP 33.

Table 3-1 Proposed Hazardous Material Storage at Bonshaw Solar Farm (Construction and Operation)

Material	Australian Dangerous Goods Class	Storage Location	Storage Method	Quantity (T)	Applying SEPP 33 Threshold		
					Min quantity	Min. storage distance from sensitive receptors	Transport
Chemicals	Various	Workshop	Domestic Storage	Domestic Quantities	N/A	N/A	N/A
Welding Cylinders	Class 2.1, 2.2	Workshop	Cylinders (AS 4332, AS 4839)	5 Welding Sets (<0.1 T)	0.5 T	N/A	N/A
Lithium Battery	Class 9	Battery Energy Storage System (BESS)	Container	Undefined	N/A	N/A	N/A
Diesel	Combustible	South Gate	Self bunded tank AST (AS 1940)	2000 T	5000 T	3m (AS 1940)	N/A
Oil Store	Combustible	Workshop	Storage (AS 1940)	<10 T	N/A	N/A	N/A

The thresholds in applying SEPP 33 represent the maximum quantities of hazardous materials that can be stored or transported without causing a significant off-site risk.

In most instances, low volumes of potentially hazardous materials would be stored on site. The volume required to be stored on site would largely depend on the anticipated rates of consumption, with deliveries of dangerous goods coordinated to match consumption rates.

Construction site planning would ensure hazardous materials are stored appropriately and at the required distance from sensitive receptors, in accordance with the thresholds established under Applying SEPP 33 and relevant Australian Standards (specifically AS1940, AS4332 and AS4839).

Environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the construction environmental management documentation. These measures would include the storage and management of all hazardous substances in accordance with the *Work Health and Safety Act 2011*, the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005) and Applying SEPP 33.

The risk screening process for the storage of hazardous materials at the Project site and the transportation of hazardous materials to/from the site demonstrates that in all cases, types and quantities would be below the Applying SEPP 33 thresholds. For storage, this demonstrates that operational inventories would not pose a significant risk of harm beyond the site boundary. For transportation, this also demonstrates that risks are unlikely to be significant.

It can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety. Given that Applying SEPP 33 thresholds are not exceeded, the Project is not considered to be a hazardous or potentially hazardous industry under SEPP 33 chemical screening. Therefore a PHA is not required to be undertaken for the Bonshaw Solar Farm under the screening thresholds, but is required as per the inclusion of hazards from non-chemical sources within the guidelines.

A base PHA has been conducted for the potential hazards associated with the project because of the non-standard potential hazards inherent in the type of industry. This will ensure that and potential hazards are recognised and potential impacts are mitigated. If changes occur to the project where screening thresholds are exceeded then a more detailed PHA may be undertaken.

3.2.3 Potentially Offensive Assessment

The assessment of the suitability of the Project site to accommodate existing or proposed development of a potentially offensive nature is based on consideration of:

- The nature and quantities of materials stored and processed on the site;
- The type of plant and equipment in use;
- The adequacy of proposed technical, operational and organisational safeguards;
- The surrounding land uses or likely future land uses; and
- The interactions of these factors.

The potential polluting discharges a development of this type could generate that would be deemed offensive and cause adverse impacts if unmitigated are outlined in **Table 3-2**. Discussion of where these issues are addressed in the Environmental Impact Statement (EIS) (ERM, 2019) and hence why they are considered to be mitigated is also outlined.

Table 3-2 Potentially Offensive Assessment

Potential Impacts	Discussion
Noise	No issues identified. Refer to Section 6.5 and Appendix G (Noise and Vibration Impact Assessment) of the EIS.
Odour	Given the nature of the Solar Farm, any odour is unlikely to arise, and is therefore not required to be assessed as a requirement of the SEARs.
Air emissions	Given the nature of the Solar Farm, no air emissions are likely to arise, and is therefore not required to be assessed as a requirement of the SEARs.
Water discharge/runoff	No issues identified. Refer to Section 6.7 of the EIS.
Ground contamination	No issues identified. Refer to Section 6.3 of the EIS.

3.2.4 Potentially Offensive Impacts Mitigation Measures

The mitigation measures to be implemented to address potential offensive impacts are provided below.

3.2.5 Potentially Offensive Assessment

With the nature of the material stored, mitigation measures implemented for the project, immediate proximity of the Dumaresq power substation, and the impacts as they are assessed in the EIS, it can be concluded that the potentially offensive impacts associated with the project are unlikely to be significant to either neighbouring properties or on the existing or likely future development. Therefore a high level PHA requiring hazard modelling and is not required to further analyse the project.

4. HAZARD IDENTIFICATION AND MANAGEMENT

4.1 Hazard Identification

Hazard identification aims to identify all reasonably foreseeable hazards and associated events that may arise due to the operation of the Project. The hazard identification was conducted as a desktop study and focused on the operational activities of the Project. Safeguards have also been identified and are required to ensure the risk scenarios that were identified are controlled, contained and minimised to an acceptable level. The acceptable level of risk associated to the Project upon assessment will be risks which are assessed as 'low' or 'moderate' (with robust controls) as described in **Table 6-1** and assessed in accordance with the risk matrix (**Appendix A**). Any risks, where sourced internally and assessed as high will require further mitigation until the risk is reduced to an acceptable level. (i.e. external bushfires are beyond the control of the company)

For each identifiable hazard, the following was considered:

- Event – the mechanism by which the hazard potential is realised
- Causes – the potential ways in which the event could arise
- Consequences – the outcome or impact of the event
- Controls – any existing aspects of the design which prevent and/or mitigate against the event and resulting consequences

4.2 Chemical and Spill Management

Chemicals brought on site for should be stored in accordance with the relevant Australian Standards which dictate requirements for handling, use, storage and disposal of chemicals. Safety Data Sheets (SDS) will be kept on site for the purpose of reference and use, and in the event that emergency services require access to the register of chemicals on site.

Additionally, appropriate safe work procedures will be implemented for the handling of all chemicals, including transfer, storage, spill prevention and clean up requirements.

4.3 Exposure to EMF

SEARs requirements dictate that an assessment be made of potential hazards and risks associated with the exposure to Electro-Magnetic Fields (EMF) against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines. Detail on exposure to EMF is presented in **Section 5**.

4.4 Risk Minimization Procedures

It is recommended that the following risk minimization procedures be implemented that incorporate practices that will prevent risk scenarios from occurring. These include:

- Ensuring ISO 9001 quality for the manufacture of the batteries and associated equipment
- Contractor management procedures – including procedures that validate works completed, approved permits to work, site sign on/off, etc.
- Verification of installation quality and operational values of BESS
- Minimising build-up of combustible materials on-site
- Installing bollards/protective barriers around key battery areas
- Inspection and maintenance regime for batteries and associated equipment

- A bushfire management plan (developed in consultation with the Rural Fire Service) including access requirements and any hazards on the site. This would be reviewed annually through consultation with the RFS

4.5 Assumptions

The assumption that have been made during the hazard identification study include:

- All plant and equipment is installed and operated in accordance with appropriate Australian Standards, codes and guidelines
- Dangerous goods are transported in accordance with the ADG Code and storage as per the relevant standards and guidelines even if not a licensable quantity.
- All equipment and systems are designed to be inherently safe.

Table 4-1 Hazard Identification

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
Vehicle interaction	Vehicle movements in vicinity of personnel Vehicle impact to infrastructure	Personal injury	Unlikely	No	Preparation of a construction management plan that includes standard traffic rules and signage. Preparation of a Traffic Impact Assessment (TIA) Implement site speed limits Provide designated pedestrian areas where necessary Ensure driver competency Bollards and positioning of batteries to minimise incidental vehicle interaction
EMF	EMF related infrastructure (such as BESS, Powerlines, Grid infrastructure etc.)	Personal injury	Extremely Unlikely	No	All designs will be in accordance with the Guidelines for limiting exposure to Time varying Electric, Magnetic and Electromagnetic Fields (ICNIRP, 1998; ICNIRP, 2010b) and relevant codes and industry best practice standards in Australia. All relevant procedures in relation to a high voltage installation will be adhered to throughout the life of the Project. The security system for the site, including safety fencing and closure of gates, will be maintained throughout the construction and operation, to provide safe exposure distances to the public. Public access to the site will be restricted throughout the life of the Project. Contractor management – such as work method statements, permits to work, etc.

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
Natural hazards	Flooding	Personal injury Plant shut down	Very Unlikely	Yes – typically a large scale external event	<p>The modelling results indicate that the proposed development will not increase peak flood levels or peak flows at the downstream boundary of the site, or in the Dumaresq River. Flooding in the Dumaresq River does not have a hydraulic impact on site runoff.</p> <p>Minor increases to peak flood levels within the site immediately upstream of the proposed crossings were observed, however, these impacts are contained within the channel and the site boundary.</p>
	Earthquake	Personal injury Plant shut down	Very Unlikely	Yes– typically a large scale external event	<p>Project site and development footprint is located on a tectonically stable area</p> <p>Built to location construction codes</p> <p>Project infrastructure is not located to subsidence or rock fall</p>
	Lightning	Personal injury Plant shut down	Very unlikely	Yes - typically a large scale external event	Infrastructure to be in accordance with electrical standards
	Bushfires	Personal injury Plant shut down Possible fire	Unlikely	Yes – typically a large scale external event	<p>A bushfire management plan will be prepared in consultation with the RFS. This plan will include but is not limited to the following aspects:</p> <ul style="list-style-type: none"> ■ Management of activities with a risk of fire ignition ■ Management of fuel loads on site ■ Storage and maintenance of firefighting equipment, including siting and provision of adequate water supplies ■ Respond to the requirements of the '<i>Planning for Bush Fire Projection 2018</i>' regulation. This can include:

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
					<ul style="list-style-type: none"> - Implementing APZ setbacks to mitigate external fire hazards, as well as mitigation of propagation of external fires to outside the Project boundary. - Providing adequate egress/access to site, including multiple entrances and exits to site - Emergency evacuation measures <ul style="list-style-type: none"> ▪ Ensuring that site staff and contractors are aware of evacuation measures and emergency procedures. ■ Operational procedures relating to mitigation and suppression of bush fire relevant to the operation of the Project <p>Locating the BESS system in the most appropriate location on the site that considers both the bushfire hazards surrounding the Project and the logistical needs of the Project.</p> <p>Installation as per AS/NZS 5139:2019</p> <p>Ensuring that there are external fire protection systems for the BESS where relevant</p> <p>Ensuring that the BESS system is relevant to the appropriate standards (Global and local)</p> <p>Design buildings/structures to appropriate codes and standards</p> <p>Manage fuel for vehicles and machinery on site to appropriate standards</p> <p>Provide fire protection systems</p>

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
External fire (adjacent to site)	Fire or explosion from adjacent land users	Asset damage Plant shut down Personal injury	Extremely unlikely	No	<p>A bushfire management plan will be prepared in consultation with the RFS. This plan will include but is not limited to the following aspects:</p> <ul style="list-style-type: none"> ■ Management of activities with a risk of fire ignition ■ Management of fuel loads on site ■ Storage and maintenance of firefighting equipment, including siting and provision of adequate water supplies ■ Respond to the requirements of the '<i>Planning for Bush Fire Projection 2018</i>' regulation. This can include: <ul style="list-style-type: none"> - Implementing APZ setbacks - Providing adequate egress/access to site by allowing more than one way in and one way out - Emergency evacuation measures ■ Operational procedures relating to mitigation and suppression of bush fire relevant to the operation of the Project <p>Locating the BESS system in the most appropriate location on the site that considers both the bushfire hazards surrounding the Project and the logistical needs of the Project.</p> <p>Installation as per AS/NZS 5139:2019</p> <p>Ensuring that there are external fire protection systems for the BESS where relevant</p>

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
					<p>Ensuring that the BESS system is relevant to the appropriate standards (Global and local)</p> <p>Design buildings/structures to appropriate codes and standards</p> <p>Manage fuel for vehicles and machinery on site to appropriate standards</p> <p>Provide fire protection systems</p>
Loss of containment of chemicals, including dangerous goods	Damage to storage containers e.g. from external impact, wear and tear, overheating	Environmental damage Personal injury	Very Unlikely	No	<p>Store chemical in line with appropriate standards</p> <p>Implement a regular inspection and maintenance schedule for chemical storage areas</p> <p>Implement standard transfer and handling procedures</p>
Decanting and transfer of chemicals i.e. with fork lift or hoses	Damage to storage containers during handling Not adhering to relevant handling standards	Environmental damage Personal Injury	Very Unlikely	No	<p>Provide a Safe Work Method Statement detailing methods for handling chemicals</p> <p>Provide spill kits to be used in the event of an incident involving release of chemicals</p>
Contact with chemicals, including dangerous goods	Maintenance of batteries	Personal injury	Very Unlikely	No	<p>SDS's available on site and referred to in handling processes</p> <p>Provide correct PPE to all staff (as per SDS)</p>
Fall from heights	Working at height	Personal injury / fatality	Very Unlikely	No	<p>Implement working at heights procedures</p> <p>Ensure all staff working at heights have completed the necessary training</p> <p>Use fall prevention equipment</p> <p>Contractor management, including:</p> <ul style="list-style-type: none"> ■ Sign on/off registers ■ Ensuring familiarity with site WHS procedures ■ Appropriate permit to work procedures

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
Contact with electricity	Contact with live electrical sources Cranes impacting overhead lines Hitting underground services Overhead services damaged during natural hazards Security issues with trespassers in contact with electrical lines	Personal injury / fatality	Very Unlikely – Unlikely (trespassers)	No	Implement Isolation procedures Install fit for purpose electrical systems Ensure that installation is carried out by a suitably qualified electrical personnel Adherence to AS 3000 Follow underground utility identification protocols, including Dial Before You Dig Contractor management, including: <ul style="list-style-type: none"> ■ Sign on/off registers ■ Ensuring familiarity with site WHS procedures ■ Appropriate permit to work procedures Crane height limitations where works are undertaken in the vicinity of overhead powerlines – overhead work height limits
Mechanical or chemical damage of lithium-ion Battery assemblies	Overheating of individual cells (e.g. lack of venting, thermal runaway reactions) Vehicle impact into batteries	Release of fluorinated hydrocarbons Personal injury / fatality Asset damage	Extremely Unlikely	Yes	Ensure Batteries are Quality Assured Install bollards/protective barriers around key battery areas and infrastructure Ensure battery units are appropriately vented Batteries to be stored as per suppliers specifications Implement a regular inspection and maintenance regime for the battery assemblies

Hazard Scenario	Causes	Consequence	Likelihood	Potential for Off Site Impact	Identified / Recommended Safeguards
Overheating of lithium-ion batteries	Thermal runaway reactions	Release of fluorinated hydrocarbons Personal injury / fatality Asset damage	Extremely Unlikely	Yes	<p>Provide ventilation system within BESS</p> <p>Batteries to be stored as per suppliers specifications</p> <p>Quality Assurance checks to be carried out routinely by qualified personnel</p> <p>Provide insulation around batteries</p> <p>Regular maintenance inspections of battery units to check for overheating</p> <p>Installation as per AS/NZS 5139:2019</p> <p>Ensuring that there are external fire protection systems for the BESS where relevant</p> <p>Ensuring that the BESS system is relevant to the appropriate standards (Global and local)</p>
Security breach	Persons seeking theft of property/battery components	Theft of equipment Personal injury	Unlikely	No	<p>Installation of fencing around facility and battery facility separately</p> <p>CCTV where practical on critical infrastructure/battery units</p> <p>Alarms/locks on battery doors</p> <p>Inspections to monitor for potential security concerns</p>
Construction risks	General miscellaneous construction risks	Personal injury / fatality	Very Unlikely	No	<p>Implement a Workplace Health and Safety (WHS) plan</p> <p>Conduct a detailed Safety in Design processes during project execution</p>
Transport and delivery (manual handling)	Personnel injury though manual handling of equipment during operations	Personal injury	Very Unlikely	No	<p>Adhere to requirement of a WHS plan and the ADG code.</p> <p>Ensure batteries have specific equipment handling advice where appropriate for staff</p>

4.6 Consequence

For each identifiable event, the resulting consequence was qualitatively assessed and described. These include impacts to personnel (e.g. fatality/injury), environment and/or assets.

4.7 Likelihood

Likelihood was estimated using a qualitative approach using the category scale shown in **Table 4-2** as well as in collaboration and endorsement from the Client (GAIA). The likelihood ratings were assigned based on the understanding of the industry, previous PHA's with a similar scale and range of identifiable hazards, and the context of the Project. The likelihood ratings were assigned accounting for the initiating causes, resulting consequences with controls (prevention and mitigation) in place.

Table 4-2 Likelihood Category

Category	Description
Extremely Unlikely	Never heard of in the industry, not realistically expected to occur
Very Unlikely	Heard of in the industry, but no expected to occur
Unlikely	Could occur in the next 10 years
Likely	Could occur in the next year

4.8 BESS Hazard and Certification Information

Fires within a lithium ion battery system can be initiated by an internal event such as a thermal runaway in one or more of the individual cells or by an external source such as a bushfire. Recorded fire events in lithium ion battery energy storage systems are unheard of within the industry. The BESS system supplied for the Bonshaw Solar Farm Project is certified under the global standard for batteries, UL9540A.

The UL is an international standard for batteries which is the UL Safety Test Method for Evaluating Thermal Runaway Fire Propagation in BESS. To become UL9540A certified you must achieve the following targets:

- Target BESS temperature cell must be less than cell surface temperature at gas venting
- Temperature increase of target walls less than 97C
- No explosion hazard exhibited by the product
- No flaming beyond the outer dimension of BESS unit

The chosen BESS supplier for the Project will be Samsung SDI. Samsung SDI is the first and only supplier currently to satisfy the global UL9540A rack level safety standards test for Energy Storage Systems (ESS). Samsung SDI was recognised by the UL test for its capability of preventing large scale fire in the ESS by applying proprietary designed for safety of cells, modules and racks to prevent battery thermal runaway propagation. The test method consists of cell The test summary and layout is presented below in **Figure 4-1**.

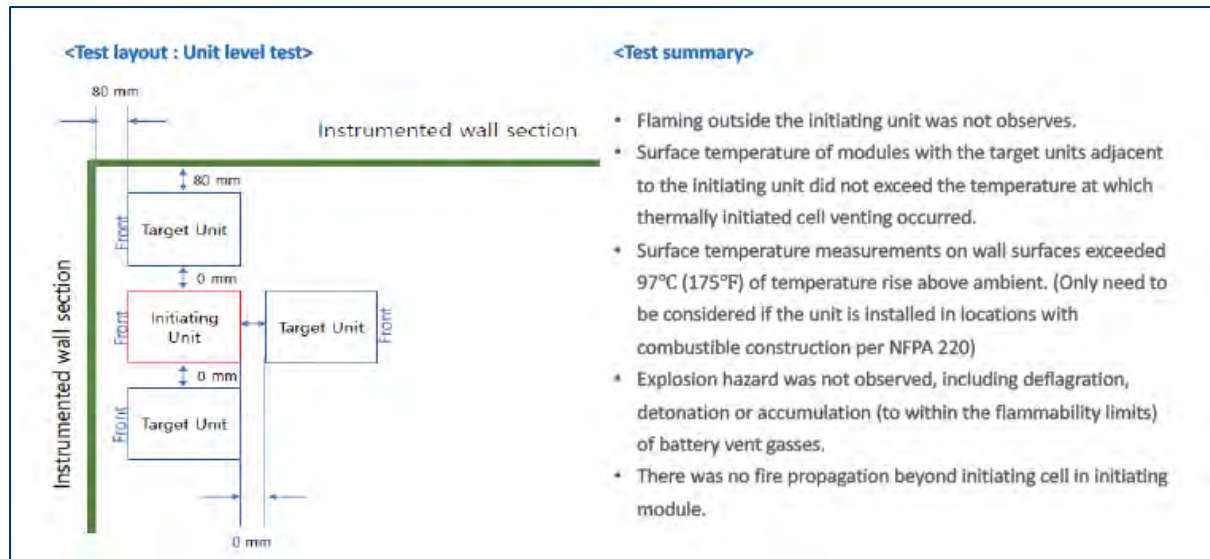


Figure 4-1 Samsung SDI test layout and results

Samsung SDI, the chosen supplier for the BESS for the Project only ships modules that comprise a fire safety countermeasure. This countermeasure is a special extinguishing system that prevents fires from spreading to nearby cells and comprises of advanced chemicals and blockers of thermal diffusion.

5. ELECTRIC AND MAGNETIC FIELDS (EMF)

5.1 Methodology

A desktop assessment of the potential hazards and risks associated with electro and magnetic fields (EMFs) in relation to the Project has been undertaken. This involved a review of publicly available information and research on EMFs associated with electricity generation infrastructure. This information was compared with applicable guidelines recommended by industry bodies to identify the potential impacts that may occur with solar farm development. The desktop assessment considered that impacts are minor and temporary in nature.

5.2 Background

EMFs exist wherever electricity is generated, transmitted, distributed or used, and are strongest closest to their source. Electric fields are produced by voltage, while magnetic fields are produced by current. In Australia, EMFs associated with the use of electricity are generated at a frequency of 50 hertz (Hz). This frequency falls within the extremely low frequency (ELF) range of 0–3,000 Hz, as defined by the Australian Radiation Protection and Nuclear Safety Agency. Subsequently, power lines, substations, transformers and other electrical sources all emit ELF EMFs (ARPANSA 2015).

The units commonly used to express the strength of a magnetic field include the Tesla (T) or microtesla (μT) and the Gauss (G) or milligauss (mG), where 1 mG is equal to 0.1 μT . The typical values of magnetic fields measured near significant electrical infrastructure in Australia, including distribution lines, substations and transmission lines are provided in **Table 5-1**. It should be noted that distribution lines operate at significantly lower voltage than transmission lines (ARPANSA 2016).

Table 5-1 Typical Values of Magnetic Fields Measured Near Powerlines and Substations

Source	Location of measurement	Range of measurements (mG)*
Distribution line	Directly underneath	2–30
Distribution line	10 m away	0.5–10
Substation	At substation fence	1–8
Transmission line	Directly underneath	10–200
Transmission line	At edge of easement	2–50

Notes: * Levels of magnetic fields may vary from the range of measurements shown.

Source: ARPANSA (2016).

Extensive research has been conducted to determine whether exposure to ELF EMFs produces adverse health consequences (WHO 2007). As noted by the World Health Organisation (WHO 2007), the health effects related to short-term, high-level exposure to EMFs have been established and form the basis of two international exposure limit guidelines. These are the 'Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic fields (up to 300 GHz)' by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998), and the 'Standard for safety levels with respect to human exposure to electromagnetic fields, 0–3kHz' by the Institute of Electrical and Electronics Engineers (IEEE) Standards Coordinating Committee (2002).

As noted by ARPANSA (2015), the majority of research indicates that ELF EMFs exposure levels normally encountered in the environment, including in the vicinity of power lines, does not pose a risk to human health. Further, there is no established evidence that exposure to magnetic fields from power lines, substations, transformers or other electrical sources causes any health effects (ARPANSA 2015). Nonetheless, the ICNIRP guidelines (1998) define reference levels for occupational and general public exposure to prevent potential adverse health effects from exposure to EMFs. These reference levels are shown in **Table 5-2** below. The ranges of measurements listed within the table are well below the exposure limits of 2,000 mG or 200 μ T, as defined by international guidelines (ARPANSA 2016).

Table 5-2 ICNIRP Reference Levels for Occupational and General Public Exposure

Exposure Characteristics	Electric field strength [kilo volts per metre - kV/m]	Magnetic flux density [μ T]
Occupational	10	1000
General public	5	200

Source: ICNIRP (1998).

A study by Chang and Jennings (1994) investigated the level of EMFs generated at two utility-scale PV solar developments in the United States. Specifically, the study compared the magnetic fields generated by these developments with published data on more prevalent magnetic field sources. The study concluded that magnetic fields, considered by Chang and Jennings (1994) to be of greatest public concern, generated by PV solar panel arrays were significantly less than for common household applications. For example, magnetic field measurements taken from the back of a PV solar panel were recorded as significantly less than those recorded from within close proximity of a hair dryer, microwave and television, respectively. Therefore, Chang and Jennings (1994) concluded that EMFs generated by PV solar panel arrays should not generate concern.

Other infrastructure installed as part of the PV solar developments assessed by Chang and Jennings (1994), such as transformers, exhibited more significant magnetic fields. However, these sources were found to be localised and could not be detected at the perimeters of each of the developments assessed (Chang and Jennings 1994). Further, it was noted that concerns about EMFs generated by transformers would also apply to several other electricity generation and storage technologies (Chang and Jennings 1994).

It is also noted that EMF levels diminish significantly over distance due to distance degradation (ARPANSA, 2016)

5.3 Assessment

The Transgrid 330 kV transmission line traverses the site. Based on the typical values of magnetic fields provided by ARPANSA (2016), the level of exposure from the existing transmission line will be significantly below the exposure limit of 2,000 mG or 200 μ T, which is defined by international guidelines. Additionally, the nature of exposure to EMFs generated by the existing transmission line will be intermittent for staff involved in the construction, operation and decommissioning stages of the Project.

In addition to Transgrid's 330 kV transmission line, staff involved in the construction and decommissioning stages of the Project will also be exposed to EMFs during works on the connection of infrastructure. Staff exposure levels will be below the recommendations for general public and occupational exposure through the construction and decommissioning of the connection infrastructure. General public and staff exposure levels will also be significantly below the recommendations due to the distance degradation EMF signals experience.

Construction of the Project includes the installation of electrical infrastructure within the site boundary including cabling, inverters, switchgear and the onsite substation, as well as, connection infrastructure to connect the Project to the Dumaresq Substation and the installation of a large number of PV solar panels. As this infrastructure will be involved in the generation, transmission and distribution of electricity, EMFs will be produced by the Project. The EMFs produced by the Project will be strongest closest to their respective sources.

Once operational, the Project infrastructure will be capable of generating EMFs. The degree of exposure to EMFs within the site boundary will vary depending on proximity to different components of the Project infrastructure. Staff exposure during the operational stage of the Project will be intermittent and limited to exposure encountered during ongoing maintenance of the site and project infrastructure. The combination of low exposure rates and the intermittent exposure of staff to elements of the Project infrastructure, capable of generating EMFs, indicate that adverse impacts from EMFs are unlikely.

The Project substation will be located within the Development Footprint, close to the site's western boundary. This location is right next to the existing switching station and any EMF will be significantly less than those emitted from the switching station, which has a higher current carrying capacity than the Project substation. Further, the Project substation will be offset from Bruxner Highway by approximately 1.4 km.

The transmission line to connect the Project to the Dumaresq Substation will be less than 150 m long and is directly adjacent to the existing 330kV transmission line and thus limit the potential exposure to ELF EMF.

5.4 Mitigation Measures

All designs will be in accordance with the Guidelines for limiting exposure to Time varying Electric, Magnetic and Electromagnetic Fields (ICNIRP, 1998; ICNIRP, 2010b) and relevant codes and industry best practice standards in Australia.

All relevant procedures in relation to a high voltage installation will be adhered to throughout the life of the Project, including work statements, approving permits to work, maintenance schedules, WHS adherence etc.

The security system for the site, including safety fencing and closure of gates, will be maintained throughout the construction and operation, to provide safe exposure distances to the public.

Public access to the site will be restricted throughout the life of the Project.

5.5 Conclusion

Based on the review of the potential issues regarding EMF, the study concludes that:

- EMF created from the project will not exceed the ICNIRP occupations exposure reference level.
- As the strengths of EMF diminishes significantly with distance, it can be determined that the ICNIRP reference level for exposure to the general public will not be exceeded and impact to the general public in surrounding land uses will be negligible.
- Assessment consequence (as demonstrated in **Table 6-1**) was assumed to result in only a slight injury (insignificant ranking).

6. RISK ASSESSMENT

The methodology for assessing risk combined the consequence and likelihood assessments as outlined in the qualitative Hazard Identification assessment (**Section 4.6** and **4.7**) with the qualitative risk matrix (**Appendix A**). This, in collaboration and endorsement with the client (GAIA) has produced the relevant risk assessment level for the Project.

the Project is The acceptable level of risk associated to the Project upon assessment will be risks which are assessed as 'low' or 'moderate' (with suitable controls) described in **Table 6-1** and assessed in accordance with the risk matrix (**Appendix A**). Any risks, where sourced internally and assessed as high will require further mitigation until the risk is reduce to an acceptable level. (ie external bushfires are beyond the control of the company).

Table 6-1 Risk Analysis

Hazard	Event	Consequence (Impact to people)	Likelihood	Risk
EMF	Exposure to EMF	Insignificant	Extremely unlikely	Low
Reaction	Thermal runaway in battery	Major	Very Unlikely	Medium
Chemical	Battery coolant leak	Minor	Very unlikely	Low
	Release of electrolyte from the battery cell (liquid/vented gas) resulting in fire and/or explosion	Major	Very Unlikely	Medium
	Refrigerant leak	Minor	Very Unlikely	Low
	Exposure to hazardous material	Moderate	Very unlikely	Medium
	Release of LPG from welding equipment point resulting in fire	Major	Very Unlikely	Medium
	Release of diesel from storage vessel or filling point resulting in fire	Major	Very Unlikely	Medium
	Release of gasoline from storage vessel or filling point resulting in fire	Major	Very Unlikely	Medium
Fire	Bushfire	Major	Unlikely	High
	Fire - BESS	Major	Extremely Unlikely	Low
	Fire - Transformers	Major	Very Unlikely	Medium

Hazard	Event	Consequence (Impact to people)	Likelihood	Risk
External factors	Water ingress resulting in fire (BESS) (from flooding)	Major	Extremely Unlikely	Medium
	Lightning strike	Major	Very Unlikely	Medium
	Earthquake	Major	Very Unlikely	Medium
	Flooding	Major	Very Unlikely	Medium
	Vandalism due to unauthorised personnel access	Moderate	Unlikely	Medium
	Fatality due to unauthorised personnel access	Major	Very Unlikely	Medium
Electrical	Exposure to live electricity	Major	Very Unlikely	Medium
Construction	Falling from heights	Major	Very Unlikely	Medium
	Manual handling injury / transport	Moderate	Unlikely	Medium
	Miscellaneous construction injuries possibility of resulting in fatalities	Major	Very Unlikely	Medium
Vehicle interaction	Incident involving people	Moderate	Unlikely	Medium
	Incident involving infrastructure	Moderate	Unlikely	Medium

6.1 BESS Risk Assessment

Hazards that are directly related to BESS operations are presented below in **Table 6-2**:

Table 6-2 BESS Risk Assessment

Hazard	Event	Consequence (Impact to people)	Likelihood	Risk
EMF	Exposure to EMF	Insignificant	Extremely unlikely	Low
Chemical	Battery coolant leak	Minor	Very unlikely	Low
	Release of electrolyte from the battery cell (liquid/vented gas) resulting in fire and/or explosion	Major	Very Unlikely	Medium
	Refrigerant leak	Minor	Very Unlikely	Low
Fire	Bushfire	Major	Unlikely	High
	Fire - BESS	Major	Extremely Unlikely	Low
	Fire - Transformers	Major	Very Unlikely	Medium
Reaction	Thermal runaway in battery	Major	Very Unlikely	Medium
External Factors	Water ingress resulting in fire (BESS) (from flooding)	Major	Extremely Unlikely	Medium
Electrical	Exposure to live electricity	Major	Very Unlikely	Medium

6.2 Summary of risk assessment

6.2.1 Consequence

The most significant consequence for the identified events is a fire event, resulting from a variety of causes (e.g. external bushfire, ignition of flammable material, battery thermal runaway, transformer fire), which has the potential to promulgate a bushfire to the surrounding areas.

6.2.2 Likelihood

The highest likelihood for the identified events is 'Unlikely', the potential to occur in the next 10 years. The associated event related to unauthorised personal access to the development footprint resulting in vandalism or asset damage to Project infrastructure. For risk assessment, the consequence impact to people, due to potential hazard on-site, to unaware trespassers was rated as moderate (sever injury category).

6.2.3 Risk Analysis

A total of 24 risk events were identified, these comprise of 4 low risk events, 19 medium risk events and 1 high risk event. Based on the risk acceptance criteria used for the study outline in the risk assessment section of the report, the risk profile for the Project is considered to be tolerable upon acceptance of suitable controls for the lone high risk event identified.

The majority of the medium risk events relate to fire events resulting from a variety of causes. Proposed controls to reduce the likelihood of these events, mitigation controls to contain fires and minimise escalation of the events are early consultation with RFS and the implementation of a fire management plan. Based on the identifiable controls, the highest likelihood for these events were rated as Unlikely (i.e. expected to occur in 10 years). While there is a risk event classified as 'high' in risk, it has been appropriately controlled, contained and mitigated by the implementation of the site's Bushfire Management Plan (BMP) developed in consultation with the local RFS.

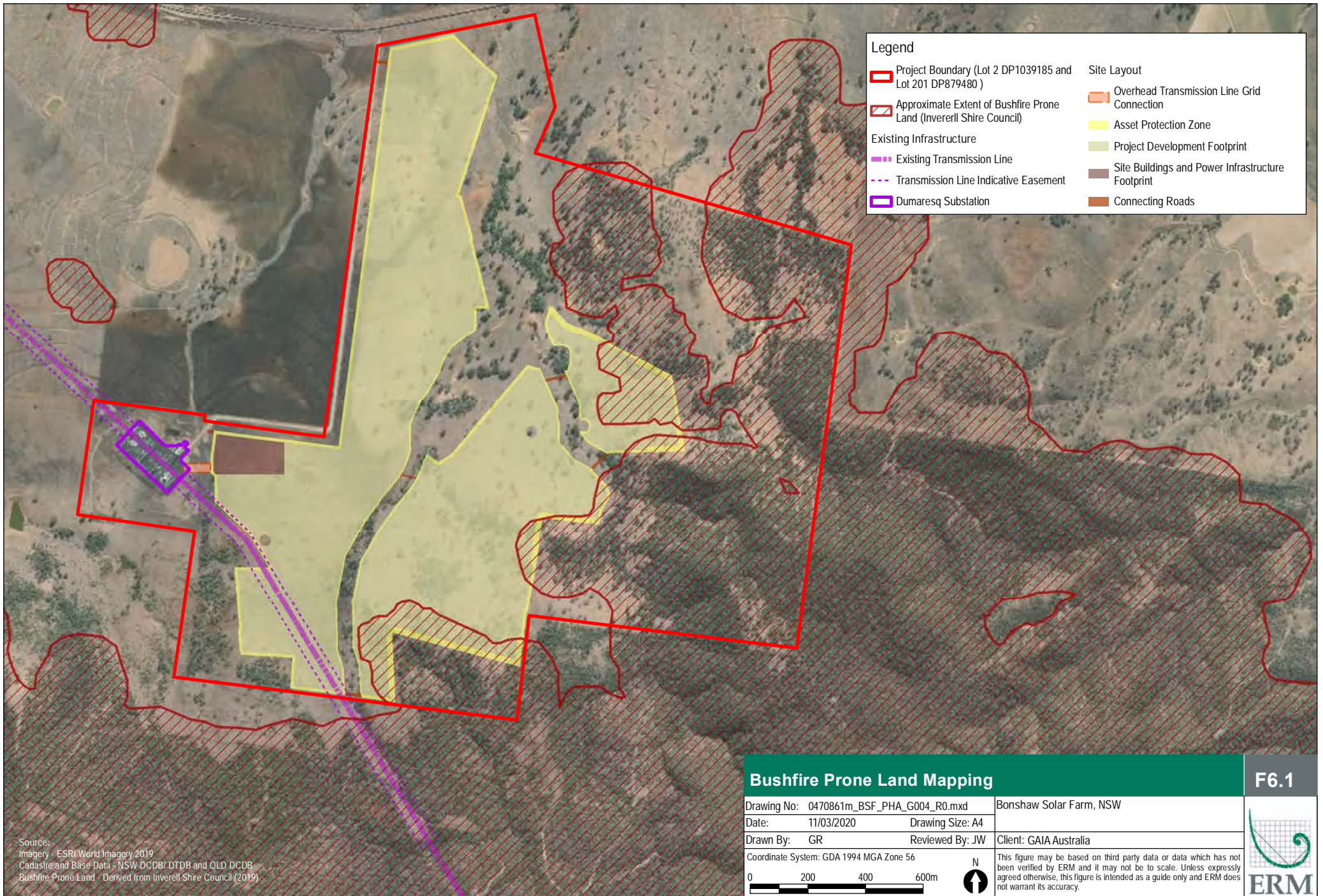
Based on the size of the development, proposed location for Project infrastructure within the development footprint, proposed controls and proximity to surrounding neighbours, the exposure to fire events will primarily be to the Project's construction and operations workforce and offsite impacts will be minimal.

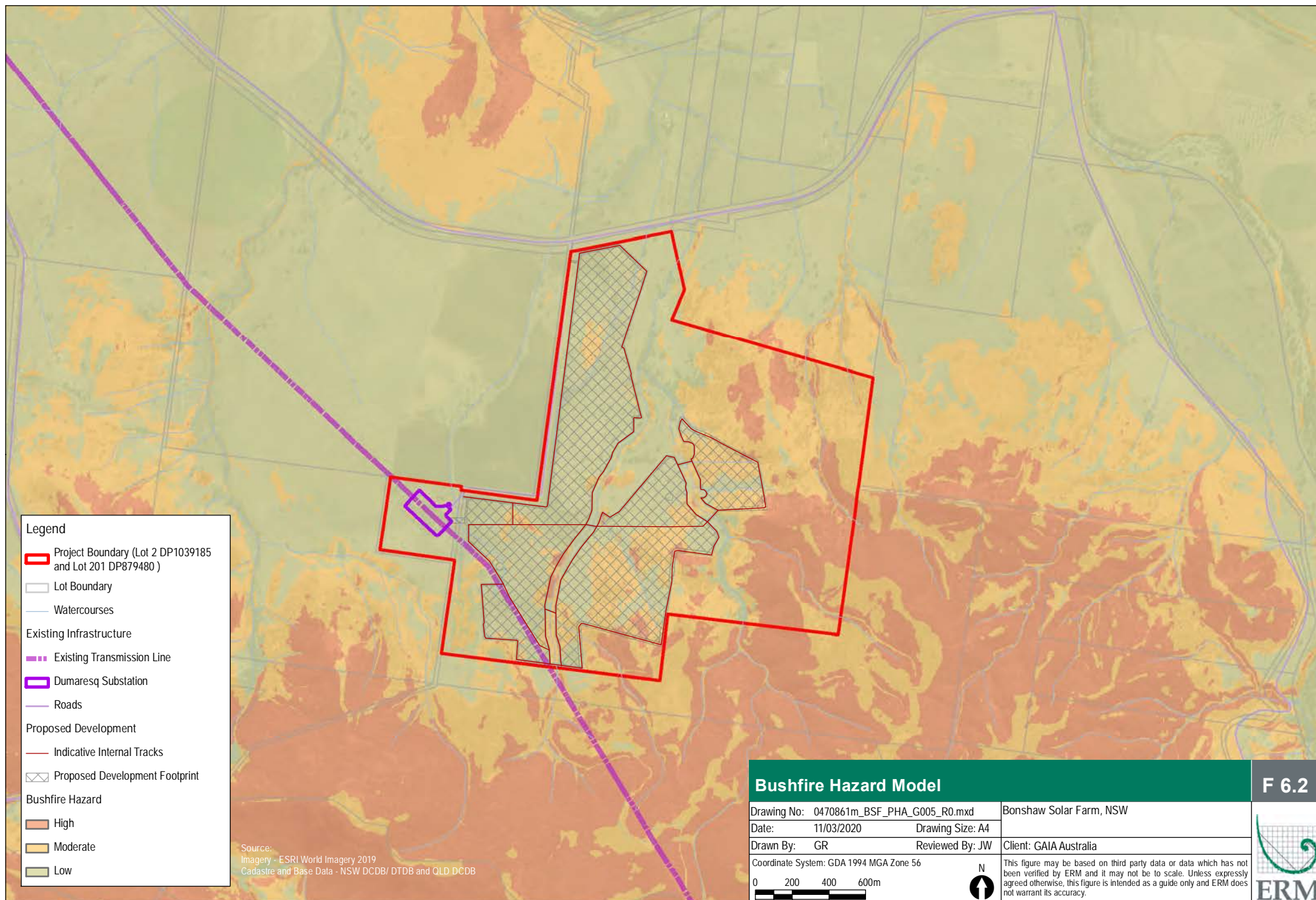
6.2.3.1 BESS Risk Analysis

A total of 10 risk events within the Project's total 24 risk events, were identified as possibly occurring in direct relation to the operations of the Project BESS. These events comprise of 4 low risk events, 5 medium risk events and 1 high risk event. As stated previously, based on the risk acceptance criteria used for the study outline in the risk assessment section of the report, the risk profile for the Project is considered to be tolerable upon acceptance of suitable controls for the lone high risk event identified.

The majority of the medium risk events relate to the fire events as caused by various sources within the BESS. The risk and hazard analysis of the BESS component of the Project are done as an overview based on any potential BESS system. Should the Project utilise Samsung SDI as the planned supplier of the BESS, these risk events are mitigated further because of the advanced technology complying with the latest global standards for batteries (UL9540A). Installation will also comply with Australian Standard AS/NZS 5139:2019.

Where there is a risk categorised as 'high', such as bushfire (both externally impacting the BESS, and as a hazard the BESS is a potential source of), the Project has taken measures to ensure that this infrastructure has the least potential to result or propagate into this hazard, and for this hazard to minimise impact to surrounding land uses. The location of the BESS has been considered as the primary mitigation consideration, both logistically supporting the project and within the most appropriate location to bushfire prone land (**Figure 6-1**). The ancillary project infrastructure boundary where the BESS is located is one of the furthest points from bushfire prone land, and represents a 'low' category of bushfire hazard, as represented in **Figure 6-1** and **Figure 6-2**. Possibility of bushfire as a result of the BESS unit is further mitigated by the supplier (Samsung SDI) where the product is UL9540A certified. This ensures that any units within the BESS meets its capability of preventing large scale fire in the ESS by applying proprietary design for safety of cells, modules and racks to prevent battery thermal runaway propagation.





7. CONCLUSION

It has been recognised that the Project is to include small quantities of hazardous materials which do not trigger the threshold. With consideration of the insignificant quantity of materials stored on site, along with the significant distance to neighbouring properties, it can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety. While there is a risk event classified as 'high' in risk, it has been appropriately controlled, contained and mitigated by the implementation of the site's Bushfire Management Plan (BMP) developed in consultation with the local RFS, the appropriate location proposal of the BESS unit and related infrastructure, ensuring supplier complies with the latest global and local standards that prevent thermal runaway propagation events, and correct installation.

Potentially offensive impacts have been previously assessed as minimal, and are to be managed as specified within relevant technical reports and as outlined within Section 7 of the EIS.

This assessment has taken into consideration the relevant materials, quantities and details as provided by GAIA for the Bonshaw Solar Farm. Compliance to the SEPP 33 by GAIA is dependent upon adhering to storage methods and procedures outlined in this assessment, and the relevant supporting Australian Standards aforementioned.

Based on the information provide and the assessment as outline in this report, the PHA determined that the risk arising from the dangerous goods stored and used onsite does not exceed the individual fatality or injury risk criteria specified in NSW DoP publications *HPAP No. 4 'Risk Criteria for Land Use Safety Planning'*.

It is recommended that management procedures be implemented that incorporate practices that will prevent the identified risk scenarios occurring through:

- Ensuring the quality of manufacturing of the batteries and associated equipment through identification of adherence to ISO 9001 and Australian Standards
- Ensuring the location of the BESS in the most appropriate location to minimise the risk of a bushfire event
- Verification of installation quality and operational values of BESS, related infrastructure and other infrastructure with potential hazards
- Minimising build-up of combustible materials on-site
- Installing bollards/protective barriers around key battery areas
- Inspection and maintenance schedules for the batteries, filters and associated equipment
- A bushfire management plan (developed in consultation with the local RFS district office), including access requirements and any hazards on the site. This would be reviewed annually through consultation with the local district office

It is important to note that any new equipment should have procedures developed for their safe operations. This is particularly important for the operation of any new fixed or mobile machinery to prevent injury to people.

Any changed to the assumptions in this report, or any introduction of new identifiable hazards (via new equipment or operational procedures), should result in a review of the PHA and updated as required.

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APPENDIX A QUALITATIVE RISK MATRIX TABLE

Appendix A – Qualitative Risk Matrix Table

			Likelihood			
			1 Extremely Unlikely	2 Very Unlikely	3 Unlikely	4 Likely
			Never heard of in the industry, not realistically expected to occur	Heard of in the industry, but not expected to occur	Could occur in the next 10 years	Could occur in the next year
Severity	4 Major	Fatality / Permanent Injury				
	3 Moderate	Severe injury / Lost time				
	2 Minor	Minor injury / Visit to Doctor				
	1 Insignificant	Slight injury / First aid				

Risk Acceptance Criteria

High	Unlikely to be tolerable - review if activity should proceed.
Medium	Tolerable, if so far as reasonably practicable
Low	Broadly acceptable

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APPENDIX B UPDATED TRAFFIC IMPACT ASSESSMENT



Proposed Solar Farm, Bruxner Highway, Bonshaw

ERM

Traffic Impact Assessment
and Management Plan
Updated Access

Final Report

26th March 2020

SECAsolution 

Solar Farm Project, Bonshaw NSW

Traffic Assessment Report- access update

Author: Sean Morgan

Client: ERM

Issue: Final/26.03.2020

Reference: P1302

26 March 2020

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1 Introduction

Seca Solution has been commissioned by Environmental Resources Management (ERM) Pty Ltd to review the traffic impacts associated with the construction and operational phase of a new Solar Farm development and to determine traffic management measures associated with the construction activities for the project. The project involves construction, operation and eventual decommissioning of a 200 megawatt (MW AC) solar farm located in Bonshaw, to the west of Tenterfield in NSW.

The traffic impact has been previously assessed by Seca Solution and has been reviewed by the Road Authority (Inverell Shire Council), the RMS (now Transport for NSW) and the Department of Planning, Industry and Environment. From this review, the access route has been altered in accordance with the Council and RMS comments and additional information provided to satisfy the requirements of these various stakeholders.

The following works and infrastructure would be required to support the construction and operation of the solar farm:

- Construction of a main access road for all access and egress for the Site
- Installation of Electrical infrastructure including:
 - A 132kV Substation including two transformers and associated 132kV switchgear.
 - Inverters to collect and convert DC to AC.
 - BESS/battery storage with up to 300 MW (AC);
 - Cabling and other electrical infrastructure (e.g. security systems).
 - A maintenance compound and buildings.
 - Fencing, landscaping and environmental works.
- Construct site access from the existing access road leading to the Dumaresq substation. A connecting road will join to the access road, connecting to the internal access road network at the north-western corner of the Project Site.
- installation of an overhead grid connection to Dumaresq Substation

The operational life of the solar farm is expected to be 30 years at which point the panels are either replaced and operations continue, or the infrastructure is removed, and the site is decommissioned and rehabilitated.

Construction of the site will take approximately 12 months.

Power generated by the facility will be transmitted via existing 330kV transmission lines, in an easement owned by TransGrid that traverses the Site.

As part of the development consent, and prior to work on site, a Construction Traffic Management Plan will need to be approved by the road authorities (Inverell Shire Council and Transport for NSW). The busiest period associated with the development with regards to traffic is during construction, with the operational phase of the project only requiring between 6-10 staff on site for the majority of the time. Seca Solution has prepared this Construction Traffic Management Plan (CTMP) for the project to ensure traffic issues can be safely and efficiently managed during the construction activities on site.

This CTMP has been developed for the construction activity for the project and the potential decommissioning element for the project, which may occur in 30 years' time. The potential decommissioning of the project site will require a similar level of activity, although will probably require less staff and would be completed over a shorter timeframe. The requirements and protocols for the decommission stage of the project will be as per the construction

phase, although it is acknowledged these may need to be reviewed and altered in 30 years to suit the road conditions at that time as well as the work requirements.

The site is located within the locality of Bonshaw, west of Tenterfield and is shown in Figure 1-1 and 1-2 to follow.

The site is currently arable land and has road frontage to the Bruxner Highway along its northern boundary.

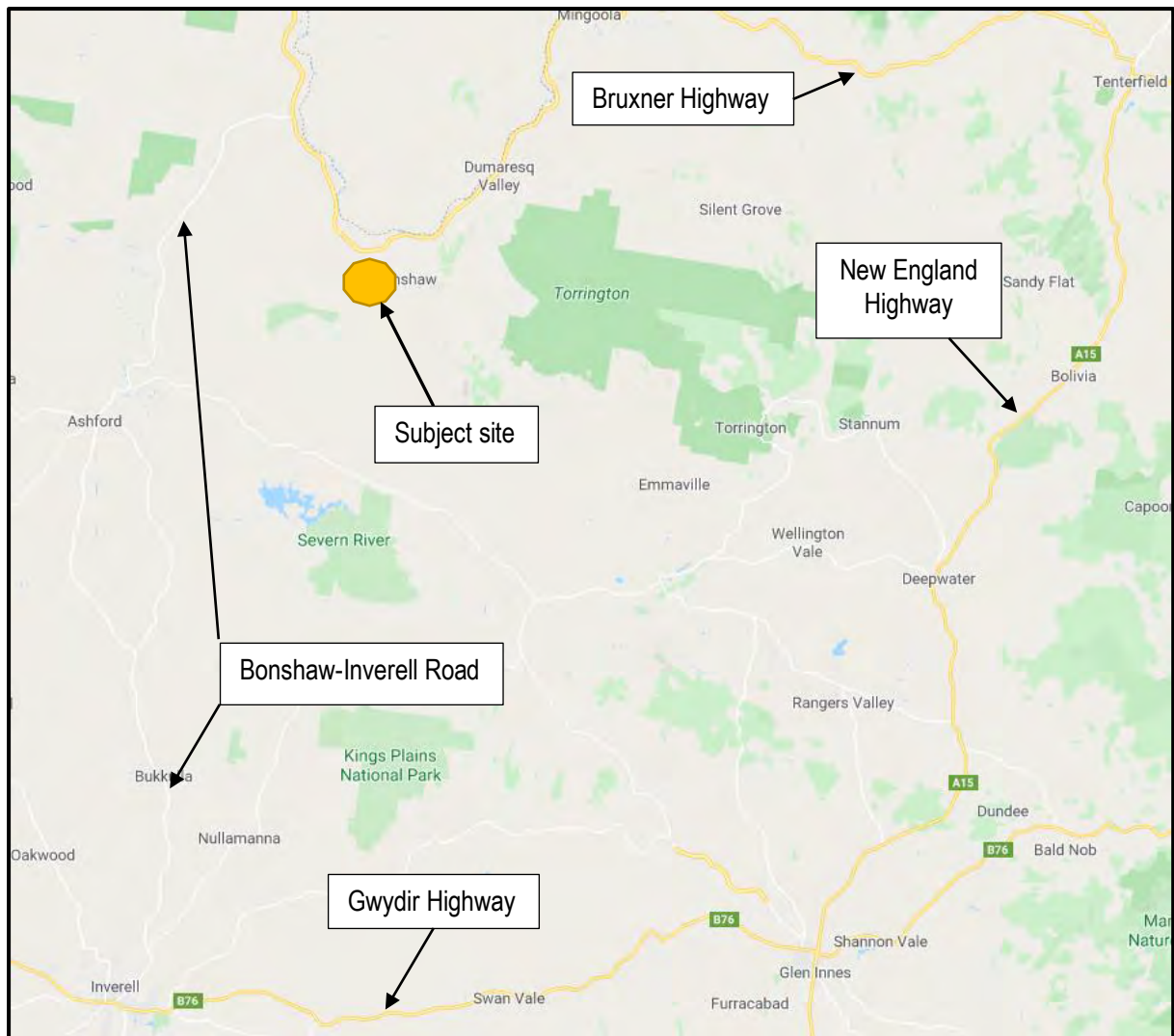


Figure 1-1: Site Location within the greater road network



Figure 1-2 – Location of Sunnyside Platform Road

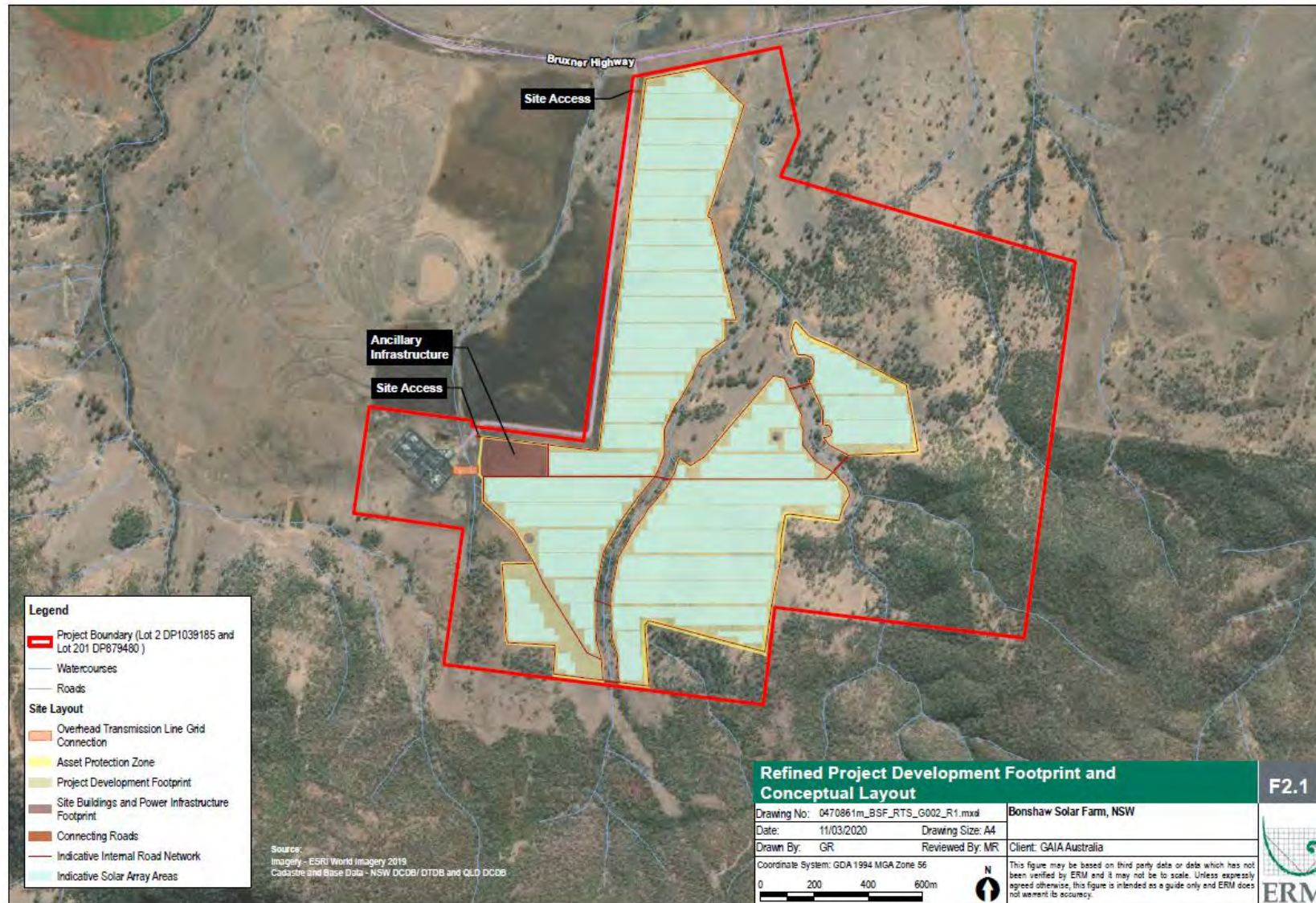


Figure 1-3 – Detailed site access and layout

1.1 Consultation and Authority Requirements

As part of the project, there has been consultation with the Department of Planning and Environment by the project manager and SEARs have been issued. A summary of the SEARs as they relate to traffic and access issues is presented below and the response is provided within this table.

SEARs issue	Response / Section of report
An assessment of the peak and average traffic generation including over-dimensional vehicle and construction worker transportation	<p>The volume of traffic has been assessed for both the construction and operational phase.</p> <p><i>Construction:</i> Peak staffing levels will require 65 light vehicles and 15 heavy vehicle inbound movements per day and similar outbound.</p> <p>For the sub-station installation there will be 3 over sized vehicles.</p> <p><i>Operational:</i> 10 light vehicles per day inbound and outbound. Infrequent heavy vehicle for specific maintenance work only</p> <p><i>Distribution:</i> Heavy vehicles via the designated heavy vehicle route to connect with the Bruxner Highway and New England Highway to east or west to Goondiwindi.</p> <p>Refer Section 2.3, 2.4 3.1.1</p>
An assessment of the likely transport impacts to the site access route (including Bruxner Highway, Glenrock Road and Rocky Creek Road), site access point, rail safety issues, any Crown Land, particularly in relation to capacity and condition of the road	<p>Heavy vehicles approaching the site will travel via the Bruxner Highway and New England Highway. For heavy vehicles exiting the site, they shall travel via the Bruxner Highway, then south through Ashford via Inverell – Bonshaw Road to Inverell then along the Gwydir Highway to the New England Highway at Glen Innes. No heavy vehicle access via Glenrock Road or Rocky Creek Road.</p> <p>Refer Section 3, Figure 3.1</p> <p>Existing traffic flows on New England Highway, Bruxner Highway and Gwydir Highway are low and well within acceptable limits. Minimal impact created by traffic during construction and operations.</p> <p>Refer Section 4.1</p>
A cumulative impact assessment of traffic from nearby developments (including cumulative impacts from Sundown Solar Farm, Sapphire Solar Farm and White Rock Solar Farm)	<p>Sundown Solar Farm located off Gwydir Highway and currently EIS being prepared. Limited interaction with the Bonshaw site on Bruxner Highway.</p> <p>Sapphire Solar Farm constructed and operational. Limited interaction with Bonshaw site on Bruxner Highway.</p> <p>White Rock Solar farm under construction. Limited interaction with Bonshaw site on Bruxner Highway.</p> <p>Refer Section 4.2</p>
A description of any proposed road upgrades developed in consultation with the relevant road authority and rail authorities (if required)	<p>Access provided on Bruxner Highway via the existing access to the electrical substation in this location. No road upgrades proposed as part of this development.</p>

A description of the measures that would be implemented to mitigate any transportation impacts during construction	<p>Map of route for heavy vehicles provided</p> <p>Refer Section 3 Figure 3.1.</p> <p>All drivers will sign code of conduct which specifies all road rules must be obeyed including driving through school zones - Refer Appendix B</p> <p>All staff and delivery drivers will be inducted to site and sign a driver code of conduct – Refer Appendix B</p> <p>The contractor on site shall establish a complaint handling process and resolution process.</p> <p>During construction activities nearby properties along the local haulage route on Bruxner Highway will be notified via a letter drop of construction work and timeframe – Refer Appendix A.</p>
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Transport for NSW consultation

Post exhibition of the project, discussion has been held with Greg Schiffe (GS) on 20th December 2019 from the RMS (now Transport for NSW) and the following points are noted:

- Agreed that the right turn out of Bruxner Highway onto the New England Highway is not suitable for the project. However, the left turn into this road is considered safe and appropriate. The right turn into the Bruxner Highway is also not considered appropriate for the project construction work;
- GS stated that the use of Sunnyside Platform Road is considered appropriate for the project, with this intersection providing a safe layout for vehicles including trucks turning right into Sunnyside Platform Road for access from the north.
- Accident data review is required for access between the site and the regional road network (being the New England Highway);
- If exit truck movements are to head south via Ashford to Inverell then this route needs to be reviewed and assessed for the impact of these trucks on this route
- Require clarification on the access location and GS indicated access via the existing access to the electric substation is the preferred option
- Require clarification on access routes for light and heavy vehicles. GS indicated that directing light vehicles to use the route via Ashford is not feasible due to the additional travel distance / time and directing light vehicles via Sunnyside Platform Road is appropriate.

RMS Consultation

Consultation has been held via a phone conversation with Andrew McIntyre, manager Land Use Assessment, Western Region (September 2017) with regard to a number of solar farms proposed to be constructed across rural NSW. The relevant outcome of the discussion with Andrew McIntyre is provided below:

- The critical phase for the assessment is the construction activities as this involves heavy vehicle access to the site along regional and local roads as well as a high number of workers;
- Consideration to the movement of staff to and from the site must be given. In remote areas where the solar farms are constructed, there are a large number of staff who can be drive in/drive out re-locating for temporary work from the established east coast centres such as Sydney and Newcastle. This requires staff to drive a long-distance home after working on the site for long hours for a week or more – consideration to controls for staff driving home after working on site should be considered;
- Provide details on the access routes to the site for heavy vehicles and the size / number of heavy vehicle movements associated with the construction and operation of the site;

- Provide details on the operational characteristics of the project – it is recognised that the staff levels and traffic volumes for the operational stage of the project are low;
- Provide comment with regard to the decommissioning stage of the project and the potential traffic impacts;
- Prepare a driver code of conduct for the project to control vehicle access and maintain safety;
- Assess impacts on road safety, including pedestrians and cyclists and any bus routes impacted
- Review alternative transport options for the site including pedestrians, cyclists and bus use
- Provide details on any road upgrades identified as part of the project and include a Road Safety Audit as required

2 Existing Road Network and Local Characteristics

The **Bruxner Highway** is a state classified road, which runs to the north of the subject site with an east-west orientation providing connection between the New England Highway to the east and Boggabilla to the west where it connects with the Newell Highway. The south, east and west boundaries of the subject lands are defined by neighbouring agricultural lots with some sections of unnamed, unsealed rural roads. The Bruxner Highway is sealed (refer Photo 1 below) and provides a width of approximately 6 metres passing the site allowing for 2-way traffic movements as required. It operates under the posted speed limit of 100 km/h.

The Bruxner Highway connects with the New England Highway to the east of the site at a four way give way controlled intersection with the New England being the priority road and Old Ballandean Road being the opposite minor road.



Photo 1 – View along Bruxner Highway in the vicinity of the project site

The **New England Highway** is a state classified road that is a key freight route in NSW and forms part of the road network designated by the Roads and Maritime to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 110 km/h outside of the urban areas where the alignment permits. As part of the state road network, the New England Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations. The **Cunningham Highway** operate in a similar manner providing key transport routes between Ipswich and the New England Highway at Warwick.

To the south of the site is the **Gwydir Highway**, which is a state classified road that is a key freight route in NSW and forms part of the road network designated by Transport for NSW to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 100 km/h outside of the urban areas where the alignment permits. As part of the state road network, the Gwydir Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations.

Bonshaw Road is a local road managed by Inverell Shire Council, located to the west of the site. It is a sealed two-way road with an overall width in the order of 7 metres. It intersects with the Bruxner Highway via a simple

give way controlled intersection with the Bruxner Highway being the priority road. This road continues south and connects with **Ashford Road** in Ashford to provide a road link through to Inverell. This route provides a consistent road standard and forms part of the approved B-double road network in NSW. Both of these road provide a single lane of travel in both directions and operate under the posted speed limit of 100 km/h.

Sunnyside Platform Road is a local road providing an approved B-double connection between the New England Highway and Bruxner Highway. It provides a pavement width in the order of 7 metres wide permitting 2-way traffic movements.

As part of the project, it is proposed that all heavy vehicles will travel via the roads identified above. Local supplies could be sourced from Goondiwindi or Tenterfield as well as accommodation for workers associated with the project.

2.1 Traffic Volumes and Road Operation

Traffic volumes in the immediate vicinity of the subject site are very low, reflective of the rural environment. The Bruxner Highway carries relatively low traffic flows, reflective of its rural setting with a mixture of local traffic as well as regional traffic demands. Observations on site during a typical morning period (Tuesday 11th September 2018) shows that the current road network in the vicinity of the subject site operates very well with no delays. The route proposed to be used for the project carries low traffic flows and operates with no delays except for those associated with drivers slowing down to observe traffic flows on the approaches to the various intersections and negotiating the intersections.

Transport for NSW webpage provides traffic data on the Bruxner Highway at Mingoola (station Id 91170), approximately 15 kms east of the subject site. The traffic data from 2011 shows that the daily traffic flow was 213 vehicles per day with around 23% heavy vehicles, reflective of rural demands in this location. It is considered that there has been limited growth in traffic since this time and as such the current daily traffic flows are considered to be similar.

The same web page shows that in 2011 the daily traffic flow on the New England Highway to the immediate north of Tenterfield (station Id 91577) was 2421. It is considered that there has been limited growth in this area since 2011 and as such the daily traffic flows would be similar. In 2012 the traffic flows on Bonshaw Road were 232 vehicles per day northbound. Assuming southbound flows to be the same would give daily flows in the order of 500 vehicles per day. It is considered that these flows would not have altered much since 2012.

For the Gwydir Highway, the same web page shows that the daily flows to the east of Inverell were 1,317 in 2019 whilst to the west of Glen Innes the flows on the Gwydir Highway in 2019 were 1,442.

2.2 Road Safety

It is recognised that as part of the project work, there will be a significant number of heavy vehicle movements associated with construction which may impact the local road network. All inbound heavy vehicle access to the project site will be via the Bruxner Highway and the New England Highway. For traffic from Goondiwindi, the route will be via the Newell Highway to town and along the Bruxner Highway. Inbound items such as the solar panels will be via the New England Highway (northbound from the Port of Newcastle) or via the Cunningham Highway connecting with the Port of Brisbane. No alternative route for inbound heavy delivery vehicles has been considered as this route is appropriate.

For outbound empty truck movements, movements to Goondiwindi would be the same, as would truck movements to the Brisbane area which shall use Sunnyside Platform Road to then turn left on the New England Highway. However, for trucks heading back towards Newcastle, the right turn out of the Bruxner Highway onto the New England Highway is not considered appropriate due to its poor visibility and intersection layout it represents a road safety risk for the project. As such, trucks wishing to head south towards Newcastle shall use the route via Inverell - Bonshaw Road to connect to Inverell and the Gwydir Highway. This is via the approved B-double road network and shall have an acceptable impact upon road safety.



Photo 2 – Sheltered turn lane for right turning vehicles into Sunnyside Platform Road from the New England Highway. Note straight alignment that allow for good visibility



Figure 2-1– aerial photo showing layout of New England Highway and Sunnyside Platform Road showing straight alignment of New England Highway and sheltered turn lane (source: google maps).

The major road safety impact is associated with the delivery trucks accessing the site and their impact upon the operation of the intersections. The trucks carrying the solar panels and other specialist materials will be accessing the site from either the Port of Newcastle or the Port at Brisbane, to which the solar panels shall be shipped. The trucks will then access Bonshaw via the regional road network which will include the New England Highway and the Cunningham Highway if from Brisbane. These regional roads currently provide a high standard of road and allow for the movement of local, regional and national road freight and carry B-double trucks. It is considered that the additional truck movements associated with the construction activities for the project will have a minimal and acceptable impact upon road safety along these roads.

For the sub-station installation there is a requirement for 3 over sized vehicles to access the site. These will require a separate approval and permit through the National Heavy Vehicle Regulator with Transport for NSW approval. Safety requirements and impacts are assessed as part of the permit application and the necessary safety controls applied which can include escort vehicles and Police vehicle support.

The nominated vehicle route currently caters for a large number of heavy vehicles including B-double combinations. This route provides a wide road pavement and in major built up areas cater for kerb side parking and the safe 2-way movement of trucks along the road. The intersections along this route are well laid out and provide good visibility in all directions to allow for the safe turning movements of vehicles. It is considered that this route through the various towns can safely accommodate the additional traffic movements associated with the project.

- Existing traffic flows on the local road are very low
- The sealed width of the road allows for two-way traffic movements
- The alignment of the road is generally good
- There are a number of sub-standard curves where there are advisory signs provided in advance with 55 and 65 km/h speed limit guidance signs
- A number of heavy vehicles were observed travelling along the Bruxner Highway during the site work, associated with local farm requirements as well as general deliveries in the area. These included semi-trailers.

[illegible]

Figure 2-2 – Designated Heavy Vehicle route to project site

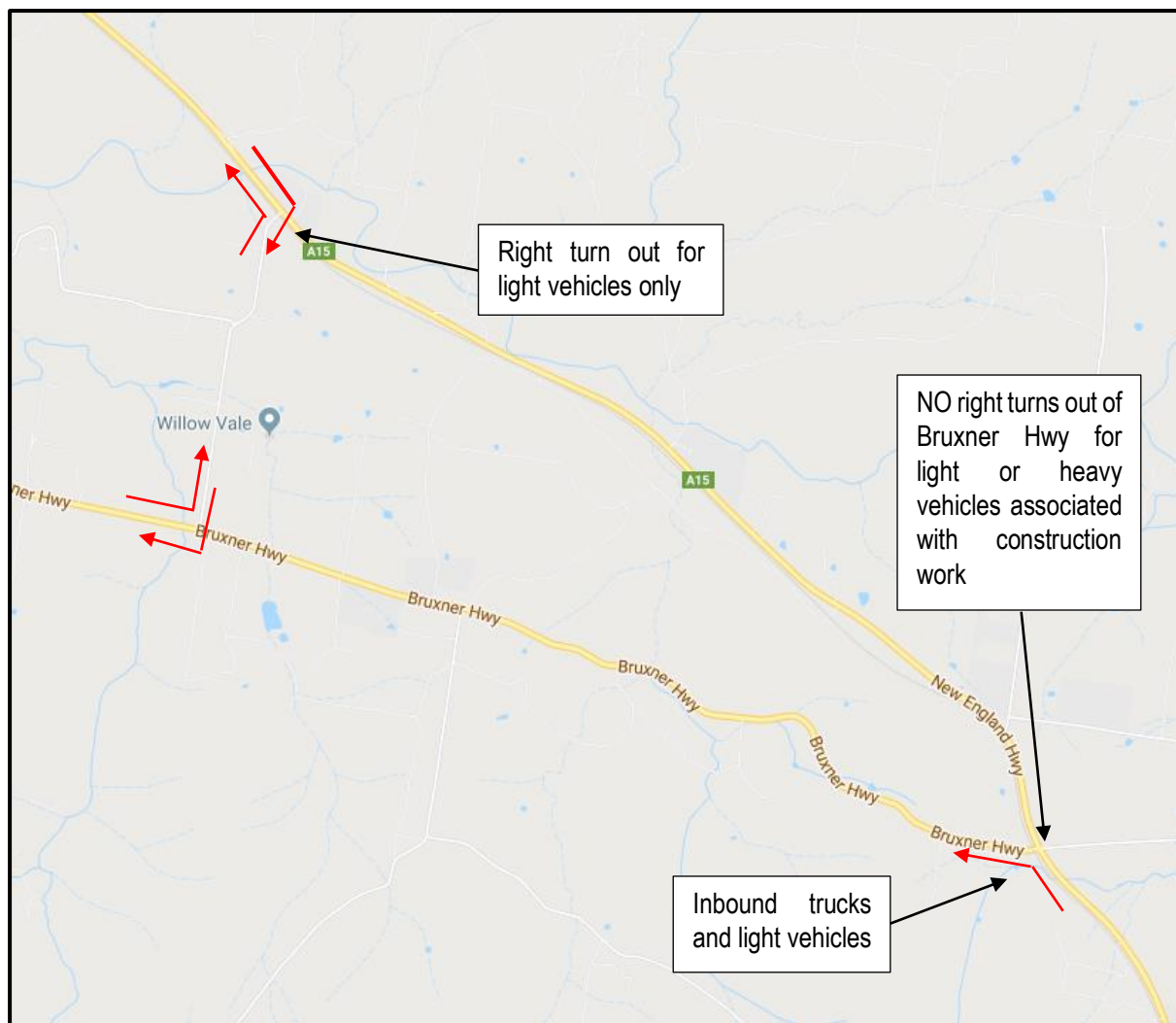


Figure 2-3 – Detail for truck connection from north between New England Highway and Bruxner Highway. Allows for inbound and outbound connection

2.2.1 Intersection of Bruxner Highway and New England Highway

The intersection of the Bruxner Highway and New England Highway is 4-way cross road with the New England Highway being the priority road. Give way signs delineate the controls for the side road. This intersection has been upgraded with new line marking that provides a sheltered right turn lane for traffic turning off the New England Highway into the Bruxner Highway from the north as well as a right turn lane for traffic from the south turning into Old Ballandean Road. It allows for all turning movements and as part of the main transport route in this area caters for the swept path of B-double combinations. This intersection is located within a posted speed zone of 100 km/h. The sight line requirements for drivers approaching the intersection have been assessed against the requirements of Austroads Guidelines. For the posted speed limit of 100 km/h the sight distance requirement is 248 metres. To the right, looking south this sight line is available for drivers. However, to the left (north) the sight line is restricted due to the vertical alignment of the road, which creates a safety concern. In addition, for a truck turning right out of this road onto the New England Highway, there is a single lane southbound which creates further safety concerns for the project. A truck turning right out of the Bruxner Highway could then be a hazard for a southbound vehicle leading to rear end accidents. In a 100 km/h speed zone this is not considered to be acceptable.

For the right turn into the Bruxner Highway off the New England Highway this visibility restriction also creates concerns with potential for rear end type accidents.



Photo 3 – View to left for a driver exiting the Bruxner Highway onto the New England Highway.



Photo 4 – View northbound on the New England Highway on approach to intersection with the Bruxner Highway. Note good forward visibility and dual lanes to allow a through vehicle movement to pass a left turning vehicle into the Bruxner Highway.

For all other movements at the intersection of the Bruxner Highway and the New England Highway the existing intersection controls are considered to be appropriate for the traffic movements associated with the project site. For traffic from the south on the New England Highway, the forward visibility is good allowing a driver to adjust their vehicle speed to cater for a vehicle in front turning left onto the Bruxner Highway. The traffic flows on the New England Highway in this location are relatively low and as such this will create minimal delays for other drivers.

With the proposed restrictions in turn movements for the construction traffic at this intersection, no upgrade works are required at this intersection to accommodate the traffic movements associated with the proposed solar farm (both construction and operation phase).

To mitigate the issue associated with the right turn out of the Bruxner Highway into the New England Highway, all trucks leaving the site wishing to head south shall instead turn left out of the site onto the Bruxner Highway, then turn left onto Bonshaw Road to head south to Ashford continuing south on Ashford Road to Inverell via the approved B-double route. These vehicles shall then travel along the Gwydir Highway to Glen Innes to connect to the New England Highway. This will eliminate right turn movements allowing for left turn movements only.

For all other intersections along the routes, the intersections are well laid out and provide good visibility for road users. As such these other routes, which are all approved for use by B-doubles, will provide a safe and appropriate route for heavy and light vehicles associated with the project site,

2.2.2 Site access on Bruxner Highway

The access to the site will be via the existing access provided to the electric substation adjacent to the subject site. This access was constructed to allow for the construction activities associated with the electric substation and is now used for maintenance purposes only for the substation.



Photo 5 View on Bruxner Highway showing layout of access connection to existing electric substation.

During the construction work, there will be some heavy vehicles arriving to the site from Goondiwindi, west of the site. These movements would be associated with the supply of equipment for the construction work. For traffic approaching from the west, the forward sight distance to the site access is approximately 700 metres. Austroads

Guidelines require a sight distance of 248 metres for the posted speed limit of 100 km/h and 300 metres for a speed limit of 110 km/h. With the forward sight distance available, a driver can adjust their vehicle speed if required on the approach to the site access if there is a vehicle propped waiting to turn right into the site. However, given the very low traffic flows on the Bruxner Highway, it is not considered that vehicles turning right into the site will need to prop on the highway with the only delays created by vehicles slowing down to negotiate the site access driveway. Safety will be maintained with a Traffic Control Plan to reduce vehicles speeds on the Bruxner Highway during this construction work with reduced vehicle speeds and truck turning advisory signs.

Trucks exiting the site will all turn left onto the Bruxner Highway. With the low traffic flows on the Bruxner Highway, this can safely occur as there are large gaps in the through traffic movements in this location. For trucks turning left out of the site, the sight distance available to the right (east) exceeds 700 metres allowing a driver to safely exit the site and travel along the highway. No left turn acceleration lane is required for this movement.



Photo 6 – View to right along Bruxner Highway for drivers exiting the project site



Photo 7 – view to left for vehicles exiting the access to the electric substation

2.3 Accident History

A review of accident data provided by TfNSW (Appendix C) for the period July 2014 to June 2019 has determined the vast majority of accidents along the proposed heavy vehicle route involved single vehicles (74%). Speeding was also determined as a contributing factor for over half of the accidents recorded, with the most common crash type being vehicles going off-road. In reviewing the data, it can be seen that speeding is a major factor in the number of accidents recorded. As discussed above the route and major intersections have been assessed on road, with no inherent road safety issue identified.

2.4 Mitigation Measures

From the details above the following mitigation measures are proposed.

- Provide a temporary TCP on the site frontage on the Bruxner Highway, adjacent to the site access, for construction work associated with upgrading the access and for traffic entering and exiting the site. This TCP shall only be in place during construction and signs shall be removed or covered outside of construction activities on the site. Once the construction work is complete this TCP shall be fully removed. This TCP will be prepared in accordance with “Traffic Control at work sites” published by the RMS dated July 2018. This TCP is provided in Appendix D to this report;
- Provide regular community updates for residents along the Bruxner Highway in the vicinity of the site to advise of construction activities and increased heavy vehicle movements along this road;

2.4.1 Light Vehicle Route

For light vehicles associated with workers, the proposed access route will be via the designated heavy vehicle route shown in Figure 2-1 above. This route provides a safe and acceptable route for light vehicles which can safely and conveniently access the site. For light vehicles leaving the site and heading towards Tenterfield or Glen Innes (via the New England Highway), these drivers will be required to turn left onto Sunnyside Platform Road and then turn right from this road onto the New England Highway, to avoid the existing safety concerns identified at the intersection of the Bruxner Highway and New England Highway. This shall be documented through the Driver Code of Conduct for the construction staff.

Light vehicle access could also be from Goondiwindi associated with construction workers via the Bruxner Highway.

The project will be utilising workers local to the site from the main centres e.g. Tenterfield, Goondiwindi, Inverell who will use this route as well as other local roads to connect between Inverell and the site. Additional specialist staff may be required, and these staff members would be located in accommodation in Tenterfield, Inverell and Goondiwindi.

3 Construction Activities

The construction and commissioning phase is expected to last approximately 12 months with expected commencement in late 2020. The main construction activities would include:

- **Site preparation:** geotechnical investigations to confirm ground conditions; site survey to confirm allotment boundary, riparian zone, and infrastructure positioning and placement; installation of fencing, internal access tracks, establishment of foundations and hardstands; office and car parking area;
- **Construction activities:** including installation of mounting structures and tracker tubes; securing PV modules to tracker tubes; installation of cabling and switching station, establishment of BESS / battery storage and maintenance compounds and associated site infrastructure; and testing and commissioning;
- **Plant and Equipment:** will include earthmoving plant and equipment for site preparation and clearing; cable trenching and laying equipment; pile drive equipment; forklifts and cranes; water truck for dust suppression and machinery equipment for construction of BESS / battery storage and associated facilities.

The project does not require any concrete footings to be provided for the solar panels construction.

A site office and compound will be established on site for the duration of the works with temporary access tracks provided to allow for access as required across the site.

Staffing levels at peak construction activities is expected to be 190 personnel on site maximum. The demand for staff numbers will be lower at the commencement of the project and shall increase overtime to the maximum of 190 staff. This demand is also expected to decrease towards the end of the project.

All staff vehicles will be able to park within the site adjacent to the site office with no external parking demands. The car park area will allow for up to 80 vehicles to park within this compound area. The size of the overall site footprint however will allow for all construction staff vehicles to park on site. As part of the project construction it is proposed to maximise the local workers content and car-pooling will be encouraged and supported as part of these trips. With 2 or 3 people arriving in a single vehicle it can be seen that the parking demands can be contained within the site.

The access to the site will be via the existing access constructed for the adjacent electric sub-station. This access road was previously used for the construction works associated with this substation and is now only used for access for maintenance work on the sub-station. With the vast majority of the heavy vehicles accessing the site from the east (via the New England Highway) it is proposed to provide a left turn deceleration lane for the site access to allow for a safe entry for the construction traffic. With limited demand for access from the west of the site, there is no requirements for a sheltered right turn lane to be provided at the access point.

3.1 Timing

The construction of the solar farm is expected to commence in 2020 and be completed within a 12 month timeframe.

3.2 Working Hours

Construction hours are in accordance with the *Interim Construction Noise Guidelines* (DECC 2009) (ICNG) with standard construction hours being

- 7:00am and 6:00pm Monday to Friday
- 8.00 AM to 1.00 PM on a Saturday

- No construction work is to be carried out on a Sunday or public holiday.

No construction work, upgrading or decommissioning activities will be undertaken outside of these hours with the exception of:

- The delivery of material as requested by the NSW Police Force to other authorities for safety reasons; or
- Emergency work to avoid the loss of life, property and / or material harm to the environment.

3.3 Construction staff numbers

Peak demand levels for the construction work will vary with a peak of 190 people for a 6 month duration and a lower level outside of this peak period. The staff will be sourced locally where appropriate with some specialist and project management staff being temporarily located in Tenterfield, Inverell and potentially Goondiwindi. Staff will be encouraged and supported to carpool as appropriate with other staff transferred to and from the site via mini coaches to reduce vehicle demands. Due to the size of the site footprint, these same vehicles will also be used on site to move staff across the site.

With a peak of 190 staff, a vehicle occupancy rate of 3 people per vehicle has been assumed based upon carpooling and the use of a mini bus e.g. Toyota Hiace. This would give around 65 vehicle movements inbound and outbound for staff movements during this peak construction activity. Either side of this peak the staff levels will be lower and hence light vehicle numbers will correspondingly decrease.

All light construction vehicles will be able to park on site within the office compound or across the site as required. The parking on site will be informal and located across the site to suit the construction work. Due to the overall footprint of the site the vehicles on site will be required to carry staff and equipment across the site to the construction activity area (which varies across the project) and as such the vehicles are not all parked in one location for the duration of the project.

Given the overall size of the project site all parking demands can be managed on site with no impact upon the external road network.

3.4 Heavy vehicle requirements

The number of heavy vehicles accessing the site will vary across the project timeframe. At the beginning of the project there will be a requirement for some earth moving equipment to construct the access road and some minor earthworks across the site as required. This may require a scraper or bulldozer which will be transported to site on a low loader. This machinery will remain on site for the duration of the earthworks portion of the project construction work.

While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the PV modules. Additionally, earthworks are required for trenching works.

In total:

- Approximately 15,000 m³ of gravel would be required to cap the access road
- Approximately 15,000 m³ of sand (subject to detailed design) would be required for the bedding of cables that are to be buried throughout the site

Should any excavated material not be suitable for reuse or additional fill material required, the maximum amount of fill is estimated to be 12,000 m³.

Once the earthworks have been completed, the balance of the construction work will commence requiring machinery including:

- Pile driver (20)
- Piling rig

- All terrain fork-lift (20)
- All terrain utility vehicles (10)
- Backhoe (10)
- Flatbed trucks (10)
- Mobile crane (1)

Other equipment if required may include an elevated work platform, scraper, roller and winches. All of the plant will be located on site and will therefore be only required to access the site once for the construction works.

The solar panels are expected to be delivered from either the Port of Newcastle or Port of Brisbane. Other specialist equipment is generally sourced from Newcastle or Brisbane as required whilst consumables such as concrete and general material supplies will be sourced locally from the Tenterfield area.

A summary of the expected vehicle movements associated with the construction work is provided below and shows the full movements for the duration of the project. These movements are spread out across the project, with the site set up and earthworks commencing at the beginning of the project. Once this work is complete, the balance of the construction work will commence with deliveries of the specialist equipment etc along with the import of backfill material being over a number of weeks to suit the construction timeframe.

These traffic numbers are based on the concept design work for the project and could alter through the detailed design phase of the project.

3.5 Vehicle movements

A summary of the vehicle movements is provided below.

Phase	Purpose	Vehicle Type / Trailer Type	No. of one-way vehicle movements
Site Set-Up and Demobilisation	Portacabin delivery and removal	Low loader	20
	Skip delivery and removal	Low loader	40
	Generator delivery and removal	Semi-trailer	4
	General deliveries	Semi-trailer	40
	Crane mobilization and demobilization	Crane	4
	Water tank delivery and removal		4
Roads and hardstands	Delivery of imported capping for road laydowns and crane hardstands	Truck and dog	500
	Plant delivery and removal: excavators, compactors drill rig	Low loader	40
	Concrete deliveries for maintenance container hardstands	Concrete agitator	120
Generating Equipment	Tool container delivery and removal	Low loader	4
	Module deliveries	Semi-trailer	2000
	Mounting structure and pile deliveries	Semi-trailer	1600
	Inverter Station deliveries	Low loader	3
	DC cabling trays and combiner boxes	Semi-trailer	400
AC Cable Installation	AC Cable delivery	Semi-trailer	400
	Backfill material delivery	Dump Truck	1800
Plant delivery and removal	Telescopic handler and excavator	Low loader	50
Overhead Line	Conductor delivery	Semi-trailer	25
	Pole deliveries	RAV	6
	Pole dressing delivery	Semi-trailer	2
Other	Miscellaneous deliveries	Light vehicle	40
	Monitoring equipment fibre SCADA servers etc	Truck	2
	Waste Collection	Truck	400
	Consumables (Oil and Fuel)	Truck	40
		TOTAL	7,544

In summary, typical vehicle movements during the peak construction period (over 6 months) are in the order of 65 light and 20 heavy vehicles two-way (65/20 inbound, 65/20 outbound) per day. For the light vehicles, the vast majority of these will be inbound movements in the morning bringing workers to the site with these vehicles then remaining on site for the full working day before leaving at the end of the working day. It is expected that there will be limited light vehicle movement outside of these periods, other than support staff e.g. office staff or the occasional visitor to the site.

For the heavy vehicles, these will typically be spread across the working day. For the solar panel deliveries, these trucks are arriving from either the Port of Brisbane or the Port of Newcastle and the journey length will be over 5 or 7 hours respectively, seeing a spread of these vehicles not all arriving at the same time. Allowing for each truck to be emptied on site one at a time, the outbound movements will also be spread out and not all leave at the same time. All other heavy vehicles will also be spread out across the normal working day with no concentration of heavy movements expected.

Outside of the peak period of construction, the staff levels will be lower and the daily light vehicle numbers will be less than 65 inbound and outbound per day. The heavy vehicle numbers will also be lower outside of the peak construction activity and less than 20 vehicles inbound and outbound per day.

The proposed traffic management measures allow for all access off the Bruxner Highway only. The access to be used will be for the construction traffic movements as well as the future on-site operational demands. This access is to be provided in accordance with the requirements for the site operations (including swept path requirements for delivery vehicles) and take into account the design requirements of Inverell Shire Council.

All vehicle movements in and out of the site are as shown below in Figure 4-1.

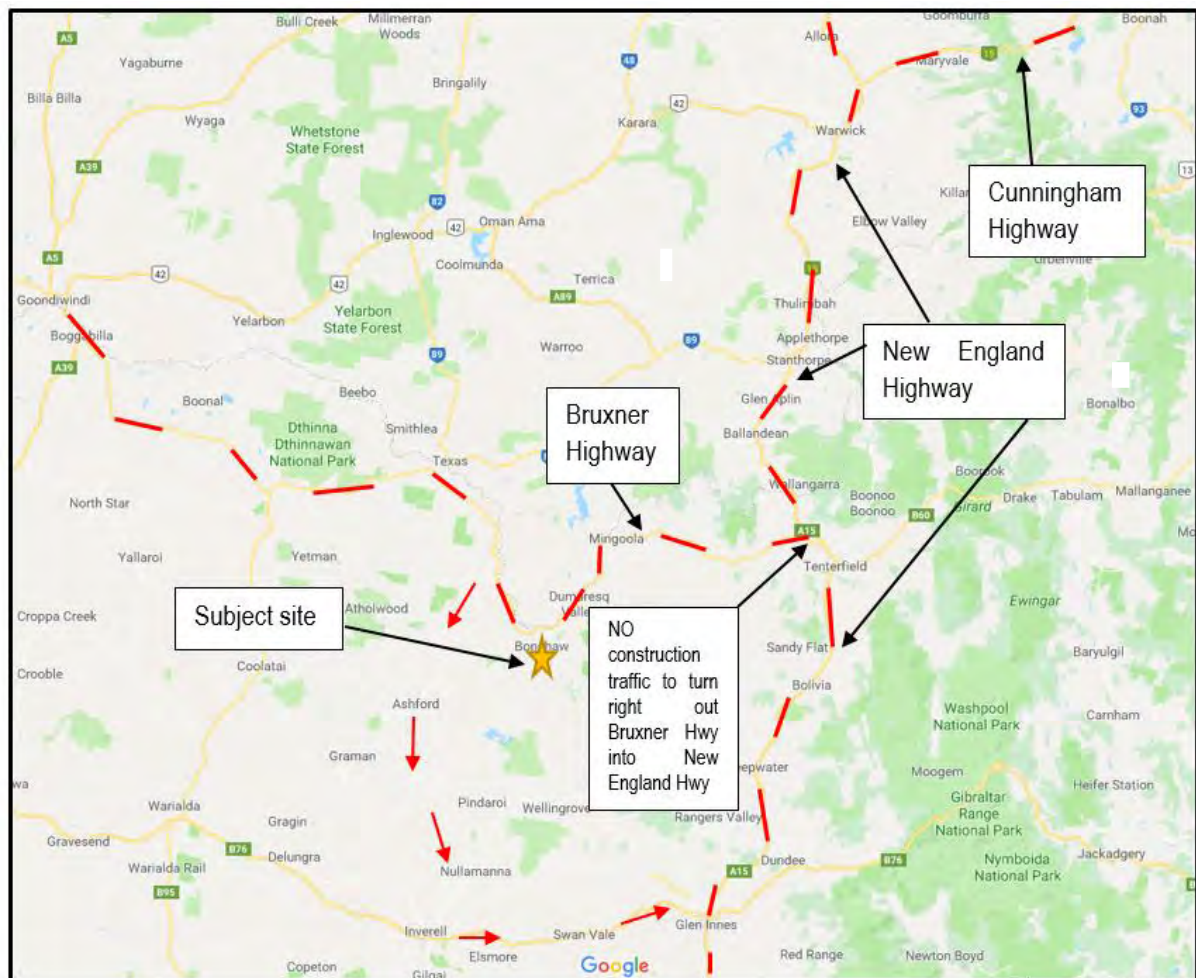


Figure 4-1 – Heavy and Light Vehicle access route to subject site



Figure 4-2 – detail for connection between New England Highway and Bruxner Highway

4.1 Impact Assessment

The project will require the delivery of the solar panels and other specialist equipment from Newcastle or Brisbane with the access route via:

- Newcastle metropolitan regional road network
- Hunter Expressway / New England Highway
- New England Highway to Bruxner Highway turn off
- Bruxner Highway to site access
- Bonshaw-Inverell Road
- Gwydir Highway
- Brisbane metropolitan regional road network
- Cunningham Highway
- New England Highway to Bruxner Highway.

These roads all form part of the road freight routes within the State road network and all are approved for heavy vehicle movements including B-double access for the full length of the routes. These routes will be documented as the Haulage Route for all delivery vehicles associated with haulage of the solar panels and other specialist materials for the project site.

These roads carry a high number of heavy vehicles, including B-doubles associated with local and regional agricultural demands. These agricultural demands are seasonal in nature and occur 24 hours a day often involving night travel and operations. There are a number of farms in the general locality of the project site as well as in the wider area that use these local and regional roads during these seasonally high demand periods. Due to the seasonal nature of this work and the requirement for quick turnaround of crop deliveries it is considered that it is not appropriate to limit truck movements for these farms. Similarly, it is considered that it is not appropriate to limit truck movements to and from the project site at these times as the traffic movements on the local roads will continue to remain low.

The roads proposed to be used for trucks accessing the site all currently accommodate the swept path requirements for B doubles to access the site. The site access on the Bruxner Highway was previously used for constructing the electric sub station on the site and accommodates the swept path movements of B doubles as well as Over Size Over Mass (OSOM) vehicles that were required as part of the construction for this electric substation.

For the regional road network e.g. New England Highway / Hunter Expressway, Bruxner Highway, Cunningham Highway the total traffic flows will remain well within acceptable limits and as such will continue to operate to a good level of service and accommodate all road users.

The traffic flows along the local roads giving access for the heavy and light vehicle movements associated with the project are currently very low based on-site observations. Therefore, during the peak construction period and peak staff / material demands, the additional 65 light vehicle movements associated with the staff movements and 20 daily truck movements (per direction) will have a minimal and acceptable impact upon the operation of these local roads during construction. Once operational, the traffic movements are much lower with a maximum of 10 staff on site per day and as such the impact will be negligible.

There is minimal background traffic growth in this location. Transport for NSW count data from the station located between Tenterfield and Glen Innes (Station I.D. DNDSTC) shows traffic flows of 2,201 in 2012 and 2,091 in 2019, with minor fluctuations up and down for the intervening years. Other counts along the regional road network show similar or lower increases in values. For the assessment of the future impacts in 10 years-time, it can be seen that the site at that time will be operational with 10 staff located on the site. The impact of these ten staff will be negligible on the local and regional road network.

The site is expected to be operational for more than 10 years so that the impact of the decommissioning of the site cannot be assessed in detail at this stage. The site could remain operational beyond 10 years and the impact will remain low beyond the 10 year design horizon.

There will be no public vehicle access within the work site during the construction works, with a fence provided at the commencement of the project along the entire site boundary. This fence will remain once the project is constructed for security purposes with a locked gate to be provided at the site access off the Bruxner Highway.

There will be no pedestrian access to the site for the general public. There are no pedestrian paths in the locality of the site nor expected demands in this remote rural area so there will be no impacts for pedestrians created by the project works.

There is a school bus that runs along the Bruxner Highway to Bonshaw in the morning with the return trip in the afternoon. There may be some deliveries occurring in the morning and afternoon during the school bus operation, depending on the stage of the construction work and travel requirements for the deliveries. All staff will be on site prior to the morning bus run and will depart site after the afternoon bus run. As such it is considered that there is very limited interaction with the school bus. On the regional and state road network all school zones will be delineated in accordance with RMS Guidelines with reduced speed limits in accordance with normal NSW road rules. All drivers associated with the project construction work will adhere to the road rules as applicable and will be advised of the school bus operation on the Bruxner Highway.

There will be no impact upon public transport services with no diversions required. There are no bus stops impacted upon by the proposal.

There will be minimal impact for emergency vehicles and heavy vehicles with no diversions required.

There will be minimal impact upon any other development within the locality of the site.

There will be minimal impact upon adjoining Council areas. Traffic routes in and out of the locality will be along the arterial road network which will experience minimal impacts due to the works.

There are no residential dwellings in the immediate locality of the site access that will be impacted upon by the project and construction work. There are a number of residences along the heavy and light vehicle access route. The residents along the Bruxner Highway will be notified in writing of the construction works and the activities as required.

Construction vehicle movement on internal roads could lead to dust generation. A water truck will be used for dust suppression to minimise the production of dust, with the amount of water spreading adjusted accordingly to respond to the conditions. Additionally, any significant deposits of dirt and other construction materials will be promptly removed from public roadways.

Post construction, the traffic numbers generated by the project are very low, with staffing levels varying daily with a maximum on-site workforce of 10 people on any one day. There will not be any need for regular heavy vehicle access to the site once the solar farm is operational except for the occasional heavy vehicle for emergency repairs or irregular maintenance.

4.2 Cumulative impacts

A search of the Major Projects Register on the DPE website was undertaken together with the requirements of the SEARs for the project. The following projects are in the council area that may add to cumulative impacts.

- Sundown Solar Farm
- Sapphire Solar Farm
- White Rock Solar Farm

Project	Cumulative construction Impacts	Cumulative operational Impacts
Sundown Solar Farm (EIS currently being prepared)	Site located off Gwydir Highway between Inverell and Glen Innes. No overlap with construction along Gwydir Highway. If constructed at same time cumulative impact along New England Highway. As a state highway there is adequate capacity to accommodate these vehicles movements.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.
Sapphire Solar Farm	Site located off Gwydir Highway and currently under constructed. This site will be fully constructed before the Bonshaw Solar Farm commences construction.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.
White Rocks Solar Farm	Construction complete.	Operational traffic would be expected to be less than 10 light vehicles per day in the morning and afternoon and no impact with traffic for Bonshaw Solar Farm site.

4.2.1 Delivery vehicles

The majority of the deliveries for the project will be via 19 metres semi-trailers and B-doubles. The access routes along the regional / state road network to the site are all along approved B double routes.

Delivery vehicles would be required throughout the project period. The travel time between the ports (Newcastle or Brisbane) and the site for the solar panels is approximately 5 to 7 hours and these deliveries will be spaced out over the construction period, to minimise the impact upon the road network and to reduce the need to store the panels on site. Other deliveries will include the metal structures for the solar panels, sand and gravel for the foundations and internal tracks and cabling. There will also be some deliveries of specialist equipment such as photovoltaic boxes or skids and delivery stations.

The trucks associated with the delivery of the supplies will all travel along the State and regional road network. There are a number of schools located along these routes, however all have marked school zones and speed limit restrictions as per State guidelines. As these routes are all on the State and regional road network it can be seen that heavy vehicles currently operate on these roads safely. It is considered that the additional truck movements associated with the construction work will result in no noticeable impact upon road safety adjacent to these schools.

There is no requirement to divert traffic as part of this construction work.

The substation will require 3 over sized vehicle deliveries to the site. These will require a separate approval and permit through the National Heavy Vehicle Regulator with RMS approval. Safety requirements and impacts are assessed as part of the permit application and the necessary safety controls applied which can include escort vehicles and Police vehicle support.

4.2.2 Construction staff movements

For the construction work, the staffing levels will peak at 190 on site and as part of the project, staff will be encouraged and supported to carpool as part of the Code of Conduct for the project and use mini buses provided to allow for shared trips to the site from shared accommodation in Tenterfield, Glen Innes and Goondiwindi. There could be 65 vehicles inbound in the morning associated with on-site staff and a similar number departing at the end of the working day. Either side of the peak demand for construction staff the light vehicle demands associated with staff movements will be less than 65 inbound and outbound per day.

The site is in a rural location well away from the local towns and as such it is considered that there will be no pedestrian or cyclists accessing the site in conjunction with staff movements.

The vehicle numbers associated with the construction work are relatively low and it is considered that the movement of vehicles in and out of the site for construction works can occur in a safe manner. No limitation on truck access times is considered appropriate for the project. Given the journey length between the port and the subject site, the vehicles as they are approaching the site will be spread out reducing the impact of the arrivals. With unloading of vehicles taking 30 minutes or more, trucks exiting the site will also be spread out.

4.3 Impacts on road pavement

A protocol will be provided for both undertaking dilapidation surveys and making any necessary repairs following construction to Bruxner Highway to within 200 metres to both sides of the site access. It is considered that there could be some impact here due to the turning movements and braking / accelerating of trucks. Beyond these limits it is considered that the impact on the state road will be minor and shall not impact upon the overall pavement construction.

With regards to any emergency repairs required within the above zone, the contractor on site would contact the relevant authorities and will ensure the road is safe. Repairs will be made in accordance with the relevant authority standard.

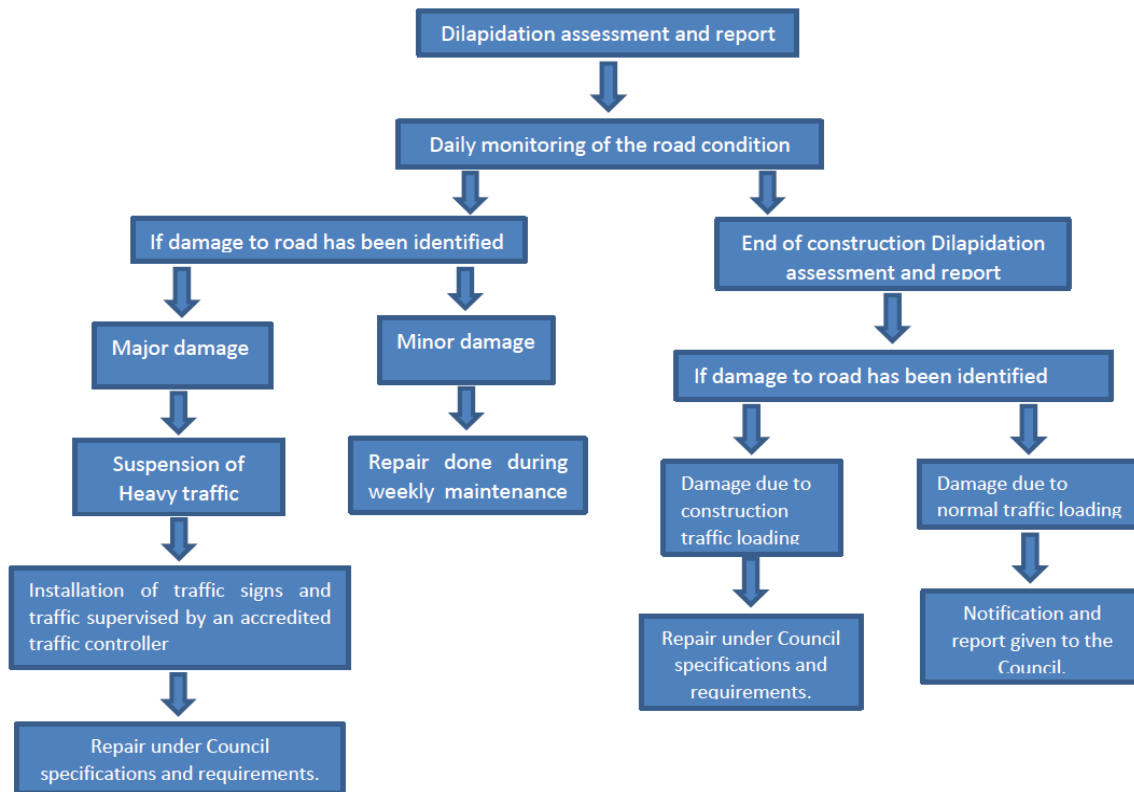


Figure 4-3 Dilapidation Assessment Protocol

5 Summary and Conclusion

The project allows for the construction of a solar farm in the locality of Bonshaw in northern NSW located off the Bruxner Highway. The construction work is planned to commence in late 2020 and will take approximately 12 months to construct. During construction there will be a requirement for a significant number of trucks to access the site for material delivery as well as light vehicles associated with construction staff. All vehicle access will be directly off the Bruxner Highway with the majority of deliveries expected to be via the New England Highway, with the solar equipment arriving via the Port of Newcastle or Port of Brisbane.

The trucks accessing the site will all travel along the regional and state road network, which currently carries heavy vehicle movements including B-doubles. The site is located in a rural setting and as such the hourly and daily traffic flows along the Bruxner Highway and the New England Highway in this location are relatively low. As such there is considerable spare capacity to cater for the additional traffic movements associated with the project construction stage. During peak construction activities, the project will generate 65 inbound light vehicle movements in the morning associated with the construction staff with a similar number of vehicles leaving the site in the late afternoon. At these peak activity times, the site will also generate approximately 20 trucks inbound and outbound per day, associated with the delivery of material and specialist equipment to the site. Outside of the peak construction activity the light and heavy vehicle movements will be lower per day.

Post construction, the operational traffic demands are very low with around 10 people working on the site. There will also be the requirement for occasional heavy vehicle movements, associated with on-going maintenance for the facility.

The access to the site will be via the existing access constructed for the adjacent electric sub-station. This access road was previously used for the construction works associated with this substation and is now only used for access for maintenance work on the sub-station. With the vast majority of the heavy vehicles accessing the site from the east (via the New England Highway) it is proposed to provide a left turn deceleration lane for the site access to allow for a safe entry for the construction traffic. With limited demand for access from the west of the site, there is no requirements for a sheltered right turn lane to be provided at the access point.

A review of the access route shows that the layout of the intersection of the Bruxner Highway and the New England Highway does not safely cater for the right turn out movement. The sight distance for this right run is restricted and the width of the New England Highway in this location does not allow for a run off area for vehicles. It is proposed that as part of the construction traffic management plan, southbound empty trucks leaving the site shall turn left onto the Bruxner Highway then proceed south via Bonshaw-Inverell Road to Inverell then along the Gwydir Highway to connect to the New England Highway via Glen Innes.

All access routes for the heavy vehicles associated with the delivery of materials to the site are approved for B-double use and carry B-doubles associated with local rural demands.

A Traffic Control Plan will be in place during construction work at the site access to ensure safety for road users and construction workers is managed in an appropriate manner. A Construction Traffic Management Plan has been prepared for the project (see below) to ensure that road safety is managed for all workers associated with the project as well as existing road users.

The overall conclusion for the project shows that the construction traffic can safely and efficiently access the site with minimal impact for existing road users. The management plan for the construction traffic access ensures that the trucks accessing the site shall have an acceptable impact on the road network and safety concerns at the intersection of the Bruxner Highway and the New England Highway are addressed through the drivers code of conduct. Once operational, the traffic demands are minimal and shall have little impact upon the local road network.

Appendix A. Safe Construction Activities

The contractor on site is responsible for the management of all traffic in connection with its activities and the construction works conducted on the site. The Contractor will provide all traffic management, safety warnings and signage including such persons as necessary to direct traffic, as required by AS 1742:2009 – Manual of uniform traffic control devices.

External traffic movements

The Contractor will:

Ensure traffic management controls are established, maintained and monitored to underpin the safety of workers, other personnel and the general public

Establish traffic management controls in consultation with relevant stakeholders

Ensure traffic management controls comply with regulatory and legislative requirements

Ensure traffic management controls comply with the contract

Ensure traffic management controls maintain the flow of traffic within the site and on surrounding public roads

Reinstate any areas affected by the temporary construction access requirements to their original condition

The primary drivers for determining the traffic management controls during the construction period are:

- Safety of personnel, the general public and construction workers
- Minimising impact (if any) on operations
- Contractual requirements (including site access)
- Road traffic authority and local government requirements
- OHS requirements in relation to the movement of all vehicular traffic and pedestrians either within or adjacent to sites
- Environmental management requirements
- The impact construction traffic has on the local community in the surrounding area, and
- The need to meet construction requirements (including any schedule and cost constraints)

The traffic management controls will be communicated to appropriate stakeholders which will include the local community in the site vicinity via a letter box drop.

The Contractor will ensure:

Any significant deposit of dirt and other materials caused by construction traffic and other operations (in relation to the works) will be promptly removed from existing public roadways

Suitable precautions are taken to ensure no rock is dislodged onto any roadway from construction vehicles

Construction plant and equipment do not park on or within the pavement or shoulders of any existing trafficked roadway

Construction vehicles (when loaded) comply with the mass, loading and access requirements of the road traffic authority

Construction traffic will cause the least possible obstruction to public and other traffic

Directional signage will be installed to direct construction traffic and warn other motorists of construction traffic.

This signage is positioned in accordance with the approved Traffic Control Plans.

All drivers will be provided with a copy of the access routes to and from the site as part of their induction for the project;

A Vehicle Movement Strategy has been developed to eliminate the impact on local roads arising from additional construction traffic (e.g. solar panel delivery vehicles). The Vehicle Movement Strategy directs all drivers to access the site from the Bruxner Highway to eliminate the impact on the local roads. There is no requirement to restrict the direction of flow and/or time of day for movements.

The Contractor will comply with any client or Road Traffic Authority signage requirements for traffic control. Where construction work is to be undertaken either on or adjacent to a public roadway that is open to traffic, the work must be undertaken in accordance with all regulatory and legislative requirements that govern the movement of vehicles and pedestrians on any public roadway.

Within the Worksite

All employees, subcontractors, suppliers and any other persons connected with the project must adhere to all such Statutory Requirements and comply with all lawful directions. Any breach of such requirements may result in disciplinary action of the persons concerned.

The maximum speed limits within the Worksite are:

- 40 kph on formed roads
- 20 kph during foggy/dusty conditions with headlights on
- 10 kph when passing pedestrians

The Contractor will manage access to and from the site by all employees, subcontractors, suppliers and any other persons connected with its activities and the works; and all occupants within the worksite and through each area of the site.

The Contractor shall provide for safe and continuous operation of normal pedestrian and vehicular traffic along all roads, pedestrian paths and vehicular access to the worksite and must provide and maintain all necessary watchmen, lights, barriers, notices and signs.

The Contractor will not unnecessarily obstruct any side road, branch track, drain or watercourse and will not break down or remove any fences or gates without prior notification to the client. If unavoidable, the Contractor will remove such obstruction or repair such breakage as soon as possible, or as directed by the Client.

A Vehicle and Traffic Management Procedures briefing will be included in the Project Site Induction.

Pedestrian Traffic

The Contractor may encounter pedestrian traffic at and near to the site. The Contractor will ensure that sites are appropriately isolated and secured from unauthorised entry; and that the Site is appropriately sign-posted and controlled. Given the location of the site it is considered that any pedestrian activity will be negligible.

Site Construction Traffic

Traffic within the Site will be managed in accordance with the Site Management Plan. The Sites Layout Plans will indicate site access and egress points and detail any required separation of construction plant and personnel. These plans will be communicated during Tool Box Meetings and/or Daily Pre-start Meetings.

The Site Layout Plan will incorporate details of parking arrangements for the site construction workers, speed limits within the construction works or through access roads established for vehicular and plant construction traffic.

The Sites Layout Plan will detail traffic management controls that are appropriate within each site.

Traffic controls shall be regularly reviewed for effectiveness and will be amended to maintain or improve a safe work environment. Traffic management controls established for sites will be inspected at ***weekly intervals*** to verify that a safe work environment is being maintained. Records of inspections shall be maintained.

Access Roads and Site Movement

Unless sign-posted otherwise, load limits on public roads adjoining the sites apply within them.

If required the Contractor shall request approval from the client prior to any over-dimensional load, or load in excess of load limits entering the site, or using the roads within the site.

All workers must travel to and from the site via the nominated access roads.

Parking

All workers must park in the Designated Parking Areas as specified in the Site Management Plan. The Contractor shall ensure no persons (in connection with its activities) parks in any other area of the site or in any other area without prior written consent.

Monitoring, Measurement and Review

The purpose of Monitoring and Measurement is to ensure that all construction works, including subcontracted activities, are being performed in accordance with the contract requirements, statutory requirement and in a controlled and safe environment. Ongoing monitoring and audit of Traffic Management procedures and the worksite implementation of traffic control shall be conducted.

Audits of the Traffic Control measures under differing operating conditions are to be carried out including during overcast and rainy weather, at night or at any other restrictive times where conditions may change in accordance with the requirements of AS1742.3.

Results of audits, inspections and improvements are to be reported in the reporting cycle of the contract to enable assessment of the adequacy of the implementation of the Traffic Control within contract performance and system review meetings.

Inspection and Auditing of Traffic Control Plan (TCP)

Regular Site Inspections by designated supervisory and field staff of worksite protection are to be arranged on a ***daily frequency*** depending on the complexity of traffic control on the site.

Site Inspections will be carried out and the following Traffic Management Forms completed:

- Traffic Control Daily Checklist
- Traffic Control Weekly Checklist

A daily record of the inspections should be kept. This should include:

- When traffic controls were erected
- When changes to controls occurred and why the changes were undertaken
- Any significant incidents or observations associated with the traffic controls and their impacts on road users or adjacent properties
- Where significant changes to the work or traffic environment or adverse impacts are observed, the controls should be reviewed as a matter of urgency.

The monitoring program should generally incorporate inspections:

- Before the start of work activities on site
- During the hours of work
- Closing down at the end of the shift period

The inspection program shall be adjusted to suit changing circumstances and/or risk environment such as during times of increased traffic flows or speeds, contra-flow arrangements or when changed controls are introduced.

The Audits of the implemented Traffic Management features will be undertaken following setup in accordance with the TCP and prior to the TCP being put into service.

Appendix B. Drivers Code of Conduct

1.1 General Requirements

All vehicles / drivers accessing the site must:

- i) Be registered and hold a valid driver's licence for the class of vehicle being operated;
- ii) Operate the vehicle in a safe and appropriate manner whilst travelling to / from the site or when operating within the site. This includes obeying all New South Wales state road rules.
- iii) ALL heavy vehicles must adhere to the designated heavy vehicle routes as far as practical;
- iv) NO trucks shall turn right from the Bruxner Highway onto the New England Highway.
- v) ALL trucks heading south shall turn left out of the site then proceed via Bonshaw-Inverell Road to Inverell then travel along the Gwydir Highway to Glen Inness to connect with the New England Highway.
- vi) Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads.
- vii) Not use a mobile phone while operating any vehicle.
- viii) Must always wear a seatbelt when operating any vehicle.

1.2 Vehicle Speeds

Drivers shall observe the posted speed limit along the designated transport route and adjust their vehicle speed as required to suit the road environment and prevailing weather conditions. Vehicle speeds must be appropriate to ensure the safe movements of the vehicle with consideration to the vehicle configuration.

Maximum speeds limits within the project site shall be as follows:

- i) 40 km/hr along formed roads.
- ii) 20 km/hr during foggy / dusty conditions. Headlights must be on.
- iii) 10 km/hr when passing pedestrians or any plant equipment.

1.3 Driver Fatigue

Drivers shall not be permitted to operate a vehicle or plant equipment when impaired by fatigue. If you suspect that you or someone else is experiencing fatigue, please inform your supervisor.

Operators of heavy vehicles shall be aware of the requirements relating to fatigue as outlined in the Heavy Vehicle National Law. Drivers shall also be aware of their adopted fatigue management scheme (shown below) and ensure that they are operating within its requirements.

- i) Standard Hours of Operation
- ii) Basic Fatigue Management (BFM)
- iii) Advanced Fatigue Management (AFM)

Basic Fatigue Management (single driver)

Time	Work	Rest
In any period of...	A driver must not work for more than a maximum of...	And must have the rest of that period off work with at least a minimum rest break of...
6 ¼ hours	6 hours work time	15 continuous minutes rest time
9 hours	8 1/2 hours work time	30 minutes rest time in blocks of 15 continuous minutes
12 hours	11 hours work time	60 minutes rest time in blocks of 15 continuous minutes
24 hours	14 hours work time	7 continuous hours stationary rest time*
7 days	36 hours long/night work time**	No limit has been set
14 days	144 hours work time	24 continuous hours stationary rest time taken after no more than 84 hours work time and 24 continuous hours stationary rest time and 2 x night rest breaks# and 2 x night rest breaks taken on consecutive days.

Advanced Fatigue management:

The seven principles are grouped into three categories:

Work-related rest breaks (such as short rest breaks):

1. Reduce the time spent continuously working in the work opportunity
2. The more frequent breaks from driving, the better

Recovery breaks (such as major rest breaks):

1. Ensure an adequate sleep opportunity in order to obtain sufficient sleep
2. Maximise adequate night sleep
3. Minimise shifts ending between 00:00-06:00
4. Minimise extended shifts

Reset breaks (such as long periods of rest or extended leave):

1. Prevent accumulation of fatigue with reset breaks of at least 30hrs (and include two night periods, 00:00 – 06:00) between work sequences

ALL details relating to fatigue management for delivery vehicles are covered by the National Heavy Vehicle Regulator

1.4 Operating Hours

Construction

Construction is to be completed in accordance with the *Interim Construction Noise Guideline* (DECC 2009) which defined standard construction work hours as:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public holidays: No work

The following construction, upgrading and decommissioning activities may be undertaken outside these hours without the approval of the secretary:

- The delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or
- Emergency work to avoid loss of life, property and / or material harm to the environment.

Vehicle movements shall be undertaken during standard construction hours (or just before to allow workers to get to site). Oversize vehicles up to 26 metres long may require access to the site after hours however this would be subject to the requirements of Roads and Maritime, Dubbo Regional Council or NSW Police.

Normal Operations

Daily operations and maintenance by site staff would be undertaken during standard working hours:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public holidays: No work

During normal operations, all vehicle movements shall be undertaken during the standard operating hours (or just before to allow workers to get to site). There may be a requirement for vehicles to access the site after hours during an emergency however these would be infrequent.

Vehicles which arrive at the site prior to commencement of working hours shall have the engine turned off to minimise noise impacts on surrounding residences.

1.5 Transport Routes

All vehicles must travel to and from the project site via the route as shown below (Figure 1).

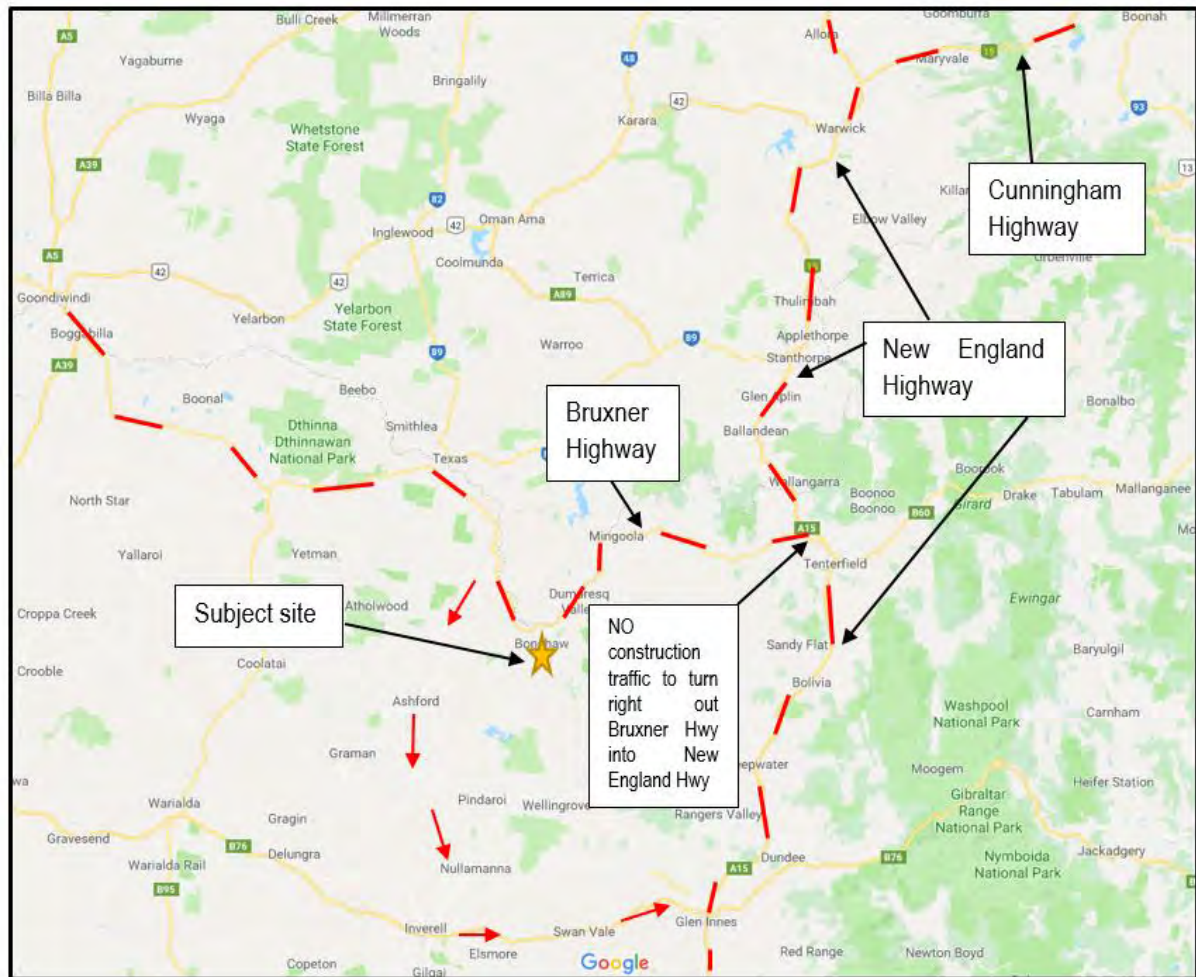


Figure 1 - Transport route to/from the site for ALL 19 m semi-trailers or greater



Figure 2 - Transport route to/from the site for ALL 19 m semi-trailers or greater (detail for northbound via New England Highway to use Sunnyside Platform Road)

1.6 Vehicle Departure and Arrival

Heavy vehicles departing the site shall have a minimum 5 minute separation to reduce the impacts upon the local road network.

Always maintain a minimum separation of at least 50 metres between vehicles when travelling within the site.

Drivers must contact the site supervisor upon arrival and await further instructions or direction before proceeding.

Drivers must also report to the site supervisor prior to departure.

All vehicles must enter and exit the site in a forward direction. Vehicles are to have clean tyres upon exiting the site to prevent dirt being tracked onto the public road network.

ALL 19 metres semi-trailer or greater must turn left out of the site and proceed via Bonshaw-Inverell Road to Inverell then via the Gwydir Highway to Glen Innes and the New England Highway when heading south.

1.7 Overtaking

Overtaking shall not be permitted within the site unless the intention to overtake has been communicated to the driver of the leading vehicle and consent to overtake granted.

1.8 Breakdowns and Incidents

Heavy Vehicles

In the case of a breakdown, the vehicle must be towed to the nearest breakdown point as soon as possible. All breakdowns must be reported to Transport for NSW Transport Management Centre on 131 700 and the vehicle protected in accordance with the Heavy Vehicle Drivers Handbook. The relevant shift manager on site shall also be notified.

If a breakdown occurs on-site please remain inside your vehicle, notify the shift manager of your location and await further instruction.

If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.

Light Vehicles

In the case of a breakdown, ensure that the vehicle is secure, notify the shift manager of your location and await further instruction.

If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.

1.9 Penalties and Disciplinary Action

Any driver who fails to comply with the above requirements will have their details recorded and may be subject to disciplinary action.

1.10 Emergency Contact Numbers

i)	RMS Transport Management Centre	131 700
ii)	Queensland Traffic	131 940
iii)	Inverell Shire Council	(02) 6728 8288
iv)	NSW Police Service	(02) 6722 0599
v)	Site Office	_____
vi)	Shift Manager on Duty	_____

1.11 Driver Declaration

I, the undersigned, hereby agree to abide by this Driver Code of Conduct for the transport of equipment or personnel to / from the Bonshaw Solar Farm, located off Bruxner Highway in the general locality of Bonshaw, NSW. I have read and understand the requirements outlined in the attached document and will, to the best of my ability, comply and assist with their implementation, requirements or ongoing administration.

The subject document to which this declaration relates is included as part of this overall document and signing of this declaration confirms that the signee has read and understood their requirements as outlined throughout.

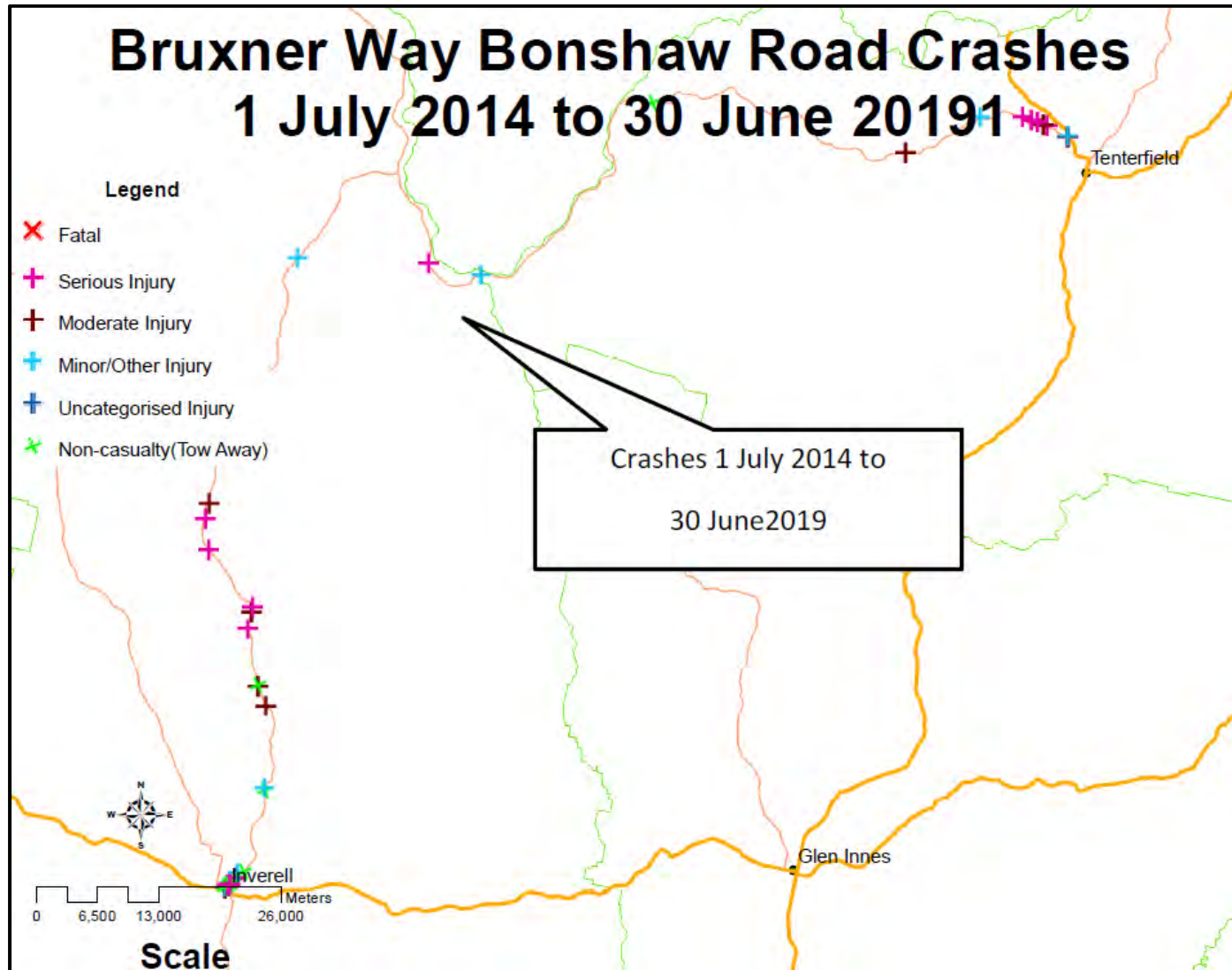
Driver Details


Full Name	
Organisation	
Signature	
Date	

Representative of:

Full Name	
Signature	
Date	

Appendix C. Accident Data





NSW

GOVERNMENT

Transport

for NSW

Centre for Road Safety

Summary Crash Report

<div># Crash Type</div> <table> <tr><td>Car Crash</td><td>24</td><td>57.1%</td></tr> <tr><td>Light Truck Crash</td><td>9</td><td>21.4%</td></tr> <tr><td>Rigid Truck Crash</td><td>2</td><td>4.8%</td></tr> <tr><td>Articulated Truck Crash</td><td>4</td><td>9.5%</td></tr> <tr><td>Heavy Truck Crash</td><td>(6)</td><td>(14.3%)</td></tr> <tr><td>Bus Crash</td><td>0</td><td>0.0%</td></tr> <tr><td>Heavy Vehicle Crash</td><td>(6)</td><td>(14.3%)</td></tr> <tr><td>Emergency Vehicle Crash</td><td>0</td><td>0.0%</td></tr> <tr><td>Motorcycle Crash</td><td>7</td><td>16.7%</td></tr> <tr><td>Pedal Cycle Crash</td><td>1</td><td>2.4%</td></tr> <tr><td>Pedestrian Crash</td><td>1</td><td>2.4%</td></tr> </table> <div> <div>* Rigid or Artic. Truck * Heavy Truck or Heavy Bus</div> <div># These categories are NOT mutually exclusive</div> </div> <div> <div>Location Type</div> <table> <tr><td>Intersection</td><td>13</td><td>31.0%</td></tr> <tr><td>Non intersection</td><td>29</td><td>69.0%</td></tr> </table> <div>* Up to 10 metres from an intersection</div> </div> <div> <div>Collision Type</div> <table> <tr><td>Single Vehicle</td><td>31</td><td>73.8%</td></tr> <tr><td>Multi Vehicle</td><td>11</td><td>26.2%</td></tr> </table> </div> <div> <div>Road Classification</div> <table> <tr><td>Freeway/Motorway</td><td>0</td><td>0.0%</td></tr> <tr><td>State Highway</td><td>3</td><td>7.1%</td></tr> <tr><td>Other Classified Road</td><td>37</td><td>88.1%</td></tr> <tr><td>Unclassified Road</td><td>2</td><td>4.8%</td></tr> </table> </div>	Car Crash	24	57.1%	Light Truck Crash	9	21.4%	Rigid Truck Crash	2	4.8%	Articulated Truck Crash	4	9.5%	Heavy Truck Crash	(6)	(14.3%)	Bus Crash	0	0.0%	Heavy Vehicle Crash	(6)	(14.3%)	Emergency Vehicle Crash	0	0.0%	Motorcycle Crash	7	16.7%	Pedal Cycle Crash	1	2.4%	Pedestrian Crash	1	2.4%	Intersection	13	31.0%	Non intersection	29	69.0%	Single Vehicle	31	73.8%	Multi Vehicle	11	26.2%	Freeway/Motorway	0	0.0%	State Highway	3	7.1%	Other Classified Road	37	88.1%	Unclassified Road	2	4.8%	<div>Contributing Factors</div> <table> <tr><td>Speeding</td><td>22</td><td>52.4%</td></tr> <tr><td>Fatigue</td><td>6</td><td>14.3%</td></tr> </table> <div>Weather</div> <table> <tr><td>Fine</td><td>36</td><td>85.7%</td></tr> <tr><td>Rain</td><td>4</td><td>9.5%</td></tr> <tr><td>Overcast</td><td>2</td><td>4.8%</td></tr> <tr><td>Fog or mist</td><td>0</td><td>0.0%</td></tr> <tr><td>Other</td><td>0</td><td>0.0%</td></tr> </table> <div>Road Surface Condition</div> <table> <tr><td>Wet</td><td>8</td><td>19.0%</td></tr> <tr><td>Dry</td><td>34</td><td>81.0%</td></tr> <tr><td>Snow or ice</td><td>0</td><td>0.0%</td></tr> </table> <div>Natural Lighting</div> <table> <tr><td>Dawn</td><td>2</td><td>4.8%</td></tr> <tr><td>Daylight</td><td>32</td><td>76.2%</td></tr> <tr><td>Dusk</td><td>4</td><td>9.5%</td></tr> <tr><td>Darkness</td><td>4</td><td>9.5%</td></tr> </table>	Speeding	22	52.4%	Fatigue	6	14.3%	Fine	36	85.7%	Rain	4	9.5%	Overcast	2	4.8%	Fog or mist	0	0.0%	Other	0	0.0%	Wet	8	19.0%	Dry	34	81.0%	Snow or ice	0	0.0%	Dawn	2	4.8%	Daylight	32	76.2%	Dusk	4	9.5%	Darkness	4	9.5%	<div>Crash Movement</div> <table> <tr><td>Intersection, adjacent approaches</td><td>1</td><td>2.4%</td></tr> <tr><td>Head-on (not overtaking)</td><td>2</td><td>4.8%</td></tr> <tr><td>Opposing vehicles; turning</td><td>0</td><td>0.0%</td></tr> <tr><td>U-turn</td><td>1</td><td>2.4%</td></tr> <tr><td>Rear-end</td><td>3</td><td>7.1%</td></tr> <tr><td>Lane change</td><td>0</td><td>0.0%</td></tr> <tr><td>Parallel lanes; turning</td><td>0</td><td>0.0%</td></tr> <tr><td>Vehicle leaving driveway</td><td>1</td><td>2.4%</td></tr> <tr><td>Overtaking; same direction</td><td>1</td><td>2.4%</td></tr> <tr><td>Hit parked vehicle</td><td>0</td><td>0.0%</td></tr> <tr><td>Hit railway train</td><td>0</td><td>0.0%</td></tr> <tr><td>Hit pedestrian</td><td>1</td><td>2.4%</td></tr> <tr><td>Permanent obstruction on road</td><td>0</td><td>0.0%</td></tr> <tr><td>Hit animal</td><td>1</td><td>2.4%</td></tr> <tr><td>Off road, on straight</td><td>2</td><td>4.8%</td></tr> <tr><td>Off road on straight, hit object</td><td>6</td><td>14.3%</td></tr> <tr><td>Out of control on straight</td><td>0</td><td>0.0%</td></tr> <tr><td>Off road, on curve</td><td>6</td><td>14.3%</td></tr> <tr><td>Off road on curve, hit object</td><td>11</td><td>26.2%</td></tr> <tr><td>Out of control on curve</td><td>2</td><td>4.8%</td></tr> <tr><td>Other crash type</td><td>4</td><td>9.5%</td></tr> </table> <div>Speed Limit</div> <table> <tr><td>40 km/h or less</td><td>4</td><td>9.5%</td><td>80 km/h zone</td><td>4</td><td>9.5%</td></tr> <tr><td>50 km/h zone</td><td>1</td><td>2.4%</td><td>90 km/h zone</td><td>0</td><td>0.0%</td></tr> <tr><td>60 km/h zone</td><td>11</td><td>26.2%</td><td>100 km/h zone</td><td>22</td><td>52.4%</td></tr> <tr><td>70 km/h zone</td><td>0</td><td>0.0%</td><td>110 km/h zone</td><td>0</td><td>0.0%</td></tr> </table>	Intersection, adjacent approaches	1	2.4%	Head-on (not overtaking)	2	4.8%	Opposing vehicles; turning	0	0.0%	U-turn	1	2.4%	Rear-end	3	7.1%	Lane change	0	0.0%	Parallel lanes; turning	0	0.0%	Vehicle leaving driveway	1	2.4%	Overtaking; same direction	1	2.4%	Hit parked vehicle	0	0.0%	Hit railway train	0	0.0%	Hit pedestrian	1	2.4%	Permanent obstruction on road	0	0.0%	Hit animal	1	2.4%	Off road, on straight	2	4.8%	Off road on straight, hit object	6	14.3%	Out of control on straight	0	0.0%	Off road, on curve	6	14.3%	Off road on curve, hit object	11	26.2%	Out of control on curve	2	4.8%	Other crash type	4	9.5%	40 km/h or less	4	9.5%	80 km/h zone	4	9.5%	50 km/h zone	1	2.4%	90 km/h zone	0	0.0%	60 km/h zone	11	26.2%	100 km/h zone	22	52.4%	70 km/h zone	0	0.0%	110 km/h zone	0	0.0%	<div>CRASHES 42</div> <table> <tr><td>Fatal</td><td>0</td><td>0.0%</td></tr> <tr><td>Serious inj.</td><td>14</td><td>33.3%</td></tr> <tr><td>Moderate inj.</td><td>10</td><td>23.8%</td></tr> <tr><td>Minor/Other inj.</td><td>7</td><td>16.7%</td></tr> <tr><td>Uncategorised inj.</td><td>0</td><td>0.0%</td></tr> <tr><td>Non-casualty</td><td>11</td><td>26.2%</td></tr> </table> <div>Self Reported Crash 8 19.05%</div> <div>Time Group % of Day</div> <table> <tr><td>00:01 - 02:59</td><td>1</td><td>2.4%</td><td>12.5%</td></tr> <tr><td>03:00 - 04:59</td><td>1</td><td>2.4%</td><td>8.3%</td></tr> <tr><td>05:00 - 05:59</td><td>1</td><td>2.4%</td><td>4.2%</td></tr> <tr><td>06:00 - 06:59</td><td>0</td><td>0.0%</td><td>4.2%</td></tr> <tr><td>07:00 - 07:59</td><td>1</td><td>2.4%</td><td>4.2%</td></tr> <tr><td>08:00 - 08:59</td><td>1</td><td>2.4%</td><td>4.2%</td></tr> <tr><td>09:00 - 09:59</td><td>4</td><td>9.5%</td><td>4.2%</td></tr> <tr><td>10:00 - 10:59</td><td>3</td><td>7.1%</td><td>4.2%</td></tr> <tr><td>11:00 - 11:59</td><td>3</td><td>7.1%</td><td>4.2%</td></tr> <tr><td>12:00 - 12:59</td><td>3</td><td>7.1%</td><td>4.2%</td></tr> <tr><td>13:00 - 13:59</td><td>2</td><td>4.8%</td><td>4.2%</td></tr> <tr><td>14:00 - 14:59</td><td>2</td><td>4.8%</td><td>4.2%</td></tr> <tr><td>15:00 - 15:59</td><td>4</td><td>9.5%</td><td>4.2%</td></tr> <tr><td>16:00 - 16:59</td><td>6</td><td>14.3%</td><td>4.2%</td></tr> <tr><td>17:00 - 17:59</td><td>2</td><td>4.8%</td><td>4.2%</td></tr> <tr><td>18:00 - 18:59</td><td>1</td><td>2.4%</td><td>4.2%</td></tr> <tr><td>19:00 - 19:59</td><td>4</td><td>9.5%</td><td>4.2%</td></tr> <tr><td>20:00 - 21:59</td><td>3</td><td>7.1%</td><td>8.3%</td></tr> <tr><td>22:00 - 24:00</td><td>0</td><td>0.0%</td><td>8.3%</td></tr> </table> <div>Street Lighting Off/Nil % of Dark</div> <table> <tr><td>3</td><td>of</td><td>4</td><td>in Dark</td><td>75.0%</td></tr> </table>	Fatal	0	0.0%	Serious inj.	14	33.3%	Moderate inj.	10	23.8%	Minor/Other inj.	7	16.7%	Uncategorised inj.	0	0.0%	Non-casualty	11	26.2%	00:01 - 02:59	1	2.4%	12.5%	03:00 - 04:59	1	2.4%	8.3%	05:00 - 05:59	1	2.4%	4.2%	06:00 - 06:59	0	0.0%	4.2%	07:00 - 07:59	1	2.4%	4.2%	08:00 - 08:59	1	2.4%	4.2%	09:00 - 09:59	4	9.5%	4.2%	10:00 - 10:59	3	7.1%	4.2%	11:00 - 11:59	3	7.1%	4.2%	12:00 - 12:59	3	7.1%	4.2%	13:00 - 13:59	2	4.8%	4.2%	14:00 - 14:59	2	4.8%	4.2%	15:00 - 15:59	4	9.5%	4.2%	16:00 - 16:59	6	14.3%	4.2%	17:00 - 17:59	2	4.8%	4.2%	18:00 - 18:59	1	2.4%	4.2%	19:00 - 19:59	4	9.5%	4.2%	20:00 - 21:59	3	7.1%	8.3%	22:00 - 24:00	0	0.0%	8.3%	3	of	4	in Dark	75.0%	<div>CASUALTIES 36</div> <table> <tr><td>Killed</td><td>0</td><td>0.0%</td></tr> <tr><td>Seriously inj.</td><td>14</td><td>38.9%</td></tr> <tr><td>Moderately inj.</td><td>12</td><td>33.3%</td></tr> <tr><td>Minor/Other inj.</td><td>10</td><td>27.8%</td></tr> <tr><td>Uncategorised inj.</td><td>0</td><td>0.0%</td></tr> <tr><td>Unrestrained</td><td>1</td><td>2.8%</td></tr> </table> <div>^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn</div> <div>Crashes Casualties</div> <table> <tr><td>8</td><td>2018</td><td>9</td></tr> <tr><td>9</td><td>2017</td><td>6</td></tr> <tr><td>10</td><td>2016</td><td>6</td></tr> <tr><td>8</td><td>2015</td><td>10</td></tr> <tr><td>7</td><td>2014</td><td>5</td></tr> </table> <div>McLean Periods % Week</div> <table> <tr><td>A</td><td>2</td><td>4.8%</td><td>17.9%</td></tr> <tr><td>B</td><td>2</td><td>4.8%</td><td>7.1%</td></tr> <tr><td>C</td><td>11</td><td>26.2%</td><td>17.9%</td></tr> <tr><td>D</td><td>1</td><td>2.4%</td><td>3.5%</td></tr> <tr><td>E</td><td>5</td><td>11.9%</td><td>3.6%</td></tr> <tr><td>F</td><td>7</td><td>16.7%</td><td>10.7%</td></tr> <tr><td>G</td><td>7</td><td>16.7%</td><td>7.1%</td></tr> <tr><td>H</td><td>5</td><td>11.9%</td><td>7.1%</td></tr> <tr><td>I</td><td>1</td><td>2.4%</td><td>12.5%</td></tr> <tr><td>J</td><td>1</td><td>2.4%</td><td>10.7%</td></tr> </table>	Killed	0	0.0%	Seriously inj.	14	38.9%	Moderately inj.	12	33.3%	Minor/Other inj.	10	27.8%	Uncategorised inj.	0	0.0%	Unrestrained	1	2.8%	8	2018	9	9	2017	6	10	2016	6	8	2015	10	7	2014	5	A	2	4.8%	17.9%	B	2	4.8%	7.1%	C	11	26.2%	17.9%	D	1	2.4%	3.5%	E	5	11.9%	3.6%	F	7	16.7%	10.7%	G	7	16.7%	7.1%	H	5	11.9%	7.1%	I	1	2.4%	12.5%	J	1	2.4%	10.7%
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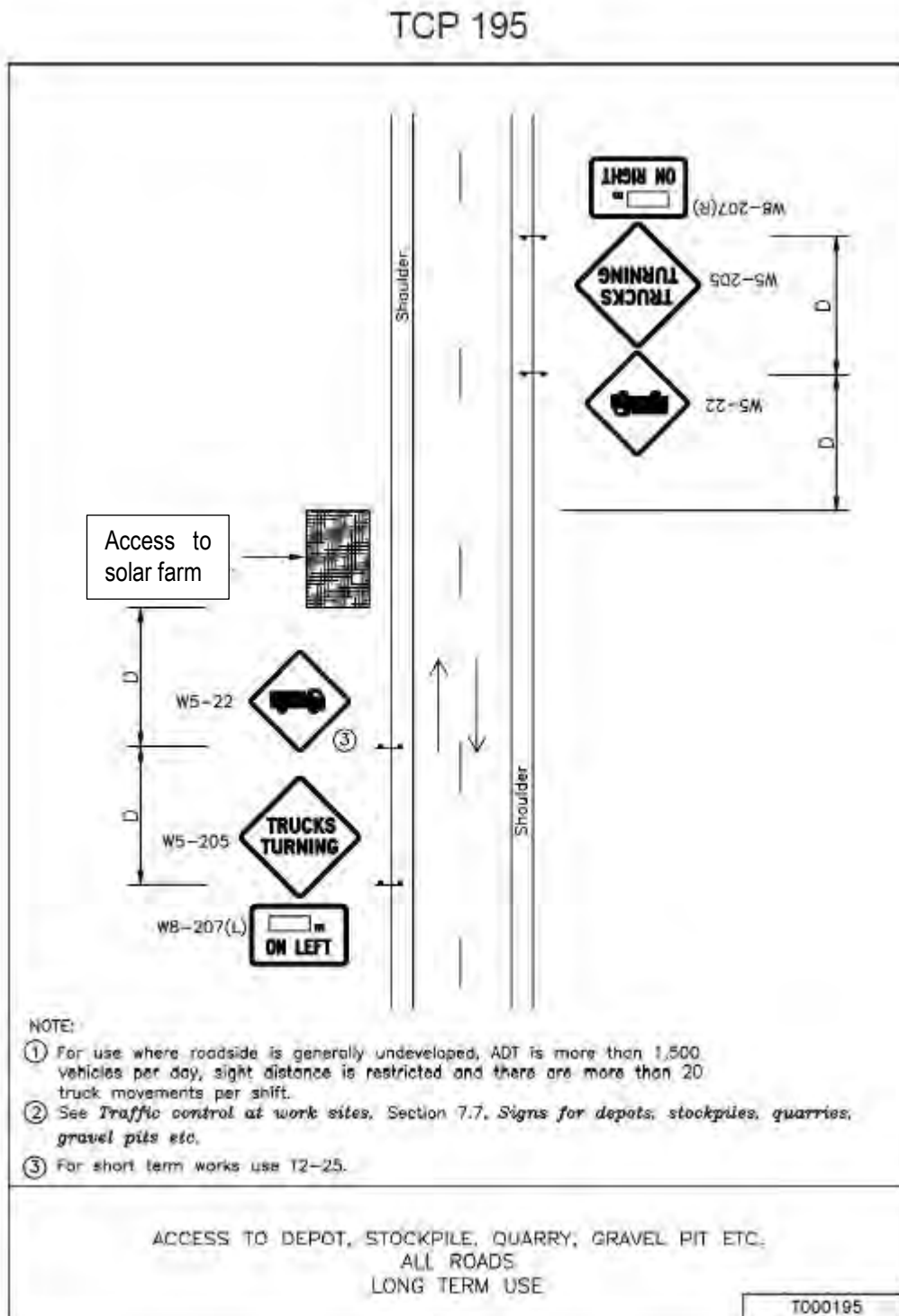
Note: Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data.

Reporting yrs 1996-2004 & 2019 Q3 onwards contain uncategorised inj crashes.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Appendix D. Traffic Control Plan for Works at Site Access on Bruxner Highway

Access controls for on-site construction (upon completion of construction of site access). Distance D = 100 metres



Appendix E. Construction Traffic Management Plan (CTMP)



Proposed Solar Farm,
Bruxner Highway,
Bonshaw

ERM

Construction Traffic
Management Plan

Final Report

26th March 2020

Bonshaw Solar Farm, Bonshaw NSW

Construction Traffic Management Plan

Author: Sean Morgan

Client: ERM Australia

Issue: Ver02

Reference: P1302

26 March 2020

Quality Review and Document History

Version	Date	Description	Prepared By	Checked By
Ver01	20/01/2020	Draft	S Morgan	C Thomas
Ver02	14/2/2020	Final	S Morgan	C Thomas
Ver03	26/03/2020	Final	S Morgan	C Thomas

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1 Introduction

The impact of the proposed Bonshaw Solar Farm has been assessed and submitted for review by the authorities. From this review Transport for NSW have requested a Construction Traffic Management Plan (CTMP) be prepared for the project. This CTMP has been prepared based upon the information available at the time of this submission, however, may be altered by the construction company for the future construction. Any changes to this CTMP in the future will be submitted to the road authorities for review and approval.

Due to the nature of works involved, the CTMP includes details of the required Traffic Control Plans (TCPs) to ensure that the safety for road users is preserved throughout the construction works.

The following CTMP has been prepared allowing for the construction of the Bonshaw Solar Farm project. Details of traffic management associated with decommissioning of the site has not been considered and shall be addressed prior to the decommissioning of the site to reflect the road and traffic conditions at this future time.

Bonshaw Solar Farm is located off the Bruxner Highway in the general locality of Bonshaw and approximately 65 kms west of Tenterfield, as shown in Figure 1-1.

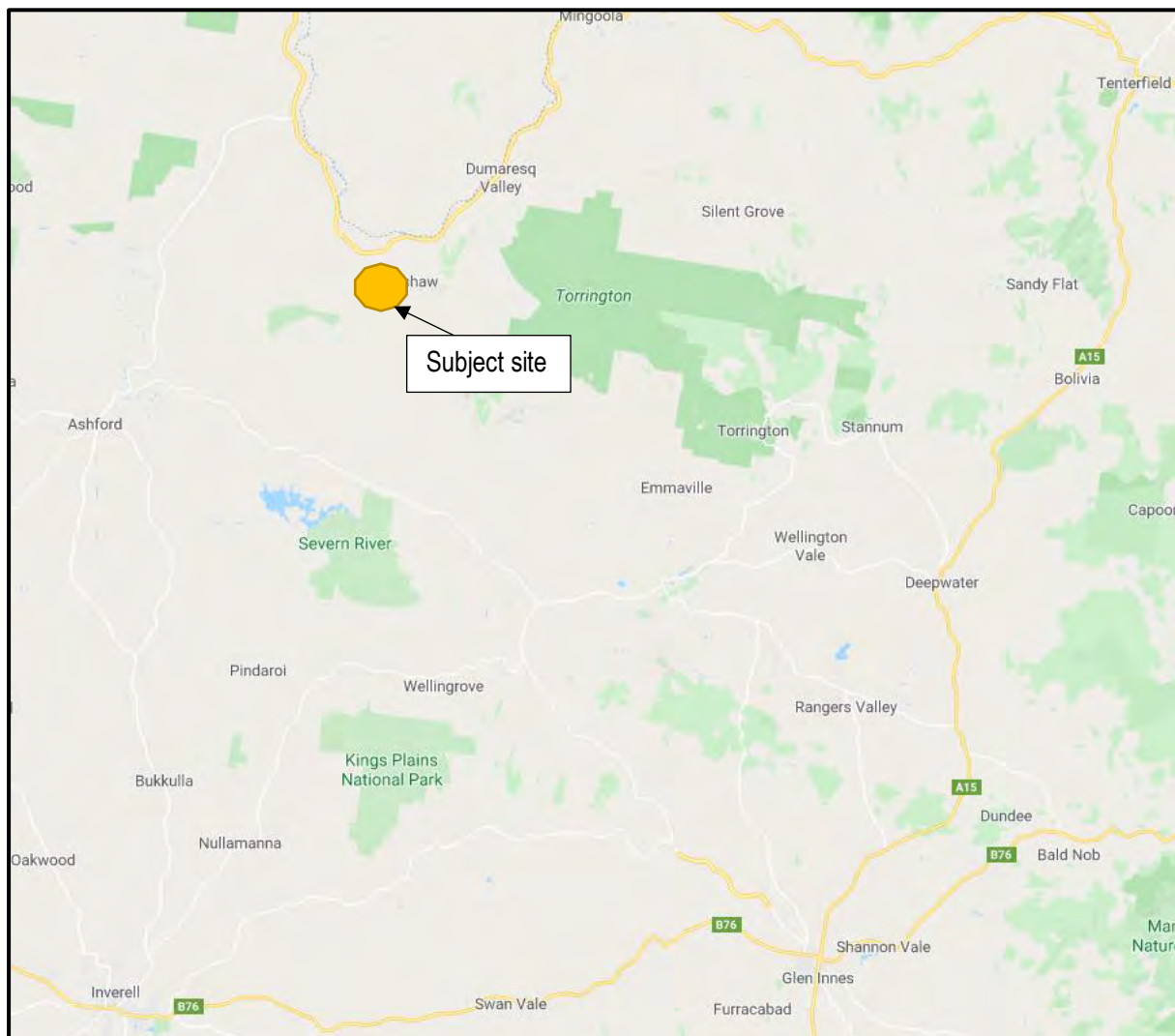


Figure 1-1 – Site Location and Road Network



Figure 1-2 - Location of Sunnyside Platform Road

1.1 Existing Road Network and Local Characteristics

The **Bruxner Highway** is a state classified road, which runs to the north of the subject site with an east-west orientation providing connection between the New England Highway to the east and Boggabilla to the west where it connects with the Newell Highway. The south, east and west boundaries of the subject lands are defined by neighbouring agricultural lots with some sections of unnamed, unsealed rural roads. The Bruxner Highway is sealed (refer Photo 1 below) and provides a width of approximately 6 metres passing the site allowing for 2-way traffic movements as required. It operates under the posted speed limit of 100 km/h.

The Bruxner Highway connects with the New England Highway to the east of the site at a four way give way controlled intersection with the New England being the priority road and Old Ballandean Road being the opposite minor road.



Photo 1 – View along Bruxner Highway in the vicinity of the project site

The **New England Highway** is a state classified road that is a key freight route in NSW and forms part of the road network designated by the Roads and Maritime to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 110 km/h outside of the urban areas where the alignment permits. As part of the state road network, the New England Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations. The **Cunningham Highway** operates in a similar manner providing key transport routes between Ipswich and the New England Highway at Warwick.

To the south of the site is the **Gwydir Highway**, a state classified road that is a key freight route in NSW and forms part of the road network designated by Transport for NSW to carry oversize, over mass vehicles. It typically provides a single lane of travel in both directions and operates under the posted speed limit of 100 km/h outside of the urban areas where the alignment permits. As part of the state road network, the Gwydir Highway carries a mixture of local, regional and inter-state traffic with a significant number of trucks including B-double combinations.

Bonshaw Road is a local road managed by Inverell Shire Council, located to the west of the site. It is a sealed two-way road with an overall width in the order of 7 metres. It intersects with the Bruxner Highway via a simple give way controlled intersection with the Bruxner Highway being the priority road. This road continues south and connects with **Ashford Road** in Ashford to provide a road link through to Inverell. This route provides a consistent road standard and forms part of the approved B-double road network in NSW. Both of these roads provide a single lane of travel in both directions and operate under the posted speed limit of 100 km/h.

Sunnyside Platform Road is a local road providing an approved B-double connection between the New England Highway and Bruxner Highway. It provides a pavement width in the order of 7 metres wide permitting 2-way traffic movements.

As part of the project, it is proposed that all heavy vehicles will travel via the roads identified above. Local supplies could be sourced from Goondiwindi or Tenterfield as well as accommodation for workers associated with the project.

1.2 Traffic Volumes and Road Operation

Traffic volumes in the immediate vicinity of the subject site are very low, reflective of the rural environment. The Bruxner Highway carries relatively low traffic flows, reflective of its rural setting with a mixture of local traffic as well as regional traffic demands. Observations on site during a typical morning period (Tuesday 11th September 2018) shows that the current road network in the vicinity of the subject site operates very well with no delays. The route proposed to be used for the project carries low traffic flows and operates with no delays except for those associated with drivers slowing down to observe traffic flows on the approaches to the various intersections and negotiate the intersections.

Transport for NSW webpage provides traffic data on the Bruxner Highway at Mingoola (station Id 91170), approximately 15 kms east of the subject site. The traffic data from 2011 shows that the daily traffic flow was 213 vehicles per day with around 23% heavy vehicles, reflective of rural demands in this location. It is considered that there has been limited growth in traffic since this time and as such the current daily traffic flows are considered to be similar.

The same web page shows that in 2011 the daily traffic flow on the New England Highway to the immediate north of Tenterfield (station Id 91577) was 2421. It is considered that there has been limited growth in this area since 2011 and as such the daily traffic flows would be similar. In 2012 the traffic flows on Bonshaw Road were 232 vehicles per day northbound. Assuming southbound flows to be the same would give daily flows in the order of 500 vehicles per day. It is considered that these flows would not have altered much since 2012.

For the Gwydir Highway, the same web page shows that the daily flows to the east of Inverell were 1,317 in 2019 whilst to the west of Glen Innes the flows on the Gwydir Highway in 2019 were 1,442 vpd.

2 Construction Works

The construction and commissioning phase is expected to last approximately 12 months with expected commencement by late 2020. The main construction activities would include:

- Site establishment and preparation for construction:
 - Installation of security measures including fencing.
 - Establishment of site compound and material layout areas. This shall include the provision of suitable on site parking for vehicles and workers.
 - Ground preparation.
- Installation of environmental controls:
 - A detailed Construction Environmental Management Plan (CEMP) would outline the environmental controls required.
- Minor vegetation clearing (grasses, shrubs and isolated trees):
 - Targeted clearance of low laying vegetation around trenching areas to steel post installation to minimise disturbance to existing ground cover.
 - Establishment of tree and vegetation protection measures as required.
 - Clearance of larger vegetation such as bushes and isolated trees.
 - Establishment of additional sedimentation and erosion controls as required.
- Preliminary civil works including:
 - Drainage works
 - Setting up foundations for the substation
 - Earthing works (see below)
- Installation of steel post and rail foundation system for the solar panels.
- Installation of PV panels and DC wiring beneath the panels.
- Installation of underground cabling (trenching) and installation of inverter stations.
- Testing of electrical infrastructure
- Removal of temporary construction facilities and rehabilitation of disturbed areas.

The project does not require any concrete footings to be provided for the solar panels construction.

A site office and compound will be established on site for the duration of the works with temporary access tracks provided to allow for access across the site as required. Internal roads shall be constructed as all-weather roads.

All staff vehicles will be able to park within the site adjacent to the site office and across the site as required. The construction site is relatively large and the vehicles will be parked across the site located near the active work site, with no external parking demands created by the project. As part of the project construction it is proposed to maximise the local workers content (from Tenterfield and Glen Innes as well as potentially Goondiwindi) and car-pooling will be supported as part of these trips. With 3 or 4 people arriving in a single vehicle it can be seen that the parking demands can be contained within the site.

2.1 Timing

Construction of the solar farm will commence in 2020 (subject to approval) requiring approximately 12 months to complete.

2.2 Working Hours

Construction hours are in accordance with the *Interim Construction Noise Guidelines* (DECC 2009) (ICNG) with standard construction hours being

- 7:00am and 6:00pm Monday to Friday
- 8.00 AM to 1.00 PM on a Saturday
- No construction work is to be carried out on a Sunday or NSW public holiday.

No construction work, upgrading or decommissioning activities will be undertaken outside of these hours with the exception of:

- The delivery of material as requested by the NSW Police Force to other authorities for safety reasons; or
- Emergency work to avoid the loss of life, property and / or material harm to the environment.

2.3 Construction staff numbers

Peak demand levels for the construction work will vary with a peak of 190 people for a 6 month duration and a lower level outside of this peak period. The staff will be sourced locally where appropriate with any specialist and project management staff from outside of the local area to be housed in Tenterfield and Glen Innes as well as potentially Goondiwindi.

Details of staff accommodation and employment shall be addressed within an Accommodation and Employment Strategy to be provided to Inverell Shire Council.

2.4 Construction Traffic

2.4.1 Light Vehicles

A shuttle bus service shall be provided to transport staff housed in Tenterfield and Glen Innes as well as potentially Goondiwindi to the site and to discourage private vehicle use. Shuttle buses will typically be 12 or 22 seater mini buses which will arrive at the start of the and leave at the end of the day. The route for these shuttle buses shall allow for collection at local hotels / motels to be determined once workers have been housed.

Specialist trades which require the use of their own vehicle for the transportation of tools and other equipment shall be encouraged to car pool where appropriate.

Local staff who reside outside of Tenterfield and Glen Innes as well as potentially Goondiwindi shall be permitted to drive to the site, however shall be encouraged and supported to car pool where appropriate to minimise demands for light vehicle travel to the site.

With a peak of 190 staff, a vehicle occupancy rate of 3 people per vehicle has been assumed based upon carpooling and the use of a mini bus e.g. Toyota Coaster. This would give 65 vehicle movements inbound and outbound for staff movements.

All construction light vehicles will be able to park on site as required.

2.4.2 Heavy Vehicles

The demands for heavy vehicles accessing the site will vary throughout the construction phase. At the beginning of the project there will be a requirement for some earthwork moving equipment to construct the access and some minor earthworks across the site as required. This may require a scraper or bull dozer which will be transported to site on a low loader. This machinery will remain on site for the duration of the earthworks portion of the project construction work.

While extensive earthworks are not proposed, some land forming (including localised cut and fill areas) may be undertaken to achieve more consistent gradients beneath the PV modules. Additionally, earthworks are required for trenching works.

In total, approximately:

- Approximately 15,000 m³ of gravel would be required to cap roads within the site
- Approximately 13,000 m³ of sand (subject to detailed design) would be required for the bedding of cables that are to be buried throughout the site

Should any excavated material not be suitable for reuse or additional fill material is required, the maximum amount of fill is estimated to be 12,000 m³.

Once the earthworks have been completed, the balance of the construction work will commence requiring machinery including:

- Pile driver
- Piling rig
- All terrain fork-lift
- All terrain utility vehicles
- Backhoe
- Flatbed trucks
- Mobile crane

Other equipment if required may include an elevated work platform, scraper, roller and winches. All of the plant will be located on site and will therefore be only required to access the site once for the construction works.

The solar panels are expected to be all delivered from the Port of Newcastle or Port of Brisbane. Other specialist equipment is generally sourced from Newcastle or Greater Brisbane as required whilst consumables be local from the Tenterfield and Glen Innes as well as potentially Goondiwindi.

Typical vehicle movements during the peak construction period (over 6 months) are in the order of 65 light and 20 heavy vehicles two-way (65/20 inbound, 65/20 outbound) per day. For the light vehicles, the vast majority of these will be inbound movements in the morning bringing workers to the site with these vehicles then remaining on site for the full working day before leaving at the end of the working day. It is expected that there will be limited light vehicle movement outside of these periods, other than support staff e.g. office staff or the occasional visitor to the site.

For the heavy vehicles, these will typically be spread across the working day. For the solar panel deliveries, these trucks are arriving from either the Port of Brisbane or the Port of Newcastle and the journey length will be over 5 or 7 hours respectively, seeing a spread of these vehicles not all arriving at the same time. Allowing for each truck to be emptied on site one at a time, the outbound movements will also be spread out and not all leave at the same time avoiding platooning of heavy vehicles on the road network. All other heavy vehicles will also be spread out across the normal working day with no concentration of heavy movements expected.

Outside of the peak period of construction, the staff levels will be lower and the daily light vehicle numbers will be less than 65 inbound and outbound per day. The heavy vehicle numbers will also be lower outside of the peak construction activity and less than 20 vehicles inbound and outbound per day

The construction company on site shall keep records of the number of heavy and over-dimensional entering and leaving each day.

3 Site Operations

Once constructed the site will operate for approximately 25 years at which point the site will either be decommissioned, or panels replaced to extend the length of operations. The site is expected to provide employment for no more than 10 staff with traffic demands associated with the ongoing operations to be significantly lower than those during construction.

4 Traffic Management

4.1 Traffic Management Objectives

The objectives of the traffic management plan are to:

- Minimise disruptions and ensure the safety of traffic on the external road network.
- Provide suitable access to the site for construction workers, heavy and over-dimensional vehicles.
- Ensure the safety and protection of workers working within the public domain.

4.2 Vehicle Movement Plan

The proposed traffic management measures allow for all access off the Bruxner Highway only, via the existing access to the adjacent electric substation. This access shall be used by the construction traffic movements as well as the future on-site operational demands.

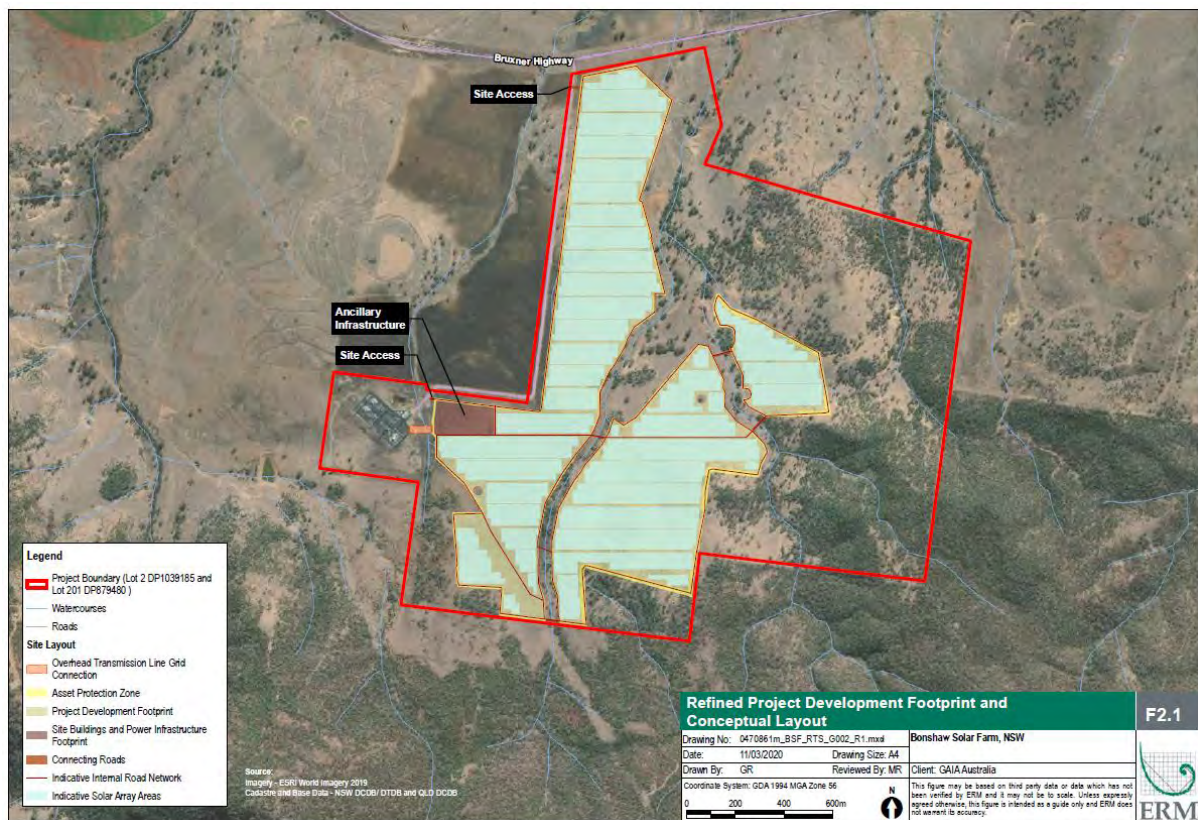


Figure 4-1 – Detailed site layout showing access point via existing access to electric sub-station

All heavy and over-dimensional vehicles associated with the development shall travel to and from the site via the Bruxner Highway. Due to safety concerns at the intersection of the Bruxner Highway and the New England Highway trucks heading south from the site shall travel via Ashford and Inverell. The proposed heavy vehicle routes are shown in Figure 4-2 below.

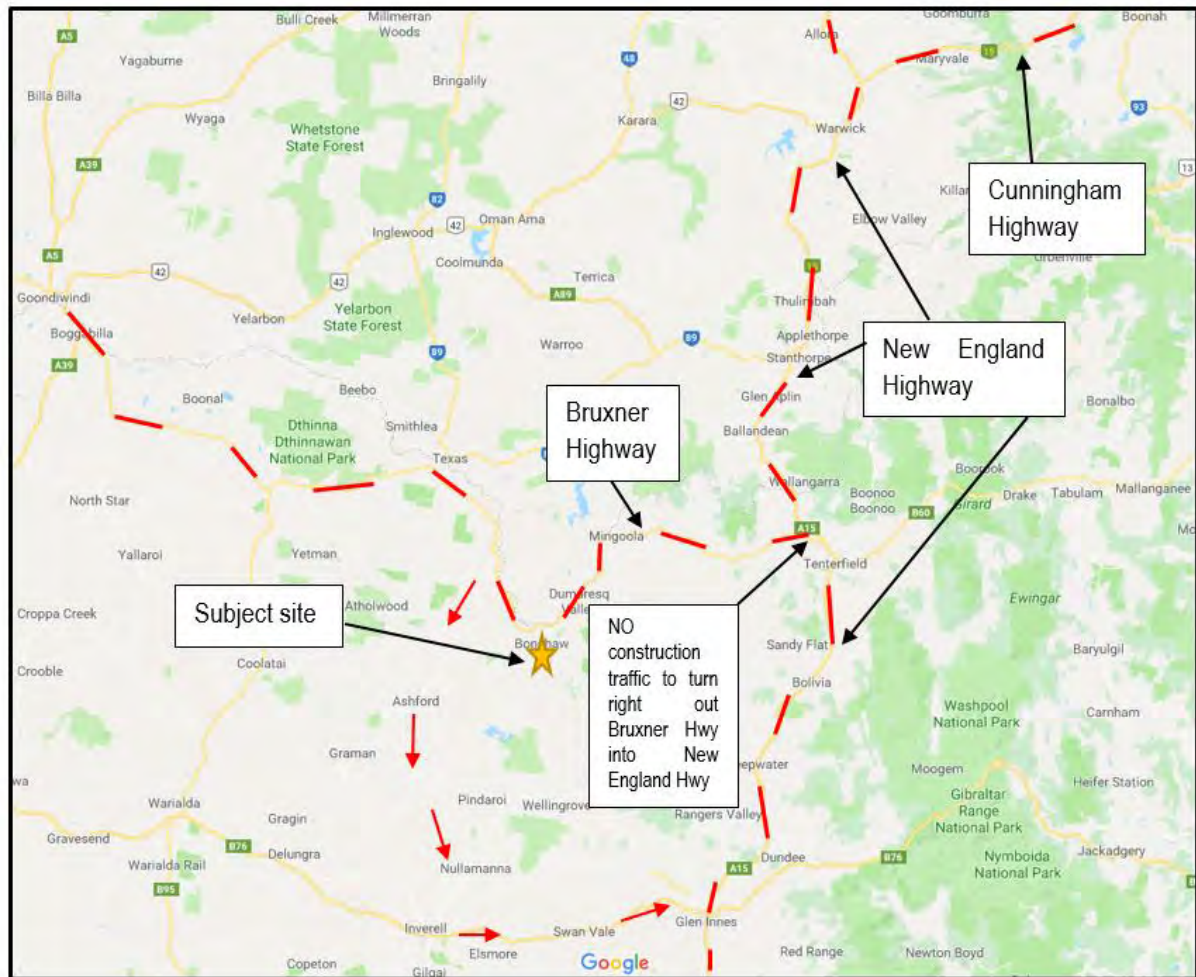


Figure 4-2 – Heavy and Over-Dimensional Vehicle Route

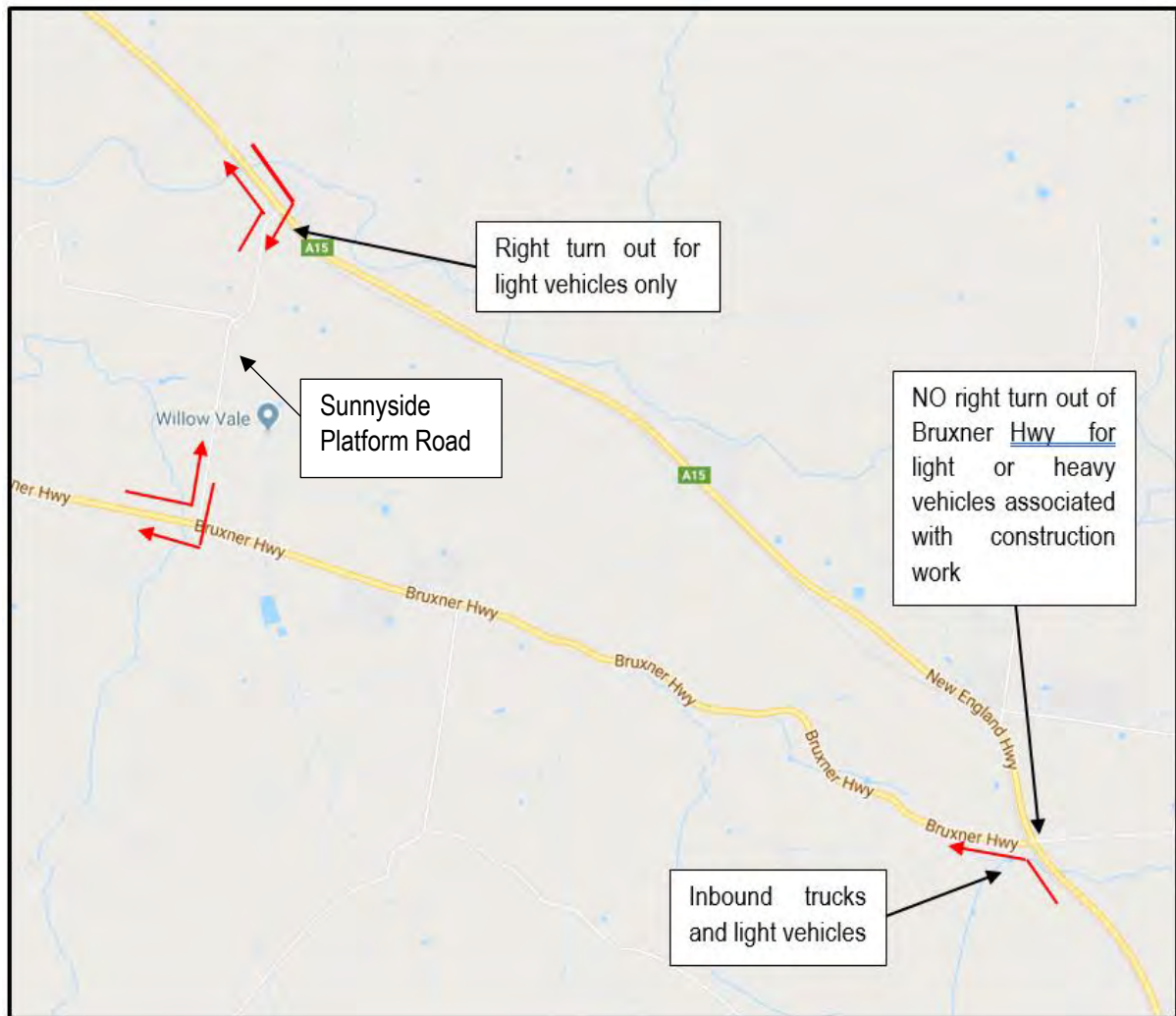


Figure 4-3 - Detail for connection between New England Highway and Bruxner Highway using Sunnyside Platform Road

The application is required to obtain relevant permits under Heavy Vehicle National Law (NSW) for the use of over-dimensional vehicles on the road network.

4.3 Traffic Diversions

There are no diversions or road closures associated with the construction or ongoing operation of the Bonshaw Solar Farm.

4.3.1 Proposed Speed Zone

No reduced speed zones shall be implemented during construction of the solar farm.

4.4 Traffic Impacts

The potential impacts of construction and operational traffic on the surrounding road network have been assessed and documented and included the cumulative impacts of other State Significant Projects within the general locality.

As there are no road closures or diversions required during the various stages of the project, there shall be only minor delays associated with the proposed on-site construction works on the Bruxner Highway.

There will be no public vehicle access within the work site during the construction works, with a fence provided at the commencement of the project along the entire site boundary. This fence will remain once the project is constructed for security purposes with a locked gate to be provided at the site access off the Bruxner Highway.

All vehicles are to be loaded and unloaded within the site only and will enter and exit in a forward direction.

Deliveries are to be scheduled to avoid platooning of heavy vehicles travelling together when accessing or departing the site. Two trucks travelling together should leave a suitable gap to enable other drivers to overtake as required.

4.4.1 Construction Parking Demands

Parking of vehicles will be accommodated as required within the site. Management policies shall be implemented to discourage construction workers living in Tenterfield and Glen Innes as well as potentially Goondiwindi driving to the site (unless required for the transportation of specialist tools and equipment).

No vehicles shall be permitted to park on the Bruxner Highway or other local roads.

4.4.2 Public Transport and School Buses

There is school bus that runs along the Bruxner Highway, with one bus in the morning and one bus in the afternoon. The majority of the nominated heavy vehicle routes does not form part of the school bus route with the only interactions being along the Bruxner Highway and the New England Highway to Tenterfield.

Whilst there may be some deliveries occurring in the morning during the school bus operation, very limited deliveries are expected in the afternoon period. All staff will be on site prior to the morning bus run and will depart site after the afternoon bus run. As such it is considered that there is very limited interaction with the school bus.

On the regional and state road network all school zones will be delineated in accordance with Transport for NSW Guidelines with reduced speed limits in accordance with normal NSW road rules. All drivers associated with the project construction work will adhere to the road rules as applicable and will be advised of the school bus operation on the Bruxner Highway.

There will be no impact upon public transport services with no diversions required. There are no bus stops impacted upon by the proposal.

4.4.3 Pedestrians and Cyclists

Given the rural location, demands for pedestrians and cyclists are very low. No pedestrian or cyclist diversions are required for the project work.

4.4.4 Emergency Services

There will be minimal impact for emergency vehicles with no diversions required.

4.4.5 Local Residents

There are no residential dwellings in the immediate locality of the site access that will be impacted upon by the project and construction work. There are a number of residences along the heavy and light vehicle access routes and these residents will be notified in writing of the construction works as necessary including any works which may impact on the local road network.

4.4.6 Other Developments

There will be minimal impact upon any other development within the locality of the site.

4.4.7 Adjoining Council Areas

There will be minimal impact upon adjoining Council areas. Traffic routes in and out of the locality will be along the arterial road network which will experience minimal impacts due to the works.

5 Environmental Conditions

Noise has been considered in the approved working times.

Construction vehicle movement on internal roads could lead to dust generation. A water truck will be used for dust suppression to minimise the production of dust, with the amount of water spreading adjusted accordingly to reflect the conditions. Additionally, any significant deposits of dirt and other construction materials will be promptly removed from public roadways.

Vehicles departing the site are to be in a clean condition to ensure dirt is not tracked into the public road network. A suitable wash bay shall be provided adjacent to the access point for the cleaning of vehicles wheels as required. The access to the sub-station provides a length of seal to prevent the tracking of dirt onto the Bruxner Highway.

The rural location of the site presents a number of environmental hazards such as fog or wildlife along the haulage route. Drivers accessing the site are to drive to suit the road conditions including slowing down in fog or adverse weather conditions. Incidents involving wildlife are to be reported to the site and relevant authorities as appropriate.

6 Incident Procedures

In the case of an incident on site, emergency services will be notified and given priority access to the site as required.

7 Complaints

Any complaints received from the community in relation to the construction and operational traffic for Bonshaw Solar Farm shall be directed to the nominated Health Safety Environment and Community Manager for the project. Details shall be confirmed.

8 Review Process

The Construction Traffic Management Plan and relevant Traffic Control Guidance Plans (TCGPs) will be monitored regularly to ensure their effectiveness and applicability and updated accordingly.

9 Compliance Documentation

Refer to Legislative and Jurisdiction compliance requirements, company policies and procedures as appropriate.

10 Traffic Control Guidance Plan

10.1 General

This TCGP has been prepared to meet the requirements of the RMS Traffic Control at Work Sites Manual 2018. The plans cover the access requirements to the site on the Bruxner Highway.

At all times the Roads and Maritime Service's Traffic Control at Work Sites guidelines must be adhered to. Please refer to the RMS guidelines for traffic control matters not listed in this report.

10.2 Existing Traffic Conditions

- 100 km/hr posted speed limit on the Bruxner Highway.
- Daily traffic volumes on the Bruxner Highway are less than 300 vehicles per day.

10.3 Cyclists and Pedestrians

Given the rural location, demands for pedestrians and cyclists are zero.

10.4 General Traffic Control Considerations

The factors that have been considered in preparing the TCGP are:

- Duration of the works and minimising potential disruptions to local traffic.
- Provision of safe access for heavy and over-dimensional vehicles off the Bruxner Highway.
- Existing traffic volumes and road conditions.

The location and nature of the work will NOT require safety barrier to be installed along the Bruxner Highway.

10.5 Traffic Control – Signage and Line Marking

The TCGP provides Work Site definition. Temporary signage required as part of the works are included due to the nature of the passing traffic, access for construction traffic to the site and the location and nature of the works.

All signs shall be placed on the verge adjacent to the road and made secure against wind and shall be covered when not in use and removed outside of working hours. The signs shall be uncovered before any trucks access the site.

A copy of this TCP must always be on site during the construction work.

10.6 Compliance

The traffic impact assessment prepared by Seca Solution demonstrates that the construction and operation will not have an unacceptable impact on the surrounding roads and intersections.

b) MANAGEMENT PLAN DETAILS:

- Statutory Requirements: Prepare in accordance with Transport for NSW and Council, identify measures that are to be implemented to ensure road safety, detail heavy vehicle routes, identify driver code of conduct, minimise road impacts and environmental risks, notification of any upcoming major works to the local community.
- Limits & Performance Measures: No traffic control is required to manage traffic throughout construction works. Refer to the above report for further details and below for indicators.

iii) Specific Performance Indicators – None required except installation of TCGP

c) DESCRIPTION OF MEASURES USED TO COMPLY WITH STATUTORY REQUIREMENTS:

- Licenced traffic consultant and traffic controllers engaged to complete the works
- Traffic control signage and plan to be maintained throughout the works
- Maintain through access on affected roads

d) PROGRAM FOR MONITORING & REPORTING To be managed by the Construction Contractor

e) CONTINGENCY PLAN:

If the traffic control plan does not maintain the safety of road users and construction workers, the TCP is to be modified by a suitably qualified and accredited person and changes recorded within the register.

f) PROGRAM TO IMPROVE PERFORMANCE

The traffic management plan will be regularly reviewed to ensure its suitability for the works being completed.

g) PROTOCOL FOR MANAGING & REPORTING INCIDENTS & COMPLAINTS

- i) All incidents and / or non-compliances that may arise will be documented and the HSEC manager notified immediately on the same business day. This will be documented within the site diary and / or raised at weekly disruption meetings.
- ii) Complaints shall be directed to the nominated HSEC manager and appropriate actions taken to address any concerns raised.

h) PROTOCOL FOR PERIODIC REVIEW

Periodic review of the plan is captured above.

10.7 Daily Checklist

In accordance with the Roads and Maritime Services of New South Wales 'Traffic Control at Worksites' guidelines, the site foreman / manager should complete a daily traffic control checklist and this checklist should be filed for future reference.

Details on this checklist can be found at <https://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/technical-manuals/traffic-control-at-worksites-manual.pdf>

10.8 Contractors Contact Details

Project Manager: TBC
Telephone: TBC
Mobile: TBC
E-mail: TBC

10.9 TCP Approval

This TCGP will be submitted to the road authority for review and approval.

Details for lodging this TCGP and the Construction Traffic Management Plan are:

Inverell Shire Council:

Inverell Shire Council Administration Offices, P O Box 138, Inverell NSW 2360

Transport for NSW (formerly RMS):

Transport for NSW, RMS, P O Box 576, Grafton NSW 2460

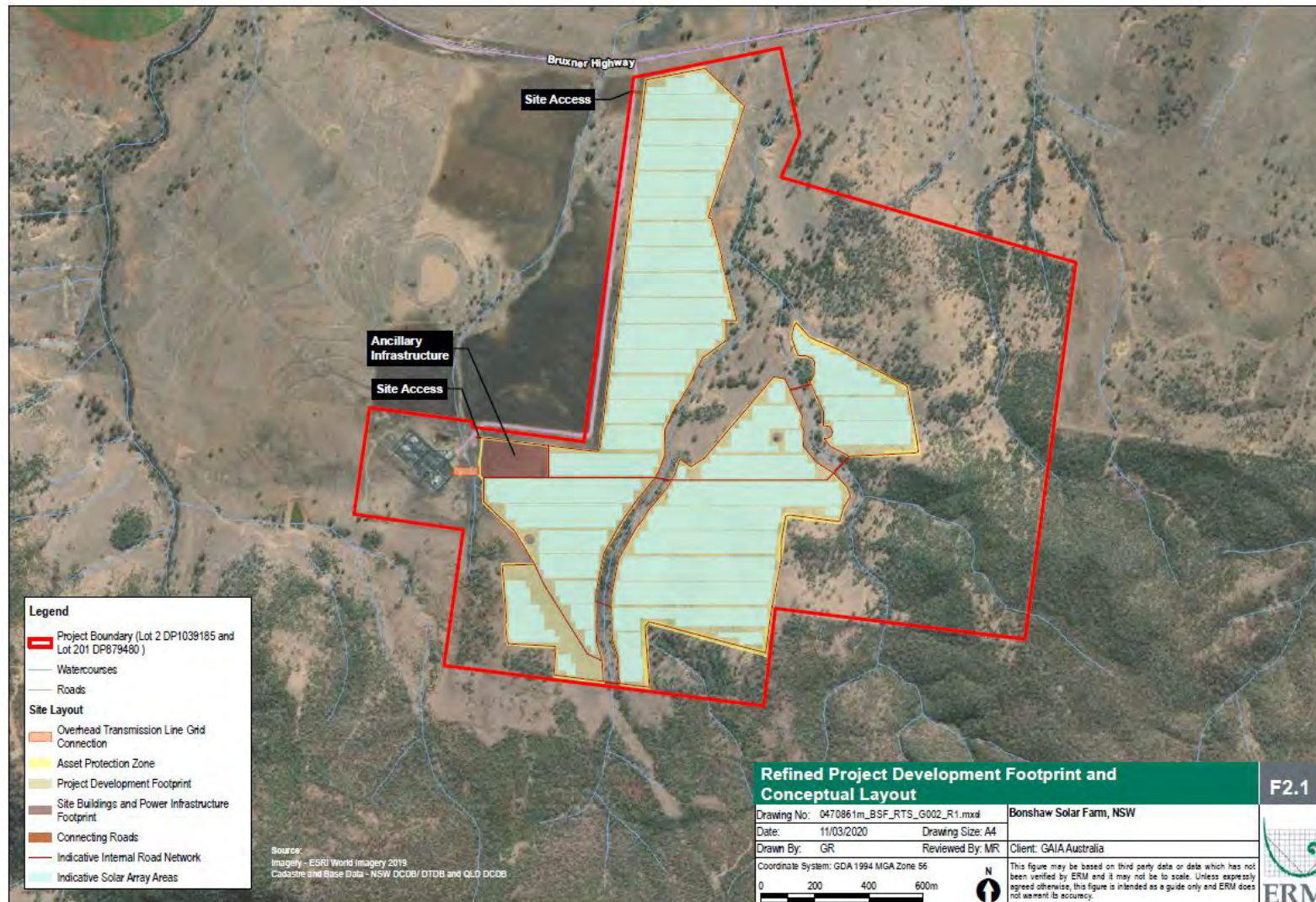
This Traffic Control Plan has been prepared and reviewed by suitable qualified professionals in accordance with the RMS Traffic Control at Work Sites Manual 2018 edition.



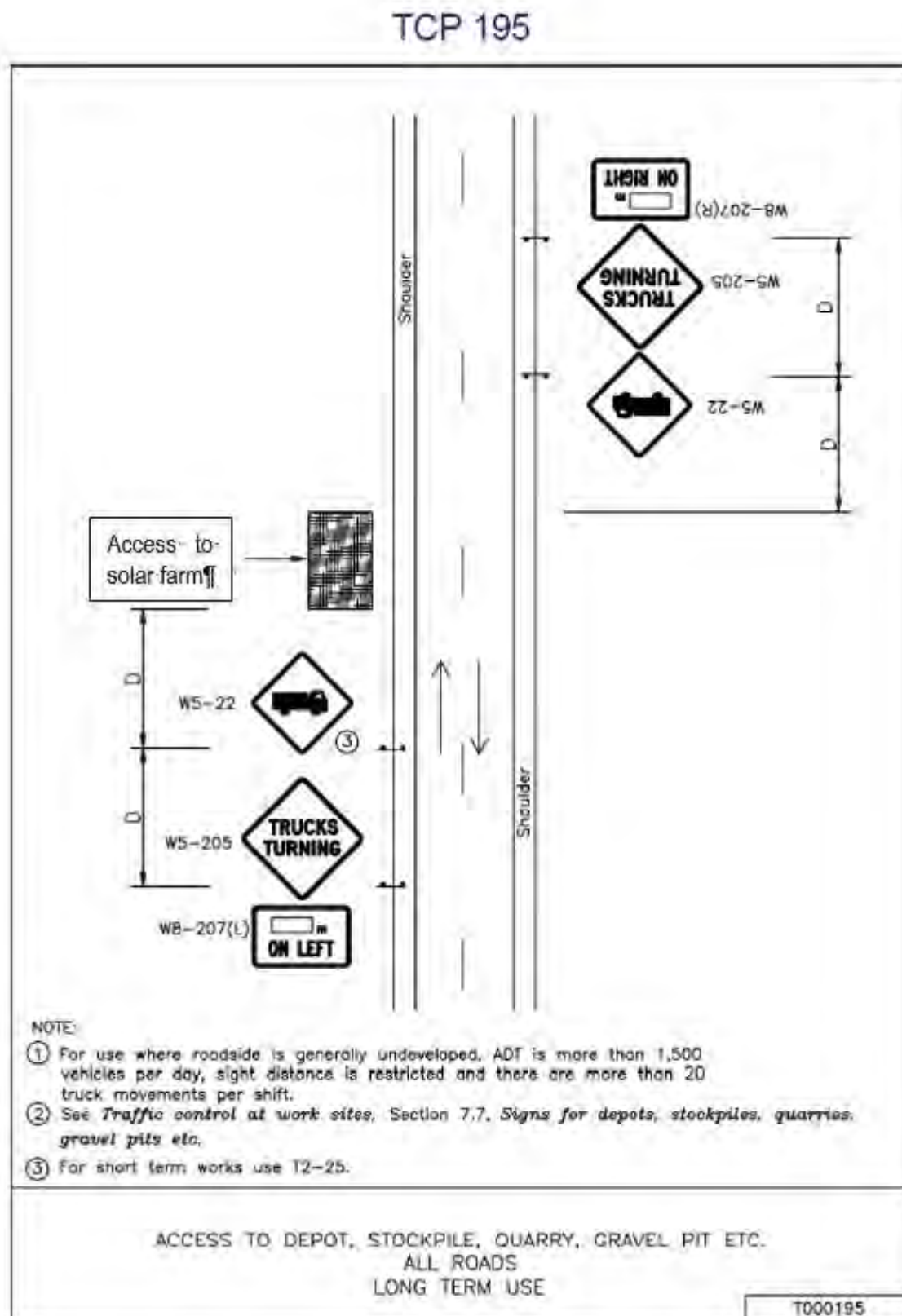
Sean Morgan (PWZTMP 0051749238)

Director

Appendix A. Site Plan



Appendix B. TCP at site access on the Bruxner Highway



Appendix C. Driver Code of Conduct

This Drivers Code of Conduct has been established to minimise the impact of our construction on the environment and the local community whilst providing our customers with a high quality, reliable and safe service.

All persons traveling to and from the Bonshaw Solar Farm must adhere to the rules detailed in this document.

Please ensure all persons attending the construction site read, understand and sign this document and return it to the nominated site representative.

General	<p>All vehicles / drivers accessing the site must:</p> <ul style="list-style-type: none"> i) Be registered and hold a valid driver's licence for the class of vehicle being operated. ii) Operate the vehicle in a safe and appropriate manner whilst travelling to / from the site or when operating within the site. This includes obeying all New South Wales state road rules. iii) Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads. iv) Not use a mobile phone while operating any vehicle. v) Must always wear a seatbelt when operating any vehicle.
Times	<p><i>Construction</i> Construction is to be completed in accordance with the <i>Interim Construction Noise Guideline</i> (DECC 2009) which defined standard construction work hours as:</p> <ul style="list-style-type: none"> • Monday to Friday: 7am to 6pm • Saturday: 8am to 1pm • Sunday and NSW Public holidays: No work <p>The following construction, upgrading and decommissioning activities may be undertaken outside these hours without the approval of the secretary:</p> <ul style="list-style-type: none"> • The delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or • Emergency work to avoid loss of life, property and / or material harm to the environment. <p>Vehicle movements shall be undertaken during standard construction hours (or just before to allow workers to get to site). Oversize vehicles up to 26 metres long may require access to the site after hours however this would be subject to the requirements of Transport for NSW, Inverell Shire Council or NSW Police.</p> <p><i>Normal Operations</i> Daily operations and maintenance by site staff would be undertaken during standard working hours:</p> <ul style="list-style-type: none"> • Monday to Friday: 7am to 6pm • Saturday: 8am to 1pm • Sunday and NSW Public holidays: No work <p>During normal operations, all vehicle movements shall be undertaken during the standard operating hours (or just before to allow workers to get to site).</p>

	There may be a requirement for vehicles to access the site after hours during an emergency however these would be infrequent.
Access	<p>All heavy vehicles must adhere to the designated heavy vehicle routes as nominated in Figure 1 below.</p> <p>Drivers must ensure they enter and exit the site in a forward direction and are not permitted to load or unload on the Bruxner Highway.</p>
Vehicle Departure and Arrival	<p>Heavy vehicles departing the site shall have a minimum 5 minute separation to reduce the impacts upon the local road network.</p> <p>Always maintain a minimum separation of at least 50 metres between vehicles when travelling within the site.</p> <p>Drivers must contact the site supervisor upon arrival and await further instructions or direction before proceeding. Drivers must also report to the site supervisor prior to departure.</p> <p>All vehicles must enter and exit the site in a forward direction. Vehicles tyres are to be washed down and in a clean condition upon exiting the site to prevent dirt being tracked onto the public road network</p>
Illegal and Unsafe Truck Parking	<p>No vehicles are permitted to park on the Bruxner Highway except in designated parking bays.</p> <p>All parking within the site is to be as directed.</p>
Heavy Vehicle Compression Braking	<p>Compression braking by heavy vehicles is a source of irritation to the community. Brakes must be applied so as not to create excessive noise that could disturb residents along the haulage routes, particularly within the township of Tenterfield.</p> <p>Compression braking should only be used if required for safety reasons.</p>
Load Covering and Restraint (as per NHVL and CoR Regulations)	<p>All trucks arriving to or departing the site are required to have an effective cover over their load for the duration of the trip.</p> <p>Drivers must ensure that following loading or unloading that all gates and tailgates are secured and locked before leaving the site.</p> <p>Drivers are to ensure that their loads are secured as per the NTC Load Restraint Guide 2018 and that checks are completed on restraint equipment such as tailgates, chains, straps, ratchet dogs, tarps etc on a regular basis to ensure they are functioning correctly.</p> <p>Drivers must exit their vehicle to inspect the above every time they are loaded, prior to arrival at the site and following unloading at the site, prior to departure. The security of your load, your life and the life of others relies upon proper load restraint practices.</p>
Mass and Dimension (as per NHVL and CoR Regulations)	<p>Drivers should be aware that:</p> <ul style="list-style-type: none"> Adhering to legal axle and gross weight limits are their responsibility Trucks accessing the site must adhere to any weight and dimension limit/restrictions that apply along the approach routes. These include those load limits applicable to roads and bridges that must be complied with.

<p>Fatigue and License Requirements (as per NHVL and CoR Regulations)</p>	<p>All drivers should be aware that:</p> <ul style="list-style-type: none"> • a person must not drive a heavy vehicle on a road while impaired by fatigue • managing driver fatigue is a shared responsibility by all parties in the chain • parties must take all reasonable steps to ensure a person does not drive the heavy vehicle on a road while impaired by fatigue. <p>Drivers shall not be permitted to operate a vehicle or plant equipment when impaired by fatigue. If you suspect that you or someone else is experiencing fatigue, please inform your supervisor.</p> <p>Operators of heavy vehicles shall be aware of the requirements relating to fatigue as outlined in the Heavy Vehicle National Law. Drivers shall also be aware of their adopted fatigue management scheme (shown below) and ensure that they are operating within its requirements.</p> <ul style="list-style-type: none"> i) Standard Hours of Operation ii) Basic Fatigue Management (BFM) iii) Advanced Fatigue Management (AFM) <p>All drivers accessing the site must be registered and hold a valid driver's licence for the class of vehicle being operated</p>
<p>Vehicle Speeds</p>	<p>Drivers shall observe the posted speed limit along the designated transport route and adjust their vehicle speed as required to suit the road environment and prevailing weather conditions. Vehicle speeds must be appropriate to ensure the safe movements of the vehicle with consideration to the vehicle configuration.</p> <p>Maximum speeds limits within the project site shall be as follows:</p> <ul style="list-style-type: none"> i) 40 km/hr along formed roads. ii) 20 km/hr during foggy / dusty conditions. Headlights must be on. iii) 10 km/hr when passing pedestrians or any plant equipment.
<p>Overtaking</p>	<p>Overtaking shall not be permitted within the site unless the intention to overtake has been communicated to the driver of the leading vehicle and consent to overtake granted.</p>
<p>Breakdowns and Incidents</p>	<p><i>Heavy Vehicles</i></p> <p>In the case of a breakdown, the vehicle must be towed to the nearest breakdown point as soon as possible. All breakdowns must be reported to the Transport for NSW Transport Management Centre on 131 700 and the vehicle protected in accordance with the Heavy Vehicle Drivers Handbook. The relevant shift manager on site shall also be notified.</p> <p>If a breakdown occurs on-site please remain inside your vehicle, notify the shift manager of your location and await further instruction.</p> <p>If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.</p> <p><i>Light Vehicles</i></p> <p>In the case of a breakdown, ensure that the vehicle is secure, notify the site manager of your location and await further instruction.</p> <p>If you are involved in an accident, please notify the shift manager immediately and contact emergency services if required.</p>
<p>Signs</p>	<p>Comply with the directions of authorised personnel when operating within the site and obey any relevant signage installed along the internal roads.</p>

Personal Protective Equipment (PPE)	<p>The mandatory Protective Clothing requirement on this site is TO BE CONFIRMED</p> <ul style="list-style-type: none"> • Hard Hat • Steel cap work shoes • Safety Glasses • High-Vis clothing • Ear Protection (as required) • Gloves (as required)
Mobile Phone Usage	<p>A mobile phone is not to be used while operating any vehicle.</p> <p>The use of a mobile phone while operating machinery or undertaking site activities is STRICTLY PROHIBITED. Driving, operating or undertaking high risk activities must be temporarily stopped to take a call.</p> <p>When a call or text message is received while driving and a hands-free kit is not available or the hands free kit is not voice activated, the driver MUST pull to the side of the road when safe to do so prior to taking the call or checking the message.</p> <p>Where a conversation is complex, technical or requires notes to be taken is mandatory to pullover when safe to do so to continue the conversation.</p> <p>Any person contravening this Policy will be subject to the Company's disciplinary procedure which may include termination of Employment/Contractor contract.</p>
Alcohol and Drug Policy	<p>All persons are to be in a "fit for work" state. This means must not be affected by alcohol or other drugs, (including prescription medication if inhibiting ability to operate plant and equipment safely) whilst at work.</p> <p>It is prohibited for any person to possess, use, sell or work under the influence of Alcohol or other Drugs.</p>
Contacts	<p>Transport for NSW Transport Management Centre 131 700</p> <p>Site Supervisor _____</p> <p>Emergency 000</p>

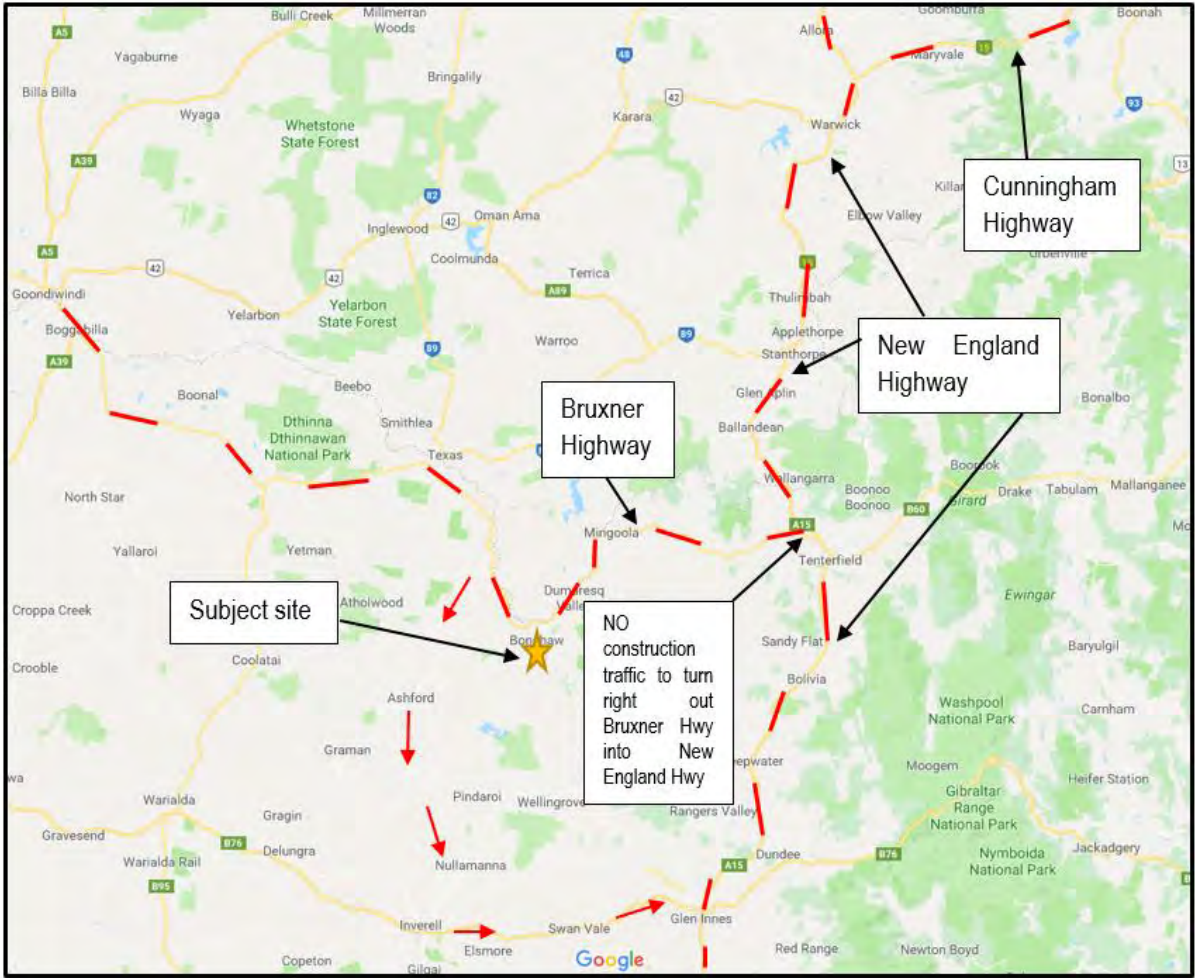


Figure 1 - Heavy and Over-Dimensional Vehicle Route



Figure 2 - Transport route to/from the site for ALL 19 m semi-trailers or greater (detail for northbound via New England Highway to use Sunnyside Platform Road)

Driver Declaration

I, the undersigned, hereby agree to abide by this Driver Code of Conduct for the transport of equipment, product or personnel to / from the construction site to the Bonshaw solar farm located off the Bruxner Highway, Bonshaw, NSW. I have read and understand the requirements outlined in the attached document and will, to the best of my ability, comply and assist with their implementation, requirements or ongoing administration.

The subject document to which this declaration relates is included as part of this overall document and signing of this declaration confirms that the signee has read and understood their requirements as outlined throughout.

Driver Details

Full Name	
Organisation	
Signature	
Date	

Representative of:

Full Name	
Signature	
Date	

Disciplinary action will be taken against drivers who do not adhere to this Code of Conduct.

APPENDIX C

UPDATED BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT



11:12 27/MAR/2019



North Coast Ecology ABN 59 175 957 475

GAIA Bonshaw Solar EIS

Revised Biodiversity Development Assessment Report

20 March 2020

Project No.: 0470861

Document details	
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Document subtitle	Revised Biodiversity Development Assessment Report
Project No.	0470861
Date	20 March 2020
Version	3.0
Author	Matt Jenkins North Coast Ecology BAAS 18029
Client Name	GAIA Australia

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				Name	Date	
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Final	02	Matt Jenkins	Joanne Woodhouse	David Dique	20 February 2020	Revision based on BCD review and comment
Final	03	Matt Jenkins	Joanne Woodhouse	Henrietta Jukes	20 March 2020	Addition of overhead transmission corridor

Signature Page

20 March 2020

GAIA Bonshaw Solar EIS

Revised Biodiversity Development Assessment Report



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Acronyms and Abbreviations

Name	Description
AoS	Assessment of Significance (under the EPBC Act)
AOBV	Areas of Outstanding Biodiversity Value
APZ	Asset Protection Zone
Assessment Area	Assessment Area refers to the 1,500m buffer area surrounding the Subject Land and other areas requiring consideration as part of the biodiversity values assessment in Stage 1 of the BAM
BAM	Biodiversity Assessment Method
BC Act	<i>NSW Biodiversity Conservation Act 2016</i>
BCD	Biodiversity Conservation Division of the Environment, Energy and Science Group in the NSW Department of Planning, Industry and Environment
BDAR	Biodiversity Development Assessment Report
BIA	Biodiversity Impact Assessment
BOSET	Biodiversity Offset Scheme Entry Threshold
BSA	Biodiversity Stewardship Agreement
Buffer area	All land within 1500 m of the Subject Land.
BV Map	Biodiversity Values Map
Candidate species	Threatened species requiring assessment other than 'ecosystem credit species' and 'species credit species'
Development Site	The area of land that is subject to either temporary or permanent impact. At the proposed Bonshaw solar farm, the development site includes the land proposed to install the solar arrays, perimeter fence, access roads, transmission line and ancillary construction areas. The development site is approximately 149.24 ha.
Ecosystem credits	Is a measurement of the value of threatened ecological communities, threatened species habitat for species that can be reliably predicted to occur with a PCT and PCTs generally. Ecosystem credits measure the loss in biodiversity values at a development site.
Ecosystem Credit Species	Are threatened species identified as such in the Threatened Biodiversity Data Collection and whose selection was based on the likelihood of occurrence of the species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection.
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>
ERM	Environmental Resources Australia Pty Ltd
FM Act	<i>NSW Fisheries Management Act 1994</i>
GAIA	GAIA Australia
Ha	Hectares
HBT	Hollow Bearing Tree
IBRA Bioregion	A bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes

Name	Description
IBRA Sub-region	A sub-region of a bioregion identified under the IBRA (Interim Biogeographic Regionalisation for Australia) system
KFH	Key Fish Habitat
Km	Kilometres
LEP	Local Environmental Plan
m	Metres
NSW	New South Wales
OEH	former New South Wales' Office of Environment and Heritage
PCT	Plant Community Type
Project Boundary	Project Boundary referred to in this report refers to Lot 2 DP 1039185
SAIL	Serious and Irreversible Impacts
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy (State and Regional Development) 2011
Species Credits	Species Credits is the class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates.
Species credit species	Species Credit Species are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits.
SSD	Stage Significant Development
Subject Land	Is the land to which the BAM is applied to assess the biodiversity values. In this assessment, the Subject Land is the same area as the Development Site. It represents the development footprint of the solar farm and associated infrastructure. It is restricted to the western portion of the property and has been the subject of all detailed assessments.
TEC	Threatened Ecological Community
ToS	Test of Significance (under BC Act 2016)
The Project	The construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid.
VIS	Vegetation Information System
WM Act	NSW Water Management Act 2000
WoNS	Weeds of National Significance

EXECUTIVE SUMMARY

Environmental Resources Australia Pty Ltd (ERM) was commissioned by GAIA Australia (GAIA) to prepare a Biodiversity Development Assessment Report (BDAR) to support an Environmental Impact Statement (EIS) for a proposed solar farm located within Lot 2 DP1039185, Bonshaw NSW.

The proposed development will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 200 MW and associated infrastructure, including a Lithium-ion Energy Storage System, supplying electricity to the national electricity grid. The Development Site includes all supporting infrastructure and site access points.

This BDAR was prepared in accordance with the requirements of the NSW *Biodiversity Conservation Act 2016*, including the Biodiversity Assessment Method (BAM) and Biodiversity Offsets Scheme (BOS). The BDAR also considers relevant matters associated with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the addresses the Secretary's Environmental Assessment Requirements (SEARs) provided for the Project.

Flora and fauna surveys were undertaken at the Development Site across four survey periods (11-13 September 2018 (spring), 11-14 December 2018 (summer), 25-28 March 2019 (autumn) and 21-22 January 2020 (summer)). Flora and habitat surveys included vegetation mapping along random meander transects and over 100 vegetation community observation points and 44 BAM plots. Targeted fauna surveys included amphibian call payback (three surveys), bird surveys (eight surveys), reptile surveys (eight surveys), arboreal/tree hollow dependent fauna surveys (eight camera trap over 28 trap nights), microchiropteran bat call recording (eight SongMeters totalling 28 trap nights) and fauna habitat observations (hollow bearing trees, ant/termite mounds, rocky areas, bird nests and creek lines).

The Subject Land is comprised of highly disturbed land whose current and historical land uses include livestock grazing and cropping. Several creeks (first, second and third order), representing tributaries of the Dumaresq River, occur within the Project Boundary along with eight farm dams. The majority of the Development Site consists of cleared grazing land (72%), with the remainder comprising disturbed native woodland vegetation (28%).

A total of 143 flora species in 47 families were recorded within the assessment area. This included a total of 111 native (78%) and 32 exotic (22%) species. No threatened flora species were recorded on the Subject Land. Vegetation occurring on the Subject Land is represented by the following four Plant Community Types (PCTs):

- PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion. Two vegetation zones of this PCT are present: moderate and low condition;
- PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion. Four vegetation zones of this PCT are present: moderate condition, low condition, very low condition and derived grassland;
- PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion. One vegetation zone of this PCT is present: low condition; and
- PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion. Three vegetation zones of this PCT are present: low condition, very low condition and derived grassland.

PCT 544 is considered to represent the following Threatened Ecological Community, which is listed as Endangered under the NSW *Biodiversity Conservation Act 2016*:

- White Box Yellow Box Blakely's Red Gum Woodland

The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of “important species” as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.

A total of 75 fauna species were recorded within the Project Boundary, including thirteen threatened species. Threatened species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bent-wing Bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), three vulnerable birds (Grey-crowned Babbler, Brown Treecreeper and Speckled Warbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were recorded as “definite” calls and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were recorded as “possible” calls by a microbat call identification expert. Brown Treecreeper and Speckled Warbler were recorded within the Project Boundary but not directly on the Subject Land.

An assessment of the impacts of the project on Matters of National Environmental Significance (MNES) within the Development Site was undertaken. A likelihood of occurrence and risk assessment was undertaken for each entity identified as likely to occur within the Project's locality. It was concluded that all TECs and threatened species as identified in the PMST would have low residual risk as a result of the Project. Therefore, assessments of significance and referral for assessment of the project to the Commonwealth Minister for the Environment is not required.

GAIA has undertaken significant steps to avoid, minimise and mitigate impacts to biodiversity. As part of the project refinement process, ERM provided advice to GAIA on areas which were of the highest priority for avoidance. This led to third and second order creeks and other conservation significant areas to be avoided.

The Project will result in the following direct impacts to flora and fauna:

- Removal of 40.97 ha of disturbed native vegetation pertaining to four PCTs and representing potential habitat for a range of threatened fauna species;
- Impacts to 116.83 ha of heavily disturbed grassland with vegetation integrity score <17;
- Removal of 34 hollow-bearing trees representing potential roosting and/or breeding habitat for threatened microchiropteran bats and other hollow-dependent species including threatened forest owls;
- Impacts to suitable foraging habitat for the Eastern Cave Bat in less disturbed areas of PCTs 516, 544, 594 and 516;
- Impacts to suitable breeding and foraging habitat components for the Bristle-faced Free-tailed Bat; and
- Removal of nests, nest trees and foraging habitat for the Grey-crowned Babbler.

Potential indirect impacts associated with the proposed development have been identified, including edge effects, fragmentation, and sedimentation and pollutant run-off. With consideration of the proposed management and mitigation measures, it is expected that potential indirect impacts will be reduced to acceptable levels and any residual impacts will be negligible.

Direct impacts to native vegetation and fauna habitat requiring offsets include:

- Impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion, requiring 65 ecosystem credits;
- Impacts on PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion, requiring 15 ecosystem credits;

- Impacts on PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion, requiring 249 ecosystems credits;
- Impacts on PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion, requiring 269 ecosystem credits;
- Impacts on Bristle-faced Free-tailed Bat habitat, requiring 1,180 species credits;
- Impacts on Eastern Cave Bat foraging habitat, requiring 1,030 species credits;
- Impacts on potential (assumed) breeding habitat for the Masked Owl, requiring 680 species credits; and
- Impacts on potential (assumed) breeding habitat for the Barking Owl, requiring 680 species credits.

This assessment has been completed in accordance with the BAM (OEH 2017a, 2018a) on behalf of GAIA. Overall the Subject Land is considered to be of moderate biodiversity value with impacts related to direct removal of native vegetation and fauna habitat and displacement of resident fauna. The proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 3,570 species credits. Retirement of these credits will be carried out in accordance with the *Biodiversity Conservation Regulation 2017* and the NSW Biodiversity Offsets Scheme.

STAGE 1: BIODIVERSITY ASSESSMENT

1. INTRODUCTION

GAIA Australia (GAIA) is seeking to develop a large scale solar photovoltaic (PV) generation facility and associated infrastructure with the capacity of 200 megawatts (MW) situated near Bonshaw in the Inverell Shire Council (ISC) of New South Wales (NSW) (the Project).

The Project is classified as State Significant Development (SSD) in accordance with Clause 20 Schedule 1 of the State Environmental Planning Policy (State and Regional Development) 2011 (SEPP) and will be assessed under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). This Biodiversity Development Assessment Report (BDAR) assesses the impacts of the Project according to the NSW Biodiversity Assessment Methodology (BAM) as required by the Secretary's Environmental Assessment Requirements (SEARs) for the proposal.

The aim of this BDAR is to undertake biodiversity and impact assessment of ecological values of the Subject Land in accordance with the BC Act. This BDAR also addresses the assessment requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

1.1 Assessment Requirements

On 16 August 2018, the Department of Planning and Environment (DPE) provided Secretary's Environmental Assessment Requirements (SEARs) for the Bonshaw Solar Farm (the Project).

A copy of the SEARs is attached to the EIS as Appendix A. The assessment requirements that specifically relate to biodiversity, are listed in Table 1.1.

Table 1.1 SEARs requirements and how they have been addressed.

Requirement	Section Addressed
An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with Section 7.9 of the <i>Biodiversity Conservation Act 2016</i> (NSW) the Biodiversity Assessment Method (BAM) and documented in a biodiversity development assessment report (BDAR), unless OEH (now BCD) and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values.	This BDAR has been prepared in accordance with the <i>Biodiversity Conservation Act 2016</i> , Biodiversity Conservation Regulation 2017 and the Biodiversity Assessment Method (BAM).
The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	Stage 2 of this BDAR, Chapter 6 to 8.
An assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the <i>Fisheries Management Act 1994</i> , and a description of the measures to minimise and rehabilitate impacts.	Section 5.2.

To inform preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DPE when preparing the SEARs. A copy of the former NSW Office of Environment and Heritage (OEH) advice to DPE was attached to the SEARs and matters relevant to the BDAR are listed in Table 1.2.

Table 1.2 Government agency requirements

Requirement	Section Addressed
DPI Fisheries	
<p>Aquatic Ecological Assessment</p> <p>The aquatic ecological environmental assessment should include the following information;</p> <ul style="list-style-type: none"> ■ A recent aerial photograph (preferably colour) of the locality (or reproduction of such a photograph) should be provided. ■ Area which may be affected either by the development or activity should be identified and shown on an appropriately scaled map (and aerial photographs). ■ Waterways within the area of development are to be identified. ■ The extent of aquatic habitat removal and riparian vegetation removal or modification which may result from the proposed development, ■ Details of the location and design of the waterway crossings or underground cabling through waterways. ■ Details of the methodology (e.g. trenching, boring) for any underground cabling passing through waterways. 	<p>Aquatic habitat is described in Section 5.7.6. Waterways are shown on the aerial photo in Figure 3.2, noting that they were dry (or very low water levels) during all survey periods due to extended drought conditions.</p> <p>The second and third order watercourses will be avoided through detailed design (including 20-30m riparian buffer zones measured from the high bank of the streams).</p> <p>Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings.</p> <p>Construction methodology is further detailed in the EIS.</p>
<p>Waterway Crossings</p> <p>The construction of permanent or temporary access tracks or underground cables through Little Oak Creek, Little Limestone Creek and unnamed creeks running into the Beardy River should be in accordance with DPI Fisheries Guideline document: Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).</p>	<p>The activities at the Development Site will not require any access track or cables through Little Oak Creek, Little Limestone Creek or tributaries to Beardy River.</p> <p>Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings.</p>

Requirement	Section Addressed
<p>Threatened Species, Populations And Ecological Communities</p> <p>The proposal should include a threatened aquatic species assessment (as per part 7A Fisheries Management Act 1994) to address whether there are likely to be any significant impacts on listed threatened species, populations or ecological communities listed under the Fisheries Management Act 1994. It should be specifically noted that the proposal is located within an area considered habitat of the threatened species Purple Spotted Gudgeon (<i>Mogurnda adspersa</i>). This species is known or expected to occur in Little Oak Creek and a number of nearby creeks. Threatened fish species mapping distributions are available at: http://www.dpi.nsw.gov.au/fishing/species-protection/threatened-speciesdistributions-in-nsw</p>	<p>A description of the aquatic habitat including consideration of the Purple Spotted Gudgeon is provided in Section 5.2 and an Assessment of Significance is provided in Appendix E.</p>
Biodiversity Conservation Division (BCD)	
<p>1. Biodiversity impacts related to the proposed development are to be assessed in accordance with Section 7.9 of the Biodiversity Conservation Act 2017, the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the <i>Biodiversity Conservation Act 2016</i> (s.6.12), Biodiversity Conservation Regulation 2017 (s6.8) and Biodiversity Assessment Method, unless OEH (now BCD) and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values.</p>	<p>This BDAR has been prepared in accordance with the <i>Biodiversity Conservation Act 2016</i>, Biodiversity Conservation Regulation 2017 and the Biodiversity Assessment Method (BAM).</p>
<p>2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.</p>	<p>Chapter 7</p>
<p>3. The BDAR must include details of the measures proposed to address the offset obligations as follows:</p> <ul style="list-style-type: none"> ■ The total number and classes of biodiversity credits required to be retired for the development/project; ■ The number and classes of like-for-like biodiversity credits proposed to be retired; ■ The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; ■ Any proposal to fund a biodiversity conservation action; ■ Any proposal to conduct ecological rehabilitation (if a mining project); ■ Any proposal to make a payment to the Biodiversity Conservation Fund. <p>If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.</p>	<p>Chapter 9</p>
<p>4. The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix A of the BAM.</p>	<p>All spatial data (ArcGIS format) will be provided to BCD in electronic format.</p>

Requirement	Section Addressed
5. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s.6.10 of the <i>Biodiversity Conservation Act 2016</i> .	Version 1 of this BDAR was co-prepared by Dr Adriana Corona Mothe (BAM Accreditation BAAS18113). Version 2 of this BDAR has been prepared by Matt Jenkins (BAM Accreditation BAAS18029) by amending Version 1 where required to address comments from BCD.

Following public exhibition of Version 1 of this BDAR, dated 26 July 2019, additional comments were received from the Biodiversity Conservation Division (BCD) of the Environment, Energy and Science Group in the NSW Department of Planning, Industry and Environment (formerly part of the Office of Environment and Heritage). This amended BDAR addresses comments and recommendations provided by the BCD in correspondence dated 2 December 2019 (refer Section 1.4 for summary of consultation and response).

1.2 The Project

The Project (Proposed Development) will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid. The Project is located approximately 16 kilometres (km) south of Bonshaw and 66 km north of Inverell and is wholly contained within the Inverell Local Government Area (LGA) (Figure 1.1). The Project would connect directly to the 330 kilovolt (kV) Dumaresq Substation located to the immediate west of the Project boundary.

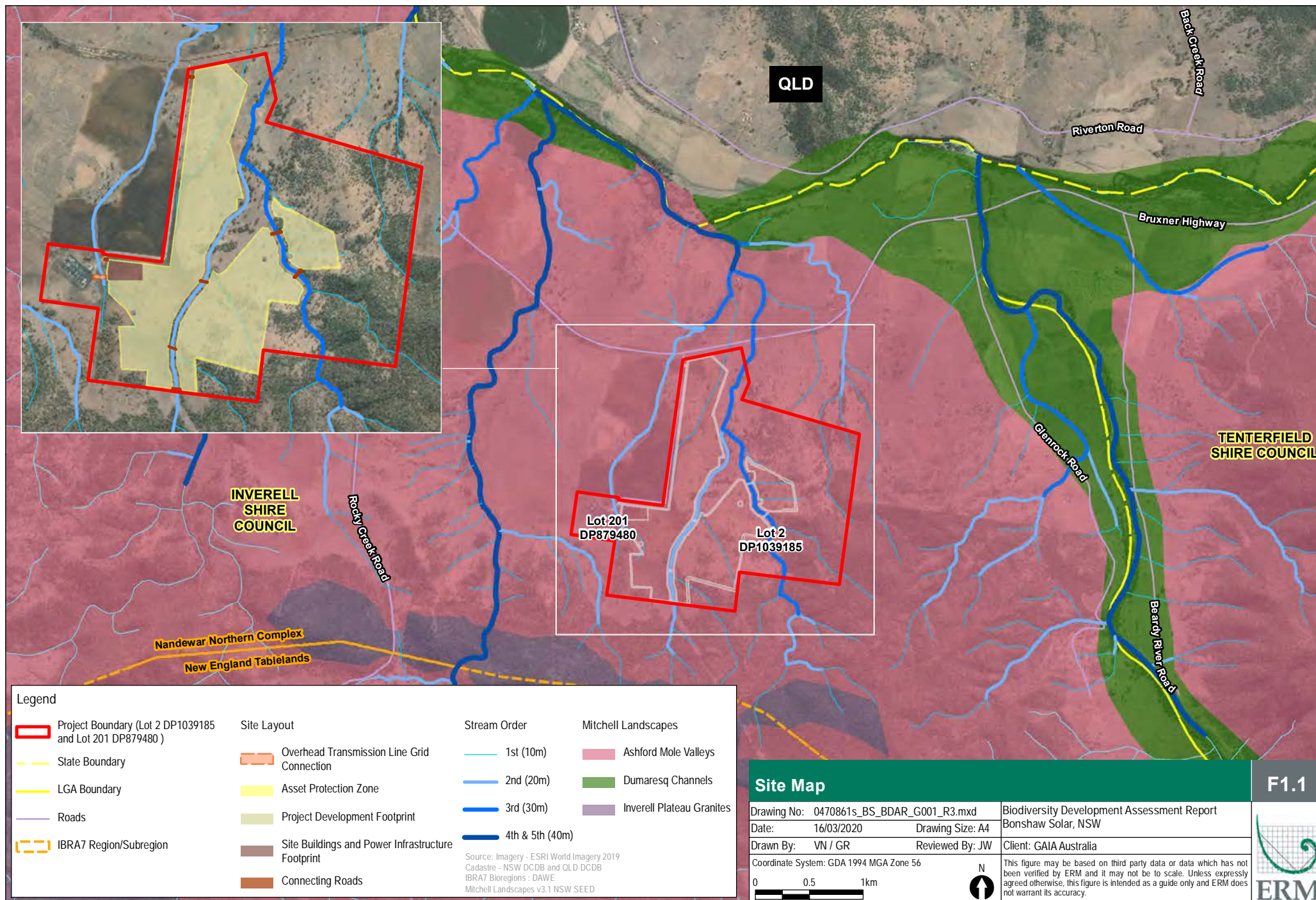
The Project incorporates arrays of PV modules (commonly referred to as “solar panels”), transmission infrastructure and substations to enable connection into the existing electricity transmission network (Figure 1.2). The exact method and point of connection is being developed with TransGrid in parallel with this planning application and the detailed infrastructure layout developed during detailed design will confirm the generating capacity of the Bonshaw Solar Farm.

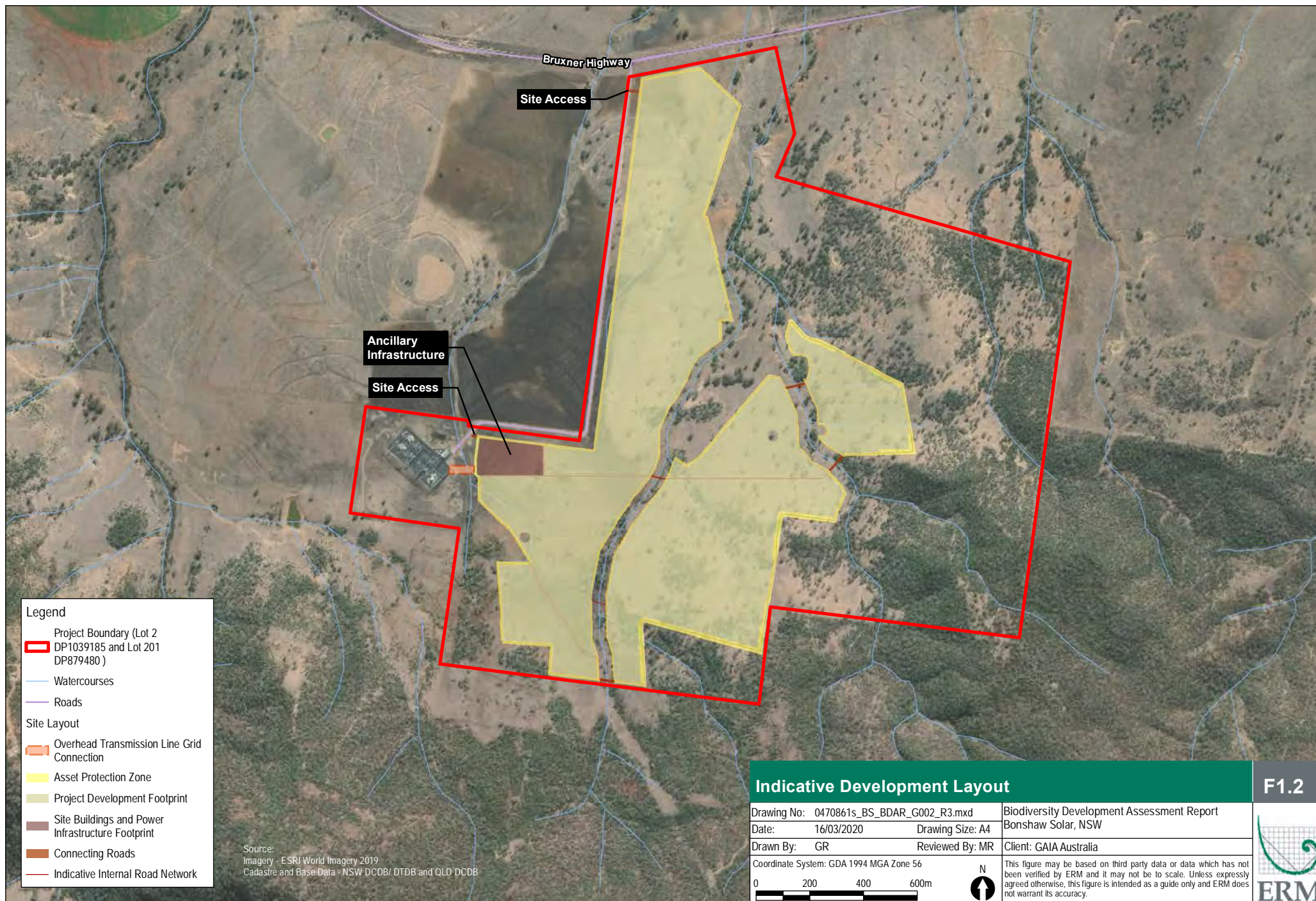
The key elements of the project include the construction and operation of:

- A network of PV modules in a fixed tilt or single axis tracking arrangement;
- Associated BESS(s) / battery storage;
- A switch yard to be connected to the 330 kV TransGrid Dumaresq Substation, on the boundary of the Project Area;
- Underground or overhead cabling for connection between arrays and inverters and transformers;
- Operations and maintenance (O&M) infrastructure, including O&M buildings including a control room, meeting facilities, a temperature controlled spare parts storage facility, supervisory control and data acquisition (SCADA) facilities, a workshop and associated infrastructure (e.g. kitchen, toilets and other facilities) car parking facilities;
- Access point to the site via the Bruxner Highway;
- A new internal road network to enable access from surrounding local roads to the array areas during construction and operations including internal access tracks, creek crossing & perimeter security fencing; and
- Temporary facilities during construction.

A full description of the Project is provided in the EIS and the final layout of the Project will be dependent on detailed design, availability and commercial considerations at the time of construction, however in terms of assessing biodiversity impacts, the following project features were considered:

- Four riparian crossings (indicative location on third and second order streams shown in Figure 1.2);
- Clearing of vegetation to be restricted to the identified 149.24 ha development footprint, noting that grazing beneath the solar panels will continue during operation of the solar farm (the height of the PV panels above natural ground is approximately 1.4 to 4.2 m based on tracker option to be used);
- Excavation of trenches and the laying of power and instrumentation cables;
- Main access point to the site via the Bruxner Highway;
- An internal private road network (up to a combined total length of approximately 13.7 km) connecting the arrays and other proposed infrastructure to the public road network; and
- A 10m-20m wide bushfire asset protection zone around the perimeter of the solar farm (located inside the identified development footprint).





F1.2

1.3 Site Description

Key features of the Subject Land are summarised in Table 1.3 below.

For the purposes of this BDAR report:

- The **Project Boundary** refers to Lot 2 DP 1039185.
- The **Subject Land** is the area that would be directly impacted by the Project. In accordance with the BAM (OEH 2017a), the term Subject Land is used in the Stage 1 – Biodiversity Assessment and the term **Development Site** is used in the Stage 2 – Impact Assessment. The terms Subject Land and Development Site are used interchangeably within this BDAR and are considered to be synonymous for the purpose of this assessment.
- The term **Assessment Area** is used in Stage 1 of this BDAR to refer to the 1,500m buffer surrounding the Subject Land and other areas requiring consideration as part of the biodiversity values assessment in Stage 1 of the BAM (OEH 2017).

Table 1.3 Key Features of the Subject Land

Key Feature	Description
Location Description	The proposed Bonshaw Solar Farm is located 16 km south of Bonshaw and 66 km north of Inverell.
Lot Description (Project Boundary)	Lot 2 DP 1039185
Subject Land	The Subject Land covers approximately 149.24 ha and corresponds to the western portion of Lot 2 DP1039185 and is partially bounded on its northern boundary by Bruxner Highway. To the south and east it is bounded by rural land and to the west, an unsealed road extends from Bruxner Highway to the existing 330kV TransGrid Dumaresq Substation located at the south-western corner.
Local Government Area	Inverell Local Government Area (LGA)
Elevation	The Project site is dominated by a gently undulating landscape to the north, forming steep slopes to the south and east dissected by second and third order streams. Based on a review of topographic maps and aerial imagery, landforms present within the Subject Land include drainage depressions, gentle to steeply inclining slopes, and upper flat ridges. The elevation at the Bruxner Highway (north boundary) is approximately 335 m and rises up to approximately 420 m in the south-western portion of the site. The ridgelines to the south of the project rise up to approximately 660 m forming the dominant landscape feature.
Previous Land Use	The Subject Land has undergone vegetation clearing associated with former land use for cropping and is currently used for sheep and cattle grazing.

1.4 Consultation

Following completion of the Spring 2018 and Summer 2018 survey periods, ERM's principal ecologist Joanne Woodhouse met with BCD (Krister Wearn) to discuss the survey methodology and preliminary survey results, particularly the positive identification of the Bristle-faced Free-tailed Bat (*Mormopterus eleyi*). The results of this meeting and follow up consultation were used to guide the Autumn 2019 survey methodology (additional BAM plots within the areas of native grasslands) and supplementary bat call analysis to confirm the positive species identification. A summary of the consultation is provided in Table 1.4 below.

Table 1.4 Summary of Consultation with BCD during preparation of the BDAR

Date	Contact Name	Summary	Response/Action
12 March 2019	<p>Meeting at BCD Grafton Office attended by:</p> <ul style="list-style-type: none"> ■ Krister Waern (BCD) ■ Joanne Woodhouse (ERM) ■ Luke Kim (GAIA, by phone) 	<p>ERM requested the meeting with BCD to discuss the survey methodology and preliminary survey results to date, particularly the positive identification of the Bristle-faced Free-tailed Bat (<i>Mormopterus eleryi</i>).</p> <p>Key points of discussion:</p> <p>Given the lack of information of the ecology of the Bristle-faced Free-tailed Bat (<i>Mormopterus eleryi</i>) ERM was seeking clarification on the species polygon determination and any additional survey requirements given that we already have a positive species identification. Given that acoustic detectors were the only survey method used, breeding habitat will be assumed to be present.</p> <p>Common Couch (<i>Cynodon dactylon</i>) is listed as native species in NSW however it is not listed in any of the PCT's identified within the Subject Land and has been introduced to the site as a pasture species. ERM was seeking clarification that we can exclude this species in the species richness calculations.</p> <p>ERM confirmed that the threatened flora surveys were undertaken as part of general observations and BAM plot areas, rather than parallel linear transect searches across the entire Subject Land.</p>	<p>BCD confirmed that information on the Bristle-faced Free-tailed Bat is not extensive and they would seek clarification from BCD's threatened species specialist.</p> <p>For other records of threatened microchiropteran bats e.g. Eastern Cave Bat (<i>Vespadelus troughtoni</i>) no additional targeted survey for breeding habitat is required although it is recommended that photographic evidence is provided as justification. Photos of rocky outcrops to be provided to confirm no viability as breeding habitat for this species.</p> <p>BCD will provide advice on the proposed exclusion of Common Couch as a native species within the Subject Land.</p> <p>Additional floristic plots required in derived native grasslands and cleared land. Derived native grassland determination to be updated based on vegetation integrity scores. Offset requirements to be determined based on integrity scores of: >15 (if PCT is a TEC), >17 (if PCT is associated with TS habitat) or >20 (if PCT is not a TEC or is associated with TS habitat).</p> <p>Vegetation mapping to be updated to merge PCT patches which are located within 100m of each other.</p> <p>BCD agreed that the threatened flora survey methodology was reasonable and should be supported by a figure to confirm that the Subject Land was effectively covered during the survey period.</p>

Date	Contact Name	Summary	Response/Action
21 March 2019	Letter from OEH (now BCD) to ERM	<p>BCD provided formal advice following the meeting held on 12 March and confirmed that:</p> <ul style="list-style-type: none"> Each vegetation zone (including areas of high weed occurrence and improved pasture areas) are required to detail the vegetation integrity survey plots as described in the BAM. All native plants in NSW (including Common Couch) are required to be considered as native plants for the purposes of applying the BAM, even if they do not naturally occur within the nominated PCT. The draft vegetation mapping appears to be focused on the canopy of the trees. The vegetation mapping should also consider the mid-storey and native ground cover to map the broader extent of the PCT. This is particularly important where canopy spacing within open forest and woodland communities can be up to 100m apart. BCD information suggests that <i>Mormopterus eleryi</i> cannot be easily distinguished from <i>Scotorepens greyii</i> by anabat call. Catching the bat is the most reliable way to determine the species presence. <p>If <i>Mormopterus eleryi</i> is confirmed on site, and based on ERMs current records and the habitat requirements of the species, most of the subject property may be captured when determining the species polygon.</p>	<ul style="list-style-type: none"> ERM undertook and additional four days in the field and an additional 28 floristic survey plots to ensure effective coverage of the all areas of grassland in accordance with advice from BCD and the requirements of the BAM. ERM have updated the assessment and Common Couch (<i>Cynodon dactylon</i>) is now included within the calculations. Vegetation mapping and calculations of areas have been updated. ERM have obtained a supplementary report to confirm the accuracy of the <i>Mormopterus eleryi</i> call identification. Greg Ford (Balance! Environmental) is a recognised expert on Australian bats, with specialist expertise in acoustic analysis of bat echolocation calls for species identification. As described in Appendix I, analysis by Balance! Environmental of numerous full-spectrum data-sets from several regions where <i>M. eleryi</i> and <i>S. greyii</i> are known to co-exist has consistently found examples of two distinctive foraging sequence types that concur with the diagnostic descriptions of Corben (2010). An overview of these findings and promotion of the inclusion of feeding buzz analysis in call identification reporting was presented recently at the International Society of Ecoacoustics Congress (Ford 2018). Support for the use of this approach has also been received from several bat-call analysis experts based throughout eastern Australia. Based on this advice, ERM has prepared this assessment based on the results of the call identification and does not consider that harp trapping is required in this instance to confirm presence. Refer to Section 5.7.4.1 and ToS in Appendix E for detailed discussion and assessment. <p>The species polygon has been prepared based on the advice from BCD and is provided in Section 5.7.4.1.</p>

Date	Contact Name	Summary	Response/Action
2 December 2019	Letter BCD to DPIE	<p>BCD provided formal advice to DPIE following public exhibition of Version 1 of this BDAR, dated 26 July 2019. In summary, the following recommendations were provided in relation to biodiversity:</p> <ul style="list-style-type: none"> ■ The BDAR should be reviewed, updated and certified to comply with the BC Act and resubmitted as part of the proposal. ■ The BDAR should ensure adequate consideration of the NVR mapping for the site. ■ Ensure the correct application of the streamlined assessment module – clearing paddock trees. ■ The BDAR should be updated to include reference to existing threatened species habitat mapping. ■ The BDAR should provide further justification of the Masked Owl to ensure it has been adequately considered. ■ The BDAR should be updated to remove the recommendation to change the offset requirement for vegetation zone 11. ■ The future vegetation integrity scores for all vegetation zones is to be reduced to zero. ■ The BAM Calculator is to be updated and finalised for review. ■ The mitigation measures as outlined in Table 7.1 of the BDAR should form part of any proposed development consent conditions. 	<ul style="list-style-type: none"> ■ ERM have engaged Matt Jenkins (Accredited Assessor - North Coast Ecology) to review, update and certify the BDAR and BAM Calculator assessment accordingly. ■ NVR mapping has been addressed in Section 4.1.2 of this BDAR. ■ The Streamlined assessment module – clearing of paddock trees has been removed from this BDAR due to the occurrence of threatened species habitat and application of the full BAM on the Subject Land in its entirety. ■ Existing important habitat mapping has been addressed in Section 5.1.1. ■ Masked Owl foraging and breeding habitat is assumed to be present and a species polygon has been provided as shown in Figure 5.3. ■ The vegetation integrity score for vegetation zone 11 was incorrectly calculated in BAM-C. The revised calculations are provided in Section 4.3.2. ■ Future vegetation integrity scores have been reduced to zero for all vegetation zones as shown in Section 4.3.2. ■ The BAM Calculator has been updated and will be finalised upon finalisation and certification of this BDAR. ■ The mitigation measures provided in Table 7.1 shall be used to formulate conditions of development consent.

1.5 Key Sources of Information used in the Assessment

The following key information sources were used in preparation of this BDAR: Proposed development layers and project footprint as provided by GAIA.

Key Sources of Information used in the Assessment

Online Resources

Australian Government's Species Profiles and Threats (SPRAT) database. Accessed online at <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

NSW Department of Planning, Industry and Environment (DPIE) Threatened Biodiversity Profile Search. Accessed online at <http://www.environment.nsw.gov.au/threatenedspeciesapp/>

NSW Department of Primary Industry (DPI) profiles of threatened species, populations and ecological communities. Accessed online at <https://www.dpi.nsw.gov.au/fishing/threatened-species>

Commonwealth Department of Environment, Climate Change & Water (DECCW) National Recovery Plan. White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. A critically endangered ecological community. May 2011.

Commonwealth Department of Environment and Energy (DEE) Protected Matters Search Tool Accessed online at <http://www.environment.gov.au/epbc/protected-matters-search-tool>

Australia's IBRA Bioregions and sub-bioregions. Accessed online at <http://www.environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps>

Native Vegetation Regulatory (NVR) Map. Accessed online via <https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap>

NSW Department of Environment and Climate Change (DECC) (2007). Identification Guidelines for Endangered Ecological Communities. White Box – Yellow Box – Blakely's Red Gum Woodland.

NSW Department of Environment and Climate Change (DECC) (2002). Descriptions for NSW (Mitchell) Landscapes, Version 2.

NSW OEH Mitchell Landscapes database v3 2011. Accessed via <https://data.gov.au/dataset/e64597db-453c-46be-a352-360b775d2852>

NSW OEH's Biodiversity Assessment Method (BAM) calculator. Accessed online via <https://www.lmbc.nsw.gov.au/bamcalc>

NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas of threatened biodiversity data collection (TBDC). Accessed online at http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

NSW Department of Planning, Industry and Environment (DPIE) Vegetation Classification Database. Accessed online via login at <http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx>

NSW Department of Planning, Industry and Environment (DPIE) VIS mapping. Accessed online via <http://www.environment.nsw.gov.au/research/VISmap.htm>

OEH (2017) Biodiversity Assessment Method.

OEH (2018a) Biodiversity Assessment Method Operational Manual – Stage 1.

Key Sources of Information used in the Assessment

NSW Government SEED Mapping. Accessed online via
https://geo.seed.nsw.gov.au/Public_Viewers/index.html?viewer=Public_Viewers&locale=en-AU

NSW Biodiversity Values Map. Accessed online via
<https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap>

Threatened Species Scientific Committee (TSSC) Advice to the Minister for the Environment and Heritage from the TSSC on Amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) – Box Gum Grassy Woodland.

Literature Review

OEH (2015) BRG-Namoi Regional Native Vegetation Mapping. Technical Notes. NSW Office of Environment and Heritage, Sydney.

Peacock R., Rolhauser A., Thönnell J. and Law E. (2009) Extant and potential natural vegetation of Yallaroi, Ashford, Bingara and Inverell 1:100,000 scale map sheet, NSW. NSW Department of Environment, Climate Change and Water.

Other literature consulted during preparation of this BDAR is referenced within the text.

The aerial imagery used in this BDAR is sourced from ESRI World Imagery (DigitalGlobe) dated 27 November 2016. Mapping has been produced using Geographic Information System (GIS). The following maps and data are provided:

- Digital mapping with aerial photography showing 1:1000 or finer
- Site Map (Figure 1.1) as described in subsection 4.2.1.1 and 4.2.1.3 of the BAM
- Location Map (Figure 3.2) as described in subsection 4.2.1.2 and 4.2.1.3 of the BAM

2. LEGISLATIVE CONTEXT

The project has been assessed against key biodiversity legislation and government policy, including:

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);
- NSW Environmental Planning and Assessment Act 1979 (EP&A Act);
- NSW Biodiversity Conservation Act 2016 (BC Act);
- NSW Local Land Services Act 2013 (LLS Act);
- NSW Fisheries Management Act 1994 (FM Act); and
- NSW Biosecurity Act 2015 (BS Act).

Table 2.1 Applicable Legislation, Plan and Guidelines

Commonwealth Legislation		
Commonwealth <i>Environmental Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)		
<p>The <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) requires approval of the Commonwealth Minister for Environment (formerly the Minister of Sustainability, Environment, Water, Population and Communities) for actions that may have a significant impact on Matters of National Environmental Significance (MNES). The EPBC Act is administered by the Commonwealth Department of Environment and Energy (DoEE) and lists threatened species, ecological communities and other MNES. Any proposed action that is expected to have an impact on MNES must be referred to the Minister for assessment under the EPBC Act, or assessed under the accredited process between the Commonwealth and the State of NSW.</p>		
Matters of National Environmental Significance	Application to the Subject Land	Addressed
World heritage properties	Not identified within the Subject Land	Not applicable
National heritage places	Not identified within the Subject Land	Not applicable
Ramsar wetlands of international importance	Not identified within the Subject Land	Not applicable
Listed threatened species and communities	Threatened species have been recorded within the locality and have potential habitat available within the Subject Land (Development Site). No Threatened Ecological Communities (TEC) are present.	<i>Chapter 5 and Appendix C & D</i>
Internationally protected migratory species	Migratory species are identified as potentially occurring within the Subject Land.	<i>Appendix C & D</i>
Commonwealth marine areas	Not identified within the Subject Land	Not applicable
The Great Barrier Reef Marine Park	Not identified within the Subject Land	Not applicable
Nuclear actions	Not applicable	Not applicable
A water resource, in relation to coal seam gas development and large coal mining development	Not applicable	Not applicable

Statutory Legislation and Guidelines

Biodiversity Conservation Act 2016 (BC Act)

The NSW *Biodiversity Conservation Act 2016* came into effect on 25 August 2017. The BC Act replaced the NSW *Threatened Species Conservation Act 1995*, the NSW *Nature Conservation Trust Act 2001* and parts of the NSW *National Parks and Wildlife Act 1974*. The BC Act establishes mechanisms for:

- The management and protection of listed threatened species of native flora and fauna (excluding fish and marine vegetation) and threatened ecological communities (TECs).
- The listing of threatened species, TECs and key threatening processes.
- The development and implementation of recovery and threat abatement plans.
- The declaration of critical habitat.
- The consideration and assessment of threatened species impacts in development assessment process.
- Biodiversity Offsets Scheme, including the Biodiversity Values Map and method to identify serious and irreversible impacts (SAIL).

The BC Act establishes a new regulatory framework for assessing and offsetting biodiversity impacts on proposed developments. Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the Biodiversity Assessment Method (BAM). A Biodiversity Values Map and Biodiversity Offsets Scheme Entry Threshold (BOSET) tool are available to identify the presence of mapped biodiversity values within land proposed for development as well as the clearing thresholds that would trigger application of the BAM.

The Biodiversity Offsets Scheme applies to all local developments, major projects or the clearing of native vegetation where the State Environmental Planning Policy (Vegetation in Non - Rural Areas) 2017 applies. Any of these will also require entry into the Biodiversity Offsets Scheme if they occur on land mapped on the Biodiversity Values Map. ERM has reviewed and can confirm that part Lot 202 DP874273, is not currently mapped on the Biodiversity Values Map (see BOSET report in *Appendix A*) although as a major project, it does trigger the Biodiversity Offsets Scheme.

In terms of the proposed solar farm, the proposed development must take into account species likely to occur within available habitat based on existing records of threatened species and ecological communities, as well as those species likely to occur based on geographic distribution and presence of potential habitat (refer to *Appendix D*)

Water Management Act 2000

A controlled activity approval under the *Water Management Act 2000* (WM Act) is required for certain types of developments and activities that are carried out in or within 40 m of a river, lake or estuary.

The WM Act provides a number of mechanisms for protection of water sources via the water management planning process. If a 'controlled activity' is proposed on 'waterfront land', an approval is required under Section 91(2) of the WM Act. 'Controlled activities' include; the construction of buildings or carrying out of works; the removal of material or vegetation from land by excavation or any other means; the deposition of material on land by landfill or otherwise. 'Waterfront land' is defined as 'the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and 40 metres inland from either the highest bank or shore'.

Major projects are exempt from requiring approvals under the Water Management Act 2000.

Biosecurity Act 2015

The NSW *Biosecurity Act 2015* came into effect on 1 July 2017, effectively replacing the *Noxious Weeds Act 1993*, and 13 other Acts, with a single Act. Under the Noxious Weeds Act all landowners have a responsibility to control noxious weeds on their property. Under the Biosecurity Act the same responsibility will apply and will be known as a General Biosecurity Duty.

The General Biosecurity Duty states “Any person who deals with biosecurity matter or a carrier and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.” The general biosecurity duty applies to all weeds listed in Schedule 3 of the Biosecurity Act (also included as Weeds of National Significance (WoNS)).

As detailed in Section 5.7.1, a total of 32 exotic species, including five high threat exotic (HTE) were recorded within the Subject Land. Two of those exotic species, Tiger Pear (*Opuntia aurantiaca*) and Velvet Tree Pear (*Opuntia tomentosa*) are listed as WoNS. A weed species of genus *Senecio* was also recorded, and the potential presence of Fireweed (*Senecio madagascariensis*) cannot be precluded.

A strategic plan for each WoNS has been developed to define responsibilities and identify strategies and actions to control the weed species. These can be downloaded from:

<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

Fisheries Management Act 1994

The *Fisheries Management Act 1994* provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. Similar to the BC Act, the Fisheries Management Act 1994 lists threatened species, populations and ecological communities of fish and marine vegetation. Consideration of likely occurrence of threatened fish in the waterways in the Subject Land is provided in Section 5.2.

Any waterway crossings along the internal access roads will need to consider an appropriately designed structure that does not obstruct fish passage and will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings. Notwithstanding this, it is noted that a permit under section 219 would not be required for waterway crossings as section 89J(e) of the EP&A Act excludes projects approved under Part 4 of the EP&A Act from requiring “a permit under section 201, 205 or 219 of the Fisheries Management Act 1994”.

SEPP No. 44 – Koala Habitat Protection

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. A review of SEPP 44 is currently under consideration. The key changes proposed in the amended SEPP 44 relate to the definitions of koala habitat; list of tree species; list of councils; and development assessment process.

SEPP 44 currently applies to land in relation to which a development application has been made within the LGAs as listed in Schedule 1, which includes Inverell LGA. An assessment of Koala habitat values has been provided in Section 5.1.

Local Land Services Act 2013

The Native Vegetation Regulatory (NVR) Map designates areas of NSW to which Part 5A of the *Local Land Services Act 2013* applies. NVR mapping guides the application of the land management code and allowable activities as part of the land management framework for NSW.

An assessment of NVR mapping and relevant land categories is provided in Section 4.1.2.

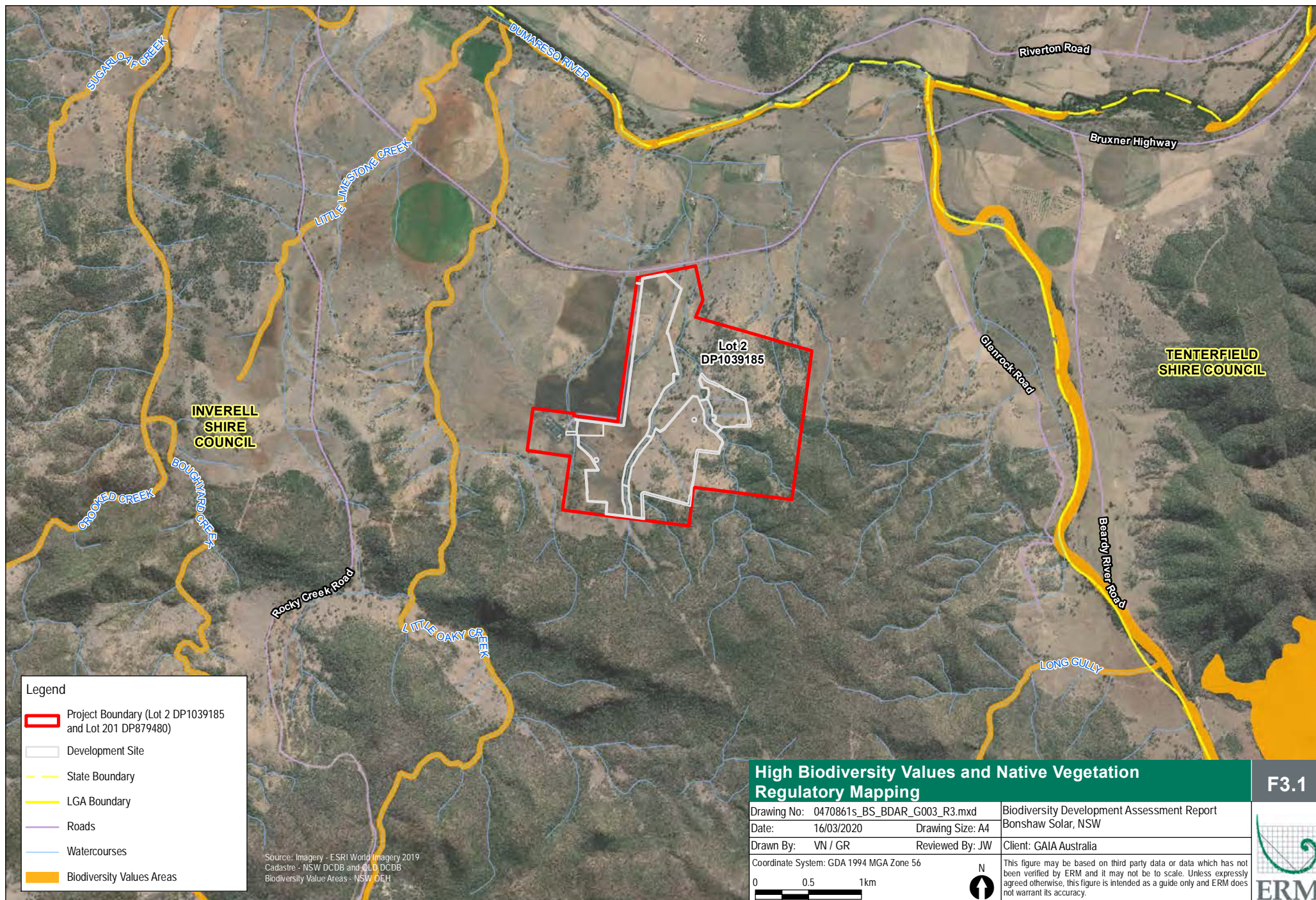
3. LANDSCAPE FEATURES

The identification of landscape features within the Subject Land was determined in accordance with Section 4 of the BAM (OEH 2017a), as summarised in Table 3.1 below.

Table 3.1 Summary of Landscape Features

Landscape Feature	Description
IBRA Bioregion	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 Subject Land is located within the NSW Nandewar Bioregion. The Nandewar region consists of hills on Palaeozoic sediments; lithosols and earths, including <i>Eucalyptus albens</i> woodlands. This region is characterized by summer rainfall (Environment Australia 2000).
IBRA Subregion	The Subject Land is located within the NSW Nandewar Northern Complex subregion. This subregion is described as low hills and ranges with abundant rock (granite) outcrop and tors. Short, steep gorges of major rivers. Karst landscapes on limestone. This IBRA Subregion is mapped as a Priority 4 investment region (OEH 2017b).
NSW Landscape Regions and Area	The Subject Land is mapped in the Ashford Mole Valleys Mitchell Landscape.
Percent Native Vegetation	<p>A combination of existing mapping and ground truthed vegetation was used to estimate the Percent Native Vegetation Cover as follows:</p> <ul style="list-style-type: none"> Existing vegetation mapping was used to estimate the percent native vegetation within the 1500 m buffer area surrounding the Subject Land (see Figure 3.2). In the buffer area, PCTs were allocated based on existing vegetation mapping of the Inverell Shire as mapped by Peacock et. al. (2009) (VIS ID 3794) and aerial imagery. GIS was used to estimate the area. Ground-truthed vegetation was used to estimate the portion of native vegetation within the Subject Land. PCT allocation was based on existing mapping and current vegetation condition (see Chapter 4). The Percent Native Vegetation Cover was calculated by estimating the percent cover of native vegetation in the buffer area and Subject Land relevant to the benchmark for the PCT. <p>Ten PCTs are mapped in the 1500 m buffer area (Table 4.1), covering approximately 1,273.70 ha. This represents 67.63% native vegetation cover within the assessment area (1,883.30 ha).</p>
Cleared Areas	Approximately 107.79 ha (72 %) of land within the Subject Land represents cleared grazing land. Cleared areas are primarily grazed land (cattle and sheep), which provides limited foraging habitat for native species. Sheep can graze very close to the ground and like other livestock can lead to loss of vegetation and soil erosion particularly during the dry conditions encountered during the survey period.

Landscape Feature	Description
Rivers, Streams and Estuaries	<p>Three major un-named creeks (tributaries of the Dumaresq River) are present within the Project Boundary (Lot 2 in DP 1039185). The largest of these creeks traverses the development site in a general north-southerly direction and is mapped as a third order stream (Strahler, 1952). The other two creeks are mapped as First Order Streams, and are located to the east and west of the third order stream. These streams were all noted to be dry (or very low water levels) at the time of the survey due to extended drought conditions.</p> <p>A review of the NSW Department of Infrastructure (DPI) threatened freshwater fish records (accessed via SEED), confirms that these creeks are not mapped as habitat of threatened aquatic species. The nearest creek with threatened aquatic species habitat is Little Oak Creek, located approximately 1.7 km west from the Subject Land.</p> <p>Aquatic habitat is described further in Section 5.2 and a preliminary aquatic impact assessment is provided in Section 5.7.6.</p>
Wetlands	<p>No wetlands occur in or adjacent to the Development Site.</p> <p>Aerial photographs show six farm dams are present within the Subject Land. These dams were all noted to be dry (or very low water levels) at the time of the survey due to extended drought conditions.</p>
Connectivity Features	<p>A wildlife corridor is a link of wildlife habitat, generally native vegetation, which joins two or more larger areas of similar wildlife habitat. Corridors are critical for the maintenance of ecological processes including allowing for the movement of animals and the continuation of viable populations. The Subject Land is located immediately north of a regional vegetated corridor that connects Crooked Creek National Park and Torrington State Conservation Area.</p> <p>Isolated paddock trees scattered across the development site also represent limited connectivity features for highly mobile species to travel across the landscape.</p> <p>The creeks present within the Subject Land have the potential to provide aquatic connectivity to Dumaresq River although it is noted that these streams were all dry (or very low water levels) at the time of the survey due to extended drought conditions and any connectivity would be seasonal at best.</p> <p>The Subject Land is not located within (or close to) any identified migratory bird flyways including the East Asian – Australasian Flyway and the West Pacific Flyway.</p>
Areas of Geological Significance	<p>No karsts, caves, crevices or cliffs or other areas of geological significance occur within the Development Site or are likely to occur within the broader Subject Land.</p>
Areas of Outstanding Biodiversity Value (AOBV)	<p>No Areas of Outstanding Biodiversity Value occur within the Development Site or the broader Subject Land.</p>
High Biodiversity Values Map	<p>In accordance with the NSW Biodiversity Values Map (See Figure 3.1 and BOSET report in Appendix A), the Subject Land does not contain high biodiversity values. The nearest area mapped with high biodiversity values are Little Oak Creek and Beardy River, located at approximately 1.7 km to the west and 2.3 km to the east, respectively.</p>
Native Vegetation Regulatory (NVR) Mapping	<p>The <i>Local Land Services Act 2013</i> (LLS Act) sets out several land categories that appear on the Native Vegetation Regulatory Map (NVR Map). The main purpose of this map is to govern clearing of vegetation associated with agricultural activities in rural areas. NVR mapping is shown in Figure 3.1 and addressed in detail in Section 4.1.2.</p>

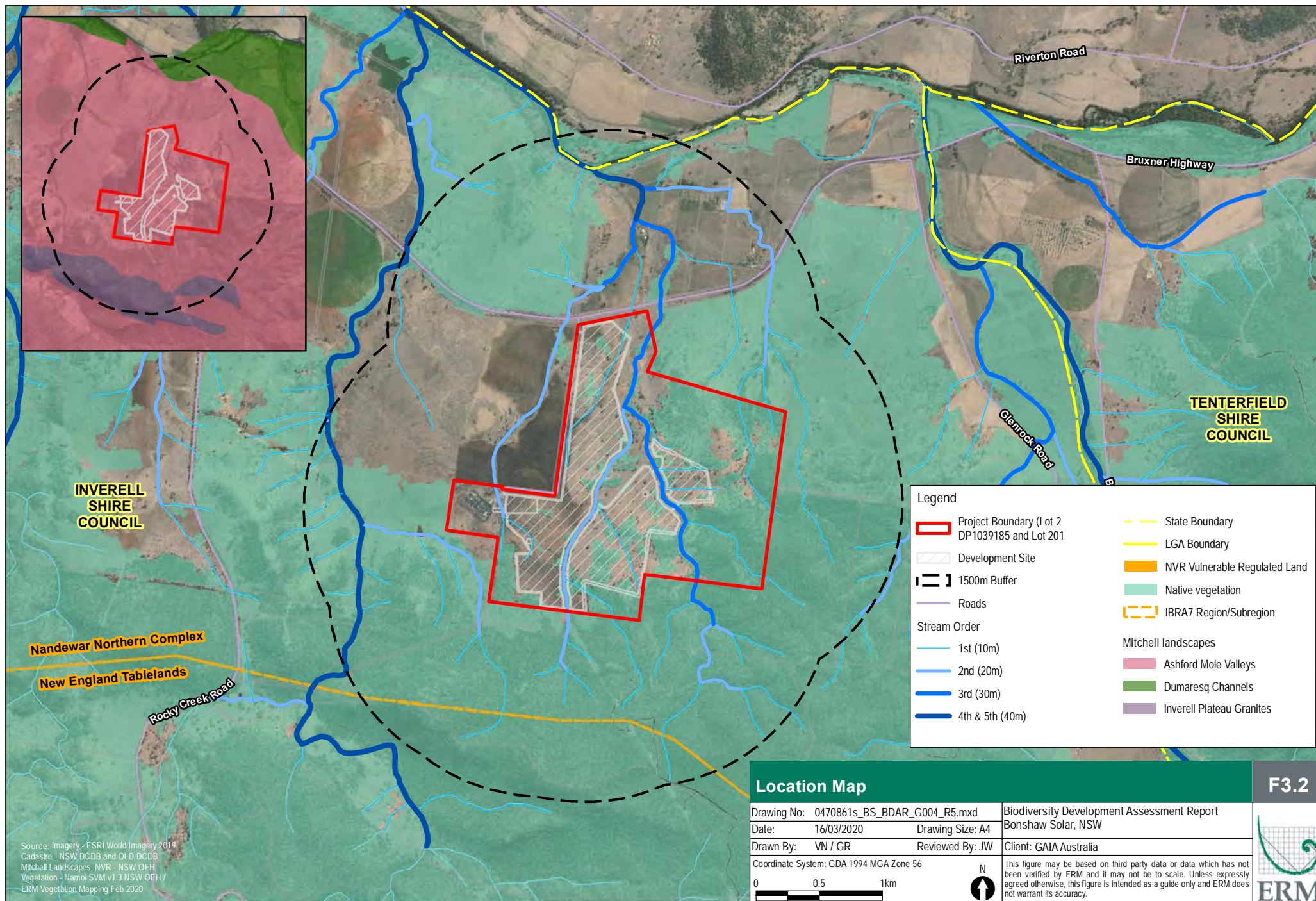


Legend

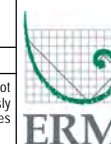
- Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
- Development Site
- State Boundary
- LGA Boundary
- Roads
- Watercourses
- Biodiversity Values Areas

Source: Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB
Biodiversity Value Areas - NSW OEH

High Biodiversity Values and Native Vegetation Regulatory Mapping			F3.1
Drawing No: 0470861s_BS_BDAR_G003_R3.mxd		Biodiversity Development Assessment Report	
Date: 16/03/2020	Drawing Size: A4	Bonshaw Solar, NSW	
Drawn By: VN / GR	Reviewed By: JW	Client: GAIA Australia	
Coordinate System: GDA 1994 MGA Zone 56		<small>This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.</small>	
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F3.2



4. NATIVE VEGETATION

The extent of native vegetation within the development site was determined in accordance with Section 5 of the BAM (OEI 2017a).

The development site is currently primarily used for sheep and cattle grazing. Native vegetation is highly modified by both historical and ongoing management practices including clearance of the original vegetation type, livestock grazing and weed invasion. A large portion of the development site is cleared and disturbed land, the majority of which no longer reflects the species composition of the community from which it was likely derived. Forb diversity and coverage is very low, dominated by those species tolerant of heavy grazing.

Woodland areas show evidence of varying degrees of impact, the most notable being on-going clearing and presence of monospecific stands (e.g. White Cypress Pine) due to a long history of timber removal. Vegetation within the development site comprises:

- 29.17 ha Native Vegetation;
- 11.80 ha Derived Native Grasslands; and
- 107.79 ha Disturbed Grasslands.

These vegetation areas total 148.76 ha. The remaining 0.48 ha of the development footprint include cleared lands and six farm dams.

4.1 Native Vegetation Assessment Methodology

4.1.1 Review of Existing Information

A search was undertaken of the NSW Department of Planning, Industry and Environment (DPIE) Vegetation Information System (VIS) database and NSW SEED (Sharing and Enabling Environmental Data) mapping to access existing vegetation mapping information within the Subject Land. The State Vegetation Type Map – Borders Rivers Gwydir / Namoi (VIS ID 4681) provides vegetation mapping for the Inverell Shire. This state vegetation type map (SVTM) is based on regional mapping in Peacock *et al.* (2009) (VIS ID 3794) and identifies seven Plant Community Types (PCTs) within the Subject Land and eleven PCTs within the 1,500m buffer area as listed in Table 4.1 below and depicted in Figure 4.1.

Table 4.1 Mapped Vegetation Communities (SVTM VIS 4681) within the Buffer Area and Subject Land (not ground-truthed)

PCT ID	PCT Name	Extent in Buffer Area (ha)	Extent in Development Site (ha)
NA	Cleared Land	609.60	108.03
1	Candidate Native Grasslands	389.86	0
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion	27.38	0
84	River Oak – Rough-barked Apple – Red Gum – Box riparian tall woodland (wetland) of the Brigalow Belt South and Nandewar Bioregions	14.73	0
505	Black Cypress Pine - Tumbledown Red Gum - Narrow-leaved Ironbark - Stringybark She Oak open forest on acid volcanics of the western New England Tableland Bioregion	1.07	0
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	42.04	3.00

PCT ID	PCT Name	Extent in Buffer Area (ha)	Extent in Development Site (ha)
544 *	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / Woodland of the Nandewar Bioregion and New England Tableland Bioregion	8.37	0.83
549	Silver-leaved Ironbark – Black Cypress Pine +/- White Box shrubby open forest mainly in the northern Nandewar Bioregion	194.97	0
578	Tumbledown Red Gum - Black Cypress Pine - Caley's Ironbark shrubby open forest of the Nandewar Bioregion and western New England Tableland Bioregion	2.96	0
594	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	225.39	13.65
596	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	366.21	11.70
599	Blakely's Red Gum - Yellow Box grassy tall woodland on flats and hills in the Brigalow Belt South Bioregion and Nandewar Bioregion	0.71	0

* PCT 544 corresponds to the BC Act listed endangered ecological community (EEC) "White Box Yellow Box Blakely's Red Gum Woodland", which also corresponds to part of the EPBC listed critically endangered ecological community (CEEC) "White Box Yellow Box Blakely's Red Gum Woodland".

4.1.2 Native Vegetation Regulatory Mapping

The *Local Land Services Act 2013* (LLS Act) sets out several land categories that appear on the Native Vegetation Regulatory Map (NVR Map). The main purpose of this map is to govern clearing of vegetation associated with agricultural activities in rural areas. However, there are important implications that affect DA assessment for one of the land categories: Category 1 – Exempt Land. This category is broadly intended to identify land that has been previously legally cleared or that comprises low conservation value grasslands. The Category 1 layer has not yet been released, but will appear as a blue layer on the completed map. While the map is being finalised, rural landholders are responsible for determining the categorisation of their land based on the criteria listed in the LLS Act.

Clearing of native vegetation for development on land that meets the definition of Category 1 land does not require assessment or offsetting under the BAM. In practice, this means that native vegetation on Category 1 land is not included in any area clearing calculations when determining whether a BDAR should be prepared. A BDAR may still be required if the development will result in:

- A prescribed impact (these are listed in [clause 6.1 of the Biodiversity Conservation Regulation](#)), not including native vegetation clearing associated with the prescribed impact
- A likely significant impact on threatened species or ecological community based on the threatened species test of significance

As identified in Section 60F of the LLS Act (Transitional arrangement until preparation of maps), an area is taken, during the transitional period, to be low conservation value grasslands if it comprises only groundcover whose clearing was permitted by section 20 of the Native Vegetation Act 2003, as in force immediately before the repeal of that Act. Note. Generally that section permitted clearing if the vegetation comprised less than 50% of indigenous species of vegetation.

Disturbed grassland areas of the Subject Land (i.e. previously cleared grazing land) are not considered to represent Category 1 – exempt land as they do not meet the definition provided for low conservation value grasslands (i.e. remaining groundcover vegetation is generally not comprised of <50% of indigenous species). Furthermore, given the presence of some threatened species habitat components (e.g. scattered hollow-bearing trees and stags) the application of the BAM to the entirety of the Subject Land is considered to be appropriate in this instance.

The Subject Land is therefore considered to represent Category 2 – Regulated Land. Some areas of steep land in the south-eastern portion of Lot 2 DP1039185 are currently mapped as Vulnerable Regulated Land, as shown in Figure 3.1.

4.1.3 Targeted Floristic Survey

Based on the results of the desktop assessment presented in Table 4.1 above, flora surveys were undertaken in September 2018, December 2018, March 2019 and January 2020 as follows:

- The first survey was undertaken between the 10th and 14th September 2018 by ERM ecologists, Joanne Woodhouse and Dr Adriana Corona Mothe. The aim of the initial survey was to determine the PCTs on the development site and their condition on site. Random meander transects were conducted in areas of native vegetation and rapid vegetation assessments were undertaken to record the presence of native vegetation, threatened flora and to ground-truth existing mapping. PCT's were identified from the native species present, landforms and physiography and location within the IBRA subregion with reference to the BioNet Vegetation Classification Database. The Subject Land was then stratified into areas of similar condition class to determine vegetation zones for each PCT and detailed floristic surveys were undertaken on 11 - 12 September 2018.
- The second survey was undertaken between the 10th and 14th December 2018 by ERM ecologists Tom Cotter and Dr Adriana Corona Mothe. Vegetation integrity plots (20m by 50m) were established in each vegetation zone over three days on the 11 - 13 December 2018. Data was collected on the composition, structure and function of the vegetation in accordance with the methodology presented in the BAM 2017 and under the directions of persons accredited under the BAM. The number of plots for each zone was based on the area of each zone and the minimum number of plots and transects required per zone area as specified by the BAM.
- The third survey was undertaken between the 25 and 29 March by Dr Toivo Zoete and Dr Adriana Corona Mothe and included additional vegetation integrity plots over four days from 25 to 28 March 2019.
- The fourth survey was undertaken on 21 and 22 January 2020 by accredited assessor Matt Jenkins (North Coast Ecology) and ecologist Chloe Hanrahan (ERM). This survey was completed in order to review existing PCT and vegetation zone mapping prepared during previous surveys.

A total of four PCTs comprising 12 vegetation zones were identified on the Subject Land as listed in Table 4.4 and mapped in Figure 4.2. Based on the assessment of each PCT, it was decided to stratify each of the four PCTs based on the following:

- Absence of upper stratum, condition of the stratum and composition. Due to the high level of disturbance at the Development Site, treed areas were commonly represented by a single species of trees or the presence of trees were significantly reduced when compared with tree composition and structure as per PCTs descriptions.
- Structure and function of the vegetation in other stratum, e.g. ground cover.
- Presence of exotic species and their abundance/cover as well as bare ground.

Each vegetation zones was considered homogeneous and well represented by the plot data. As outlined in Table 4.2, a total of 42 flora plots were collected in accordance with section 5 of the BAM (OEH 2017) by ecologists trained in the BAM (Joanne Woodhouse and Adriana Corona Mothe) and under the direction of Dr Adriana Corona Mothe who is accredited under the BAM. An additional two plots were completed during the January 2020 survey by Matt Jenkins (accredited under the BAM) and Chloe Hanrahan (ERM ecologist). At each plot location the following was undertaken:

- one 20 x 20 m plot for assessment of composition and structure; and
- one 20 x 50 m plot for assessment of function, including a series of five 1 x 1 m plots to assess average leaf litter cover.

The assessment of composition and structure recorded species name, stratum, growth form, cover and abundance rating for each species present within the plot. Cover (foliage cover) was estimated for all species rooted in or overhanging the plot, and recorded using decimals (if less than 1%, rounded to whole number (1 - 5%) or estimated to the nearest 5% (5 - 100%). Abundance was counted (up to 20) and estimated above 20.

The assessment of function recorded the number of large trees, the presence of tree stem size class, tree regeneration, number of trees with hollows and length of fallen logs, as well as leaf litter cover within the 20 x 50 m plot and five 1 x 1 m subplots. The minimum number of plots and transects per vegetation zone was determined using Table 4 of the BAM (OEH 2017a). Portions of the land within the study area are either cleared land, cropped or consist of exotic grassland. Under the BAM (OEH 2017a), land not containing native vegetation is not subject to assessment beyond Section 5.4 (determination of a vegetation integrity score). A large proportion of grassland occurs within the development site, ranging from exotic with few native grass species, to areas of low diversity native pasture. Cleared land and disturbed grasslands were assigned to the most likely PCT and mapped as "Disturbed Grasslands".

4.1.4 PCT Identification

The method used for PCT identification included the following:

- Use of the BioNet Vegetation Classification's Community Identification keys. Search Criteria used included Vegetation Formation, Vegetation Class, IBRA Region and selected community species in the upper / mid / low stratum. This search produced a shortlist of potential PCTs.
- Selection of the PCT was undertaken by comparing the descriptions of each potential PCT with characteristics of the vegetation such as landform location, species composition and other landscape features relevant to the vegetation community. When the vegetation community under assessment was likely to conform to more than one PCT, the decision on a given PCT over other options was based on presence of characteristic species, species richness and other aspects of the PCT description.
- The condition of the PCT was defined based on the absence of upper stratum, dominance of exotics over natives and percentage bare land present.
- Where derived grasslands were identified, the most likely PCT was allocated based on number of native species shared with a given PCT, its location, landscape features and the neighbouring PCTs.

4.2 PCTs Identified in the Subject Land

Determination of PCTs within the Subject Land identified the presence of four Plant Community Types (PCT) as shown in Table 4.2 below.

Table 4.2 Plant Community Types Occurring within the Subject Land

Plant Community Type		Vegetation Formation	Vegetation Class
ID No	Name		
516	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
544	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
594	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	North-west Slopes Dry Sclerophyll Woodlands
596	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Dry Sclerophyll Forests (Shrub/grass sub-formation)	North-west Slopes Dry Sclerophyll Woodlands

A detailed description of each of these PCTs follows in Table 4.3 to Table 4.6.

Table 4.3 PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion**PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion**

Vegetation Formation	Dry Sclerophyll Forest (Shrub/grass sub-formation)	
Vegetation Class	North-west Slopes Dry Sclerophyll Woodlands	
Vegetation Type	PCT ID:	594
	PCT's Common Name:	Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion
	Condition	Moderate Low
Description	<p>Tall woodland to open forest dominated by Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>). Other trees may include White Box (<i>Eucalyptus albens</i>), White Cypress Pine (<i>Callitris glaucophylla</i>), Tumbledown Red Gum (<i>Eucalyptus dealbata</i>), Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) and less often Smooth-barked Apple (<i>Angophora leiocarpa</i>). The shrub layer is sparse to mid-dense and includes <i>Olearia elliptica</i>, <i>Notelaea microcarpa</i> var. <i>microcarpa</i>, <i>Hibbertia obtusifolia</i>, <i>Melichrus urceolatus</i>, <i>Xanthorrhoea johnsonii</i>, <i>Acacia elongata</i>, <i>Breynia cernua</i>,</p>	

PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion

	<p><i>Acacia leiocalyx</i> subsp. <i>leiocalyx</i>, <i>Acacia penninervis</i> var. <i>penninervis</i>, <i>Beyeria viscosa</i> and <i>Pimelea neo-anglica</i>. The ground layer is sparse with frequent grass species including <i>Eragrostis leptostachya</i>, <i>Enneapogon gracilis</i>, <i>Aristida ramosa</i>, <i>Cymbopogon refractus</i>, <i>Austrostipa scabra</i> and <i>Aristida vagans</i>. Forb species include <i>Dichondra repens</i>, <i>Vittadinia cuneata</i>, <i>Brunoniella australis</i>, <i>Dichondra</i> sp. A, <i>Rostellularia adscendens</i> subsp. <i>adscendens</i>, <i>Scleria mackaviensis</i> and <i>Phyllanthus virgatus</i>. The rock ferns <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> and <i>Cheilanthes distans</i> are common. Climbers include <i>Parsonsia eucalyptophylla</i>, <i>Desmodium brachypodum</i> and <i>Desmodium varians</i>. Occurs on shallow loamy sand soils mostly derived from sandstone on hills with rocky outcrops mainly in the northern Nandewar Bioregion from north of Bingara to Arakoola with outliers in the Mole River district. The PCT is found on conglomerate and sandstone on hills and low hills.</p> <p>At the Subject Land the PCT is present in both moderate and low condition. Dominant tree species recorded were Silver-leaved Ironbark, White Box and White Cypress Pine. Some areas of the community lack Eucalypt trees completely and identification of likely PCT was based on landform and characteristic ground cover species. Species characteristic of the community include <i>Oxalis perennans</i>, Poison Pimelea (<i>Pimelea neo-anglica</i>), <i>Mielichrus urceolatus</i>, Purple Wiregrass (<i>Aristida ramosa</i>), Speargrass (<i>Austrostipa scabra</i> subsp. <i>scabra</i>), Yellow Burr-daisy (<i>Calotis lappulacea</i>), Slender Flat-sedge (<i>Cyperus gracilis</i>), Barbed Wrie Grass (<i>Cymbopogon refractus</i>), <i>Cheilates sieberi</i>, <i>Glycine clandestina</i> and Corrugated Sida (<i>Sida corrugata</i>).</p>
Approximate extent within Subject Land	<p>Moderate: 4.10 ha</p> <p>Low: 9.54 ha</p>
BAM Plots in PCT	<p>Moderate: Four plots (P2, P7, P15 and P16)</p> <p>Low: five plots (P1, P9, P17, P21 and P40)</p>
Justification of evidence used to identify the PCT	<p>PCTs 594 and 596 had similar distributional patterns and a total of nine species characteristic of each PCT was recorded in some of these plots, including White Cypress Pine, which is listed as a dominant species in both PCTs.</p> <p>The decision was made to select PCT 594 based on the abundance of <i>Austrostipa scabra</i> subsp. <i>scabra</i>, <i>Sporobolus creber</i> and/or Poison Pimelea which are characteristic species of PCT 594 and are absent in PCT 596.</p> <p>This PCT was identified relying on the presence of species typical of the PCT as follows:</p> <p>Upper stratum: dominated by Silver-leaved Ironbark</p> <p>Mid-stratum: presence of White Cypress Pine and/or Poison Pimelea</p> <p>Ground stratum: presence of <i>Oxalis perennans</i>, <i>Austrostipa scabra</i> subsp. <i>scabra</i>, <i>Cymbopogon refractus</i> and <i>Aristida ramosa</i></p> <p>The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.</p>
TEC Status	PCT 594 is not associated with a TEC
Estimate of percent cleared	53%

PCT 594: Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion

Images of PCT
within the
Subject Land



Photograph 4-1 View of PCT 594 in Plot 2




Photograph 4-2 View of PCT 594 in Plot 21

PCT – Plant Community Type; TEC – Threatened Ecological Community

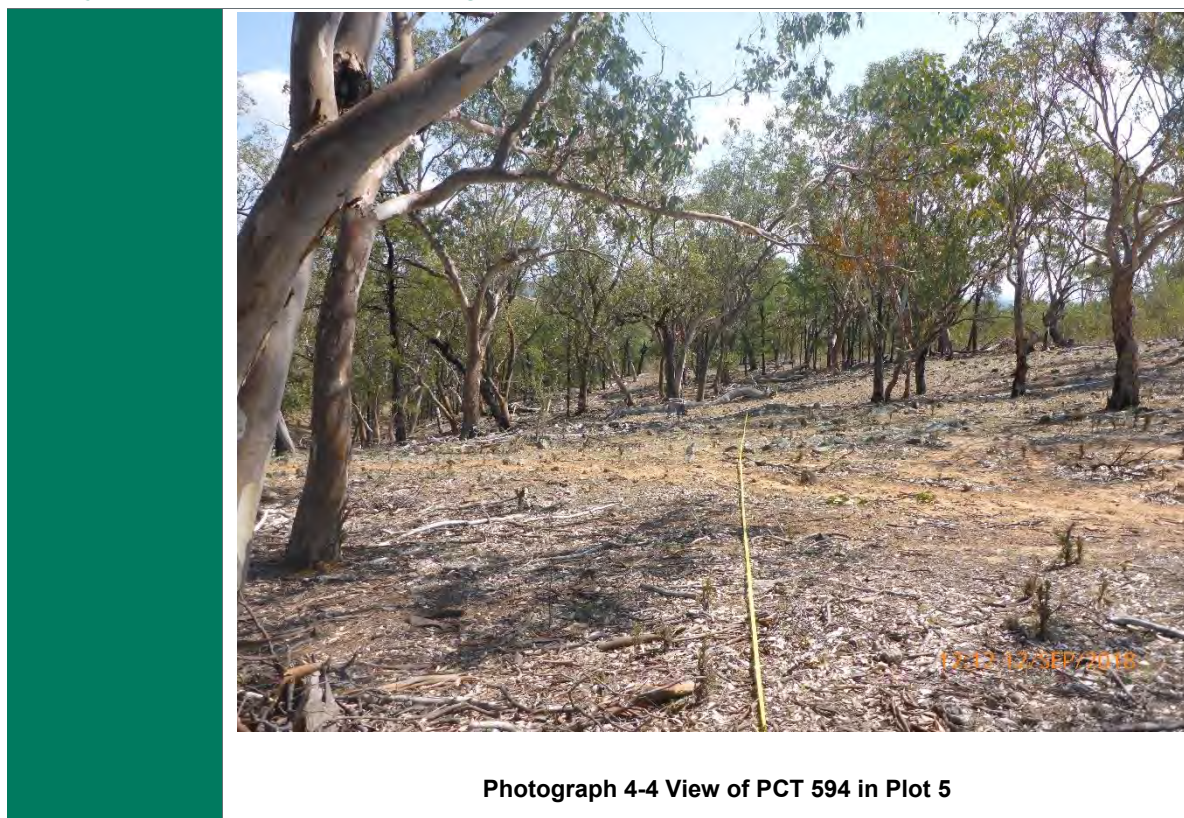
Table 4.4 PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion**PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion**

Vegetation Formation	Dry Sclerophyll Forest (Shrub/grass sub-formation)	
Vegetation Class	North-west Slopes Dry Sclerophyll Woodlands	
Vegetation Type	PCT ID:	596
	PCT's Common Name:	Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion
	Condition	Moderate Low Very Low Derived Native Grassland
Description	<p>Mid-high to low woodland or open forest dominated by Tumbledown Red Gum (<i>Eucalyptus dealbata</i>), White Cypress Pine (<i>Callitris glaucophylla</i>) and Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>). Other tree species may include Caley's Ironbark (<i>Eucalyptus caleyi</i> subsp. <i>caleyi</i>), Rough-barked Apple (<i>Angophora floribunda</i>), Long-fruited Bloodwood (<i>Corymbia dolichocarpa</i>), Black Cypress Pine (<i>Callitris endlicheri</i>) and Rusty Fig (<i>Ficus rubiginosa</i>). There is usually a dense shrub/small tree layer of species such as <i>Leptospermum brevipes</i>, <i>Acacia cheelii</i>, <i>Notelaea microcarpa</i> var. <i>microcarpa</i>, <i>Melichrus urceolatus</i>, <i>Xanthorrhoea johnsonii</i> and <i>Leucopogon muticus</i>. The vine <i>Pandorea pandorana</i> is often abundant. The ground layer is sparse with <i>Cheilanthes distans</i>, <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>, <i>Aristida vagans</i>, <i>Cymbopogon refractus</i>, <i>Entolasia stricta</i> and <i>Aristida ramosa</i> most frequent. Forb species include <i>Plectranthus parviflorus</i>, <i>Commelina cyanea</i>, <i>Scleria mackaviensis</i>, <i>Dichondra</i> species A, <i>Calotis lappulacea</i>, <i>Phyllanthus virgatus</i>, <i>Vittadinia sulcata</i> and <i>Galium guadichaudii</i>. Occurs on shallow loamy sand soils in hilly areas at low altitudes.</p> <p>At the Subject Land, the PCT is present in a disturbed state due to the long history of clearing, grazing and timber removal. Upper stratum is represented by Tumbledown Red Gum (<i>Eucalyptus dealbata</i>), Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>), Black Cypress Pine (<i>Callitris endlicheri</i>) and White Cypress Pine (<i>Callitris glaucophylla</i>). Other species present include: Purple Wiregrass (<i>Aristida ramosa</i>), Bristly Cloak Fern (<i>Cheilanthes distans</i>), Barbed Wire Grass (<i>Cymbopogon refractus</i>), Slender Flat-sedge (<i>Cyepus gracilis</i>), Slender Tick-trefoil (<i>Desmodium varians</i>), Urn-heath (<i>Melichrus urecolatus</i>), Thargomindah Nightshade (<i>Solanum sturtianum</i>), Yellow Burr-daisy (<i>Calotis lappulacea</i>), Johnson's Grass Tree (<i>Xanthorrhoea johnsonii</i>), <i>Glycine clandestina</i> and <i>Vittadinia sulcata</i>.</p>	
Approximate extent within the Subject Land	<p>Moderate: 11.15 ha Low: 0.25 ha Very Low: 0.30 ha Derived Grassland in Low condition: 9.04</p>	
BAM Plots in PCT	<p>Moderate: four plots (P8, P10, P11 and P12) Low: two plots (P3 and P5) Very Low: one plot (P41) Derived Grassland in Low condition: four plots (P14, P23, P26 and P29)</p>	

PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

Justification of evidence used to identify the PCT	<p>This PCT was identified relying on the presence of dominant tree species and other typical species of the PCT as follows:</p> <ul style="list-style-type: none"> ■ Upper stratum: dominated by Tumbledown Red Gum and Silver-leaved Ironbark ■ Mid-stratum: dominated by White Cypress Pine, presence of other species such as Black Cypress Pine ■ Ground stratum: presence of <i>Cheilantes distans</i>, a frequent species in the PCT; along with other species such as Thargomindah Nighshade. <p>The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.</p>
Species relied upon for PCT identification	Tumbledown Red Gum, Silver-leaved Ironbark, Black Cypress Pine, White Cypress Pine, Barbed Wire Grass and Bristly Cloak Fern (<i>Cheilantes distans</i>).
TEC Status	PCT 596 is not associated with a TEC
Estimate of percent cleared	38%
Images of PCT within the Development Site	 <p style="text-align: center;">Photograph 4-3 View of PCT 596 in Plot 10</p>

PCT 596: Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion



Photograph 4-4 View of PCT 594 in Plot 5

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

Table 4.5 PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Vegetation Formation	Grassy Woodlands	
Vegetation Class	Western Slopes Grassy Woodlands	
Vegetation Type	PCT ID:	516
	PCT's Common Name:	Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion
	Condition	Moderate (occurring adjacent to Subject Land) Very Low (occurring within Subject Land) Derived Native Grasslands in Moderate condition (occurring within Subject Land)
Description	This PCT is described as widespread, mid-high to very tall woodland or open forest occurring on flat to undulating sites at low to mid elevation, mainly on fine-grained soils on sedimentary and metasedimentary substrates. It is dominated by Grey Box	

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

	<p>(<i>Eucalyptus moluccana</i>) (crossing with <i>Eucalyptus albens</i> at sites with basalt influence) which is associated with Blakely's Red Gum (<i>Eucalyptus blakelyi</i>), Yellow Box (<i>Eucalyptus melliodora</i>) and/or White Cypress Pine (<i>Callitris glaucophylla</i>), with occasional Rough-barked Apple (<i>Angophora floribunda</i>). A sparse shrub layer of <i>Notelaea microcarpa</i> var. <i>microcarpa</i> and/or <i>Dodonaea viscosa</i> subsp. <i>spatulata</i> is sometimes present. The ground layer is dense and diverse, containing a mix of grasses and forbs including <i>Cymbopogon refractus</i>, <i>Austrostipa scabra</i> subsp. <i>scabra</i>, <i>Aristida ramosa</i>, <i>Asperula conferta</i>, <i>Bothriochloa decipiens</i>, <i>Daucus glochidiatus</i>, <i>Dichanthium sericeum</i> subsp. <i>sericeum</i>, <i>Carex inversa</i>, <i>Chrysocephalum apiculatum</i>, <i>Cymbonotus lawsonianus</i>, <i>Dichondra</i> sp. A, <i>Glycine tabacina</i>, <i>Poa sieberiana</i>, <i>Desmodium varians</i>, <i>Eremophila debilis</i>, <i>Austrodanthonia racemosa</i> var. <i>obtusata</i>, <i>Austrostipa verticillata</i>, <i>Dichondra repens</i>, <i>Hydrocotyle laxiflora</i>, <i>Plantago debilis</i>, <i>Rostellularia adscendens</i> subsp. <i>adscendens</i>, <i>Chloris ventricosa</i>, <i>Geranium solanderi</i> var. <i>solanderi</i>, <i>Cyperus gracilis</i>, <i>Hypericum gramineum</i>, and (rarely) <i>Panicum paludosum</i>. This community is found in the undulating floors of the major river valleys of the Nandewar and far western New England bioregions.</p> <p>At the Subject Land, the community is highly disturbed with few characteristic species present, including: White Cypress Pine (<i>Callitris glaucophylla</i>), Silver-leaved Ironbark (<i>Eucalyptus melanophloia</i>), Small-leaf Bluebush (<i>Maireana microphylla</i>), Purple Wiregrass (<i>Aristida ramosa</i>), <i>Dichondra</i> sp. A, Red Grass (<i>Bothriochloa decipiens</i>) and Speargrass (<i>Austrostipa scabra</i> subsp. <i>scabra</i>),</p>
Approximate extent within the Subject Land	<p>Moderate: 0 ha Very Low: 3.00 ha Derived Grassland in Moderate condition: 2.76 ha</p>
BAM Plots in PCT	<p>Moderate: one plot (P38) Very Low: three plots (P31, P39 and P42) Derived Grassland in Moderate condition: two plots (P28 and P32)</p>
Justification of evidence used to identify the PCT	<p>PCT 516 was identified based on the presence of characteristic species of this vegetation community and its distribution at landform elements such as drainage depression.</p> <p>This PCT was identified relying on the presence of species typical of the PCT as follows:</p> <ul style="list-style-type: none"> ■ Upper stratum: Grey Box ■ Mid-stratum: presence of Small-leaf Bluebush ■ Ground stratum: presence of <i>Dichondra</i> sp. A, Purple Wiregrass, Speargrass and Red Grass <p>The condition of this PCT was selected based on the presence of upper stratum, cover of exotic species (e.g. Tiger Pear) and intensity of sheep and cattle grazing.</p>
Species relied upon for PCT identification	<p>Grey Box, Small-leaf Bluebush, Purple Wiregrass, <i>Dichondra</i> sp. A, Red Grass and Speargrass</p>
TEC Status	<p>PCT 516 is not associated with a TEC</p>
Estimate of percent cleared	<p>85%</p>

PCT 516: Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion

Images of PCT within the
Subject Land



Photograph 4-5 View of Moderate Condition PCT 516 in Plot 38




Photograph 4-6 View of Very Low Condition PCT 516 in Plot 42

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

Table 4.6 PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion		
Vegetation Formation	Grassy Woodlands	
Vegetation Class	Western Slopes Grassy Woodlands	
Vegetation Type	PCT ID:	544
	PCT's Common Name:	Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion
	Condition	Moderate (occurring adjacent to Subject Land) Low (occurring within Subject Land)
Description	<p>This PCT is described as tall open forest to woodland dominated by Rough-barked Apple (<i>Angophora floribunda</i>) in association with Blakely's Red Gum (<i>Eucalyptus blakelyi</i>), White Cypress Pine (<i>Callitris glaucophylla</i>) or Yellow Box (<i>Eucalyptus melliodora</i>) or Black Cypress Pine (<i>Callitris endlicheri</i>) or White Box (<i>Eucalyptus albens</i>). The shrub layer is sparse comprising species such as <i>Notelaea microcarpa</i> var. <i>microcarpa</i>, <i>Leptospermum polygalifolium</i> subsp. <i>transmontanum</i>, <i>Olearia elliptica</i>, <i>Leptospermum brevipes</i>, <i>Beyeria viscosa</i>, <i>Cassinia quinquefaria</i>, <i>Dodonaea viscosa</i> subsp. <i>angustifolia</i>, <i>Pimelea neo-anglica</i>, <i>Maireana microphylla</i> and <i>Acacia neriifolia</i>. The ground layer is often dense and is comprised of the mat-rush (<i>Lomandra longifolia</i>) and a range of grasses including <i>Microlaena stipoides</i> var. <i>stipoides</i>, <i>Bothriochloa macra</i>, <i>Austrostipa verticillata</i>, <i>Echinopogon caespitosus</i>, <i>Eragrostis leptostachya</i> and blady grass (<i>Imperata cylindrica</i>). Forb species include <i>Dichondra</i> sp. A, <i>Dichondra repens</i>, <i>Plantago debilis</i>, <i>Oxalis perennans</i>, <i>Rostellularia adscendens</i> subsp. <i>adscendens</i>, <i>Swainsonia galegifolia</i>, <i>Urtica incisa</i>, <i>Cynoglossum australe</i> and <i>Vittadinia dissecta</i>. Sedges include <i>Cyperus gracilis</i> and <i>Carex inversa</i>. The invasive weed Coolatai grass (<i>Hyparrhenia hirta</i>) occurs at some sites. Occurs on a variety of alluvial or colluvial soils from sand to loamy-clay soil along stream banks and on valley flats throughout the Nandewar and west New England Tableland Bioregions. Grades into ID84 River Oak Riparian Woodland or ID78 River Red Gum woodland. Similar to the Rough-barked Apple woodland ID281 in the BBS Bioregion. Mainly cleared and often weed infested. A threatened community.</p> <p>At the Subject Land the PCT is present in low condition. Dominant tree species recorded were Rough-barked Apple (<i>Angophora floribunda</i>), Yellow Box (<i>Eucalyptus melliodora</i>) and White Cypress Pine (<i>Callitris glaucophylla</i>). Other characteristic species included <i>Notelaea microcarpa</i> var. <i>microcarpa</i>, <i>Beyeria viscosa</i>, <i>Maireana microphylla</i>, <i>Pimelea neo-anglica</i>, <i>Microlaena stipoides</i> var. <i>stipoides</i> and <i>Austrostipa verticillata</i>.</p>	
Approximate extent within the Subject Land	Moderate: 0 ha Low: 0.83 ha	
BAM Plots in PCT	Moderate: one plot (P43) Low: one plot (P44)	
Justification of evidence used to identify the PCT	PCT 544 was identified based on the presence of characteristic species of this vegetation community and its distribution at landform elements such as bank (streambank), stream bed, stream channel.	

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely’s Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

	<p>This PCT was identified relying on the presence of species typical of the PCT as follows:</p> <ul style="list-style-type: none"> ■ Upper stratum: Rough-barked apple and Yellow box ■ Mid-stratum: presence of <i>Notelaea microcarpa</i> var. <i>microcarpa</i>, <i>Beyeria viscosa</i>, <i>Maireana microphylla</i>, <i>Pimelea neo-anglica</i> ■ Ground stratum: presence of <i>Microlaena stipoides</i> var. <i>stipoides</i> and <i>Austrostipa verticillata</i> <p>The condition of this PCT was selected based on the cover/integrity of upper stratum.</p>
Species relied upon for PCT identification	As above
TEC Status	<p>PCT 544 corresponds to the NSW listed endangered ecological community (EEC) “White Box Yellow Box Blakely’s Red Gum Woodland”.</p> <p>The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of “important species” as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.</p>
Estimate of percent cleared	65%
Images of PCT within the Subject Land	

Photograph 4-7 View of Moderate Condition PCT 544

PCT 544: Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion



Photograph 4-8 View of Low Condition PCT 544

Notes: PCT – Plant Community Type; TEC – Threatened Ecological Community

4.2.1 Cleared and Disturbed Land

Cleared and disturbed land within the Subject Land has a long history of heavy grazing and does not correspond to any recognisable PCT. However to facilitate this assessment and in accordance with the BAM (and advice from BCD confirming that Common Couch is to be included in the BAM calculator as a native species), these areas have been assigned a likely PCT based on surrounding vegetation and location within the landscape. Three vegetation zones for cleared and disturbed land were assessed:

- 516_Disturbed Grassland: a total of 7.39 ha of cleared and/or highly disturbed land. A total of three BAM plots were assessed in this vegetation zone (P27, P33 and P35).
- 594_Disturbed Grassland: a total of 48.81 ha of cleared and/or highly disturbed land. A total of eight BAM plots were assessed in this vegetation zone (P6, P18, P19, P22, P24, P25, P36 and P37).
- 596_Disturbed Grassland: a total of 50.59 ha of cleared and/or highly disturbed land. A total of five BAM plots were assessed in this vegetation zone (P4, P13, P20, P30 and P34).

Cleared and disturbed land was widespread across the Subject Land which is consistent with its historical and current land uses which include clearing, cropping and grazing. Cattle, sheep and goats were present across the Subject Land and a very intense level of grazing was observed. Flora species included a mix of native and exotic species, including high threat exotics (see flora list in Appendix H). Upper and mid-stratum were generally absent, with the exception of some isolated scattered trees as shown in Photographs 4-7 to 4-10.

4.3 Vegetation Integrity Assessment

4.3.1 Vegetation Zones and Survey Effort

The random meander surveys and detailed floristic plots have been used to assist the delineation of zones. Each of the identified PCTs were stratified into zones with a similar broad condition state. These zones were defined based on the overstorey condition, understorey condition and observed land management practices.

A total of 9 native vegetation zones plus cleared land were identified in the development site as listed in Table 4.6 and mapped in Figure 4.2.

A total of 44 vegetation integrity plots were collected in accordance with section 5 of the BAM (OEH 2017) to determine their condition.



Photograph 4-7: View of cleared land in plot P4



Photograph 4-8: View of cleared land in plot P13



Photograph 4-9: View of cleared and disturbed land in plot P35



Photograph 4-10: View of cleared and disturbed land in plot P22

Table 4.7 Vegetation Zones on the Subject Land

Zone ID	PCT ID	Stratification Unit / Condition Class	Extent within development site	BAM plots required	Survey effort (number of Plots)	Patch Size (ha) (Number of patches)	Reference
Native Vegetation							
1	594_ Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Moderate	4.10 ha	2	4	>1000 ha (1)	Table 4.3
2	594_ Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Low	9.54 ha	3	5	<5 ha (3); >1000 ha (1)	
3	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Moderate	11.15 ha	3	4	>1000 ha (1)	Table 4.4
4	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Low	0.25 ha	1	2	>1000 ha (1)	
5	596_ Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Very Low	0.30 ha	1	1	>1000 ha (1)	
6	596_ Derived Grassland	Low	9.04 ha	3	4	<5 ha (5)	
7	516_ Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Very Low	3.00 ha	2	3	>1000 ha (1)	Table 4.5

Zone ID	PCT ID	Stratification Unit / Condition Class	Extent within development site	BAM plots required	Survey effort (number of Plots)	Patch Size (ha) (Number of patches)	Reference
8	516_Derived Grassland	Moderate	2.76 ha	2	2	<5 ha (7)	
9	544_Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	Low	0.83 ha	1	1	>1000 ha (1)	Table 4.6
Predominantly Cleared and Disturbed land							
NA	516_Disturbed Grassland	Other	7.39 ha	3	3	N/A	Refer Section 4.2.1
10	594_Disturbed Grassland	Other	49.81 ha	4	8	N/A	
11	596_Disturbed Grassland	Other	50.59 ha	5	5	N/A	
12	Cleared Land / Dams	Other	0.48 ha	-	-	N/A	

4.3.2 Vegetation Integrity Assessment Results

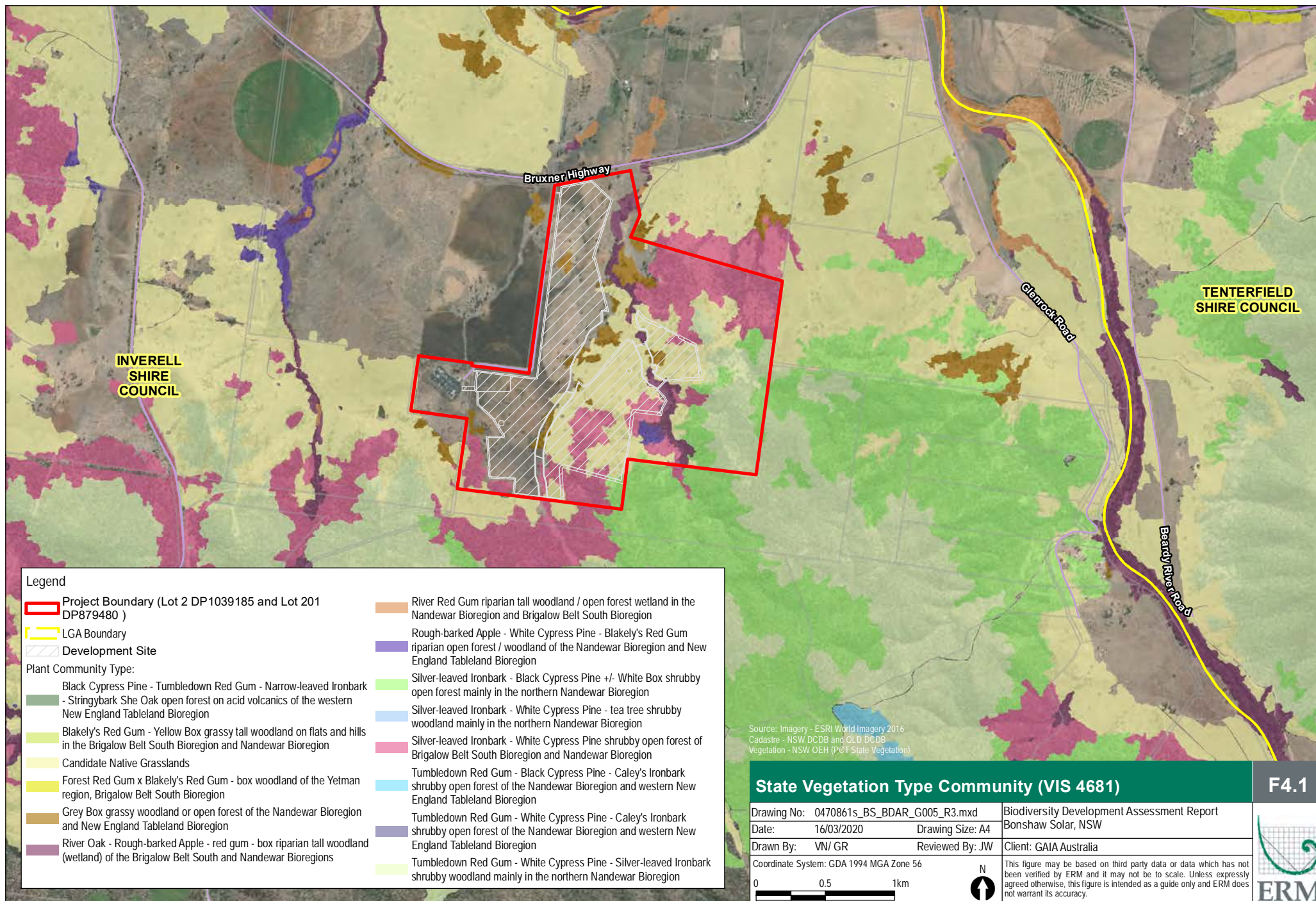
A total of 134 plant species were recorded within the 44 vegetation integrity survey plots (see Table H.6 in Appendix H). The field data sheets with results of the vegetation plots and photos of each plot are shown in Appendix G.

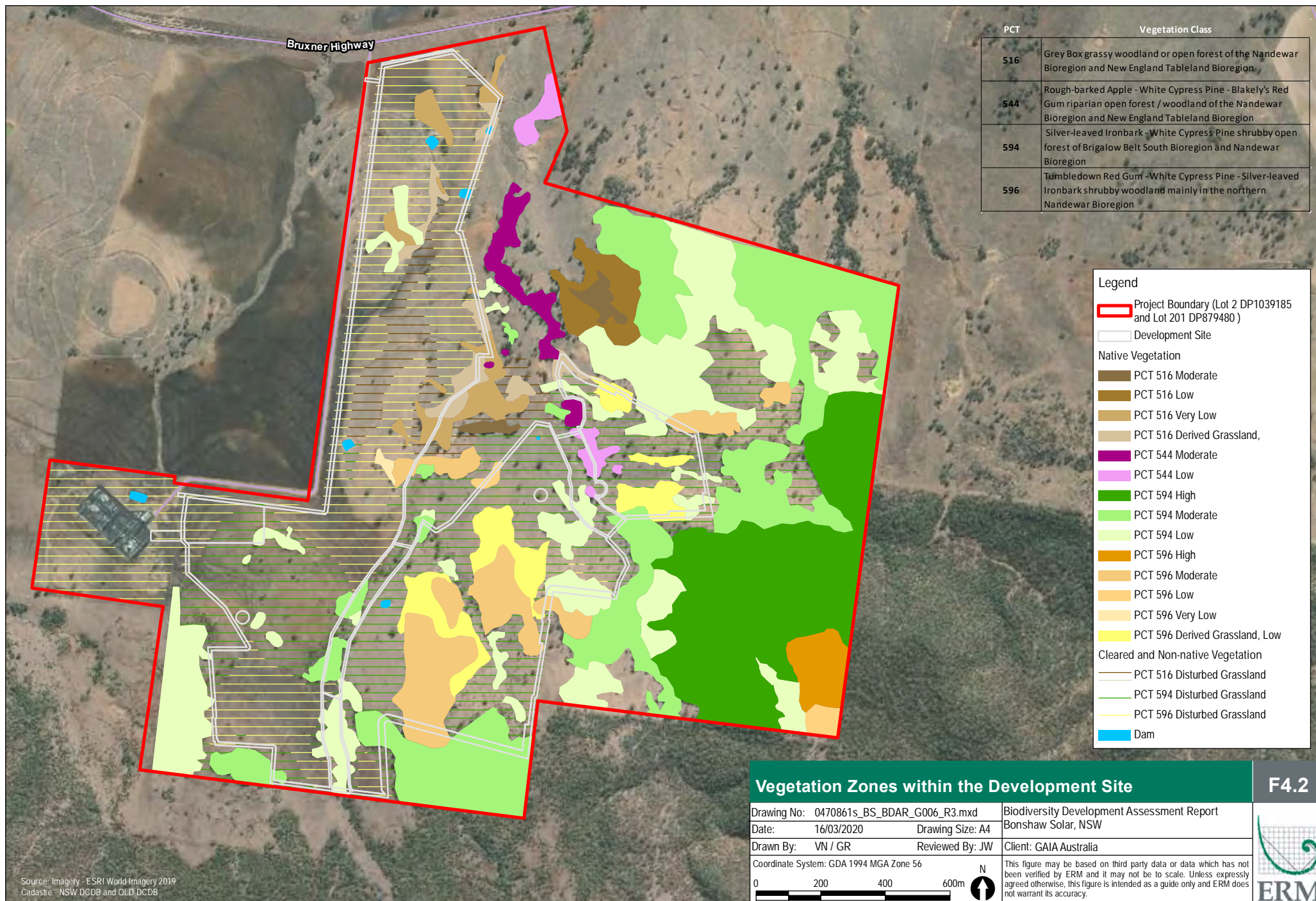
The plot data from the vegetation integrity survey plots were entered into the BAM calculator. The results of the vegetation integrity assessment are provided in

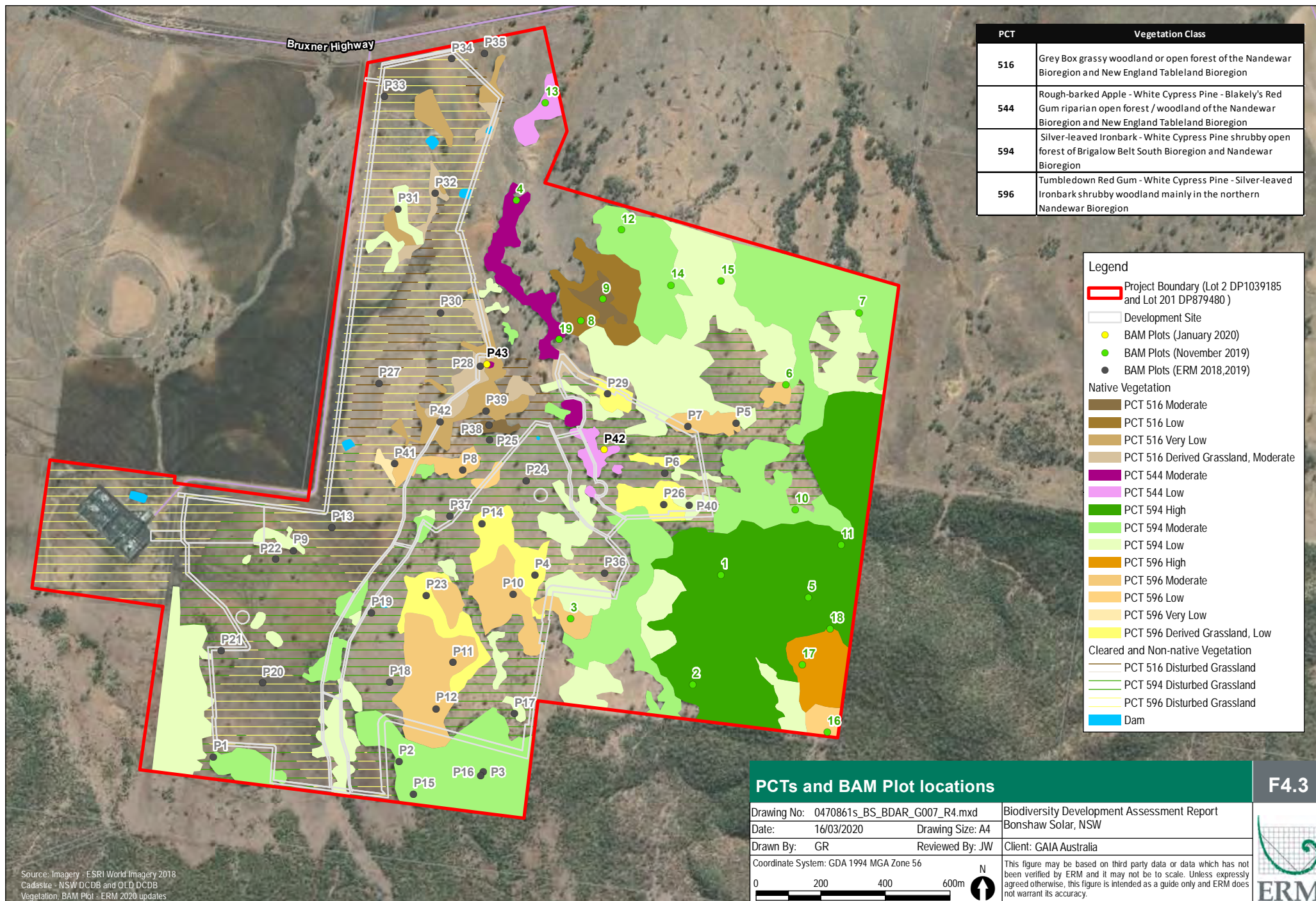
Table 4.6.

Table 4.6 Summary of Vegetation Integrity Scores

No	Vegetation Zone ID	Composition Score	Structure Score	Function Score	Vegetation Integrity Score
1	PCT 594_Moderate	52.9	43.6	99.8	61.3
2	PCT 594_Low	39.3	18.4	50.9	33.3
3	PCT 596_Moderate	67.4	52.3	69.4	62.6
4	PCT 596_Low	18.9	40.9	71.8	38.2
5	PCT 596_Very Low	18.4	22.7	31.6	23.6
6	<i>PCT 596_Derived_Low</i>	<i>48.7</i>	<i>0.4</i>	<i>29.3</i>	<i>8</i>
7	PCT 516_Very Low	31.6	11.2	24.9	20.7
8	PCT 516_Derived_Moderate	20	50.3	15	24.7
9	PCT 544_Low	26.7	24.3	65.9	35
10	<i>516_Disturbed Grasslands</i>	<i>19.3</i>	<i>13.5</i>	<i>15</i>	<i>15.8</i>
11	<i>594_Disturbed Grasslands</i>	<i>25.7</i>	<i>2.4</i>	<i>26.2</i>	<i>11.8</i>
12	<i>596_Disturbed Grasslands</i>	<i>17.7</i>	<i>0.9</i>	<i>11</i>	<i>5.6</i>







5. THREATENED SPECIES

5.1 Fauna Habitat Assessment

5.1.1 Important Habitat Mapping

For a small number of threatened species, a habitat constraint may refer to a mapped location that identifies areas that are considered important for those species. Maps currently available include important areas for the Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*). These maps have been reviewed and the Subject Land does not form part of the important habitat mapping for either of these species.

5.1.2 Onsite Habitat Assessment

A habitat assessment was undertaken onsite seeking to identify the following fauna habitat features within the Subject Land:

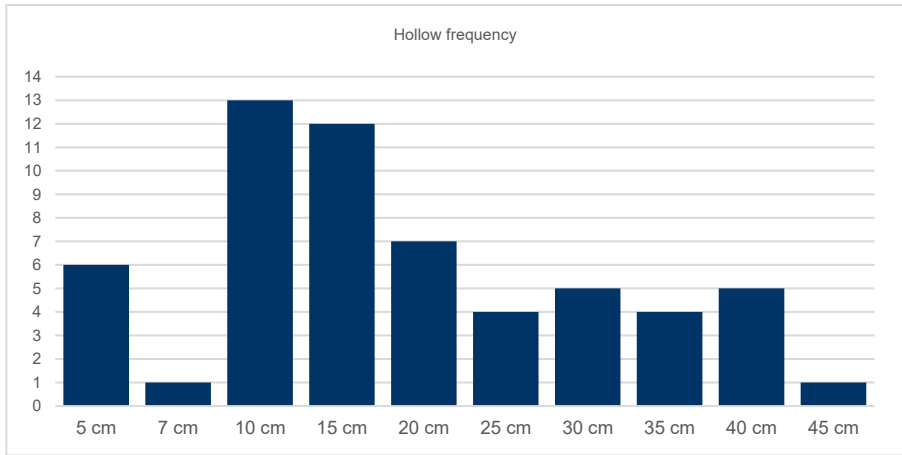
- Habitat trees including hollow-bearing trees and nest trees;
- Foraging resources including fruiting and flowering plants and other feed tree species;
- Waterbodies including condition assessment;
- Rocks, ground litter and logs;
- Burrows, dens, nests and dreys; and
- Koala food trees.

Searches were also completed for indirect evidence of fauna habitat including scats, bones, tracks and trails.

The onsite habitat assessment identified that the majority of the Subject Land is highly disturbed, only supporting fauna species which are able to persist in highly modified agricultural landscapes and within woodland remnants. Additional habitat features assessed are provided in Table 5.1.

Table 5.1 Additional Habitat Features Considered

Habitat Features	Available with the Development Site
Occurrences of Karst, Caves, Crevices and Cliffs	Not present within the Development Site
Occurrences of Rock	<p>A total of eleven rocky areas were recorded within the Subject Land (see Figure 5.b). Targeted reptile searches were undertaken in six of those rocky areas. Rocky areas were present on crests and hillsides as shown in Photograph 5-1 to Photograph 5-4 below.</p> <p>Threatened species that could occur in these rocky outcrops are the:</p> <ul style="list-style-type: none">■ Pink - tailed Legless Lizard (<i>Aprasia parapulchella</i>)■ Rodd's Star Hair (<i>Astrotricha roddii</i>)■ Border Thick-tailed Gecko (<i>Uvidicolus sphyrurus</i>) <p>As these species were not detected, the rocky outcrops were considered unlikely to provide habitat for threatened species.</p>

Habitat Features	Available with the Development Site																						
Occurrences of Human made structures and Non-native Vegetation	The only human made structures present within the Subject Land are fences, gates and stockyards. No built structures, such as sheds or dwellings, are present.																						
Termite/ ant mounds	A total of 39 ant/termite mounds were observed across the Subject Land as shown in Figure 5.b. An example of mounds found within the Subject Land are shown in Photograph 5-5 and Photograph 5-6 below.																						
Hollows and Hollow Bearing Trees	<p>A total of 60 hollow bearing trees were recorded across the Subject Land (see Table H.7 in Appendix H and Figure 5.b). Trees with hollows were eucalypt trees and stags (see Photograph 5-7 to Photograph 5-10). As shown in Graph 5-1 below, most hollows were medium size of less than or equal to 20cm diameter, followed by large hollows (greater than 20cm diameter) and small hollows (less or equal to 5cm diameter).</p>  <table border="1"> <caption>Hollow frequency data</caption> <thead> <tr> <th>Hollow Size (cm)</th> <th>Frequency</th> </tr> </thead> <tbody> <tr><td>5</td><td>6</td></tr> <tr><td>7</td><td>1</td></tr> <tr><td>10</td><td>13</td></tr> <tr><td>15</td><td>12</td></tr> <tr><td>20</td><td>7</td></tr> <tr><td>25</td><td>4</td></tr> <tr><td>30</td><td>5</td></tr> <tr><td>35</td><td>4</td></tr> <tr><td>40</td><td>5</td></tr> <tr><td>45</td><td>1</td></tr> </tbody> </table> <p>Graph 5-1 Tree hollow sizes and their frequency</p>	Hollow Size (cm)	Frequency	5	6	7	1	10	13	15	12	20	7	25	4	30	5	35	4	40	5	45	1
Hollow Size (cm)	Frequency																						
5	6																						
7	1																						
10	13																						
15	12																						
20	7																						
25	4																						
30	5																						
35	4																						
40	5																						
45	1																						
Bird nests	Numerous bird nest were observed across the Subject Land (see Photograph 5-11 to Photograph 5-14). Grey-crowned Babbler were observed actively adding sticks to one nest which indicates that the Subject Land is occupied by a breeding population of this species. Twenty-one nests were considered likely to be used by the Grey-crowned Babbler. The distribution of bird nests is shown in Figure 5.b and Figure 5.2.																						
Koala Habitat Values	<p>Only nine records of koala exists within the 10km locality as per BioNet atlas. The nearest records were recorded in 1999 at approximately 1.5km south from the Subject Land. Threatened species surveys indicated that no koalas, koala scats or evidence of koala scratches were observed within the Subject Land. This is not unexpected due to the high level of clearance and disturbance at the Subject Land.</p> <p>Only one species listed as Koala Feed Tree (SEPP44), White Box (<i>Eucalyptus albens</i>), was recorded in low numbers within the Subject Land.</p>																						



Photograph 5-1 View of rocky area on a hillside



Photograph 5-2 View of rocky area on a hillside



Photograph 5-3 View of rocky area on a hillside and crest



Photograph 5-4 View of rocky area on a hill crest



Photograph 5-5 Example of termite/ant mound



Photograph 5-6 Example of termite/ant mounds



Photograph 5-7 View of tree with hollow



Photograph 5-8 View of stag with hollow



Photograph 5-9 View of tree with hollows



Photograph 5-10 View of hollowed stag



Photograph 5-11 View of Grey-crowned Babbler nest



Photograph 5-12 Bird's nests on tree



Photograph 5-13 Tree with bird nest



Photograph 5-14 View of bird's nest on Eucalypt tree

5.2 Rivers, Streams and Wetlands

Riparian areas and farm dams were inspected along random meander transects in the assessment area surrounding the Subject Land.

5.2.1 Creek Lines

Third, second and first order un-named creek lines are present within Lot 2 in DP1039185 and are mapped tributaries of the Dumaresq River (see Figure 3.2). The creeks within the Project Boundary can be grouped as follows:

- Western Creek: This is a first order creek located within the Subject Land. This creek was dry during all the three survey periods (September 2018, December 2018 and March 2019) and provides very limited, if any aquatic habitat value.
- Central Creek and tributaries: This is a third order creek within the northern portion of the Project boundary and then diverges into a third order (eastern arm) and second order (western arm) to the south. These creeks were dry during all the three survey periods (September 2018, December 2018 and March 2019) and provides limited, seasonal aquatic habitat value only. Approximately six first order streams also converge into this central creek and provide very limited, if any aquatic habitat value.
- Eastern Creek: The southernmost portion of a first order stream is located on the eastern portion of the Project boundary (Lot 2 DP1039185) and outside of the Subject Land. This creek was not surveyed and will not be affected as part of the proposed development.

The overall condition of creek lines within the development footprint and the Project boundary is poor. Creek lines were dry during all three survey periods and erosion was noted along their banks (see **Photograph 5-15** to **Photograph 5-18**). Clearly defined river banks and channels are evident within the western, central and eastern creek lines indicating that at some point, these areas do contain large amounts of water and would provide some limited aquatic habitat for those species not dependent on a permanent water resource. The remaining 1st order creek lines within the Subject Land do not have conspicuous banks and bed and are not considered an aquatic habitat resource.

Riparian vegetation is mostly absent with scattered trees or patches of trees present. However, remnants of the Threatened Ecological Community – White Box Yellow Box Blakely's Red Gum Woodland were observed in several locations in association with stream banks and channels. Several vehicle crossing are present on creek lines within the Project Boundary.

It is worth noting that in natural conditions, when an aquatic species is present in a major river, that species is expected to also be distributed in the tributaries of that river because the river system is connected and water flows freely across the tributaries of the system. Where natural connectivity in riparian systems occur, naturally occurring restrictions to aquatic biodiversity are related to species-specific habitat and ecological requirements. Natural connectivity between the Dumaresq River and its tributaries at the Project Boundary no longer exists based on the presence of Bruxner Way, which runs in a general east-west direction along the northern boundary of the Project Boundary and beyond. It is worth noting that bridges were built on the highway at some of the major creeks and rivers intersections, such as Little Oak Creek and Beady River. This was not the case for tributaries crossing the Project Boundary.

Given that no connectivity exists between other tributaries of the Dumaresq River/Beady River system and the creeks present at the Project Boundary, it is unlikely for those creeks to currently represent suitable habitat for aquatic biodiversity from the Dumaresq River.



Photograph 5-15 View of riparian area on the Project Boundary



Photograph 5-16 View of riparian area with vegetated bed.



Photograph 5-17 View of dry and eroded creek line with sparse trees on river bank



Photograph 5-18 View of creek near vehicle crossing

5.2.2 Farm Dams

A total of six farm dams are located within the Subject Land. Most of the farm dams were dry during surveys although they would provide a catchment for overland flow. As shown in photographs below, no fringing or submerged aquatic vegetation was present in these farm dams. An unidentified turtle was observed.



Photograph 5-19 View of a farm dam with water within the assessment area



Photograph 5-20 View of a small farm dam within the assessment area



Photograph 5-21 View of dry farm dam within the assessment area



Photograph 5-22 View of farm dam within the assessment area

5.3 Ecosystem Credit Species

A list of ecosystem credit species predicted to occur within the Subject Land, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017a) is provided in Table 5.2. The potential for these species to occur within the Subject Land was assessed in accordance with Section 6.2 of the BAM (OEH 2017a).

Two ecosystem credit species, the Glossy Black Cockatoo and White-bellied sea-eagle, were excluded from the assessment based on lack of foraging habitat across the Subject Land, all other species have been assumed to occur and contribute to ecosystem credits.

Table 5.2 Ecosystem Credit Species (BAM Calculator)

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
<i>Anomalopus mackayi</i> Five-clawed Work skink	E	V	Included. Potential habitat for the species is present within fallen logs and open paddocks with scattered trees.
<i>Anthochaera phrygia</i> Regent Honeyeater (Foraging)	CE	CE	Included. Potential foraging habitat is present. This woodland bird species forages in woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. No habitat is available within the disturbed grasslands.
<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	V	-	Included. Potential foraging habitat is present in most woodland vegetation zones, excluding grasslands, cleared and disturbed land.
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo (Foraging)	V	-	Excluded as the Subject Land does not contain preferred foraging resources (<i>Allocasuarina</i> or <i>Casuarina</i> sp) for the species
<i>Chalinolobus picatus</i> Little Pied Bat	V		Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
<i>Chthonicola sagittata</i> Speckled Warbler	V	-	Included. This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.
<i>Circus assimilis</i> Spotted Harrier	V	-	Included. Potential habitat for the species occurs across all vegetation zones in the Subject Land.
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies)	V	-	Included. This species was recorded adjacent to the Subject Land during potential offset site investigations. Suitable habitat for the species is considered to occur in woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	Included. Potential habitat for the species occurs in woodland vegetation within the Subject Land.
<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	Included. Potential habitat for the species occurs in Eucalypt trees across all vegetation zones within the Subject Land.
<i>Grantiella picta</i> Painted Honeyeater	V	V	Included. Potential habitat for the species occurs in Box and Ironbark trees across the Subject Land.

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
<i>Haliaeetus leucogaster</i> White-bellied Sea-eagle (Foraging)	V	-	Excluded. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. No foraging habitat available within the Subject Land.
<i>Hieraaetus morphnoides</i> Little Eagle (Foraging)	V	-	Included. Potential foraging habitat for the species occurs in woodland areas within the Subject Land.
<i>Lathamus discolor</i> Swift Parrot (Foraging)	E	CE	Included. Potential foraging habitat for the species occurs in Eucalypt trees in treed vegetation zones within the Subject Land. Derived grasslands and cleared (disturbed grasslands) excluded.
<i>Lophoictinia isura</i> Square-tailed Kite (Foraging)	V	-	Included. Potential foraging habitat for the species occurs over the canopy of woodlands along riparian zones within the Subject Land.
<i>Macropus dorsalis</i> (Black-striped Wallaby)	E		Included. Potential foraging habitat for the species occurs across the Subject Land.
<i>Melanodryas cucullata cucullata</i> Hooded Robin (south-eastern form)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
<i>Melithreptus gularis gularis</i> Black-chinned Honeyeater (eastern subspecies)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
<i>Miniopterus orinae oceanensis</i> Large Bent-winged bat (Foraging)	V	-	Included. The species' calls were recorded within the Subject Land. The species forages over the canopy of trees, so suitable habitat is present in woodland vegetation zones within the Subject Land.
<i>Neophema pulchella</i> Turquoise Parrot	V	-	Included. Suitable habitat for the species includes woodlands and native grasslands. Roosting and breeding habitat for this woodland bird are hollow-bearing trees in woodlands. It forages in woodlands and native grasslands.
<i>Ninox connivens</i> Barking Owl (Foraging)	V	-	Included. Potential foraging habitat is present in woodland vegetation zones within the Subject Land.
<i>Nyctophilus corbeni</i> Corben's Long-eared Bat	V	-	Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
<i>Petroica boodang</i> Scarlet Robin	V	-	Included. Limited suitable habitat for the species occurs in woodlands with fallen logs and timber within the Subject Land.

Ecosystem Credit Species	BC Act Listing	EPBC Act Listing	Justification for inclusion/exclusion
<i>Petroica phoenicea</i> Flame Robin	V	-	Included. Limited potential habitat is present in woodland vegetation zones within the Subject Land.
<i>Phascolarctos cinereus</i> Koala (Foraging)	V	-	Included. A small number of suitable feeding trees (i.e. <i>E. albens</i>) were recorded within the Subject Land. Koalas, or evidence of Koala activity, were not recorded during surveys.
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	V	-	Included. Recorded on site. Foraging and breeding habitat for the species is present in woodland vegetation zones. Cleared land (i.e. disturbed grasslands) excluded.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox (Foraging)	V	V	Included. Potential foraging habitat is present in canopy of Eucalypt trees. Grasslands and cleared land excluded as potential foraging habitat.
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V	-	Included. The species' calls were recorded in the assessment area and hollow bearing trees are present across the Subject Land.
<i>Stagonopleura guttata</i> Diamond Firetail	V	-	Included. Potential roosting and breeding habitat for the species occurs in woodlands, foraging habitat for the species occurs across the entire Subject Land.
<i>Tyto novaehollandiae</i> Masked Owl (Foraging)	V	-	Included. Potential foraging habitat is present in eucalypt forests/woodlands and along their edges within the Subject Land.

5.4 Species Credit Species

An assessment of habitat constraints for threatened species was undertaken in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a). For those threatened species predicted to occur and for which habitat constraints are listed, an assessment was undertaken of the presence of the habitat features within the development site.

The species generated by the calculator with habitat constraints, as well as the results of the habitat constraints assessment, are shown in Table 5.3.

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).

A total of eight candidate species credit species were excluded as no suitable habitat is present within the Subject Land (see Table 5.3). The species excluded are: Regent Honeyeater (Breeding), White-bellied Sea Eagle (Breeding), Swift Parrot (Breeding), Square-tailed Kite (Breeding), Grey-headed Flying Fox (Breeding), Eastern Bentwing Bat (Breeding), Koala (Breeding) and Ovenden's Ironbark.

Table 5.3 Species Credit Species

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Adelotus brevis</i> Tusked Frog population in the Nandewar and New England Tableland Bioregion	E	-	-	Very High	Included	Six first order streams and several farm dams are present within the Subject Land although they do not provide any preferred habitat for this species. This species are usually found near creeks, ditches and ponds, and call while hidden amongst vegetation or debris. Limited riparian or and no fringing vegetation was noted in creeks and near the dams, respectively. Therefore, aquatic habitat is marginal at best
<i>Amalosia rhombifer</i> Zigzag Velvet Gecko	E	-	-	High	Included	Suitable habitat for the species occurs within the woodland habitats. This species is largely arboreal, living and foraging in trees.
<i>Anthochaera phrygia</i> Regent Honeyeater (Breeding)	CE	CE	-	High	Excluded	The Subject Land is not considered to be used as breeding or foraging habitat for the species. There are four known key breeding areas for this species, three of them in NSW - Capertee Valley, Bundarra-Barraba and Hunter Valley districts. For the Bundarra-Barraba area, three subsidiary foraging and breeding areas are known, Inverell-Ashford-Emmaville, Pilliga and Warrumbungles.
<i>Astrotricha roddii</i> Rodd's Star Hair	E	E	Rocky areas, Granite or acid volcanic outcrops	High	Included	A total of eleven rocky areas were recorded within the Subject Land and provide potential habitat for the species.
<i>Burhinus grallarius</i> Bush Stone-curlew	E	-	Fallen/standing dead timber including logs	High	Included	This species inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Potential habitat is available within the grassy woodlands only. The heavily grazed areas do not constitute preferred habitat.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo (Breeding)	V	-	-	High	Included	Suitably sized hollows have been recorded within the Subject Land although no preferred foraging habitat has been recorded which would limit the likelihood of this species nesting on site.
<i>Dichanthium setosum</i> Bluegrass	V	V	-	High	Included	The species has potential to occur in the Subject Land.
<i>Digitaria porrecta</i> Finger panic Grass	E	-	-	Moderate	Included	The species has potential to occur in the Subject Land.
<i>Eucalyptus caleyi subsp. ovendenii</i> Ovenden's Ironbark	V	V	-	High	Excluded	The preferred altitudes for the species are between 610 and 820 m, on granitic substrates. The Subject Land is located at much lower elevations between 335 and 420 m.
<i>Geophaps scripta scripta</i> Squatter Pigeon (southern)	CE	V	-	High	Included	The species has potential to occur within the woodland habitats although the species prefers sandy areas and usually close to water (within 3 km of water bodies or courses).
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle (Breeding)	V	-	-	High	Excluded	Breeding habitat for this species consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat (not available within the Subject Land). Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'.
<i>Hieraaetus morphnoides</i> Little Eagle (Breeding)	V	-	-	Moderate	Included	Potential breeding habitat is available within the woodland habitats. This species nests in tall living trees within remnant vegetation where pairs build a large stick nest in winter.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Homopholis belsonii</i> Belson's Panic	E	V	-	NA	Included	Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. The species has potential to occur in the Subject Land
<i>Hoplocephalus bitorquatus</i> Pale-headed Snake	V	-		High	Included	Suitable habitat for the species occurs within the Subject Land. A small number of historical records are known for the New England Tableland from Glenn Innes and Tenterfield; however, the majority of records appear to be from sites of lower elevation. The species is found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. It has limited potential to occur in the Subject Land
<i>Indigofera baileyi</i> Bailey's Indigo	E	-	-	High	Included	The species is known from around Inverell and Ashford in the western inland slopes. It prefers open woodlands on loam and clay loam soils, typically from granite or basalt, and has potential to occur in the Subject Land
<i>Lathamus discolour</i> Swift Parrot (Breeding)	E	CE	-	Moderate	Excluded	The species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Lophoictinia isura</i> Square-tailed Kite (Breeding)	V	-	-	Moderate	Excluded	No suitable breeding habitat for the species is present within the Subject Land, as the species prefers coastal and subcostal environments and inland wooded watercourses. Second and third order streams are excluded from the Subject Land. Scattered records of the species throughout NSW indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.
<i>Miniopterus orinae oceanensis</i> Large Bent-winged bat (Breeding)	V	-	-	Very High	Excluded	Caves are the breeding habitat for the species. Caves, suitable for maternity areas, are not present within the Subject Land. Being a dual credit species, foraging habitat resources are already accounted for in the ecosystem credits.
<i>Ninox connivens</i> Barking Owl (Breeding)	V	-	Hollow bearing trees. Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground	High	Included	Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land. However, only a small number of these trees are likely to represent suitable breeding habitat for this species due to limiting factors associated with hollow size and height above ground. Potential breeding habitat is considered to comprise Vegetation Zones 594_Moderate, 594_Low, 596_Moderate, 544_Low and 516_Very low given that hollow-bearing trees (with suitable hollows) were observed to be concentrated within these zones.

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	-	High	Included	Substandard suitable habitat is present in Eucalypt trees in the Subject Land.
<i>Phascolarctos cinereus</i> Koala (Breeding)	V	V	-	High	Excluded	Breeding habitat is not considered to be present on the Subject Land. This determination has been made on the basis that no koalas, or evidence of koala activity, has been recorded on the Subject Land and given that recognised feed trees occur only in very low numbers onsite.
<i>Polygala linariifolia</i> Native Milkwort	E	-	-	High	Included	The species has potential to occur in the Subject Land
<i>Pomaderris queenslandica</i> Scant Pomaderris	E	-	-	High	Included	The species has potential to occur in the Subject Land
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox (Breeding)	V	V	-	High	Excluded	No known breeding camp is present within the Subject Land.
<i>Swainsona sericea</i> Silky Swainson-pea	V	-	-	High	Included	The species has the potential to occur within the Subject Land.
<i>Thesium australe</i> Austral Toadflax	V	V	-	Moderate	Included	The species has potential to occur in the Subject Land

Species Credit Species	BC Act Listing	EPBC Act Listing	Habitat components and geographic restrictions	Sensitivity to gain class	Included or Excluded	Reason for inclusion or exclusion
<i>Tyto novaehollandiae</i> Masked Owl (Breeding)	V	-	-	High	Included	The Masked Owl is a large forest owl and prefers uncleared or lightly cleared areas with high densities of old hollow bearing trees. Given that habitat is present on site that meets the breeding habitat constraint for this species (living or dead trees with hollows greater than 20cm diameter), breeding habitat has been assumed to be present for this species. Potential breeding habitat is assumed to occur within Vegetation Zones 594_Moderate, 594_Low, 596_Moderate, 544_Low and 516_Very low given that hollow-bearing trees (with suitable hollows) were observed to be concentrated within these zones. However, it is considered unlikely that the Masked Owl would use these habitat features given the highly disturbed and highly fragmented context in which these habitat features occur.
<i>Uvidicolus sphyrurus</i> Border Thick-tailed Gecko	V	V	-	High	Included	The species has potential to occur in the Subject Land

5.5 Additional Species Considered

Based on results of the BioNet Atlas search (see Appendix B), the PMST (see Appendix C) and the likelihood of occurrence assessment undertaken during desktop review (see Appendix D), the following species were also considered for assessment:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Bristle-faced Free-tailed Bat (*Setirostris eleryi* – previously *Mormopterus eleryi*)
- Eastern Cave Bat (*Vespadeuls vulturnus*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Narrow-leaved Black Peppermint (*Eucalyptus nicholii*)
- Heath Wrinklewort (*Rutidosis heterogama*)

5.6 Candidate Species Surveyed

The species listed in Table 5.4 are those that are considered to have habitats present at the Subject Land. Surveys have been conducted for these species. The results are summarised in Table 5.5.

Details of the survey methodologies for each surveyed species are provided in Appendix F and Appendix H. Targeted survey locations are mapped on Figure 5.1a.

Species polygons have been defined for relevant species credit species that have been confirmed, or are assumed, to be present on the Subject Land as mapped on Figure 5.3.

Table 5.4 Candidate Species Surveyed

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
<i>Adelotus brevis</i> Tusked Frog population in the Nandewar and New England Tableland Bioregion	E	-	Very High	3	December	No	No	No
<i>Amalosia rhombifer</i> Zigzag Velvet Gecko	E	-	High	2	December	No	No	No
<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	Very High	3	December	No	No	No
<i>Astrotricha roddii</i> Rodd's Star Hair	E	E	High	2	September December	No	No	No
<i>Burhinus grallarius</i> Bush Stone-curlew	E	-	High	2	December	No	No	No
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo	V	-	High	2	No	No	No	No
<i>Dichantium setosum</i> Bluegrass	V	V	High	2	December March	No	No	No
<i>Digitaria porrecta</i> Finger Panic Grass	E	-	High	2	December March	No	No	No
<i>Geophaps scripta scripta</i> Squatter Pigeon (southern)	CE	V	Very High	3	December	No	No	No
<i>Hieraaetus morphnoides</i> Little Eagle	V	-	Moderate	1.5	December	No	No	No
<i>Homopholis belsonii</i> Belson's Panic	E	V	N/A	1	December March	No	No	No

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
<i>Hoplocephalus bitorquatus</i> Pale-headed Snake	V	-	High	2	December	No	No	No
<i>Indigofera baileyi</i> Bailey's Indigo	E	-	High	2	September December	No	No	No
<i>Lophoictinia isura</i> Square-tailed Kite	V	-	Moderate	1.5	December	No	No	No
<i>Mormopterus eleryi</i> (syn. <i>Setirostris eleryi</i>) Bristle-faced Free-tailed Bat	E	-	High	2.0	December	Survey	Yes	Yes
<i>Miniopterus orianae oceanensis</i> Large Bent-winged bat	V	-	Very High	3.0	December	Survey	Yes	No
<i>Ninox connivens</i> Barking Owl	V	-	High	2	None	Assumed Present	N/A	Yes
<i>Petaurus norfolcensis</i> Squirrel Glider	V	-	High	2	December	No	No	No
<i>Phascolarctos cinereus</i> Koala	V	V	High	2	December	No	No	No
<i>Polygala linariifolia</i> Native Milkwort	E	-	High	2	December January	No	No	No
<i>Pomaderris queenslandica</i> Scant Pomaderris	E	-	High	2	September December March	No	No	No
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	High	2	December	No	No	No
<i>Swainsona sericea</i> Silky Swainson-pea	V	-	High	2	September December	No	No	No

Species Credit Species	BC Act Listing	EPBC Act Listing	Biodiversity Risk	Biodiversity Risk Weighting	Survey Time	Assumed to occur/survey/ expert report	Recorded during field surveys	Species polygon area or count
<i>Thesium austral</i> Austral Toadflax	V	V	Moderate	1.5	September December	No	No	No
<i>Tyto novaehollandiae</i> Masked Owl	V	-	High	2	None	Assumed Present	N/A	Yes
<i>Uvidicolus sphyrurus</i> Border Thick-tailed Gecko	V	V	High	2	December	No	No	No
<i>Vespadeuls vulturnus</i> Eastern Cave Bat	V	-	Very High	3.0	December	Survey	Yes	Yes

5.7 Targeted Survey Results

Targeted surveys for flora and fauna species were completed across the Subject Land. A description of survey methodology and effort is provided in Appendix F. Figure 5.1a shows the location of survey tracks across the Subject Land.

5.7.1 Flora Species Recorded

No threatened flora species were recorded during site surveys. A complete list of flora species recorded on the Subject Land is provided in Table H.6 (Appendix H).

A total of 143 flora species in 47 families were recorded within the assessment area. This included a total of 111 native (78 %) and 32 exotic (22 %) species. The most numerous families were Poaceae (30 species), Asteraceae (21 species) and Fabaceae (Faboideae) (10 species).

Exotic species included two HTE and WoNS, Tiger Pear (*Opuntia aurantiaca*) and Velvet Tree Pear (*Opuntia tomentosa*). Due to the high level of grazing and lack of reproductive material, identification of some flora specimens was only viable to genus level, including *Senecio* sp., *Hypericum* sp. and *Solanum* sp. Therefore, presence of an additional WoNS, Fireweed (*Senecio madagascariensis*), cannot be precluded. Fireweed is also listed as a Priority Weed in the Northern Tablelands. Similarly, exotic species within genera *Hypericum* and *Solanum* were recorded. Therefore, potential presence of priority weeds St John's Wort (*Hypericum perforatum*) and Silverleaf Nightshade (*Solanum elaeagnifolium*), cannot be precluded. As per the Biosecurity Act, all exotic species require management and preparation of a Weed Management Plan for the proposed solar farm will be required.

5.7.2 Fauna Species Recorded

A total of 78 fauna species were recorded on and adjacent to the Subject Land. A summary of faunal groups recorded is presented in Table 5.5 and a complete fauna species list is provided in Appendix H.

A total of eleven threatened species were recorded within the Subject Land (see Table 5.5 below). The species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bentwing-bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), one vulnerable bird (Grey-crowned Babbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were definite call identifications and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were potential calls. Two additional Vulnerable bird species (Brown Treecreeper and Speckled Warbler) were also recorded adjacent to the Subject Land during potential offset site investigations.

Table 5.5 Summary of Fauna Species Recorded

Fauna Type	Number of Species	BC Act	EPBC Act
Woodland Birds	46 on the Subject Land and an additional 7 adjacent to the Subject Land	One species, the Grey-crowned Babbler is listed as Vulnerable and has been further assessed in Section 5.7.3 Two additional Vulnerable species were recorded adjacent to the Subject Land during potential offset site investigations – Brown Treecreeper (<i>Climacteris picmnus victoriae</i>) and Speckled Warbler (<i>Chthonicola sagittata</i>)	One species, the Cicadabird is listed as Marine and has been further assessed in Section 5.7.5
Raptors	2 flying over Subject Land	No	No
Forest Owls	0	No	No
Reptiles	9	No	No
Amphibians	3	No	No
Terrestrial Mammals	11 including 5 introduced species	No	No
Arboreal Mammals	1	No	No
Microchiropteran Bats	12 definite + 6 potential	Six Vulnerable species: Little Pied Bat, Eastern Bentwing-bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat (this species has been further assessed in Section 5.7.4) and Eastern False Pipistrelle Two potential Vulnerable species: Greater Broad-nosed Bat and Hoary Wattled Bat. One Endangered species: Bristle-faced Free-tailed Bat. This species has been further assessed in Section 5.7.4.	One vulnerable species: Corben's Long-eared Bat

Results of each threatened species recorded on the Subject Land are summarised in sub-sections below.

5.7.3 Grey-crowned Babbler

The Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) is listed as an ecosystem credit species.

It inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Its flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year (OEH 2019).

Grey-crowned Babblers are obligate communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. Young birds stay with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. In some populations, breeding success is related to the number of helpers. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction. In NSW, the species breeds between July and February (OEH 2019).

It has been suggested that cooperative breeder species, such as the Grey-crowned Babbler, are more sensitive to habitat fragmentation and loss (including loss due to fire) as availability of resources for breeding decreases (Fischer 2011). Habitat fragmentation and predation by introduced species being the major threats to the species. The species is reported to survive in disturbed landscapes, such as urban areas, where proportion of ground cover and leaf litter provides sufficient food (Lambert and Ford 2016, Stevens *et. al.* 2015).

The Grey-crowned Babbler was observed during surveys in September and December 2018, heard during the March 2019 survey and observed more recently during surveys in November 2019 and January 2020. In December 2018, the Grey-crowned Babbler was recorded at 20 points within the Subject Land and a total of 21 bird nests likely to belong to the species were observed (see Figure 5.2). The records included up to 15 individuals observed, 21 calls heard with an additional two potential calls heard at distance. Also, a pair was observed adding twigs to a nest located on the lower branches of a Silver-leaved Ironbark (*Eucalyptus melanophloia*).

The Grey-crowned Babbler was observed in the following vegetation zones:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 4.1 ha of this vegetation zone is present across the Subject Land;
- 596_Moderate (Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion). A total of 11.15 ha of this vegetation zone is present across the Subject Land;
- 544_Low (Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion). A total 0.83 ha are present within the Subject Land;
- 516_Very Low (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion), a total of 3.00 ha of this vegetation zone is present across the Subject Land; and
- 516_Disturbed Grasslands (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). A total 7.39 ha of this vegetation zone is present within the Subject Land.

A Test of Significance for the species was undertaken and is included in Appendix E.

5.7.4 Microchiropteran Bats

A total of nine threatened microchiropteran bat species were recorded within the assessment area, including eight vulnerable species and one endangered species. In accordance with the 'Species Credit' *threatened bats and their habitats* guide (OEH 2018b), the species fall into the following credit species types:

■ Ecosystem Credit Species:

- Little Pied Bat (*Chalinolobus picatus*) (V)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (V) – Foraging Habitat only
- Corben's Long-eared Bat (*Nyctophilus corbeni*) (V)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (V)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) (V)
- Hoary Wattled Bat (*Chalinolobus nigrogriseus*) (V)
- Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) (V)

■ Species Credit Species:

- Bristle-faced Free-tailed Bat (*Mormopterus eleryi*) (E)
- Eastern Cave Bat (*Vespertilio vulturnus*) (V)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) (V) – Breeding habitat only listed as SCS

Habitat polygons for Species Credit Species (SCS) have been assessed in accordance with Step 5 of Section 6.4 of the BAM (OEH 2017a and OEH 2018a). Based on the analysis of habitat availability for SCS within the Subject Land (see Table 5.6), a species polygons is only required for the Bristle-faced Free-tailed Bat.

Suitable breeding and/or roosting habitat is not considered to occur on the Subject Land for the Eastern Bentwing Bat or Eastern Cave Bat.

Table 5.6 Habitat Summary for Microchiropteran Bat Species Credit Species

Scientific Name Common Name	BC Act Listing	Habitat as per TBDC					Habitat Constraints		PCTs	Comments
		Roosting	Breeding	Foraging	Are paddock trees important habitat?	Patch Size	Description	Present		
<i>Mormopterus eleryi</i> (syn. <i>Setirostris eleryi</i>) Bristle-faced Free-tailed Bat	E	Hollows and tree fissures. Habitat is within 500m of riparian areas (including dry river/creek beds) and water bodies within the PCTs associated with the species.	Tree hollows (Ellis 2006)	Insectivorous species that forage typically well-above the canopy and only coming low in relatively open areas (Ellis and Wilson 1992)	No	5-24 ha	Land within 500 m of watercourses or dams surrounded by eucalypts containing hollows.	Yes	516, 544, 594, 596	Hollow bearing trees within 500m of watercourses and dams are the relevant habitat component for the species.
<i>Vespadelus troughtoni</i> Eastern Cave Bat	V	Caves, Scarps, cliffs, disused mine workings.	Potential breeding habitat is the PCTs associated with the species (as per the TBDC) within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within potential habitat.	Found in dry open forests and woodland, near cliffs or rocky overhangs.	No	5-24 ha	Caves within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.	No	516, 544, 594, 596	Trees and treed areas represent potential foraging habitat for the species within the Subject Land. No roosting or breeding habitat is present.
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	V	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures	Maternity caves. Potential breeding habitat is caves, tunnels, mines or other structures known or suspected to be used by the species	Being an insectivorous species it is assumed foraging habitat is treed areas. Within 300km range of maternity caves.	No	<5 ha	Breeding: Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500	No	516, 544, 594, 596	Trees and treed areas represent potential foraging habitat for the species within the Subject Land. No roosting or breeding habitat is present.

5.7.4.1 Bristle-faced Free-tailed Bat

As described in Table 5.6, the Bristle-faced Free-tailed Bat roosts in tree hollows and tree fissures, breeds in tree hollows and forages for insects over the canopy of trees (Ellis 2001, NSW SC 2004, OEH 2019). In defining the habitat polygon for the Bristle-faced Free-tailed Bat, ecological information from the TBDC and scientific literature was taken into account including the following from BioNet:

This species may move distances greater than 10km, dispersal distance of 100m - 10km was selected as this is the distance at which females regularly move to establish new colonies in available habitat. Additionally, selected <1 for average number of offspring because females do not give birth every (often miscarry etc).

Potential habitat is riparian areas (including dry river/creek beds) within the PCTs associated with the species. Survey should sample the available range of suitable vegetation along riparian areas on the Subject Land. Traps or nets should be set near water holes (especially if isolated), under/beside large trees, in/beside creek beds, or in 'flyway' spaces between vegetation. NB. Use of acoustic detection alone is not suitable for this species as the call is difficult to distinguish from other common species. Refer to Threatened Bat Survey Guide.

All habitat on the Subject Land where the Subject Land is within 500m of a river, creek or riparian area must be mapped. Use aerial imagery to map river, creek or riparian areas (including dry creek channels, former creek channels, billabongs etc.) on or within 500m of the Subject Land. Species polygon boundaries should align with PCTs on the Subject Land to which the species is associated that are within 500m of waterbodies mapped.

In accordance with Table 1 of the OEH (2018b) 'Species Credit' threatened bats and their habitats guide, the species polygon for the Bristle-faced Free-tailed Bat has been prepared and includes the following features:

- *All habitat on the Subject Land where the Subject Land is within 500m of a river, creek or riparian area.*

A review of information on the Bristle-faced Free-tailed Bat has been undertaken and is presented in Appendix E. It is acknowledged that little information is available regarding the ecology and biology of this species. It is assumed that the species roosts and breeds on tree hollows and tree fissures. Based on feeding behaviour of species within the *Mormopterus* / *Setirostris* genus, it is assumed that the species is aerial insectivorous and that is a vegetation dependent species which forage typically well above the canopy of any vegetation type when feeding. Therefore, suitable roosting, breeding and foraging habitat for the species within the Subject Land includes individual trees (particularly hollow-bearing trees, trees with fissures and tree canopies) and woodland areas within 500m of riparian areas. Cleared areas are not considered to represent suitable habitat for the species.

A species habitat polygon for the Bristle-faced Free-tailed Bat is provided in Figure 5.3.

5.7.4.2 Eastern Cave Bat

As described in Table 5.6, the Eastern Cave Bat roosts in Caves, Scarps, cliffs, disused mine workings. Potential breeding habitat is the PCTs associated with the species (as per the TBDC) within 100m of rocky areas, caves, overhangs crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within potential habitat.

The BioNet Atlas indicates that the Eastern Cave Bat:

- *"Any impacts on breeding habitat could be considered potentially serious and irreversible. This species is retained as dual credit because foraging habitat is broad ranging but breeding habitat is highly specific. At lower altitudes this species is usually more abundant during winter months, the lower numbers of individuals from October to February are due to females moving to maternity sites. Additionally, selected <1 for average number of offspring because females do not give birth every (often miscarry etc)."*

- *“All breeding habitat including the cave, or other features, used for breeding and the area immediately surrounding this feature must be mapped. Species polygon boundaries should have a 100m radius buffer around an accurate GPS point location centred on the cave/feature entrance.”*

In accordance with Table 1 of the OEH (2018b) ‘Species Credit’ threatened bats and their habitats guide, a species polygon for the Eastern Cave Bat would need to be prepared that includes the following features:

- *“All habitat on the Subject Land where the Subject Land is within 2km of caves, scarps, cliffs, rock overhangs and disused mines.”*
- *“Note: any breeding habitat identified for this species (see Table 2) is a potential serious and irreversible impact.”*

In accordance with Table 2 of the OEH (2018b), the features and approach required to develop the species polygon for the Eastern Cave Bat, a species that require identification of breeding habitat are:

- *“All breeding habitat on or within 100m of the Subject Land and the area immediately surrounding the feature. Artificial structures should be inspected and included if the species is using these features for breeding (see Section 3.2).”*
- *“Note all habitat for this species should also be mapped if present (i.e. including that described in Table 1).”*

Roosting and/or breeding habitat for the Eastern Cave Bat does not occur on the Subject Land. Aerial images covering an area of 2km surrounding the Project Boundary were assessed for the potential presence of caves, cliffs, rock overhangs and disused mines. No suitable breeding and/or roosting habitat features were identified. However, rocky areas containing boulder piles and crevices were observed within 2km of the Subject Land.

It is considered that only foraging resources for the Eastern Cave Bat are available on the Subject Land. In accordance with the TBDC, the four PCTs identified at the Subject Land (i.e. PCT 516, 544, 594 and 596) represent potential foraging habitat. The profile for the species (OEH 2019) indicates that “little is understood of its feeding or breeding requirements or behaviour”. All vegetation zones, with the exception of disturbed and derived grasslands, have therefore been considered as potential foraging habitat for the Eastern Cave Bat. A species habitat polygon for the Eastern Cave Bat is provided in Figure 5.3.

A test of significance for the species is presented in Appendix E. Given the absence of roosting and/or breeding habitat for the species at the Subject Land, it is considered that the proposed development does not represent a significant impact on this species.

5.7.5 Cicadabird

One individual of the Cicadabird (*Coracina tenuirostris*) was observed within the Subject Land during surveys. A significant impact assessment for the species was undertaken (see Appendix E) and it was concluded that significant impacts on this migratory/marine species are unlikely to result due to the proposed solar farm development. The Cicadabird is not further assessed.

5.7.6 Threatened Aquatic Species

No threatened aquatic species are considered likely to occur within the Development Site.

Threatened species maps prepared by the NSW Department of Primary Industries were reviewed (<https://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw/freshwater-threatened-species-distribution-maps>) via the SEED Portal. The following threatened species listed under the NSW Fisheries Management Act have been considered:

- Southern Purple Spotted Gudgeon (*Mogurnda adspersa*): The Subject Land is located within the indicative distribution area of the Southern Purple Spotted Gudgeon, which is listed as Endangered under the FM Act. DPI's indicative distribution map indicates that none of the creeks within the Subject Land are mapped as habitat for the species (see Figure 5.4). The nearest creeks mapped as habitat for the Southern Purple Spotted Gudgeon are:
 - Dumaresq River: it is located at approximately 1.2 km north from the Development Site. This river runs in a general east-west direction.
 - Little Oak Creek: it is located at approximately 1.7 km west from the Development Site. Little Oak Creek is a tributary of Dumaresq River.
 - Crooked Creek: it is located at approximately 4.5 km west from the Development Site and 2.5 km west from Little Oak Creek. Crooked Creek is a tributary of Dumaresq River.
 - Beardy River: is located to the east from the Development Site. The nearest point is located at approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Development Site.

All creeks within the Development Site were dry during the three survey periods in September 2018, December 2019 and March 2019 and have low habitat value for the Southern Purple Spotted Gudgeon.

- Eel Tailed Catfish (*Tandanus tandanus*): The Subject Land is located within the indicative distribution area of the Murray-Darling Basin population of Eel Tailed Catfish (Endangered Population). DPI's indicative distribution map indicates that none of the creeks within the Subject Land are mapped as habitat for the species (see Figure 5.4). The nearest creeks mapped as habitat for the Eel Tailed Catfish are:
 - Dumaresq River: it is located at approximately 1.2 km north from the Subject Land. This river runs in a general east-west direction.
 - Beardy River: is located to the east of the Subject Land. The nearest point is located at approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Subject Land.
- Olive Perchlet (*Ambassis agassizii*): The Development Site is located within the indicative distribution area of the Western Population of Olive Perchlet which is listed as an endangered population under the FM Act. The nearest creeks mapped as habitat for the Olive Perchlet are:
 - Dumaresq River: it is located at approximately 1.2 km north from the Subject Land. This river runs in a general east-west direction.
 - Beardy River: is located to the east from the Subject Land. The nearest point is located at approximately 3 km from the development footprint. Beardy River runs on a general north-south direction from its convergence with Dumaresq River. None of the first order tributaries of Beardy River are located within the Subject Land.

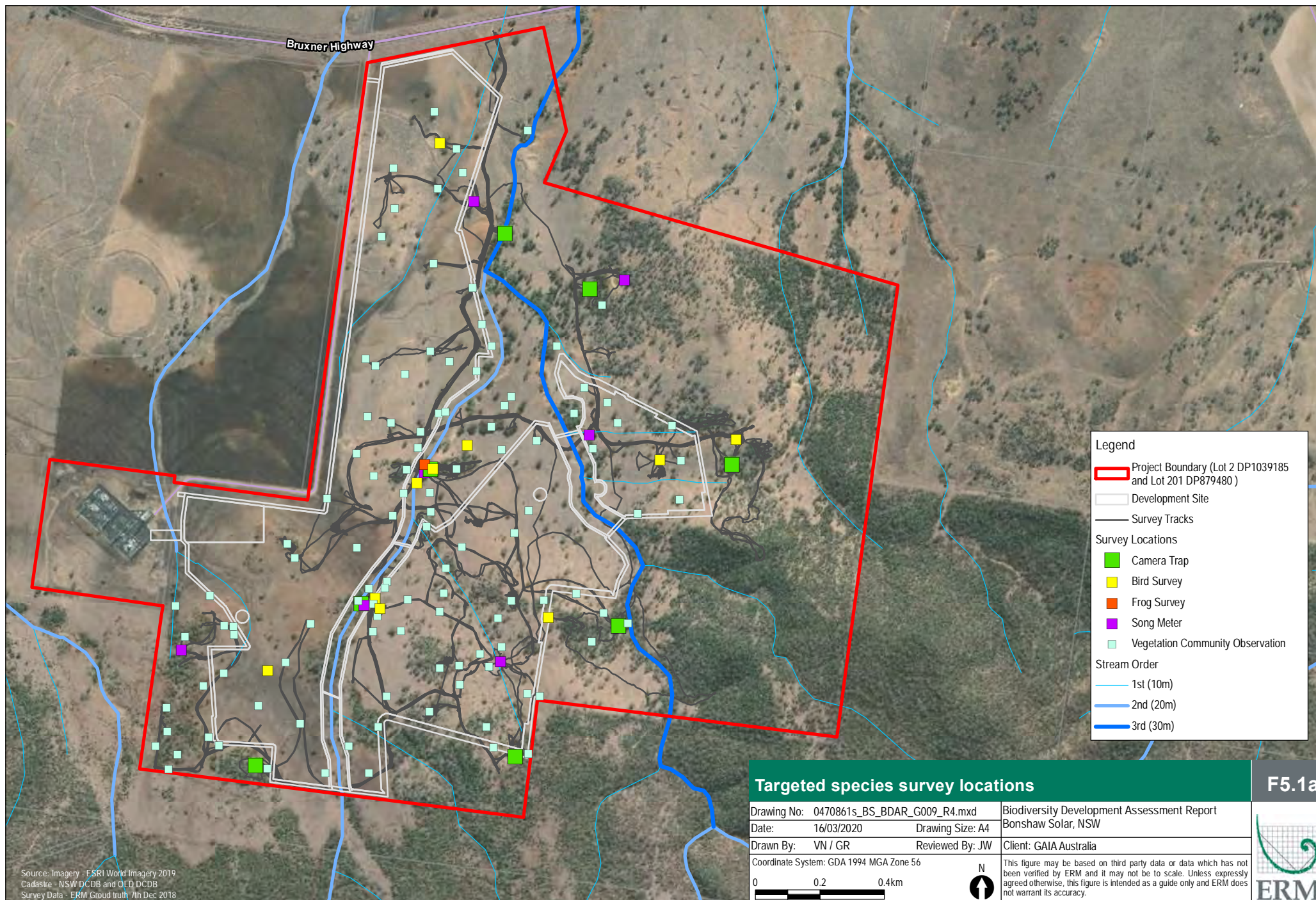
5.8 Limitations To Data

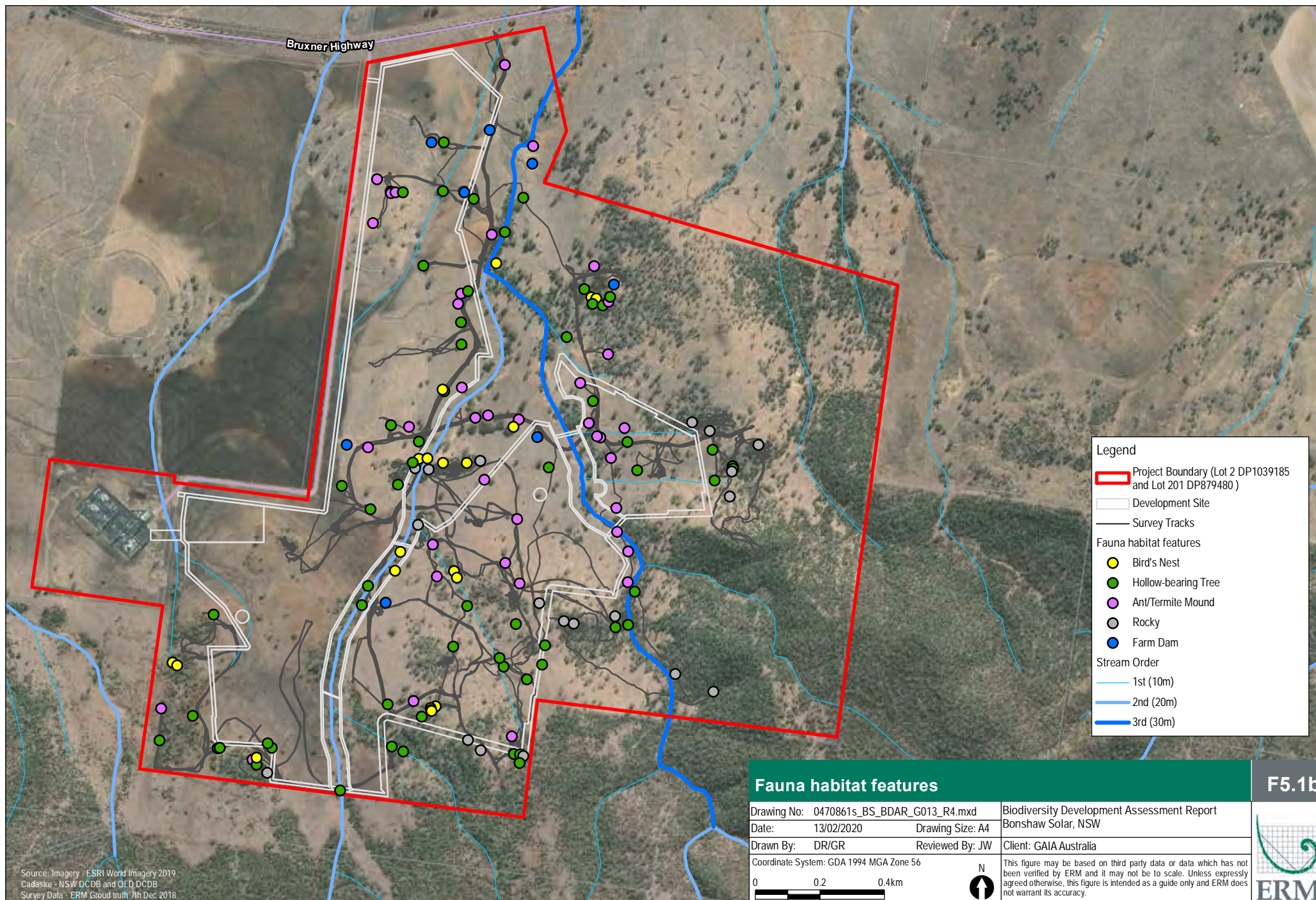
It is possible that some species were not detected on the Subject Land due to surveys being completed outside of the appropriate/recommended survey period for those species. Where survey effort or timing is not consistent with the BAM or relevant guidelines, this is stated explicitly in the assessment and measures identified to address the limitation (e.g. assumed presence of Masked Owl and Barking Owl breeding habitats).

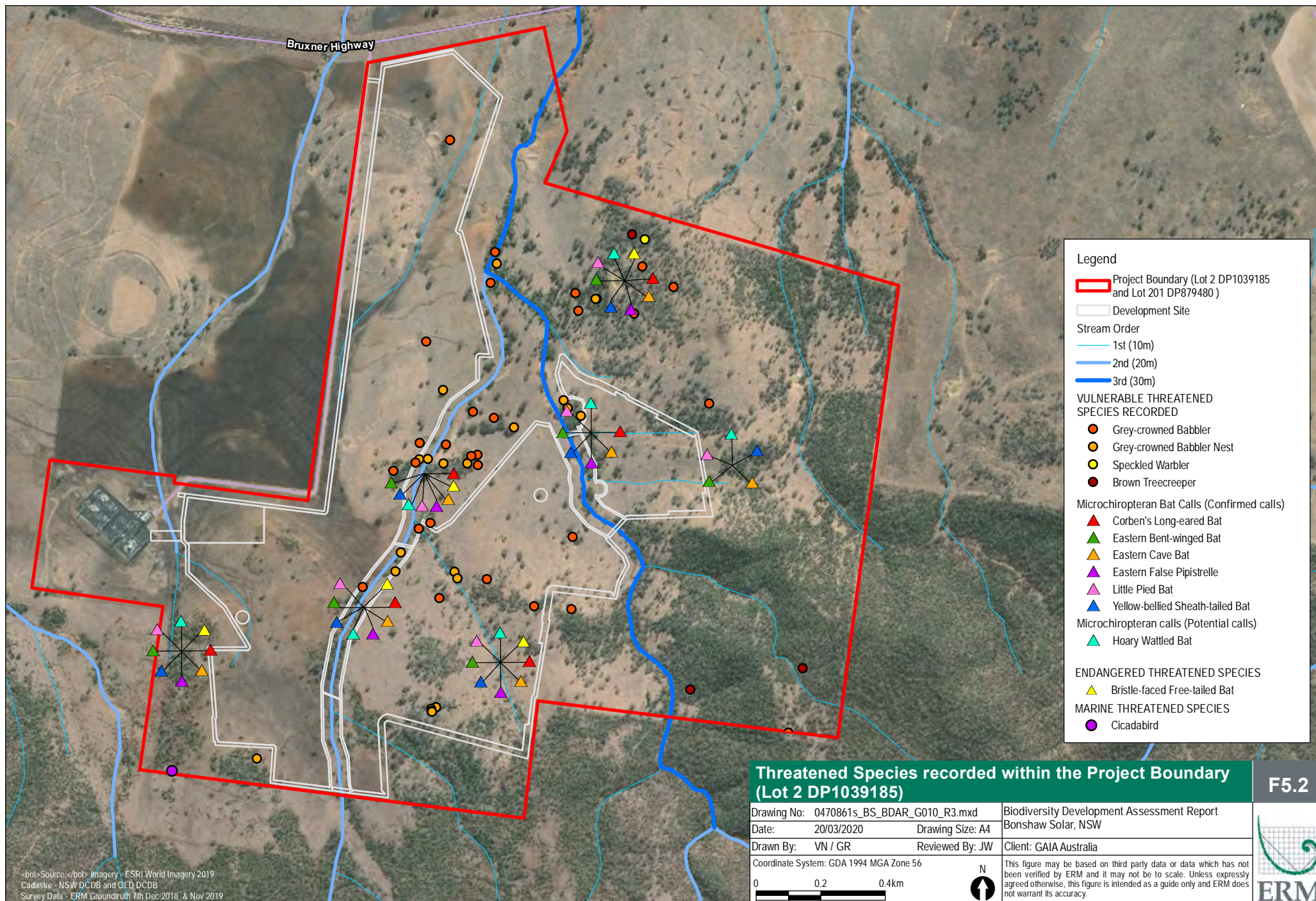
The calculation of hollow-bearings trees, in particular the size and number of hollows, was made from ground level. It is possible that some hollows are present that were not visible from ground level, which may result in underestimates.

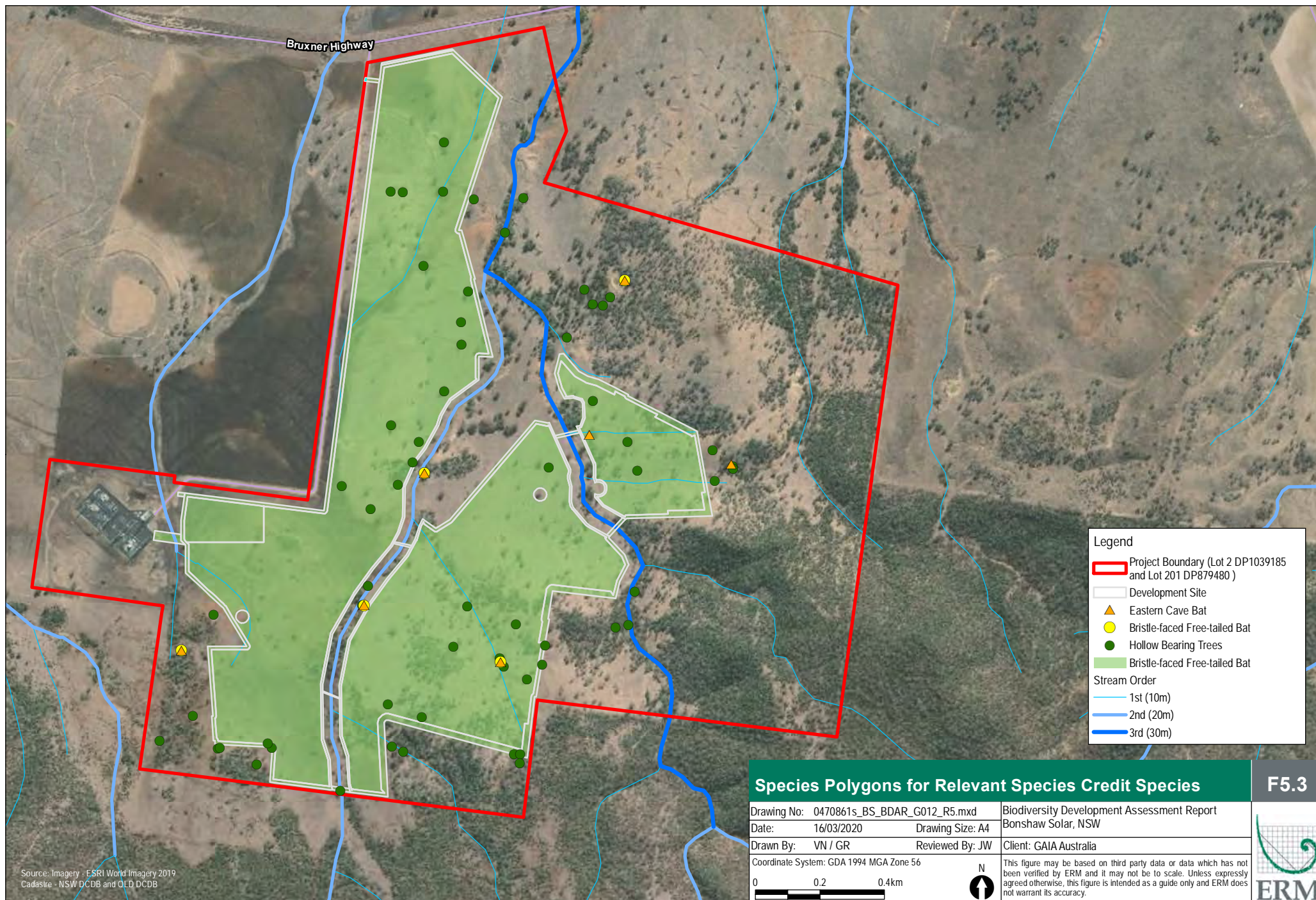
The combined impacts of intensive livestock grazing and extended drought period may have altered the visible foliage cover of native grasses, forbs and high threat exotic species. Some native grasses and/or forbs may not have been present/visible at the time of survey. Likewise, some heavily grazed grasses were unidentifiable to species level.

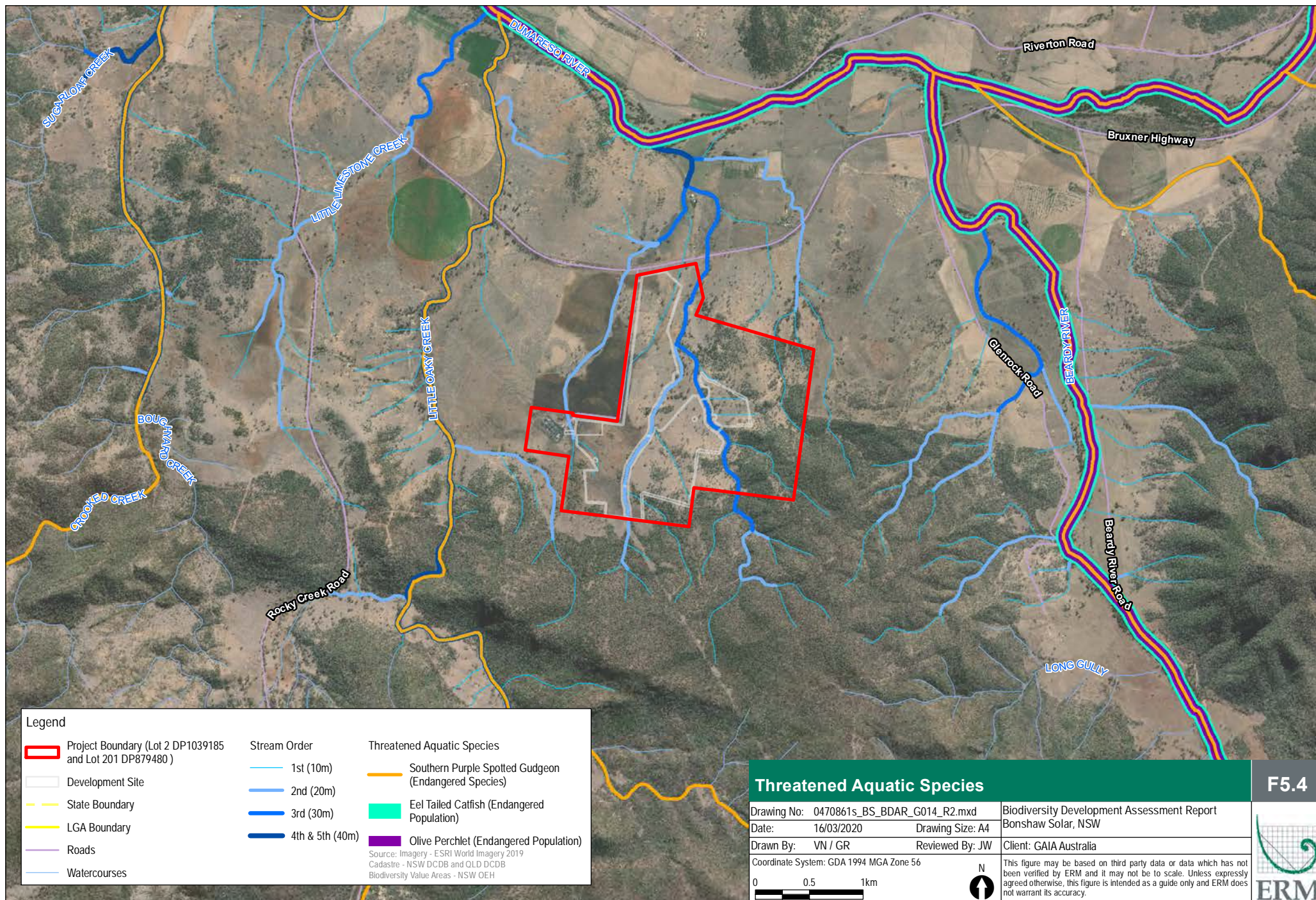
It is also noted that at the time of surveys, all streams were dry and no detailed aquatic assessment has been undertaken on the Subject Land.











STAGE 2: IMPACT ASSESSMENT (BIODIVERSITY VALUES)

6. IMPACT ASSESSMENT (BIODIVERSITY VALUES)

This chapter identifies the potential impacts of the project on the biodiversity values of the Development Site. Measures taken to date to avoid and minimise impacts are summarised and recommendations are provided, which will assist GAIA to design a development that further avoids, minimises and mitigates impacts.

6.1 Avoiding and Minimising Impacts On Native Vegetation and Habitat

As discussed in the EIS, various options relating to location, technology and scale of the project were evaluated in developing the proposal. The site was selected as being a suitable site for a solar plant based on;

- A mostly cleared landscape with minimal vegetation removal required;
- Compatible land use zoning of the land; and
- Proximity to the transmission network.

The development footprint is of a scale that allows for flexibility in the design, allowing ecological and heritage constraints to be avoided (refer to EIS for greater detail on the site selection process).

The Project site has had extensive environmental investigation and assessment which has informed the current concept layout. The layout has been reassessed and reduced to minimise its impact on the environment. Careful consideration of the existing environmental constraints has seen the total development footprint reduced from 1,097 ha (including adjacent Lots to the west and east of the Project Boundary identified during the Preliminary Environmental Assessment) to 149.24 ha.

In terms of biodiversity values, GAIA has undertaken significant steps to avoid, minimise and mitigate impacts, as per the process outlined below:

- Identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- Communication of identified values to the project team;
- Consultation between the design team and project ecology leader to consider direct and indirect impacts and work through the design process to achieve a feasible project with the least biodiversity impact; and
- Consultation with BCD, to seek input and discuss measures proposed to avoid and minimise impacts (see Table 1.4).

Through continued detailed design the Project will avoid the following areas of high biodiversity value:

- Avoid the large areas of intact vegetation communities within the eastern and south eastern portion of the Project Boundary;
- Avoid the majority of areas identified as a TEC, with the exception of <1 ha of low condition vegetation representing a TEC. All areas of moderate condition vegetation representing a TEC have been avoided;
- The second and third order watercourses will be avoided through detailed design and survey, with riparian buffers to be applied either side of the streams, measured from the edge of the top of bank. The buffers applied to this BDAR are 20m either side of the second order stream and 30m to either side of the third order streams.
- Locating ancillary facilities in areas where there are minimal biodiversity values.

Regardless of the above, the proposed development will result in unavoidable impacts to some areas containing native vegetation and habitat values to accommodate the necessary infrastructure associated with the proposal. These impacts are described in the following sections.

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. Prescribed Biodiversity impacts relevant to the proposal are:

- Impacts of development on the habitat of threatened species associated with rocks.
- Impacts of development on the habitat of threatened species associated with human made structure.
- Impacts of development on the habitat of threatened species associated with non - native vegetation.
- Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.
- Impacts of development on movement of threatened species that maintains their life cycle.
- 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.

Prescribed impacts requiring assessment are identified in Section 8.2.1.2 of the BAM (OEH 2017a). How these prescribed impacts have been avoided and minimised by the proposal is detailed in Table 6.1.

Table 6.1 Avoidance and Minimisation of Impacts

Impact	Avoidance/Minimisation Measures	Outcome
Prescribed Impact		
(a) Impacts of development on the habitat of threatened species or ecological communities associated with: <ul style="list-style-type: none"> ■ (i) karst, caves, crevices, cliffs and other geological features of significance, or ■ (ii) rocks, or ■ (iii) human made structures, or ■ (iv) non-native vegetation 	<p>A total of eleven rocky areas were recorded within the Subject Land.</p> <p>Five of these have been avoided by the proposal. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.</p> <p>Vegetation within the Development Site comprises 108.03 ha of Cleared Land, Disturbed Grasslands and Dams. These areas were selected to be removed as they represent areas with reduced biodiversity value.</p>	Avoidance of five rocky areas within the Project Boundary. Loss of only two rocky areas located in the centre of the Development Site. Four additional rocky areas likely to be avoided during detailed design.
(b) Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.	<p>The predominantly cleared landscape provides low quality connectivity across the Development Site itself. Isolated trees scattered across the Development Site represent limited connectivity features for highly mobile species to travel across the landscape.</p> <p>The second and third order creeks within the Development Site have some, albeit limited, potential to provide aquatic connectivity to Dumaresq River and have been avoided.</p>	Retention of the second and third order streams which are the landscape features with highest potential as linking corridor.

Impact	Avoidance/Minimisation Measures	Outcome
(c) Impacts of development on movement of threatened species that maintains their life cycle	<p>The predominantly cleared landscape provides low quality connectivity across the Development Site and the movement of the Grey-crowned Babbler largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided.</p> <p>Regarding the Cicadabird and microchiropteran bats, it is not considered the project will restrict the movement of these highly mobile aerial species and they will continue to utilise retained habitats surrounding the solar farm.</p>	Retention of the second and third order creek lines along which movement of threatened species will continue to occur.
(d) Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	<p>The second and third order watercourses will be avoided through detailed design (including 20-30m riparian buffer zones measured from the top of bank of the streams).</p> <p>Any waterway crossings required as a result of the Project will be designed in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management and the Policy and Guidelines for Fish Friendly Waterway Crossings.</p> <p>Six farm dams are present within the development site. These farm dams could not be avoided due to the size constraints of the solar panels. These farm dams would be filled in during construction of the solar farm. The impacts proposed to these dams are not anticipated to have any broader impacts for environments that sustain and interact with rivers, streams or wetlands either on or offsite.</p> <p>Appropriate drainage features would be constructed along internal access roads to minimise the risk of polluted water leaving the site or entering water bodies. Ground cover would be maintained beneath the solar arrays and there would be a low risk of contamination in the event of a chemical spill (fuels, lubricants, herbicides etc.) as storage and emergency handling protocols will be implemented.</p>	Avoidance of second and third order creek lines. Loss of six first order creeks and six farm dams.
(e) Impacts of wind turbine strikes on protected animals	Not applicable	Not applicable

Impact	Avoidance/Minimisation Measures	Outcome
(f) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	<p>The proposal would not directly increase impacts of vehicle strikes on threatened species. Threatened species would not be funnelled into transport corridors.</p> <p>An increase in vehicle traffic may indirectly increase vehicle strikes on native fauna. Site design would be unlikely to reduce impacts associated with vehicle strikes. Site management to enforce and reduce site speed limits would minimise the likelihood of vehicle strikes.</p>	Increased traffic may indirectly increase vehicle strikes with fauna, including threatened species such as Grey-crowned Babbler.

Impacts to Other Biodiversity Values

Loss of Species Credit Species Habitat or Individuals	<p>Habitat for the Bristle-faced Free-tailed Bat will be retained within riparian buffers of 2nd and 3rd creek lines. The bat was also detected in one of the first order creeks to be retained.</p> <p>To further avoid impact, vegetation clearance shall only be undertaken outside breeding period for the species to prevent miscarriage in gravid females.</p> <p>Hollow bearing trees within the development footprint will be inspected prior to removal. If this species is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert.</p>	The species polygon for the Bristle-faced Free-tailed Bat occupies the entire Development Site. Offsets will be required to compensate for unavoidable impacts.
Loss of habitat for the Grey-crowned Babbler, Brown Treecreeper and Speckled Warbler	<p>A total of 21 Grey-crowned Babbler nests were recorded across the assessment area, with 13 of these to be avoided.</p> <p>The predominantly cleared landscape provides low quality connectivity across the development site and the movement of the Grey-crowned Babbler is largely confined to woodland areas and riparian corridors.</p> <p>Riparian corridors (including 20-30m buffer) have been avoided. However, there will be some loss of suitable (albeit degraded) woodland habitat for this species and potentially for the Brown Treecreeper and Speckled Warbler (recorded adjacent to Subject Land during investigation of potential offset areas).</p> <p>To further minimise impacts, enhancement of linking corridors along 2nd and 3rd order riparian zones will be provided. This is expected to improve the current fragmented condition of riparian corridors and assist movement and dispersal of these and other fauna species.</p>	Offsets will be required to compensate for unavoidable impacts.

Impact	Avoidance/Minimisation Measures	Outcome
Loss of Hollow Bearing Trees (HBT)	<p>A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint.</p> <p>Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. A minimum of 68 trees shall be planted within the riparian corridor with commitment to 100% recruitment rate. As naturally formed tree hollows take many decades to develop, nest-boxes suitable for relevant hollow dependent species will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development.</p>	The impacts of the loss of HBT will be minimised via revegetation and the provision of nest boxes .
Impacts of Development on the Habitat of Threatened Species or Ecological Communities	<p>One TEC was recorded on and adjacent to the Subject Land – White Box Yellow Box Blakely's Red Gum Woodland. Impacts on this TEC have been largely avoided by retaining riparian and buffer areas.</p> <p>Threatened species recorded within the Development Site included the Grey-crowned Babbler and a number of microbats. In addition, Brown Treecreeper and Speckled Warbler were recorded adjacent to the Subject Land during investigation of potential offset areas.</p> <p>Large areas of intact vegetation representing better quality habitat for the above species have been avoided during the design phase of the project. Avoided areas include forest, woodland and riparian habitats.</p> <p>However, there will be some loss of suitable (albeit degraded) habitat for these species.</p>	Implementation of mitigation measures will result in negligible impact on retained habitat of threatened species on and adjacent to the Development Site.
Impacts of Development on the Habitat of EPBC Listed Migratory Species	<p>The project will not result in impacts on habitat of EPBC listed migratory species.</p> <p>One individual of the Cicadabird was recorded within the Development Site. The species occupies several types of vegetation across its range and forages on fruits and insects.</p> <p>No species-specific avoidance measures have been proposed for the Cicadabird. However, measures proposed for other threatened species will enhance roosting habitat and foraging resource availability for this migratory bird.</p>	Implementation of mitigation measures will result in negligible impacts on migratory species.

6.3 Impact that Cannot be Avoided

6.3.1 Direct Impacts

Direct impacts associated with the construction and operational phases of the proposed development are outlined in Table 6.2.

Table 6.2 Direct Impacts to Biodiversity during the Construction and Operational Phases

Nature of Impact	Area of impact	Frequency/Timing	Description of the Impact	Threatened species and habitats likely to be affected
Loss of habitat	Up to approx. 150ha	Construction	Direct removal of native vegetation representing flora and fauna habitat. Direct removal of fallen timber and bush rock representing fauna habitat.	Grey-crowned Babbler and other threatened woodland birds. Microchiropteran bats, such as Bristle-faced Free-tailed Bat.
Displacement of resident fauna	Unknown	Construction and Operation	Direct loss of native fauna from the Subject Land.	Grey-crowned Babbler and other threatened woodland birds. Microchiropteran bats, such as Bristle-faced Free-tailed Bat.
Potential injury or death of fauna	Unknown	Construction and Operation	Injury and/or mortality of fauna during removal of vegetation and other fauna habitat components. Potential decline in local fauna populations.	Resident and dispersing fauna
Removal of important habitat features e.g. Hollow bearing trees	34 trees with hollows to be removed	Construction	Direct loss of native fauna habitat. Injury and mortality of fauna during clearing of fauna habitat and habitat trees.	Hollow dependent fauna, including arboreal mammals (e.g. Possum), microbats and birds
Bush Rock removal and disturbance	Up to six outcrops may be disturbed	Construction	Direct loss of native fauna habitat. Injury and mortality of fauna during clearing of fauna habitat	Reptiles Ground-dwelling mammals
Shading by solar infrastructure	Up to approx. 150ha	Operation	Modification of ecosystem grassland composition.	Flora species

The likely changes in vegetation integrity scores as a result of clearing for the solar array, laydown areas and access roads are documented for each vegetation zone in Table 6.3.

Table 6.3 Current and Future Vegetation Integrity Scores for each Vegetation Zone

Vegetation Zone		PCT	Area of Impact ^A	Vegetation integrity scores	
No	Name			Current	Future
1	594_Moderate	594	4.10	61.3	0
2	594_Low	594	9.54	33.3	0
3	596_Moderate	596	11.15	62.6	0
4	596_Low	596	0.25	38.2	0
5	596_Very Low	596	0.30	23.6	0
6	596_Derived_Low	596	9.04	8	0
7	516_Very Low	516	3.00	20.7	0
8	516_Derived_Moderate	516	2.76	24.7	0
9	544_Low	544	0.83	35	0
10	516_Disturbed Grassland	NA	7.39	15.8	0
11	594_Disturbed Grassland	NA	49.81	11.8	0
12	596_Disturbed Grassland	NA	50.59	5.6	0
13	Cleared Land / Dams	NA	0.48	-	-

6.3.2 Indirect Impacts

Identified indirect impacts that could occur as a result of the project include:

- Increased noise, vibration and dust levels;
- Increased sedimentation and erosion;
- Increased mortality and/or injury of fauna;
- Artificial lighting impacting nocturnal species behaviour; and
- Increase in invasive species, weeds and pathogens.

Table 6.4 Potential Indirect Impacts Associated with the Proposed Development

Nature of Impact	Area of impact	Frequency/ Timing	Description of the Impact and Consequence for Bioregional Persistence	Threatened species and habitats likely to be affected
Increased noise, vibration and dust levels	Development Site	Working hours during the Construction and Operational phases	Construction activities may result in increased levels of noise and vibration. No significant impacts are anticipated as the fauna abundance is low across the development site and largely limited to highly mobile species. A number of Grey-crowned Babblers and one confirmed nest were observed within the Development Site, family groups of the species stay together within their home range (generally 10 ha and up to 50 ha). It is expected that individuals of the local family group would move to roosting nests outside of the Development Footprint. No other threatened species are anticipated to rely on any of the habitats currently present and no sensitive receptors have been identified.	All fauna species, including the Grey-crowned Babblers
Increase sedimentation and erosion	Development Site & Project Boundary	During and following the Construction and Operational Phases	Mobilisation of soils/sediments may occur during inclement weather over disturbed soils and sediments in areas where vegetation has been cleared and/or areas where soil and construction material has been stockpiled. Reduction in watercourse bank stability following any nearby construction and any clearing of riparian vegetation could also result in bank erosion and input of sediments into watercourses.	Aquatic fauna and habitat within the Dumaesq riparian system
Artificial lighting impacting	Development Site & Project Boundary	Night time during the Construction and Operational Phase	The project will require limited permanent night lighting, most likely for the operations and maintenance buildings and substations. Temporary, localised night lighting may be required during general maintenance activities conducted during the operational stage of the project. Lighting has the potential to impact species behaviour. Any impacts are anticipated to be highly localised and are not anticipated to be significant given the low diversity and abundance of fauna recorded within the Development Site.	All fauna, including the Grey-crowned Babbler and microbats
Increase in invasive species	Development Site & Project Boundary	During and following the Construction and Operational Phases	Increased movement of vehicles has the potential to transport weeds and pathogens into the development site and adjacent vegetation. Given the high levels of disturbance within the development site, there is also the risk that weeds may be transported off-site. Infection of native plants by <i>Phytophthora cinnamomi</i> is listed as a key threatening process under the BC Act and EPBC Act. <i>P. cinnamomi</i> can lead to death of trees and shrubs, resulting in devastation of native ecosystems (DECC 2008). As described by DoE (2014), infection of susceptible communities with <i>P. cinnamomi</i> can lead to:	Predation of fauna species, including threatened birds (e.g. Grey-crowned Babbler) and microbats (e.g. Bristle-faced Free-tailed Bat)

Nature of Impact	Area of impact	Frequency/ Timing	Description of the Impact and Consequence for Bioregional Persistence	Threatened species and habitats likely to be affected
			<ul style="list-style-type: none"> ■ changes in the structure and composition of native plant communities; ■ a significant reduction in primary productivity and functionality; and ■ habitat loss and degradation for dependent flora and fauna. <p>Clearing of vegetation and construction of roads provides increased potential for the introduction/spread of invasive pest species. Invasive species can also be unintentionally transported in vehicles and machinery. Monitoring and management of invasive species, such as cats, foxes and cane toads should be completed.</p>	
Impacts to Riparian Habitats	Development Site & Project Boundary	During and following the Construction and Operational Phases	Second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of these streams, measured from the edge of the high bank. This includes a 20m buffer either side of second order streams and 30m either side of third order streams. Furthermore, watercourses within the Development Site are highly disturbed being heavily grazed and eroded. The project is unlikely to result in any increased impact to the aquatic habitat, and the change in land use may improve habitats by reducing stocking rate and revegetating disturbed riparian areas.	Movement of fauna species, including the Grey-crowned Babbler and microbats.
Increased Fragmentation	Development Site	Permanent after clearing	The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding riparian corridors).	All fauna species, including the Grey-crowned Babbler and microbats

6.3.3 Prescribed Impacts

Prescribed impacts requiring assessment are identified in Section 8.2.1.2 of the BAM (OEI 2017a). Avoidance of prescribed impacts is discussed in Section 6.2. These are discussed in Table 6.5 below.

Table 6.5 Identification of Prescribed Impacts associated with the Proposed Development

Prescribed Impact	Likely to occur as result of the proposed Solar Farm
<p>(a) Impacts of development on the habitat of threatened species or ecological communities associated with:</p> <ul style="list-style-type: none"> ■ karst, caves, crevices, cliffs and other geological features of significance, or ■ rocks, or ■ human made structures, or ■ non-native vegetation 	<p>A total of eleven rocky areas were recorded within the Development Site.</p> <p>Up to six of these may be impacted by the proposed development. No threatened species were observed, or likely to be dependant on these six outcrops.</p> <p>No threatened species are likely to be dependant on any human made structures or areas of non-native vegetation.</p>
<p>(b) Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range.</p>	<p>Isolated paddock trees scattered across the Development Site represent limited connectivity features for highly mobile species to travel across the landscape. A number of these trees would be removed as a result of the proposed development.</p> <p>The Subject Land does not represent a known connectivity link for threatened species and the proposal is therefore unlikely to significantly disrupt the movement of a threatened species across its range. However, the removal of some degraded woodland habitat is likely to represent a minor reduction in the availability of dispersal habitat for the Grey-crowned Babbler and potentially Brown Treecreeper and Speckled Warbler (recorded adjacent to Subject Land during investigation of potential offset areas).</p>
<p>(c) Impacts of development on movement of threatened species that maintains their life cycle</p>	<p>A breeding population of Grey-crowned Babbler have been recorded on the Subject Land. The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. Although riparian corridors (with a 20-30m buffer) have been avoided, there will be some impacts to degraded woodland habitat that may facilitate the movement of this species across the Subject Land.</p> <p>Regarding the Cicadabird and microchiropteran bats, it is not considered the project will restrict the movement of these highly mobile aerial species and they will continue to utilise retained habitats adjacent to the solar farm.</p> <p>The Subject Land does not represent a known migratory path for any threatened species. Due to the highly cleared and fragmented landscape the proposal is not likely to disrupt the movement of a threatened species that maintains their lifecycle.</p>

Prescribed Impact	Likely to occur as result of the proposed Solar Farm
(d) Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	<p>Six farm dams are present within the development site. These farm dams would be filled in during construction of the solar farm. The filling of these dams is not anticipated to have any broader impacts for environments that sustain and interact with the rivers, streams and wetlands either onsite or offsite. These dams are not considered to represent important habitat for any threatened species or ecological community.</p> <p>The proposed development will affect six first order streams which are located within the proposed Development Site. These six first order creeks will be lost permanently.</p> <p>The proposal has the potential to affect surface water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses. Pollutants to water courses may be associated with vehicle movement, spill of chemicals used for solar panel maintenance/cleaning and maintenance of associated infrastructure.</p>
(e) Impacts of wind turbine strikes on protected animals	Not applicable
(f) Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	Vehicle strikes may occur during the construction and operational phases of the proposed development given the likelihood of increased vehicle movements.

6.4 Impacts to Matters of National Environmental Significance

An assessment of the impacts of the project on MNES within the Development Site was prepared to determine whether referral of the project to the Commonwealth Minister for the Environment is required. Matters of MNES relevant to the development site are summarised in Table 6.6 below.

A likelihood of occurrence assessment considering each entity individually is provided in Appendix D. Based on the results of the likelihood of occurrence and risk assessment, all TECs and threatened species as identified in the PMST were concluded to have a low residual risk. Given that one individual of the Cicadabird was recorded on the Subject Land, an assessment of significance for the species was undertaken as a precautionary measure (see Appendix E). No additional assessments of significance are considered to be required for other MNES (Appendix D).

Referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

Table 6.6 Assessment of the Project in relation to EPBC Act

MNES	Predicted MNES	Result
Wetlands of International Importance	<p>Three wetlands of national importance were identified as being between 1,100 and 1,300 km from the Development Site:</p> <ul style="list-style-type: none"> ■ Banrock Station Wetland Complex ■ Riverland ■ The Coorong, and lakes Alexandrina and Albert wetland. 	No direct or indirect effects on these wetlands of international importance will result from the proposal.
Threatened Ecological Communities (TECs)	<p>Four TECs were identified as likely to occur within the project area:</p> <p>Natural Grasslands on basalt and fine-textured alluvial plains of northern New South Wales and Southern Queensland (CEEC)</p> <p>New England Peppermint (<i>Eucalyptus nova-anglica</i>) Weeping Myall Woodland (CEEC)</p> <p>Weeping Myall Woodlands (EEC)</p> <p>White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CEEC)</p>	<p>A likelihood of occurrence analysis was undertaken for these TECs (see Table D.3 in Appendix D). This analysis concluded that the proposed development is unlikely to affect EPBC listed TECs.</p> <p>Although the NSW listing of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland is considered to be represented on the Subject Land by PCT 544, this vegetation does not satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of "important species" as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan (DECCW 2011).</p>
Threatened Species	<p>A total of 36 threatened species were predicted to occur within the project area, including:</p> <ul style="list-style-type: none"> ■ Eight mammals ■ Seven birds ■ Four reptiles ■ One fish ■ 16 flora 	<p>Seven species were identified as likely to occur within the Development Site and were taken into account during survey design.</p> <p>No EPBC listed threatened species have been recorded within the Development Site.</p>
Migratory Species	<p>A total of 11 migratory species were predicted to occur within the project area.</p>	<p>One migratory bird, Cicadabird (<i>Coracina tenuirostris</i>), was recorded during the surveys. A Significant Impact Assessment for this migratory species was undertaken (see Appendix E) and it was concluded that the species is unlikely to be significantly impacted as result of the proposed development.</p> <p>No further assessment for the Cicadabird is required.</p>

7. MANAGEMENT AND MITIGATION MEASURES

The key measures required to mitigate the impacts of the proposal is provided below in Table 7.1.

Table 7.1 Recommended Mitigation Measures for Residual Impacts

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Loss of Species Credit Species Habitat or Individuals	<p>Vegetation clearance:</p> <ul style="list-style-type: none"> ■ Preparation and implementation of a vegetation clearing protocol. ■ Clearing to be supervised by an experienced fauna catcher / ecologist. ■ Time works to avoid critical life cycle events such as breeding. ■ Monitoring of tree hollows prior to removal to avoid impacting any breeding females or juveniles. If Bristle-cased Freetail Bat is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed and managed in accordance with the Biodiversity Management Plan. ■ Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). A minimum of 68 trees will be planted within the riparian corridor with commitment to a 100% recruitment rate. ■ Nest-boxes suitable for hollow dependent microbats will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development. 	<ul style="list-style-type: none"> ■ Principal contractor to ensure implementation of vegetation clearing protocol. ■ Experienced fauna catcher / Ecologist to supervise clearing and relocate native fauna. 	<ul style="list-style-type: none"> ■ Vegetation clearing protocol to be prepared by an Ecologist prior to vegetation clearing. ■ Clearing supervision to occur during the entire clearing process. ■ Letter with results of clearing to be prepared by the fauna catcher/Ecologist supervising the clearance. Letter to be available for review by delegated authority (if requested). 	Vegetation Clearing Protocol as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
	<ul style="list-style-type: none"> No stockpiling or storage within dripline of any mature trees. Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. 			
Grey-crowned Babbler habitat	<p>Nest removal:</p> <ul style="list-style-type: none"> Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. Removal of trees with nests will be supervised by an experienced fauna catcher or ecologist. A portion of felled trees will be salvaged as habitat for fauna and translocated in suitable areas in the remainder of the Project Boundary. 	<ul style="list-style-type: none"> Principal contractor to ensure implementation of vegetation clearing protocol. Experienced fauna catcher / Ecologist to supervise clearing and relocate native fauna 	<ul style="list-style-type: none"> Clearing supervision to occur during the entire clearing process. Letter with results of clearing to be prepared by the fauna catcher/Ecologist supervising the clearance. Letter to be available for review by delegated authority (if requested). 	Vegetation Clearing Protocol as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Loss of Hollow Bearing Trees	<ul style="list-style-type: none"> ■ Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). A minimum of 68 trees will be planted within the riparian corridor with commitment to a 100% recruitment rate. ■ Nest-boxes suitable for hollow dependent microbats will be installed prior to HBT removal. Nest boxes shall be installed within suitable retained habitat (e.g. riparian corridors) and will be monitored and maintained during the construction and operational phases of the development. 	<ul style="list-style-type: none"> ■ GAIA to appoint a qualified ecologist for preparation of the monitoring plan. ■ GAIA to liaise with relevant authority regarding outcomes. ■ Appointed Ecologist to undertake monitoring as required. 	<ul style="list-style-type: none"> ■ Monitoring Plan to be prepared and approved prior to commencement of clearing. ■ Monitoring to be implemented as required. 	Tree Replacement and Nest Box Monitoring Plan as part of the Biodiversity Management Plan
Impacts of Development on the Habitat of Threatened Species or Ecological Communities	<ul style="list-style-type: none"> ■ A tree replacement and nest box monitoring plan will be prepared for the Project. The plan will provide details of monitoring and Key Performance Indicators (KPIs) to ensure objectives of tree replacement and nest box monitoring is achieved. ■ Monitoring and reporting to be undertaken by a qualified ecologist. Avoidance of use of chemicals, such as pesticides and herbicides, within the solar farm during the construction and operational phases to prevent contributing to the global decline in insect population and diversity. ■ Facilitation of natural regeneration of native ground cover within viable solar farm footprint (e.g. under solar panel arrays) and in retained areas. This will include management of weeds. 	<ul style="list-style-type: none"> ■ GAIA to appoint a qualified ecologist for preparation of the monitoring plan. ■ GAIA to liaise with relevant authority regarding outcomes. ■ Appointed Ecologist to undertake monitoring as required. 	<ul style="list-style-type: none"> ■ Monitoring Plan to be prepared and approved prior to commencement of clearing. ■ Monitoring to be implemented as required. 	Tree Replacement and Nest Box Monitoring Plan as part of the Biodiversity Management Plan

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Impacts of Development on the Habitat of EPBC Listed Migratory Species	None required	NA	NA	NA
Impacts of Development on Water Quality, Water Bodies and Hydrological Processes that sustain Threatened Species and TECs	<ul style="list-style-type: none"> An erosion and sediment control plan (ESCP) would be prepared in conjunction with the final design and implemented. Design of creek crossings to meet best practice industry standards. ESCP to include requirements for water quality monitoring, chemical use and control. 	<ul style="list-style-type: none"> GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments. 	<ul style="list-style-type: none"> ESCP to be prepared and approved prior to commencement of works. Reporting, evaluation and auditing as per the ESCP. 	CEMP ESCP
Impacts of Vehicle Strikes on Threatened Species of animals or on animals that are part of a TEC	<p>Actions to minimise mortality of wildlife involved in vehicle strikes:</p> <ul style="list-style-type: none"> Appropriate vehicle speeds and signage to be installed within the solar farm. Protocol detailing actions to be undertaken in the event of a vehicle strike. Identification of a wildlife veterinary and/or wildlife carer group and agreement for injured wildlife to be taken care of or being humanely euthanised. 	<ul style="list-style-type: none"> GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments. 	<ul style="list-style-type: none"> CEMP to be prepared and approved prior to commencement of works. Reporting, evaluation and auditing as per the CEMP. 	CEMP
	<ul style="list-style-type: none"> Avoid night works. Direct lights away from retained native vegetation. 	<ul style="list-style-type: none"> GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments. 	<ul style="list-style-type: none"> CEMP to be prepared and approved prior to commencement of works. Reporting, evaluation and auditing as per the CEMP. 	CEMP

Impact	Mitigation Measure	Responsibility	Timing	Reporting
Invasive Species	<ul style="list-style-type: none"> ■ CEMP will include a Management protocol for declared priority weeds under the <i>Biosecurity Act 2015</i> during and after construction. ■ Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas. ■ Monitoring and management protocol for invasive feral/pest species, including cats, foxes and cane toads. 	<ul style="list-style-type: none"> ■ GAIA has overall responsibility to ensure meeting that they are meeting environmental commitments. 	<ul style="list-style-type: none"> ■ CEMP to be prepared and approved prior to commencement of works. ■ Reporting, evaluation and auditing as per the CEMP. 	CEMP

8. SERIOUS AND IRREVERSIBLE IMPACTS (SAIL)

A Serious and Irreversible Impact (SAIL) is listed under the BC Act as an impact that is likely to contribute significantly to the risk of extinction of a threatened entity.

In accordance with the BAM, species and ecological communities with a 'very high' biodiversity risk weighting will be a potential serious and irreversible impact (SAIL). Whenever potential SAIL are identified for a Development Site, those SAIL need to be address as per Section 10.2 of the BAM (OEH 2017a).

The following guidelines were consulted to identify potential SAIL:

- OEH (2017b) *Guidance to assist a decision-maker to determine a serious and irreversible impact.*
- OEH (2018b) *'Species Credit' threatened bats and their habitats guide.*

8.1 Potential Serious and Irreversible Impact Entities

Based on candidate ecosystem credit species, species credit species and results of field surveys, the potential SAIL for the Development Site are listed in Table 8.1 below.

Table 8.1 Potential SAIL within the Development Site

Scientific Name Common Name	Justification as potential SAIL	Corresponding habitat constraint	Is SAIL present?
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	The species is dependent on non-responding attribute (breeding habitat only) (OEH 2017b)	Caves are the primary breeding habitat for the Eastern Bentwing Bat. Breeding habitat does not occur on the Subject Land.	No
<i>Vespadelus troughtoni</i> Eastern Cave Bat	Breeding habitat is classified as SAIL (OEH 2018b)	Breeding habitat for the species is caves, overhangs, crevices, cliffs and escarpments, or old mines or tunnels, old buildings and sheds within the potential habitat. Breeding habitat is not considered to occur on the Subject Land.	No
White Box Yellow Box Blakely's Red Gum Woodland	Threatened Ecological Community with very high sensitivity to loss due to small population size (extent)	Fertile lower footslopes and flats. This TEC is represented onsite by PCT 544 which is associated with stream banks, beds and channels. Riparian areas associated with this TEC have largely been avoided.	No

8.1.1 Threatened Ecological Communities

One threatened ecological community, that is a candidate for serious and irreversible impacts, was identified on the Subject Land – White Box Yellow Box Blakely's Red Gum Woodland. This TEC is represented on the Subject Land by disturbed areas of PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion of New England Tableland Bioregion. The majority of this TEC has been avoided by retaining riparian corridors and associated buffers. The proposed development is not considered to represent a SAIL on this TEC as impacts on 0.83 ha of highly disturbed vegetation representing PCT 544 are unlikely to contribute to the risk of extinction of the TEC. This TEC will be allowed to naturally regenerate within retained riparian areas and buffers. Infill plantings will also be provided that will expand the extent of this TEC on the Subject Land and improve its current condition.

8.1.2 Threatened Species

Two potential SAIL entities were identified, the Eastern Bentwing Bat and the Eastern Cave Bat. The echolocation calls of these species were recorded within the assessment area. However, breeding habitat for these microbat species, i.e. caves, overhangs crevices, cliffs or escarpments, are not present on the Subject Land. It is concluded that due to the lack of suitable breeding habitat, the Subject Land represents foraging habitat only. Therefore, the proposed development does not represent a SAIL on these species.

8.1.3 Additional Potential Entities

No other threatened species or communities, were identified as potential candidates for serious and irreversible impacts.

8.2 Assessment of SAIL

The proposed development is not considered to represent a serious and irreversible impact on any identified SAIL entities.

9. REQUIREMENT TO OFFSET

This chapter provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017a).

9.1 Impacts Requiring an Offset

9.1.1 Impacts on Native Vegetation – Ecosystem Credits

Impacts to native vegetation requiring offsets include:

- Direct impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion;
- Direct impacts on PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion;
- Direct impacts on PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion; and
- Direct impacts on PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

A total of 598 ecosystem credits are required to offset impacts of the proposed development. The impacts on the vegetation zones within each of the four PCTs is shown in Table 9.1.

Table 9.1 Summary of Ecosystem Credits

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion						
1	594_Moderate	4.1	61.3	0	-61.3	110
2	594_Low	9.54	33.3	0	-33.3	139
Total Ecosystem Credits required to offset impacts on PCT 594						249
PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion						
3	596_Moderate	11.15	62.6	0	-62.6	262
4	596_Low	0.25	38.2	0	-38.2	4
5	596_Very Low	0.30	23.6	0	-23.6	3
Total Ecosystem Credits required to offset impacts on PCT 596						269

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion of New England Tableland Bioregion						
7	516_Very Low	3.00	20.7	0	-20.7	31
8	516_Derived_Moderate	2.76	24.7	0	-24.7	34
Total Ecosystem Credits required to offset impacts on PCT 516						65
PCT 544 – Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion of New England Tableland Bioregion						
9	544_Low	0.83	35	0	-35	15
Total Ecosystem Credits required to offset impacts on PCT 544						15

9.1.2 Impacts on Threatened Species – Species Credits

Impacts to habitat of Threatened Species requiring offsets include:

- Habitat for the Bristle-faced Free-tailed Bat in PCTs 516, 544, 594 and 596, requiring 1,180 species credits;
- Foraging habitat for Eastern Cave Bat in PCTs 516, 544, 594 and 596, requiring 1,030 species credits; and
- Potential (assumed) breeding habitat for Masked Owl and Barking Owl in PCTs 516, 544, 594 and 596, where suitably sized hollows occur, requiring 680 species credits for each of these species.

A total of 3,570 species credits are required to offset loss of fauna habitat within the Development Site.

9.1.3 Offsets Required Under the EPBC Act

No offsets requirements under the EPBC Act have been identified for the proposed development.

9.2 Impacts Not Requiring an Offset

In accordance with the BAM, an offset is not required for impacts on native vegetation where the vegetation integrity score is below those set out in Paragraph 10.3.1.1. These thresholds are as follows:

- A vegetation zone that has a vegetation integrity score <15 where the PCT is representative of an endangered or critically endangered ecological community, or
- A vegetation zone that has a vegetation integrity score <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.

Areas of the Subject Land that are not required to be offset in accordance with the thresholds described above are provided in Table 9.2. These vegetation zones represent highly disturbed areas, including cleared areas, heavily grazed grasslands and low integrity derived grasslands.

Table 9.2 Summary of Impacts on Vegetation Not Requiring Offsets

Vegetation Zone Number	Vegetation Zone Name	Area (ha)	Vegetation Integrity Score	Future Vegetation Integrity Score	Change in Vegetation Integrity Score	Credits Required
PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion						
6	596_Derived_Low	9.04	8	0	-8	0
12	596_Disturbed Grasslands	50.59	5.6	0	-5.6	0
PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion						
11	594_Disturbed Grasslands	49.81	11.8	0	-11.8	0
PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion of New England Tableland Bioregion						
10	516_Disturbed Grassland	7.39	15.8	0	-15.8	0

9.3 Summary of Offset Credits Required

The proposed development will incur loss of native vegetation and threatened fauna habitat requiring offsets for a total of 598 ecosystem credits and 3,570 species credits.

9.4 Biodiversity Offset Framework

This section outlines several options that are available to proponents to offset project related impacts on biodiversity in accordance with the Biodiversity Offset Scheme (BOS). The final offset strategy for the project is yet to be developed. However, GAIA is committed to satisfying all offset requirements prior to the commencement of works (including bulk earthworks and vegetation removal).

In accordance with the BOS, proponents may use one or more of the following methods to satisfy an offset requirement:

- Purchasing credits: Identify and purchase the required 'like for like' credits in the market and then retire those credits via Biodiversity Offsets and Agreement Management System (BOAMS).
- Generating credits: Identify potential offset land containing the biodiversity values required to be offset. Generate credits by applying the BAM and placing a Biodiversity Stewardship Agreement (BSA) on proposed offset land.

- Offsets Payment Calculator: Determine the cost of the credit obligation and transfer this amount to the Biodiversity Conservation Fund via the BOAMS. The Biodiversity Conservation Trust is then responsible for identifying and securing the credit obligation.
- Submit approval to the consent authority to apply variation rules. This excludes impacts on threatened species and TECs.

Given that impacts on threatened species habitat are associated with the proposed development, variation rules are not applicable to the Bonshaw Solar Farm development. GAIA will use one, or a combination, of the first three options above to meet the offset obligation.

The BAM Biodiversity Credit Report (like-for-like) detailing requirements for offsetting impacts on PCTs (i.e. 516, 544, 594 and 596) and threatened fauna habitat (i.e. Bristle-faced Free-tailed Bat, Eastern Cave Bat, Barking Owl and Masked Owl) is provided in Appendix K.

10. CONCLUSIONS

GAIA is proposing to develop a solar farm in disturbed land located in Lot 2 DP 1039185 (Project Boundary), Bonshaw within the Inverell LGA. The Development Site is located in the western portion of the Project Boundary and will occupy approximately 149.24 ha. The purpose of this BDAR was to address the requirements of the BAM and to address the biodiversity matters raised in the SEARs.

Based on the results of extensive field surveys, a total of 12 vegetation zones were identified on the Subject Land pertaining to the following four plant community types (PCTs):

- PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion;
- PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion; and
- PCT 596 – Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion

PCT 544 is considered to represent the following Threatened Ecological Community, which is listed as Endangered under the NSW *Biodiversity Conservation Act 2016*:

- White Box Yellow Box Blakely's Red Gum Woodland

The occurrence of this TEC on the Subject Land is not considered to satisfy the minimum condition criteria for the Commonwealth listing of this TEC. This determination has been made on the basis of very small patch sizes occurring on the Subject Land, low diversity of native understorey species and absence of “important species” as described in the Threatened Species Scientific Committee listing advice and National Recovery Plan for the TEC.

An assessment of the potential impacts on the biodiversity values of the Subject Land has identified the following direct impacts to native vegetation requiring offset:

- Impacts on PCT 516 – Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion, requiring 65 ecosystem credits;
- Impacts on PCT 544 - Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest/woodland of the Nandewar Bioregion and New England Tableland Bioregion, requiring 15 ecosystem credits;
- Impacts on PCT 594 – Silver-leaved Ironbark – White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion, requiring 249 ecosystem credits; and
- Impacts on PCT 596 – Tumbledown Red Gum – White Cypress Pine – Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion, requiring 269 ecosystem credits

A total of 598 ecosystem credits are required to offset the impacts of the project.

A total of thirteen threatened fauna species were recorded within the Project Boundary. Threatened species included eight vulnerable microchiropteran bats (Little Pied Bat, Eastern Bent-wing Bat, Corben's Long-eared Bat, Yellow-bellied Sheath-tailed Bat, Eastern Cave Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Hoary Wattled Bat), one endangered microchiropteran bat (Bristle-faced Free-tailed bat), three vulnerable birds (Grey-crowned Babbler, Brown treecreeper and Speckled Warbler) and one migratory bird (Cicadabird). Out of the eight Vulnerable microchiropteran bats, six were recorded as “definite” calls and two (Greater Broad-nosed Bat and Hoary Wattled Bat) were recorded as “possible” calls by a microbat call identification expert. Brown Treecreeper and Speckled Warbler were recorded within the Project Boundary but not directly on the Subject Land.

Impacts on threatened fauna habitat generated the following species credits:

- Bristle-faced Free-tailed Bat, requiring a total of 1,180 species credits;
- Eastern Cave Bat, requiring a total of 1,030 species credits;
- Masked Owl, requiring a total of 680 species credits; and
- Barking Owl, requiring a total of 680 species credits.

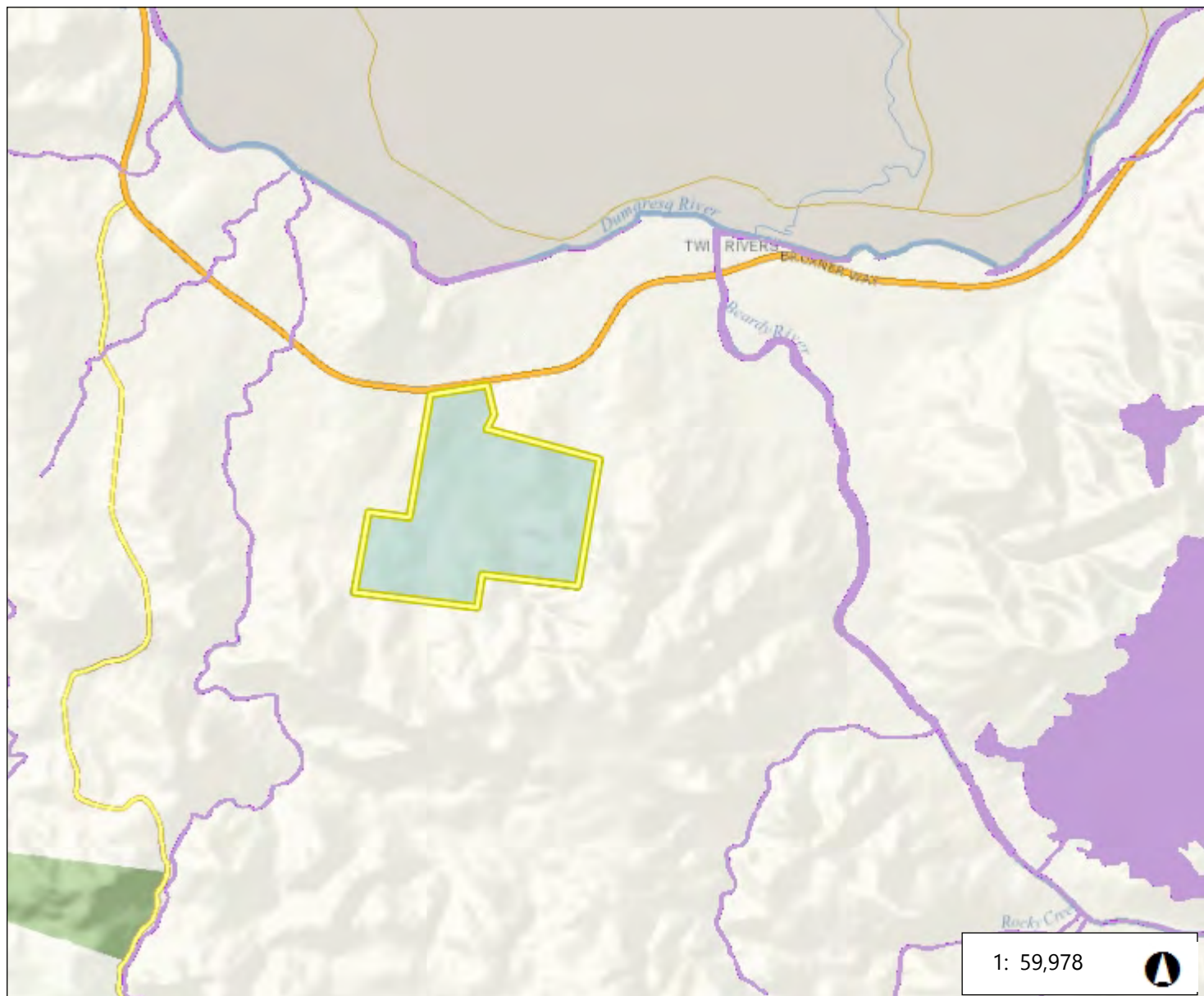
The proposed Bonshaw Solar Farm development in its current footprint requires a total offset of 598 ecosystem credits and 3,570 species credits. Retirement of these credits will be carried out in accordance with the *Biodiversity Conservation Regulation 2017* and the NSW Biodiversity Offsets Scheme.

11. REFERENCES

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- DPI (2012) **Controlled Activities on Waterfront Land – Guidelines for watercourse crossings on waterfront land**. NSW Department of Industry (July 2012).
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APPENDIX A BOSET REPORT

Biodiversity Offset Scheme (BOS) Entry Threshold Map



3.0 0 1.52 3.0 Kilometers

GCS_GDA_1994

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

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NSW Environment & Heritage

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	08/01/2019 10:12 AM	BDAR Required*
Total Digitised Area	356.35 ha	
Minimum Lot Size Method	Lot size	
Minimum Lot Size	199.02 ha	
Area Clearing Threshold	1 ha	
Area clearing trigger Area of native vegetation cleared	Unknown #	Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	no	no

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to <https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor> to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
- 'No': you have not exceeded the BOS threshold. You may still require a permit from local council. Review the development control plan and consult with council. You may still be required to assess whether the development is "likely to significantly affect threatened species" as determined under the test in s. 7.3 of the Biodiversity Conservation Act 2016. You may still be required to review the area where no vegetation mapping is available.

Where the area of impact occurs on land with no vegetation mapping available, the tool cannot determine the area of native vegetation cleared and if this exceeds the Area Threshold. You will need to work out the area of native vegetation cleared - refer to the BOSET user guide for how to do this.

Disclaimer

This results summary and map can be used as guidance material only. This results summary and map is not guaranteed to be free from error or omission. The State of NSW and Office of Environment and Heritage and its employees disclaim liability for any act done on the information in the results summary or map and any consequences of such acts or omissions. It remains the responsibility of the proponent to ensure that their development application complies with all aspects of the *Biodiversity Conservation Act 2016*.

The mapping provided in this tool has been done with the best available mapping and knowledge of species habitat requirements. This map is valid for a period of 30 days from the date of calculation (above).

Acknowledgement

I as the applicant for this development, submit that I have correctly depicted the area that will be impacted or likely to be impacted as a result of the proposed development.

Signature _____ Date: 08/01/2019 10:12 AM

APPENDIX B NSW BIONET ATLAS RECORDS

Results of search of existing records of threatened species and Threatened Ecological Communities (TECs) in the NSW BioNet Atlas is summarised in Table B.1 below.

Table B.1 BioNet Atlas results

Family	Scientific Name	Common Name	NSW status	Comm. status	Records within 10km radius
Reptilia					
Gekkonidae	<i>Uvidicolus sphyrurus</i>	Border Thick-tailed Gecko	V	V	1
Aves					
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	V		1
Psittacidae	<i>Glossopsitta pusilla</i>	Little Lorikeet	V		2
Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	V		6
Climacteridae	<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V		2
Acanthizidae	<i>Chthonicola sagittata</i>	Speckled Warbler	V		2
Pomatostomidae	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V		3
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		1
Artamidae	<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V		1
Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V		1
Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	V		2
Mammalia					
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V	V	9
Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	V		1
Macropodidae	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	1
Vespertilionidae	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		1

Family	Scientific Name	Common Name	NSW status	Comm. status	Records within 10km radius
Vespertilionidae	<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing-bat	V		1
Vespertilionidae	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		2
Flora					
Araliaceae	<i>Astrotricha roddii</i>	Rodd's Star Hair	E	E	12
Asteraceae	<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	V	1
Fabaceae (Faboideae)	<i>Swainsona sericea</i>	Silky Swainson-pea	V		1
Myrtaceae	<i>Eucalyptus caleyi subsp. ovendenii</i>	Ovenden's Ironbark	V	V	1
Myrtaceae	<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	1

Notes: V = Vulnerable; E = Endangered

APPENDIX C MATTERS OF NATIONAL SIGNIFICANCE ASSESSMENT – PMST REPORT



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: 08/01/19 09:21:50

[Summary](#)

[Details](#)

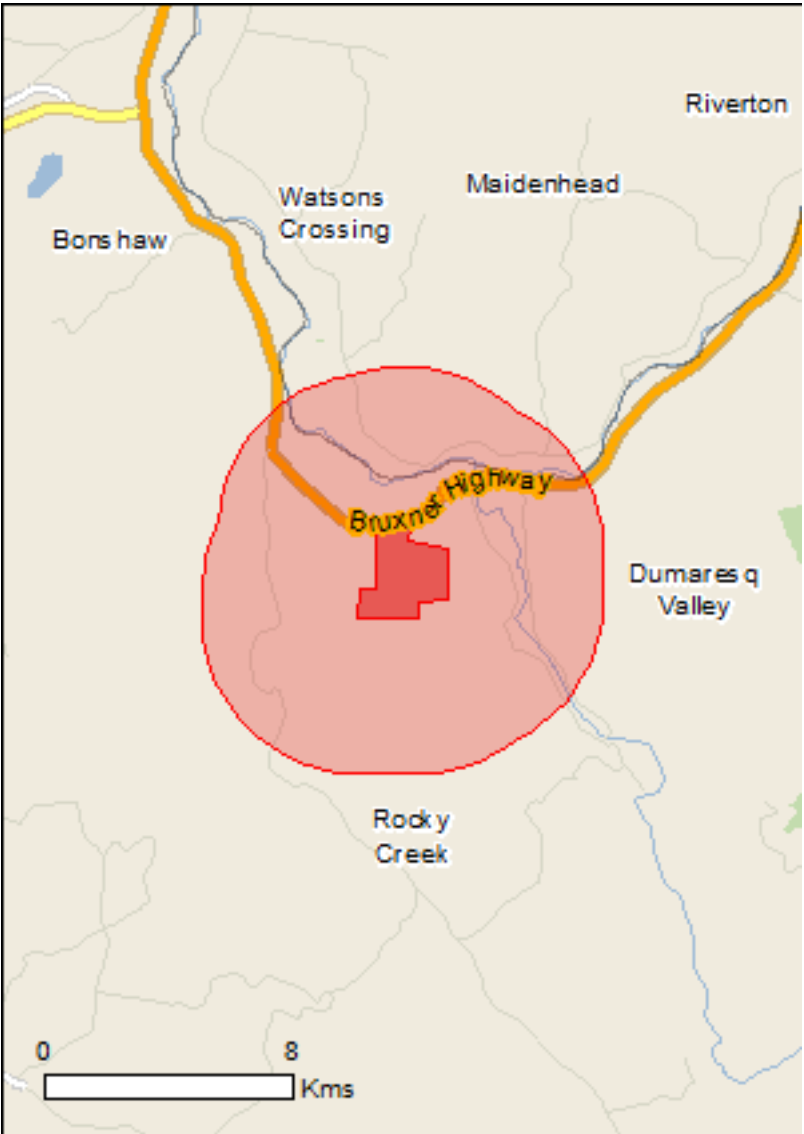
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

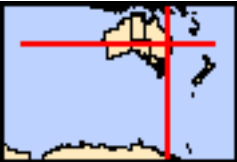
[Acknowledgements](#)



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

[Coordinates](#)

[Buffer: 5.0Km](#)



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:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	36
Listed Migratory Species:	11

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
Australian Marine Parks:	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:	1
Regional Forest Agreements:	1
Invasive Species:	19
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	1100 - 1200km	
Riverland	1100 - 1200km	
The coorong, and lakes alexandrina and albert wetland	1300 - 1400km	

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
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
New England Peppermint (Eucalyptus nova-anglica)	Critically Endangered	Community may occur within area
Grassy Woodlands	Endangered	Community may occur within area
Weeping Myall Woodlands		
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	Foraging, feeding or related behaviour likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythroriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely 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 likely to 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 may 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 likely to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Acacia pubifolia Velvet Wattle [19799]	Vulnerable	Species or species habitat may occur within area
Astrotricha roddii [56312]	Endangered	Species or species habitat known to occur within area
Boronia granitica Granite Boronia [18598]	Endangered	Species or species habitat may occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark [56193]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus mckieana McKie's Stringybark [20199]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus nicholii Narrow-leaved Peppermint, Narrow-leaved Black Peppermint [20992]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat may occur within area
Leucopogon confertus Torrington Beard-heath [14417]	Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area

Reptiles		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat known to occur within area
Wollumbinia belli Bell's Turtle, Western Sawshelled Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle [86071]	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
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 likely to occur within area

Migratory Wetlands Species		
----------------------------	--	--

Name	Threatened	Type of Presence
Actitis hypoleucos Common Sandpiper [59309]	Critically Endangered	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]		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
Pandion haliaetus Osprey [952]		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
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
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
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
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely 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
Crooked Creek	NSW

Regional Forest Agreements	[Resource Information]
Note that all areas with completed RFAs have been included.	
Name	State
North East NSW RFA	New South Wales

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		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species

Name	Status	Type of Presence
Sturnus vulgaris Common Starling [389]		habitat likely to occur within area Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may 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
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		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
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle,		Species or species habitat likely to occur within area

Name	Status	Type of Presence
------	--------	------------------

Prairie-berry, Satansbos, Silver-leaf Bitter-apple,
Silverleaf-nettle, Trompillo [12323]

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

-29.190623 151.336471,-29.190324 151.336299,-29.190324 151.336299,-29.188525 151.345569,-29.190474 151.34677,-29.193471 151.346255,-29.195269 151.357242,-29.208156 151.357242,-29.208605 151.348659,-29.212651 151.349345,-29.212651 151.331493,-29.205459 151.331664,-29.205459 151.336642,-29.190623 151.336471

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.

APPENDIX D LIKELIHOOD OF OCCURRENCE AND RISK ANALYSIS

In order to complement identification of likely threatened species likely to occur within the Development Site, the NSW BioNet and the PMST were undertaken. A likelihood of occurrence and risk assessments were undertaken for all species. Where results identify additional species to those generated in the BCD Calculator as “Ecosystem Species Credits” or “Species Credit Species”, those species were added in the surveys design.

Likelihood of Occurrence

Species identified in the NSW BioNet atlas and the PMST were collated into a table where an assessment of the likelihood of occurrence of that threatened biodiversity was undertaken. In making this determination, the following factors were considered:

- habitat quality within and adjacent to the Development Site as determined through review of regional vegetation mapping and the results of the September survey;
- breeding habitat/resources present – assists with identification of the importance of habitat to the species;
- dispersal ability - based on known ecology - whether the species have an ability to disperse to new areas of habitat following disturbance; and
- local records in similar habitat/distance/connectivity to the Development Site.

This allows for assessment of cryptic or seasonal species that are unlikely to be readily identified during brief site inspections and/or due to seasonal constraints. The likelihood of each species occurring was categorised as known, potential or unlikely to occur based on the definitions provided in Table D-1. Results of likelihood of occurrence is presented in Table D.3 for TECs and Table D.4 for threatened species.

Table D.1 Definitions of Likelihood of Occurrence

Category	Description
Known	<ul style="list-style-type: none"> ■ the ecological community/species/matter has been recorded in the Development Site during field surveys; or ■ database records demonstrate that the ecological community/species has been known to occur in the Development Site within the last 10 year period.
Potential	<ul style="list-style-type: none"> ■ the ecological community/species' known distribution includes the Development Site, and suitable habitat is present within it, or, ■ database records demonstrate that the ecological community/species has been known to occur in the Development Site, however has not been recorded within the last 10 years, or ■ the species is a wide ranging flying species which may 'fly-over' the Development Site, regardless of the habitat types present and has been recorded within the 10 km locality surrounding the Development Site.
Unlikely	<ul style="list-style-type: none"> ■ the ecological community/species has not been recorded within 10 km locality of the Development Site and suitable habitat does not occur within the Development Site, or ■ the Development Site is not within the TEC/species' known distribution, or ■ sufficient field surveys have been conducted to conclude that the species is likely to be absent.

The following considerations were made in assessing habitat suitability and distribution:

Habitat quality within and adjacent to the Site.

Breeding habitat/resources present – assists with identification of the importance of habitat to the species.

The species' ability to disperse to new areas of habitat following disturbance.

Local records in similar habitat/distance/connectivity to the Site.

Risk Assessment

A risk assessment was undertaken using the definitions of Species Sensitivity and Consequence to assign a relative risk ranking for each listed ecological value (Low, Medium, High or Very High, as shown in Table D.2). Impacts to ecological values with potential to occur that were assessed as having a Low risk was not further assessed. Results of risk assessment is presented in Table D.3 for TECs and Table D.4 for threatened species.

Impacts to ecological values with potential to occur that were assessed as having a Medium, High or Very High risk were further assessed in accordance with the requirements of the EPBC Act and BC Act, including the preparation of detailed Assessments of Significance (see Appendix E).

Species sensitivity rankings are based on the species conservation status under the EPBC Act, FM Act and BC Act. Where the conservation status differs between listings, the conservation status with higher sensitivity is used.

Table D.2 Risk Assessment Matrix

		Consequence			
Sensitivity		Negligible	Minor	Moderate	Major
	Ecological value not listed as threatened	Low	Low	Medium	High
	Ecological value listed as Vulnerable or Migratory	Low	Medium	Medium	High
	Ecological value listed as Endangered	Low	Medium	High	Very High
	Ecological value listed as Critically Endangered	Medium	High	Very High	Very High

Consequence Definitions

- Negligible:** No impacts or removal of ecological community. Effect on species is within the likely normal range of variation. No removal of specific breeding habitat features.
- Minor:** Indirect impacts to listed ecological community which may affect a small proportion of the ecological community. Effects a small proportion of a population and Project-related mortality of a small number of individuals may occur, but does not substantially affect other species dependent on it, or the populations of the species itself. No removal of specific breeding habitat features.
- Moderate:** Direct removal of a portion of a listed ecological community. Effects a sufficient proportion of a species population that it may bring about a substantial change in abundance and/or reduction in distribution over one or more generations, but does not threaten the long term viability of that population or any population dependent on it.
- Major:** Direct removal of a listed ecological community. Effects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.

Species sensitivity definitions

Species sensitivities refer to listed under either the EPBC Act or BC Act. Where listings differ, the higher sensitivity is used.

Table D.3 Threatened Ecological Communities: Likelihood of Occurrence and Risk Assessment

TEC name	EPBC Act	BC Act	Community Description	Likely of TEC Occurring in the Site	Potential Impacts	Mitigation Measures	Risk Rating
<p>Natural Grasslands on Basalt and Fine-textured alluvial plains of northern New South Wales and southern Queensland</p> <p>Source: PMST</p>	CE		<p>The Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (NSW) and southern Queensland are native grasslands typically composed of perennial native grasses. They are found on soils that are fine textured (often cracking clays) derived from either basalt or alluvium on flat to low slopes (< 1 degree). A tree canopy is usually absent, but when present, comprises ≤10% projective foliage cover. The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium.</p> <p>Temperate grasses and grassland forbs comprise the ground layer. Tussock grasses within this vegetation community can be dominated by species of the genera <i>Austrodanthonia</i>, <i>Austrostipa</i>, <i>Bothriochloa</i>, <i>Chloris</i>, <i>Enteropogon</i>, or <i>Themeda</i>. In the Darling Downs component of the community, Bluegrass (<i>Dichanthium sericeum</i>) tends to dominate, whereas the Plains Grass (<i>Austrostipa aristiglumis</i>) tend to dominate in the Liverpool Plains component. The herbaceous cover includes species within genera <i>Desmodium</i>, <i>Glycine</i>, <i>Lotus</i> and <i>Rhynchosia</i>. The shrub layer is generally a minimum component of the community, it can include Mimosa (<i>Acacia farnesiana</i>), <i>Pittosporum phylliraeoides</i>, <i>Pimelea</i> spp. and <i>Sclerolaena</i> spp. A tree canopy is typically absent. Where trees are present, they are of variable species composition and comprise less than 10% of projective crown cover. Tree species that may be present as scattered individuals include: <i>Acacia pendula</i> (Weeping Myall), <i>Eucalyptus albens</i> (White Box), <i>E. conica</i> (Fuzzy Box), <i>E. coolabah</i> (Coolabah), <i>E. melliodora</i> (Yellow Box), <i>E. populnea</i> (Poplar Box) or <i>E. tereticornis</i> (Forest Red Gum).</p> <p>This ecological community occurs from the Darling Downs in Queensland to Dubbo in NSW and incorporates the Liverpool and Moree Plains. This ecological community occurs within the Brigalow Belt South Bioregion and Border Rivers-Gwydir, Central West, Namoi, Condamine, Burnett Mary and Fitzroy Basin Natural Resource Management Regions. Patches of this vegetation community extend into the Nandewar, Sydney Basin and Darling Riverine Plains bioregions.</p>	<p>Unlikely</p> <p>The Development Site is located immediately south form the Darling Downs, Queensland. Cracking clays were observed in the southern portion of the Development Site, however, the site is highly disturbed and the characteristic species in the northern portion of the distribution of this TEC, i.e. Queensland Bluegrass (<i>Dichanthium sericeum</i>) were not recorded. Therefore, it is considered unlikely this CEEC occurs.</p>	NA	NA	Low
<p>New England Peppermint (<i>Eucalyptus nova-anglica</i>) Grassy Woodlands</p> <p>Source: PMST</p>	CE	CE	<p>The New England Peppermint (<i>Eucalyptus nova-anglica</i>) Grassy Woodlands ecological community occurs in northern NSW and southern Queensland, in the New England Tablelands, NSW North Coast and Nandewar IBRA Bioregions. The tree canopy is typically dominated (>50%) or co-dominated (>30%) by the tree species <i>Eucalyptus nova-anglica</i> (New England Peppermint). A range of other associated tree species may be present, and may be co-dominant in the ecological community, but do not dominate it by themselves, in particular <i>E. pauciflora</i> (Snow Gum) and <i>E. dalrympleana</i> subsp. <i>heptantha</i> (Mountain Gum). The understorey is usually made up of a dense, species-rich ground layer of grasses and herbs. Shrubs are typically sparse to absent. The main tree species in the community are New England Peppermint (<i>Eucalyptus nova-anglica</i>). Other tree species include Snow Gum (<i>E. pauciflora</i>), Black Sallee (<i>E. stellulata</i>), Mountain Gum (<i>E. dalrympleana</i> subsp. <i>heptantha</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Fuzzy Box (<i>E. conica</i>).</p>	<p>Unlikely</p> <p>No tree elements characteristic of the vegetation community were observed within the Development Site during surveys.</p>	NA	NA	Low
<p>Weeping Myall Woodlands</p>	E		<p>The Weeping Myall Woodlands ecological community occurs on the inland alluvial plains west of the Great Dividing Range in NSW and Queensland. It occurs in the Riverina, NSW South Western Slopes, Darling Riverine Plains, Brigalow Belt South, Brigalow Belt North, Murray-Darling Depression, Nandewar and Cobar</p>	<p>Unlikely</p> <p>No elements characteristic of the vegetation community were observed within the Development Site during surveys.</p>	NA	NA	Low

TEC name	EPBC Act	BC Act	Community Description	Likely of TEC Occurring in the Site	Potential Impacts	Mitigation Measures	Risk Rating
Source: PMST			<p>Penepplain IBRA Bioregions. The ecological community currently occurs in small pockets throughout this range.</p> <p>The Weeping Myall Woodlands occur in a range from open woodlands to woodlands, generally 4-12 m high, in which Weeping Myall (<i>Acacia pendula</i>) trees are the sole or dominant overstorey species. Weeping Myall trees often occur in monotypic stands, however other vegetation may also occur in the ecological community, though not as dominant species. These include: Western Rosewood (<i>Alectryon oleifolius subsp. elongatus</i>); Poplar Box (<i>Eucalyptus populnea</i>); or Black Box (<i>Eucalyptus largiflorens</i>). Grey Mistletoe (<i>Amyema quandang</i>) commonly occurs on the branches of Weeping Myall trees throughout the ecological community's range.</p> <p>Weeping Myall goes through regular cycles of senescence (aging and death) and regeneration. Weeping Myall trees are also susceptible to defoliation by Bag-shelter Moth (<i>Ochrogaster lunifer</i>) caterpillars and are often lopped for domestic stock fodder. Therefore, the ecological community can be dominated by Weeping Myall trees that are in a living, defoliated or dead state. The understorey of Weeping Myall Woodlands often includes an open layer of shrubs above an open ground layer of grasses and herbs, though the ecological community can exist naturally either as a shrubby or a grassy woodland.</p>				
<p>White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland</p> <p>Source: PMST</p>	CE	E	<p>Box – Gum Grassy Woodlands and Derived Grasslands are characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of White Box, Yellow Box or Blakely's Red Gum trees. In the Nandewar Bioregion, Grey Box (<i>Eucalyptus microcarpa</i> or <i>E. moluccana</i>) may also be dominant or codominant. The tree-cover is generally discontinuous and consists of widely-spaced trees of medium height in which the canopies are clearly separated.</p> <p>Associated, and occasionally co-dominant, trees include, but are not restricted to: Grey Box (<i>Eucalyptus microcarpa</i>), Fuzzy Box (<i>E. conica</i>), Apple Box (<i>E. bridgesiana</i>), Red Box (<i>E. polyanthemus</i>), Red Stringybark (<i>E. macrorhyncha</i>), White Cypress Pine (<i>Callitris glaucophylla</i>), Black Cypress Pine (<i>C. enderlicheri</i>), Long-leaved Box (<i>E. gonicalyx</i>), New England Stringybark (<i>E. calignosa</i>), Brittle Gum (<i>E. mannifera</i>), Candlebark (<i>E. rubida</i>), Argyle Apple (<i>E. cinerea</i>), Kurrajong (<i>Brachychiton populneus</i>) and Drooping She-oak (<i>Allocasuarina verticillata</i>). This ecological community occurs in areas where rainfall is between 400 and 1200 mm per annum, on moderate to highly fertile soils at altitudes of 170 metres to 1200 metres.</p> <p>The White Box – Yellow Box – Blakely's Red Gum grassy woodlands that existed prior to European settlement now exists as remnants in three different states. The three states are: i) An overstorey of eucalypt trees exists, but there is no substantial native understorey. ii) A native understorey exists, but the trees have been cleared; and iii) Both a native understorey and an overstorey of eucalypts exist in conjunction. In order for an area to be included in the EPBC listed ecological community, a patch must have a predominantly native understorey.</p> <p>The size and life-form of understorey species are such that viable populations can exist in very small areas. Therefore, in order to be the listed ecological community, an understorey patch, in the absence of overstorey trees, must have a high level of native floral species diversity, but only needs to be 0.1 hectares or greater in size. A patch in which the perennial vegetation of the ground layer is dominated by native species, and which contains at least 12 native, non-grass understorey species (such as forbs, shrubs, ferns, grasses and sedges) is considered to have a sufficiently high level of native diversity to be the listed ecological community. At least one of the understorey species should be an important species (e.g. grazing-sensitive, regionally significant or uncommon species; such as Kangaroo Grass or orchids) in order to indicate a reasonable condition.</p>	<p>Potential</p> <p>An area likely to conform to the Box-Gum community was recorded in the southern portion of the Subject Land.</p> <p>An individual tree, potentially identified as Blakely's Red Gum (<i>Eucalyptus blakely</i>), was observed during the September 2018 survey. The tree was later confirmed as <i>Eucalyptus dealbata</i> by ecologists Joanne Woodhouse and Tom Cotter. No elements of this vegetation community were found across the Development Site although it is likely to occur within the broader Project Boundary.</p>	Negligible	Avoidance	Low

Table D.4 Threatened Species: Likelihood of Occurrence and Risk Assessment

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
Fauna							
Reptilia							
<i>Delma torquata</i> Adorned Delma, Collared Delma Source: PMST		V	<p>Adorned Delma is the smallest of the legless lizards. The Collared Delma normally inhabits eucalypt dominated woodland and open forest where it is associated with suitable micro-habitats (exposed rocky outcrops). The ground cover is predominantly native grasses, such as Kangaroo Grass (<i>Themeda triandra</i>), Barbed-wire Grass (<i>Cymbopogon refractus</i>), Wiregrass (<i>Aristida</i> sp.) and <i>Lomandra</i>.</p> <p>The Collared Delma is known from the western suburbs of Brisbane, Queensland, and the following sites: Bunya Mountains, Blackdown Tableland National Park (NP), Bullyard Conservation Park, D'Aguilar Range NP, Expedition NP, Naumgna and Lockyer Forest Reserves, Western Creek near Millmerran and the Toowoomba Range. It occurs within the South East Queensland, Condamine, Burnett Mary and Fitzroy (Queensland) Natural Resource Management regions.</p>	<p>Unlikely</p> <p>No records of the species are known within a 10km radius of the Site. The species was not recorded during target reptile surveys within the rocky outcrops in December 2018.</p>	NA	NA	Low
<i>Furina dunmalli</i> Dunmall's Snake		V	<p>Dunmall's Snake preferred habitat is Brigalow forest and woodland with fallen timber and ground litter, growing on cracking clay soils and clay loam soils. It also occurs in eucalypt and <i>Callitris</i> woodland with fallen timber and ground litter. The species is nocturnal.</p> <p>Dunmall's Snake occurs in south-east interior of Queensland, including the Darling Downs, and is thought to potentially extend into inland north-eastern NSW. Most locality records are between 200 and 500 m elevation</p>	<p>Unlikely</p> <p>No records of the species are known within a 10km radius of the Site. The species was not recorded during target reptile surveys in December 2018.</p>	NA	NA	Low
<i>Uvidicolus sphyrurus</i> Border Thick-tailed Gecko Source: BioNet, PMST	V	V	<p>The Border Thick-tailed Gecko is a small lizard up to 10 cm long (average 7 cm). It often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. These Geckos are active at night and shelter by day under rock slabs, in or under logs, and under the bark of standing trees. It is found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2km.</p>	<p>Potential</p> <p>Habitat resources for the species are present within the Development Site.</p> <p>The only record within the 10km locality is at approximately 2.4km south from the site and was recorded over 10 years ago (in 1999)</p> <p>The species was not recorded during target reptile surveys within the rocky outcrops in December 2018.</p>	<p>Negligible</p> <p>A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.</p>	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Wollumbinia belli</i> Bell's Turtle	E	V	Bell's Turtle occurs in shallow to deep pools in upper reaches or small tributaries of major rivers in granite country. Occupied pools are most commonly less than 3 m deep with rocky or sandy bottoms and patches of vegetation. Most typically uses narrow stretches of rivers 30 - 40 m wide. Most surrounding habitat has been converted to grazing land. Nests are dug out in riverbanks of sand or loam during late September to January. Eggs take 80 days to hatch and are thus vulnerable to nest predation for an extended period. Primarily a vegetarian, eating both aquatic plants and terrestrial leaves that fall into the watercourse. Also takes invertebrates ranging from insects to crayfish, other small animals and carrion. In NSW, currently found in four disjunct populations in the upper reaches of the Namoi, Gwydir and Border Rivers systems, on the escarpment of the North West Slopes.	Unlikely No deep pools occur within any of the unnamed creeks or their tributaries.	Negligible	NA	Low
Aves							
<i>Anthochaera phrygia</i> Regent Honeyeater Source: PMST	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests, particularly Box – Ironbark woodland and riparian forests of River Sheoak. The species inhabits woodlands that support a significantly high abundance and species richness of birds. These type of woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. The species can also be found in drier coastal woodlands and forests in some years. Non-breeding flocks of the species can be seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests. Although the species is a generalist forager, it feeds mainly on the nectar from a small number of eucalypts that produce high volumes of nectar (e.g. Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany).	Potential Limited foraging habitat is present within the woodland and riparian corridor . This woodland bird species forages in woodlands with significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. No habitat is available within the disturbed grasslands. The Regent Honeyeater has not been recorded within the Site.	Negligible. The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
<i>Artamus cyanopterus cyanopterus</i> Dusky Woodswallow	V		The Dusky Woodswallow primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. It has also been recorded in shrublands, heathlands and very occasionally in moist forest or rainforest. Also found in farmland, usually at the edges of forest or woodland. The species forages on invertebrates, mainly insects, which are captured whilst hovering or sallying above the canopy or over water. It builds an open, cup-shape nest made of twigs, grass, fibrous rootlets and occasionally casuarina needles. Generally, nests are located on shrubs or low trees, living or dead, horizontal or upright forks in braches, spouts, hollow stumps or logs, behind loose bark or in a hollow in the top of a wooden fence post.	Potential. Potential foraging habitat is present in most woodland vegetation zones, excluding grasslands, cleared and disturbed land.. No records of the species exist for the Site and the nearest location is at approximately 4 km south-east where it was recorded in 1995.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo Source: BioNet	V		<p>The Glossy Black-cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods.</p> <p>Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i>, and <i>A. gymnathera</i>. Belah is also utilised and may be a critical food source for some populations.</p> <p>In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (<i>Casuarina cristata</i>).</p> <p>Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill.</p>	<p>Unlikely.</p> <p>Limited breeding habitat for the species is present within the Development Site. However, no suitable feeding habitat is present as its preferred feed tree species have not been recorded within the Site. It is unlikely the sepcies would breed in hollow-bearing trees at the site as the cost to travel long distances to feed will be too high.</p> <p>The nearest location is at approximately 3.6 km to the east, where one record from 1999 exists.</p>	Negligible	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies) Source: BioNet	V		<p>The Brown Treecreeper (eastern subspecies) is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.</p> <p>It is considered resident of areas where it occurs and is usually observed in pairs or small groups of 8 to 12 birds. It forages on trunks and branches of trees and among fallen timber. Hollows in standing dead or live trees and stumps are essential for nesting.</p>	<p>Potential</p> <p>This species was recorded adjacent to the Subject Land during potential offset site investigations.</p> <p>Suitable habitat for the species is considered to occur in the woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species..</p>	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Chthonicola sagittata</i> Speckled Warbler Source: BioNet	V		<p>The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding.</p> <p>The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or at the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.A clutch of 3-4 eggs is laid, between August and January, and both parents feed the nestlings. Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellow-rumped, Buff-rumped, Brown and Striated Thornbills.</p>	<p>Potential</p> <p>This species was recorded adjacent to the Subject Land during potential offset site investigations.</p> <p>Suitable habitat for the species is considered to occur in the woodland PCTs. Grasslands and cleared land (disturbed grasslands) do not represent suitable habitat for the species.</p>	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Daphoenositta chrysoptera</i> Varied Sittella Source: BioNet	V		<p>The Varied Sittella inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. It feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Generation length is estimated to be 5 years. The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west.</p>	<p>Potential Potential foraging habitat is present in most woodland vegetation zones.</p> <p>The nearest record of the species dates back in 1995 and was located at approximately 4 km south from the Site.</p>	<p>Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.</p>	Low
<i>Erythroriorchis radiatus</i> Red Goshawk Source: PMST	CE	V	<p>Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.</p>	<p>Unlikely Limited habitat for the species exists within the Development Site. Riparian corridor was dry at the time of surveys and highly fragmented. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.</p>	Negligible	NA	Low
<i>Geophaps scripta scripta</i> Squatter Pigeon Source: PMST	CE	V	<p>Squatter Pigeons are medium-sized ground-dwelling pigeons. They are found in grassy woodlands and plains, preferring sandy areas and usually close to water. Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground. The species is found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range.</p>	<p>Potential Substandard foraging habitat is present within the Development Site. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.</p>	Negligible	NA	Low
<i>Glossopsitta pusilla</i> Little Lorikeet Source: BioNet	V		<p>The Little Lorikeet is a small parrot distributed widely across the coast and Great Divide regions. The species forages primarily in the canopy of open Eucalyptus forests and woodland. It also forages in Angophora, Melaleuca and other species including paddock, roadside remnants and urban trees. It feeds mainly on nectar and pollen, occasionally on native fruits.</p>	<p>Potential. Limited suitable foraging habitat for the species is present in Eucalypt trees within the remnant trees and vegetation. The nearest records of the species dates back in 1995 (two records) and were located at approximately 1 km east from the Site.</p>	<p>Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Develop fauna clearance protocol that includes procedures to be followed should any injured fauna be encountered.</p>	Low

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<i>Grantiella picta</i> Painted Honeyeater Source: PMST	V	V	The Painted Honeyeater inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> . Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Potential Limited foraging resources for the species are available in Box and Ironbark trees across the Subject Land. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Neophema pulchella</i> Turquoise Parrot Source: BioNet	V		The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range (OEH 2019). The Turquoise Parrot lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. It prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. It nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust (OEH 2019).	Potential Suitable habitat for the species includes woodlands and native grasslands. Roosting and breeding habitat for this woodland bird are hollow-bearing trees in woodlands. It forages in woodlands and native grasslands. The nearest record of the species dates back in 1995 and was located at approximately 1 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Ninox connivens</i> Barking Owl	V	-	The Barking Owl is found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats (OEH 2019).	Potential Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

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<i>Petroica boodang</i> Scarlet Robin Source: BioNet	V		The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Its habitat usually contains abundant logs and fallen timber: these are important components of its habitat. It breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. It breeds between July and January. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees. It builds nests in the fork of branches, usually more than 2 metres above the ground.	Potential Limited suitable habitat for the species occurs in woodlands with fallen logs and timber in the Subject Land. The nearest record of the species dates back in 1995 and was located at approximately 4 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies) Source: BioNet	V		The Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year. Grey-crowned Babblers are communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. In some populations, breeding success is related to the number of helpers. Young birds stay with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction.	Known A breeding population of Grey-crowned have been recorded on site. The nearest BioNet record of the species dates back in 2010 and was located at approximately 500 m east from the Development Site.	Moderate A breeding population of Grey-crowned have been recorded on site. The movement of this species is largely confined to the riparian corridors as this species has limited flying capacity. These corridors (with a 20-30m buffer) have been avoided although nests will be removed within the development footprint..	Approved clearing limits to be clearly delineated with temporary fencing or similar prior to construction commencing. Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. Removal of trees with nests will be supervised by an experienced fauna catcher or ecologist. A portion of felled trees will be salvaged as habitat for fauna and translocated in suitable areas in the remainder of the Project Boundary.	Medium

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<i>Rostratula australis</i> Australian Painted-snipe Source: PMST	E	E	The Australian Painted Snipe is small freshwater wader. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Incubation and care of young is all undertaken by the male only. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Unlikely No preferred habitat is available. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	NA	NA	Low
<i>Stagonopleura guttata</i> Diamond Firetail Source: BioNet	V		Diamond Firetails are found in open grassy woodland, heath and farmland or grassland with scattered trees. Diamond Firetails feed on the ground and generally eat ripe or partially ripe seeds and can be seen hopping around on the ground. They occasionally eat insects and their larvae. The Diamond Firetail builds a nest with green grass blades and stems and lines it with fine grasses and feathers. The nest can be found in trees and shrubs with dense foliage and has sometimes been known to build in the base of a hawk's nest.	Potential Potential roosting and breeding habitat for the species occurs in woodlands, foraging habitat for the species occurs across the entire Subject Land.. The nearest BioNet record of the species dates back in 1995 and was located at approximately 3 km south-east from the Site.	Negligible The second and third order watercourses will be avoided through detailed design. Riparian buffers will be applied to either side of the streams, measured from the edge of the high bank. The distances applied to this BDAR are 20m either side of the second order stream and 30m either side of the third order streams. This will significantly reduce the risk of the potential impacts.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Tyto novaehollandiae</i> Masked Owl	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. It lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting(OEH 2019).	Potential Hollow bearing trees occur within woodland habitats and also as isolated trees within highly disturbed vegetation zones on the Subject Land.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Calidris ferruginea</i> Curlew Sandpiper Source: PMST	E	CE, Mi	The Curlew Sandpiper is a migratory bird inhabiting coastal habitats and sometimes freshwater wetlands. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	Unlikely No preferred habitat is available. No existing records of the species within the 10 km locality exist. The species was not recorded during surveys.	NA	NA	Low

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Mammals							
<i>Dasyurus maculatus</i> Spotted-tailed Quoll Source: PMST	V	E	The Spotted-tailed Quoll is recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares. Are known to traverse their home ranges along densely vegetated creeklines	Unlikely The high level of disturbance at the Development Site suggests no suitable habitat for the species is present. No known records of the species exists within the 10 km locality. The species was not recorded during surveys in September and December 2018.	NA	NA	Low
<i>Petaurus norfolcensis</i> Squirrel Glider Source: BioNet	V		The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or <i>Acacia</i> midstorey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.	Unlikely. No suitable habitat for the species occurs within the Site. Only one record of the species exist within the 10km locality. It is located at approximately 3.5 km to the south from the Site and was recorded in 1997.	Negligible	NA	Low
<i>Petauroides volans</i> Greater Glider Source: PMST		V	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. The greater glider is an arboreal nocturnal marsupial, largely restricted to eucalypt forests and woodlands. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees. The greater glider is considered to be particularly sensitive to forest clearance.	Unlikely Limited substandard foraging habitat for the species occurs in remnant vegetation within the Development Site. No rsheltering habitat is present and the species has not been recorded within the 10km locality.	Negligible	NA	Low
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby Source: BioNet PMST	V		In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night.	Unlikely. Limited habitat for the species occurs within the Site. Only one record of the species exist within the 10km locality. It is located at approximately 2.2 km to the south-west from the Site and was recorded in 1997.	Negligible	NA	Low

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<i>Phascolarctos cinereus</i> Koala Source: BioNet, PMST	V	V	The Koala is an arboreal marsupial that inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 species of eucalypt and 30 non-eucalypt species.	Potential Suitable feeding trees (e.g. E. albens) are present within the Subject Land. . No known records exists within the site. The nearest record is located at approximately 3 km south-east and is dated 1995.	Negligible. Any clearing of koala feed tree species has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Pseudomys novaehollandiae</i> New Holland Mouse, Pookila Source: PMST		V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes It is a social animal, living predominantly in burrows shared with other individuals Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	Unlikely. Limited substandard woodland habitat for the species is present within the Development Site. No records of the species are known within the 10km locality.	Negligible	NA	Low
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox Source: PMST	V	V	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. Also forage in cultivated gardens and fruit crops.	Potential Potential foraging habitat is present in canopy of Eucalypt trees. Grasslands and cleared land excluded as potential foraging habitat.. No records of the species exist within the 10km locality. The species was not recorded during surveys.	Negligible. Any clearing of Eucalypt trees has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
Microchiropteran Bats							
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat Source: PMST	V	V	The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. The species is found in well-timbered areas containing gullies. The species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years.	Potential. Potential foraging/hunting habitat for cave dependant microchiropteran bats is present in the remnant trees and vegetation. No suitable roosting habitat is available and the microchiropteran bats	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Breeding habitat for these species is not present within the Development Site and avoidance measures for breeding habitat is not required.	Low

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<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle Source: BioNet	V		<p>The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (OEH 2019). The species prefers moist habitats, with trees taller than 20 m. It generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. It hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer (OEH 2019). Only one record of the species exist within the 10km locality. It is located at approximately 3.2 km to the south-west from the Site and was recorded in 1997.</p>	<p>Known.</p> <p>Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.</p>	<p>Minor</p> <p>Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region.</p> <p>Removal of important habitat features e.g. 37 hollow bearing trees are to be removed</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor.</p> <p>As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm</p>	Medium
<i>Miniopterus schreibersii (orinae) oceanensis</i> Eastern Bentwing-bat (Large Bentwinged-bat) Source: BioNet	V		<p>Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Hunt in forested areas, catching moths and other flying insects above the tree tops. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. At other times of the year, populations disperse within about 300 km range of maternity caves.</p> <p>The nearest known record is located at approximately 150m north-west from the site and was recorded in 2006.</p>	<p>Known.</p> <p>Potential foraging/hunting habitat for cave dependant microchiropteran bats is present in the remnant trees and vegetation.</p> <p>No suitable roosting habitat is available and the microchiropteran bats assessed are unlikely to be dependent on any of the resources available.</p>	<p>Minor</p> <p>Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region.</p> <p>Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Breeding habitat for these species is not present within the Development Site and avoidance measures for breeding habitat is not required.</p>	Low
<i>Nyctophilus corbeni</i> Corben's Long-eared Bat, South-eastern Long-eared Bat Source: PMST	V	V	<p>Corben's Long-eared Bat inhabits a variety of vegetation types, including mallee, bullock <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. It roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer.</p> <p>Corben's Long-eared Bat has not been recorded within the 10 km locality.</p>	<p>Known.</p> <p>Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.</p>	<p>Minor</p> <p>Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region.</p> <p>Removal of important habitat features e.g. 37 hollow bearing trees are to be removed</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor.</p> <p>As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm</p>	Medium

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat Source: BioNet	V		The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Although this species usually roosts in tree hollows, it has also been found in buildings. Only two records of the species exist within the 10km locality. The nearest record is located at approximately 3.2 km to the south from the Site and was recorded in 1997.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium
<i>Mormopterus eleryi</i> Bristle-faced Free-tailed Bat	V		Distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. In NSW, the species has been recently recorded from only three disjunct locations: thirteen individuals from Gundabooka National Park, south of Bourke; one individual from Dhinna Dthinawan Nature Reserve (formerly Bebo State Forest), north of Warialda two individuals near Bonshaw. Knowledge of the ecology of the Hairy-nosed Freetail Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites. All other Australian species from the same family generally roost in tree hollows and fissures. Appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations.	Known. Potential foraging/hunting and roosting habitat for hollow dependant microchiropteran bats is present in the remnant trees and vegetation.	Minor Any clearing of native vegetation has the potential to add to the incremental decline of potential foraging habitat available within the region. Removal of important habitat features e.g. 37 hollow bearing trees are to be removed	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat. Trees will be planted at a rate of 2:1 with two new trees planted for each HBT removed. This results in planting of 74 new trees within the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm	Medium
Fish							
<i>Maccullochella peelii</i> Murray Cod Source: PMST		V	The Murray Cod is a large freshwater fish endemic to the Murray-Darling Basin, from south east Queensland, through NSW, into Vitoria and South Australia. The species can grow to 100 kg in the wild. The species requires permanent streams and is highly dependent on instream woody structures for habitat, is highly territorial and very aggressive.	Unlikely No suitable habitat for the species is present within the Development Site.	Negligible	NA	Low
Flora							
<i>Acacia pubifolia</i> Velvet Wattle Source: PMST	E	V	Velvet Wattle is a shrub or small tree 3 - 8 m tall with golden yellow flowers and dark-grey bark. It occurs in NSW and Qld. In NSW it is known from two main populations, one north of Emmaville and the other near Warrabah National Park. The species generally grows in dry shrubby woodland on granite and metasediment soils.	Unlikely No suitable habitat for the species occurs within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Astrotricha roddii</i> Rodd's Star Hair Source: BioNet, PMST	E	E	Rodd's Star Hair is an upright, sparsely-branched shrub 1 - 3 m tall. Rodd's Star Hair usually grows in low dry woodland and shrublands on granite and acid volcanic outcrops, often in rock crevices. The species occurs in NSW in the Ashford area north of Inverell, including Kwiambal and Kings Plains National Parks, Severn River Nature Reserve and Severn River State Forest, and has also been recorded at one site in southern Queensland.	Potential Limited potential habitat for the species occurs within the Subject Land. A total of 12 records of the species exist within the 10 km locality. No records exist within the Development Site and the species was not recorded within the development footprint. The nearest record is located at approximately 4.3 km to the south and was recorded in 1999.	Negligible A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
<i>Boronia granitica</i> Granite Boronia Source: PMST	V	E	Granite Boronia is a medium-sized shrub 0.6 - 2 m tall. It flowers from July to October. It grows on granitic soils amongst rock outcrops, often in rock crevices, and in forests and woodlands on granite scree and shallow soils. Important site characteristics include low precipitation and high levels of solar radiation. This semi-arid soil environment will have selected the more xerophytic species from the available regional assemblage of rainforest species. The largely barren substrate (e.g. granite) may help to control too frequent fire, thus allowing maturity and seed set. Granite Boronia occurs in scattered localities on the New England Tablelands and North West Slopes north from the Armidale area to the Stanthorpe district in southern Queensland. It can be locally common in appropriate habitat (e.g. Torrington).	Potential Suitable substrate for the species is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible A total of eleven rocky areas were recorded within the Subject Land. Five of the rocky outcrops have been avoided. Only two outcrops occur in the middle of the cleared paddocks and cannot be avoided by the development footprint. The remaining four may also be avoided during the detailed design and survey of the required riparian buffers and perimeter road.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation and habitat features to be retained within the adjacent habitat.	Low
<i>Cadellia pentastylis</i> Ooline Source: PMST	V	V	Ooline is a medium-sized spreading tree usually about 10 m tall, and rarely to 25 m. Appears to flower spasmodically, during a general flowering period of October to January. Dispersal of fruit and seed is probably by "passive fall" or by birds. Seeds showed a high rate of infertility at all sites, although they have been successfully germinated and established after heat application. Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. Has the capacity to resprout from rootstock and coppice vigorously from stumps, a feature which may be critical for the species survival in a fire-prone environment. Populations display a variety of age classes including large mature trees, suckering regrowth and seedlings. The total area occupied by Ooline is only about 1200 hectares, with remaining populations in NSW still threatened to various degrees by clearing for agriculture and grazing pressures.	Potential The development Site is located within known distribution of the species although it was not recorded on site during seasonal surveys. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Callistemon pungens</i> Source: PMST		V	<i>Callistemon pungens</i> is a distinct shrub or small tree ranging from 2-5 m tall. The species inhabits a range from riparian areas dominated by <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> to woodland and rocky shrubland. Often in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. Flowers over spring and summer, mostly in November.	Unlikely No suitable habitat is present within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
<i>Dichanthium setosum</i> Bluegrass Source: PMST	V	V	Bluegrass is an upright grass less than 1 m tall. Flowering time is mostly in summer. Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched). It is open to question whether the species tolerates or is promoted by a certain amount of disturbance, or whether this is indicative of the threatening processes behind its depleted habitat. Associated species include <i>Eucalyptus albens</i> , <i>Eucalyptus melanophloia</i> , <i>Eucalyptus melliodora</i> , <i>Eucalyptus viminalis</i> , <i>Myoporum debile</i> , <i>Aristida ramosa</i> , <i>Themeda triandra</i> , <i>Poa sieberiana</i> , <i>Bothriochloa ambigua</i> , <i>Medicago minima</i> , <i>Leptorhynchus squamatus</i> , <i>Lomandra</i> aff. <i>longifolia</i> , <i>Ajuga australis</i> , <i>Calotis hispidula</i> and <i>Austrodanthonia</i> , <i>Dichopogon</i> , <i>Brachyscome</i> , <i>Vittadinia</i> , <i>Wahlenbergia</i> and <i>Psoralea</i> species. Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas.	Potential. Suitable habitat elements for the species occur within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Eucalyptus caleyi</i> subsp. <i>ovendenii</i> Ovenden's Ironbark Source: BioNet, PMST	V	V	Ovenden's Ironbark grows in grassy woodland on dry, shallow soils of moderate fertility. Its preferred altitudes are 610 to 820 m, on granitic substrates. Ovenden's Ironbark occupies a higher geographical range than that of subspecies <i>caleyi</i> , occurring on the crests of broad high ridges and replacing subspecies <i>caleyi</i> inhabiting the lower slopes in the same general area. Associated species include <i>Eucalyptus melliodora</i> , <i>Eucalyptus dealbata</i> , <i>Eucalyptus albens</i> , <i>Eucalyptus melanophloia</i> and <i>Geijera parviflora</i> . Flowering occurs from July to September, with fruits having a distinctly square cross-section. Can be locally abundant within its grassy woodland habitat. Juveniles were present in about half the sampled sites within Torrington State Conservation Area, indicating good recruitment	Potential The species was not recorded within the Development Site during surveys in September and December 2018. Several species with which Ovenden's Ironbark is associated were recorded within the Development Site, including <i>Eucalyptus dealbata</i> , <i>Eucalyptus albens</i> and <i>Geijera parviflora</i> . Only one record of the species exist within the 10 km locality and at approximately 5.3 km to the south-west from the Development Site. The species was recorded in 1999.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Eucalyptus mckieana</i> Mickie's Stringybark Source: PMST	V	V	Mickie's Stingybark is a medium sized tree about 25 m tall. The species flowers are white, with a flowering period of March to May. The species is remarkable for its very narrow and numerous sucker leaves, the narrowest of all the stringybarks and which persist to a height of 2 to 4 metres. <i>Eucalyptus mckieana</i> is found in grassy open forest or woodland on poor sandy loams, most commonly on gently sloping or flat sites. Associated species at Northern Tablelands sites include <i>Angophora floribunda</i> , <i>Eucalyptus amplifolia</i> , <i>Eucalyptus andrewsii</i> , <i>Eucalyptus bridgesiana</i> , <i>Eucalyptus youmanii</i> , <i>Eucalyptus nicholii</i> , <i>Eucalyptus blakelyi</i> and <i>Eucalyptus conica</i> , and at North Western Slopes sites <i>Eucalyptus andrewsii</i> , <i>Eucalyptus stannicola</i> , <i>Eucalyptus prava</i> and <i>Angophora floribunda</i> . Confined to the drier western side of the New England Tablelands of NSW, from Torrington to Bendemeer. Most populations occur on private property, but it does occur in Kings Plain National Park, Torrington State Conservation Area and Severn River Nature Reserve.	Unlikely. Very limited potential habitat is present. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
<i>Eucalyptus nicholii</i> Narrow-leaved Black Peppermint Source: BioNet, PMST	V	V	The Narrow-leaved Black Peppermint typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock. Seedling recruitment is common, even in disturbed soils, if protected from grazing and fire. It tends to grow on lower slopes in the landscape. This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield, being most common in central portions of its range. Found largely on private property and roadsides, and occasionally in conservation reserves. Planted as urban trees, windbreaks and corridors.	Potential The species was not recorded during surveys in September and December 2018. Only one record of the species exist within the 10 km locality and at approximately 5.5 km to the south-west from the Development Site. The species was recorded in 2000.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low
<i>Homopholis belsonii</i> Belson's Panic Source: PMST		V	Belson's Panic is a perennial grass growing to 0.5m high. It is known to occur in dry woodland habitats on poor soils, such as those derived from basalt. It occurs on rocky hills supporting White Box (<i>Eucalyptus albens</i>) and in Wilga (<i>Geijera parviflora</i>) woodland; flat to gently undulating alluvial areas supporting Belah (<i>Casuarina cristata</i>) forest; and soils and plant communities of Poplar Box (<i>Eucalyptus populnea</i>) woodlands. It may also be associated with shadier areas of Brigalow (<i>Acacia harpophylla</i>), Myall (<i>A. melvillei</i>), and Weeping Myall (<i>A. pendula</i>) communities; in Mountain Coolibah (<i>Eucalyptus orgadophila</i>) communities; and on roadsides. It is generally found among fallen timber at the base of trees or shrubs, among branches and leaves of trees hanging to ground level or along the bottom of netting fences. It is known to occur within the southern Brigalow belt, Queensland and on the north-western slopes and plains of NSW. In NSW, this species occurs between Wee Waa, Goondiwindi and Glen Innes.	Potential Limited suitable habitat for the species occurs within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region. Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.	Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Lepidium peregrinum</i> Wandering Pepper-cress Source: PMST		E	The Wandering Pepper-cress is a spreading soft-stemmed perennial herb to sub-shrub 10 - 80 cm tall but sometimes ascending to 2 m in surrounding vegetation. Flowers from January to April. The largest population of Wandering Pepper Cress occurs in an open riparian forest on the banks of the Tenterfield creek at Clifton. Sandy alluvium is the main soil type at the site. Associated species at the Clifton site are dominated by <i>Eucalyptus camaldulensis</i> and <i>Casuarina cunninghamiana</i> , with a variably dense shrubby understorey of <i>Hymenanthera dentata</i> , <i>Bursaria spinosa</i> , <i>Acacia fimbriata</i> , <i>Acacia floribunda</i> , <i>Callistemon viminalis</i> and <i>Leptospermum brachyandrum</i> . <i>Lepidium peregrinum</i> was most abundant in the tussock grassland fringe of the riparian open forest, comprising <i>Poa</i> species, <i>Lomandra longifolia</i> and <i>Paspalum dilatatum</i> . After 2001, the species was found near Tenterfield and south-eastern Queensland.	Unlikely No suitable habitat for the species is present. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
<i>Leucopogon confertus</i> Torrington Beard-heath Source: PMST		E	<i>Leucopogon confertus</i> is known from only one collection along Silent Grove Road, near Torrington, in the NSW Northern Tablelands. It is possible that the species is extinct. Little is known of the habitat of <i>L. confertus</i> , but it may occur in open forest or woodland in rocky granite areas. This species occurs within the Border Rivers–Gwydir (NSW) Natural Resource Management Region. The distribution of this species overlaps with the “White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland”.	Potential Limited potential habitat is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low
<i>Polygala linariifolia</i> Native Milkwort	E	-	Native Milkwort is an annual or perennial herb recorded to occur north from Copeton Dam and the Warialda area to southern Queensland; also found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. It occurs in sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of <i>Eucalyptus caleyi</i> , <i>Eucalyptus dealbata</i> and <i>Callitris</i> , and in yellow podsolic soil on granite in layered open forest. Flowers from spring to summer (OEH 2019).	Potential Limited potential habitat is present within the Subject Land. No known records of the species exist within the 10 km locality. The species was not recorded during surveys.	Negligible	NA	Low
<i>Prasophyllum</i> sp. Wybong (C.Phelps ORG 5269) A leek Orchid Source: PMST		CE	<i>Prasophyllum</i> sp. Wybong (C. Phelps ORG 5269) is a terrestrial orchid that grows to approximately 30 cm high. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland. Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.	Potential Suitable habitat for the species is present within the Development Site. No known records of the species exist within the 10 km locality. The species was not recorded during surveys in September and December 2018.	Negligible	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Rutidosia heterogama</i> Heath Wrinklewort Source: BioNet, PMST	V	V	<p>The Heath Wrinklewort is a small perennial herb to 30 cm tall. It grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides. It flowers mainly in Autumn.</p> <p>The species has been recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Wooli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes.</p>	<p>Potential</p> <p>Limited potential habitat for the species might occur within the Subject Land.</p> <p>Surveys were undertaken outside the flowering period for the species.</p> <p>Only one record of the species exist within the 10 km locality and at approximately 5.4 km to the south from the Development Site. The species was recorded in 1999.</p>	<p>Negligible.</p> <p>Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region.</p> <p>Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.</p>	Low
<i>Swainsona sericea</i> Silky Swainson-pea Source: BioNet	V		<p>The Silky Swainson-pea is a prostrate or erect perennial, growing to 10 cm tall. The species flowers in spring and produces hairy pods. It is found in Natural Temperate Grassland and Snow Gum <i>Eucalyptus pauciflora</i> Woodland on the Monaro. It is also found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. It is sometimes found in association with cypress-pines <i>Callitris</i> spp. Habitat on plains unknown. Regenerates from seed after fire.</p>	<p>Potential.</p> <p>Cypress pines, White Cypress Pine (<i>Callitris glaucophylla</i>), was recorded within the Development Site. The Development Site is highly disturbed due to historical land use and current land use for grazing. Therefore, it is considered the species has a very low potential to occur within the Development Site.</p> <p>The species was not recorded during surveys in Spring and Summer.</p> <p>Only one record of the species exist within the 10 km locality and at approximately 3.5 km to the south-west from the Development Site. The species was recorded in 2003.</p>	<p>Negligible.</p> <p>Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region.</p> <p>Future development is unlikely to exacerbate the existing degree of edge effects or degradation of any retained habitats.</p>	<p>Limit clearing through delineation of designated construction areas. This will help to protect native vegetation to be retained within the Development Site and adjacent habitat.</p>	Low
<i>Thesium australe</i> Austral Toadflax, Toadflax Source: PMST	V	V	<p>The Austral Toadflax is a small, straggling herb to 40 cm tall. It is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. It occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. It is often found in association with Kangaroo Grass (<i>Themeda australis</i>).</p> <p>The species is a root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.</p>	<p>Potential</p> <p>Limited suitable habitat for the species is present within the Development Site.</p> <p>No records of the species exist within the 10 km locality and the species was not recorded during the September and December 2018 surveys.</p>	Negligible	NA	Low

Scientific Name Common Name	BC Act	EPBC Act	Species and Habitat Information	Likelihood of species occurring in the Site	Potential Impacts	Mitigation Measures	Residual Risk Rating
<i>Tylophora linearis</i> Source: PMST	V	E	<i>Tylophora linearis</i> is a slender, almost hairless twiner with a clear sap. It grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i> , <i>Eucalyptus sideroxylon</i> , <i>Eucalyptus albens</i> , <i>Callitris endlicheri</i> , <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i> . Also grows in association with <i>Acacia hakeoides</i> , <i>Acacia lineata</i> , <i>Melaleuca uncinata</i> , <i>Myoporum</i> species and <i>Casuarina</i> species. It flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.	Potential Limited suitable habitat for the species is present within the Development Site. No records of the species exist within the 10 km locality and the species was not recorded during the September and December 2018 surveys.	Negligible	NA	Low

APPENDIX E TEST OF SIGNIFICANCE AND SIGNIFICANT IMPACT ASSESSMENT

Test of Significance

The following Test of Significance (ToS) have been prepared in accordance with Section 7.3 of the BC Act and OEH (2018) *Threatened Species Test of Significance Guidelines*.

Grey-crowned Babbler (*Pomatostomus temporalis*) – Vulnerable

Species Overview

The Grey-crowned Babbler is a bird listed as vulnerable under the BC Act.

The Grey-crowned Babbler inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions. Its flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. It lives in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. It is insectivorous and it forages on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. It builds nests that are used as dormitory and roosting and uses them all year round. It breeds between July and February. Territory ranges from one to 50 hectares (usually ten hectares) and are defended all year.

Grey-crowned Babblers are obligate communal breeders that form a family group, in which offspring from the previous season and other unrelated birds help to raise the current's year's brood. Young birds stay with the family group for at least one year after fledging and may remain for two or more years acting as non-breeding helpers. As breeding spaces become available in the population, some helpers may disperse to establish their own breeding group. In some populations, breeding success is related to the number of helpers. Population viability studies in Victoria suggests that a viable population is likely to contain more than ten family groups, while populations with less than ten family groups are likely to have high rate of extinction. In NSW, the species breeds between July and February (OEH 2019).

It has been suggested that cooperative breeder species, such as the Grey-crowned Babbler, are more sensitive to habitat fragmentation and loss (including loss due to fire) as availability of resources for breeding decreases (Fischer 2011). Habitat fragmentation and predation by introduced species being the major threats to the species. The species is capable to survive in disturbed landscapes, such as urban areas, where proportion of ground cover and leaf litter provides sufficient food (Lambert and Ford 2016, Stevens *et. al.* 2015).

Results of the NSW BioNet atlas indicated that a total of three records of the Grey-crowned Babbler exists within the 10 km locality. None of those known (i.e. BioNet) records are within the Development Site. The nearest BioNet record of the species dates back to 2010 and was located approximately 500 m east of the Development Site.

The Grey-crowned Babbler was observed during surveys in September and December 2018, heard during the March 2019 survey and observed more recently during surveys in November 2019 and January 2020. In December 2018, the Grey-crowned Babbler was recorded at 20 locations on the Subject Land and a total of 21 bird nests likely to belong to the species were observed (see Figure 5.2). The records included six individuals observed, 21 calls heard with an additional two potential calls heard at distance. A pair was also observed adding twigs to a nest located on the lower branches of a Silver-leaved Ironbark (*Eucalyptus melanophloia*). At least 12 individuals were observed on and adjacent to the Subject Land during more recent surveys in November 2019 and January 2020.

The Grey-crowned Babbler was observed in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). This vegetation zone covers a total of 4.10 ha on the Subject Land;
- 596_Moderate (Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion). This vegetation zone covers a total of 11.15 ha are on the Subject Land;
- 544_Low (Rough-barked Apple – White Cypress Pine – Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 0.83 ha on the Subject Land
- 516_Very Low (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 3.00 ha on the Subject Land; and
- 516_Disturbed Grasslands (Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion). This vegetation zone covers a total of 7.39 ha on the Subject Land.

Test of Significance	
(a)	<p><i>in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</i></p> <p>The Grey-crowned Babbler individuals observed within the Development Site are likely to be part of a single family group utilising the grassy woodlands and derived grasslands. Based on published information, the home range of a local population can range from one to 50ha (usually 10 ha). It is likely the family group range extends beyond the development footprint, as two potential Grey-crowned Babbler nests were recorded to the north-east from the Development Site. The movement of this species is expected to be largely confined to the woodland habitats as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided although nests will be removed within the development footprint and any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region.</p> <p>The removal of 8 nests (38 % of the 21 nests recorded on site) will reduce the availability of roosting dormitories for the species, and will likely reduce available nesting sites for current breeding adults and for young individuals sexually mature seeking to establish breeding nests. Removal of trees with nests will be included in the vegetation clearing protocol including any seasonal constraints to avoid impacting any juveniles or unfledged chicks. The vegetation clearance protocol should also consider that nests are salvaged and translocated to a suitable location within the riparian corridor where possible.</p> <p>A portion of felled trees will be salvaged as foraging habitat for fauna and translocated to suitable areas in the remainder of the Project Boundary.</p> <p>Tree replacement is also proposed as a mitigation measure for loss of hollow bearing trees. Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). This results in planting of 68 new trees within the riparian corridor. In the event that a newly-planted tree dies during the lifespan of the solar farm, the client has the responsibility to replace it in order to achieve a 100% recruitment of 68 trees. This is expected to improve the current fragmented condition of the riparian corridor and assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields. Monitoring of the revegetation works would also include monitoring of the local Babbler population including population numbers and evidence on ongoing breeding (active nests).</p> <p>Based on the application of these mitigation measures the proposed solar farm is unlikely to result in an adverse effect on the life cycle of the species such that the local population might be placed at risk of extinction.</p>
(b)	<p><i>in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</i></p> <p><i>‘(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i></p> <p>Not applicable</p> <p><i>‘(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i></p> <p>Not applicable</p>

Test of Significance	
(c)	<i>in relation to the habitat of a threatened species or ecological community:</i>
	<i>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</i>
	<p>The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. Habitat to be removed includes 29.17 ha of woodland zones and 11.80 ha of Derived Native Grasslands. This constitutes 27.5 % of the Development Site.</p> <p>The riparian corridors (with a 20-30m buffer) have been avoided although 8 nests (38% of the 21 nests recorded on site) will be removed within the development footprint and any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region.</p> <p>No vegetation removal will occur outside of the Development Site and the remainder of the Property Boundary will not be modified as result of the current proposal.</p>
	<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
	<p>The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible for species such as the Grey-crowned Babbler given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor).</p> <p>The movement of this species is largely confined to the woodland habitats and riparian corridors as this species has limited flying capacity. The riparian corridors (with a 20-30m buffer) have been avoided and the proposed replacement tree planting is expected to improve the current fragmented condition of the riparian corridor and assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields. Monitoring of the plantings would also include monitoring of the local Babbler population including population numbers and evidence on ongoing breeding (active nests).</p> <p>It is considered that the development of this site will not further isolate or fragment any known habitat linkages for the local population of Grey-crowned Babbler.</p>
	<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality</i>
	<p>The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required.</p> <p>Habitat to be removed includes 29.17 ha of woodland zones and 11.80 ha of Derived Native Grasslands (27.5 % of the Development Site). Although localised and short term impacts may be observed, the local population of Babbler would not be dependent on this habitat for their long term survival, particularly given the retention (and enhancement) of the riparian corridors which will assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields.</p>
(d)	<i>whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</i>
	<p>The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.</p>

Test of Significance

(e)

whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.

The proposed development of this site is likely to include the following key threatening processes (KTP):

- Infestation of habitat by invasive weed exotic perennial grasses.
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners.
- Nest predation by species such as ravens and butcherbirds in the fragmented landscape.

Mitigation measures such as weed management, monitoring and control of invasive and nuisance species will be required during the construction and operational phase of the proposed solar farm development..

Conclusion

Although localised and short term impacts may be observed, the local population of the Grey-crowned Babbler would not be dependent on development site for their long term survival, particularly given the retention (and enhancement) of the riparian corridors which will assist movement of the Grey-crowned Babbler along creek-lines outside of the Development Site and beyond the solar panel fields.

Loss of habitat for the Grey-crowned Babbler within the Development Site will require offsetting as per the BC Act. The possibility to offset the direct impact on habitat of the Grey-crowned Babbler by active management and/or enhancement of retained areas of habitat may be considered a viable option in consultation with BCD.

It is considered that with the implementation of mitigation measures, the proposed solar farm development will not result in any long term significant effect on the population.

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Bristle-faced Free-tailed Bat (*Mormopterus eleryi*) – Endangered

Species Overview

The Bristle-faced Free-tailed Bat or Hairy-nosed Freetail Bat (*Mormopterus eleryi* Reardon and McKenzie, 2008) (Reardon et. al. 2008) or *Mormopterus (Setirostris) eleryi* (Reardon et. al. 2014) is a microchiropteran bat species listed as endangered under the BC Act. The species was collected and referred to as *Mormopterus* 'Species 6' (e.g. Churchill 1988, Adams et. al. 1988) in publications prior to its formal description. The species is identified as data deficient in the action plan for Australian Bats (Duncan et. al. 1999).

The Bristle-faced Free-tailed Bat is distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. The species appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations. In NSW, the species has been recently recorded from only three disjunct locations (NSW SC 2004, Pennay et. al. 2011, OEH 2019): thirteen individuals were recorded on 21 November 1998 at Yanda Creek in Gundabooka National Park, south of Bourke (Ellis 2001, Pennay 2006 in Scotts 2012); one individual was recorded in 2001 from Dhinna Dhinawan Nature Reserve (formerly Bebo State Forest) (Pennay 2002); two individuals at and near Maroomba State Conservation Area (near Bonshaw) (Arden 2004 in Scotts 2012) and one individual captured on 25th March 2010 at the McIntyre River in Kwiambal National Park (Scotts 2012), Kwiambal National park and Maroomba State Conservation Area are located at approximately 37km south-west and 27km north-west from the proposed Bonshaw solar farm.

Knowledge of the ecology of the Bristle-faced Free-tailed Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites (NSW SC 2004, OEH 2019). All other Australian species from the family Molossidae, which includes the genus *Mormopterus*, generally roost in tree hollows and fissures (NSW SC 2004, OEH 2019) and Ellis (2001) recorded the species along with other six species known to roost in three hollows. Ellis and Wilson (1992) indicate that species within genus *Mormopterus* are aerial insectivorous with very high flight speed and limited manoeuvrability. They forage typically well-above the canopy and only coming low in relatively open areas. Three species within the genus *Mormopterus*, *M. nolkensis*, *M. planiceps* and *Mormopterus* sp 1 were classified as an assemblage of vegetation dependent bats that generally fly over the canopy of any vegetation type when feeding; and which are dependent on hollows, usually in larger trees, for roosting and breeding (Ellis 2006).

At Yanda Creek (Gundabooka National Park), three individuals of the species were captured in a harp trap set under a *Eucalypt* tree on the margins of a dry creek (Ellis 2001), a similar habitat where the species' calls were recorded in the Bonshaw Solar Farm's assessment area. The habitat where the species was recorded by Ellis (2001) was a River Red Gum (*Eucalyptus camadulensis*) and Poplar Box (*E. populnea*) lined watercourse set in Poplar Box woodlands with areas of Mulga (*Acacia aneura*) shrublands in the vicinity. The species has also been regarded as using tree hollows for roosting with a "significant bias" for foraging and roost at locations along riparian habitats (Pennay 2006 in Scotts 2012). At Kwiamba National Park (Scotts 2012), the species was captured on a forested terrace adjacent to the McIntyre River where vegetation comprised a mixed overstorey of Blakely's Red Gum (*Eucalyptus blakelyi*), Silver-leaved Ironbark (*E. melanophloia*) and Rough-barked Apple (*Angophora floribunda*). The mid-storey was generally sparse but with patch thickets of tea tree (*Leptospermum brevipes*) and White Cypress Pine (*Callitris glaucophylla*). A grassy understorey dominated the more open areas.

Lactating females had been recorded in November (Ellis 2001).

The calls of the Bristle-faced Free-tailed Bat were recorded in five of the eight SongMeters located within the assessment area. The records were analysed by Mr. Greg Ford (Balance!, see call report in Appendix I). Mr Ford is one of the most experience bat call analysis experts in Australia. Following consultation with BCD, Mr Greg Ford was requested to re-analyze the bat calls to ensure the records of the Bristle-faced Free-tailed Bat were confident. Regarding the Bristle-faced Free-tailed Bat, he noted that the calls of the species are similar to the non-listed Inland Broad-nosed Bat (*Scotorepens greyii*) but that the species can be differentiated based on their feeding buzzes (Ford 2018). A total of 53 definite calls of the species were recorded from S4 (11 definite calls) S2 (5 definite calls), S5 (25 definite calls), S6 (one definite call) and S7 (12 definite calls) (see Figure 5.2). The locations with the highest number of calls were S5 (25 calls), S7 (12 calls) and S4 (11 calls). These locations were near creek lines (S5 adjacent to a second order creek line with water, whereas S4 and S7 are located at/near a dry first order creek line).

Species Overview

Based record of the Bristle-faced Free-tailed Bat in the assessment area is considered to be a genuine record of this rare microbat species.

The Bristle-faced Free-tail Bat was recorded in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 18.78 ha of this vegetation zone is present within the Development Site.
- 594_Low (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 7.02 ha of this vegetation zone is present within the Development Site.
- 594_Disturbed Grassland is cleared land allocated as PCT 594 (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion) for assessment purposes. A total of 45.95 ha of this vegetation zone is present within the Development Site.

Test of Significance

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

Little is known about the species and it has been assumed that similar to other species within the genus *Mormopterus*, it relies on tree hollows for roosting and maternity sites. It appears that the species is rare in NSW and no information is currently available regarding its habitat range, reproduction period and social activities although many of the existing records are along riparian habitats. This is also consistent with the results of the surveys within the Project Boundary, within a higher number of calls recorded near creek lines and water bodies. Within the Project Boundary, the riparian corridors (with a 20-30m buffer) have been avoided.

A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region and the removal of trees will be included in the vegetation clearing protocol including any seasonal constraints and monitoring of the hollows prior to removal to avoid impacting any breeding females or juveniles. If this species is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert.

Tree replacement is also proposed as a mitigation measure for loss of hollow bearing trees. Replacement of trees at a rate of 2:1 (i.e. two trees will be planted to replace each hollow bearing tree removed). This results in planting of 68 new trees within the riparian corridor. In the event that a newly-planted tree dies during the lifespan of the solar farm, the client has the responsibility to replace it in order to achieve a 100% recruitment of 68 trees. This is expected to improve the current fragmented condition of the riparian corridor. As naturally formed tree hollows will take many decades to develop, nest-boxes suitable for hollow dependent microbats will be installed prior to HBT clearance and will be monitored during the lifespan of the solar farm

Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Species Overview	
(b)	<i>in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</i>
	<i>‘(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i>
	Not applicable
	<i>‘(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i>
	Not applicable
(c)	<i>in relation to the habitat of a threatened species or ecological community:</i>
	<i>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</i>
	<p>The Development Site is located in a highly disturbed environment that has undergone extensive clearing. Approximately 34 hollow-bearing trees (HBTs) will be removed across the Development Site, including at least three HBTs along first order streams. No trees will be removed along the second and third order creeklines, where echolocation calls of the Bristle-faced Free-tailed Bat is more frequently recorded.</p> <p>Also, it is estimated that a larger number of trees, particularly rough bark <i>Eucalyptus</i> and <i>Callitris</i> are available in vegetation to be retained within the Project Boundary and wider locality. Therefore the removal of approximately 34 trees will represent a small portion of trees available as breeding and roosting habitat for the Bristle-faced Free-tailed Bat.</p> <p>Loss of approximately 34 HBTs represent net-loss of suitable habitat for the Bristle-faced Free-tailed Bat and other hollow dependent fauna. However, on a landscape scale, loss of approximately 34 HBTs within a mostly cleared area is not considered significant when considering currently available tree resources elsewhere in the Project Boundary and broader locality.</p>
	<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
	<p>The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor which will be avoided).</p> <p>As part of mitigation measures to compensate for loss of trees and vegetation, replacement of trees will be planted along the second and third order streams within the Project Boundary. This will increase the vegetation density along the creek-lines and enhance its value as a linking corridor with remnant vegetation fragments and paddock trees beyond the Development Site. This will also enhance corridors for mobile fauna such as the Bristle-faced Free-tailed Bat and other microbats recorded within the Project Boundary.</p> <p>Therefore, it is considered that the development of this site will not further isolate or fragment the existing landscape.</p>

Species Overview

	<p><i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality</i></p> <p>The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required. It appears that the species is rare in NSW and no information is currently available regarding its habitat range, reproduction period and social activities although many of the existing records are along riparian habitats. This is also consistent with the results of the surveys within the Project Boundary, within a higher number of calls recorded near creek lines and water bodies. Within the Project Boundary, the riparian corridors (with a 20-30m buffer) have been avoided.</p> <p>The importance of hollow bearing for this species within NSW is also not known however for the purposes of this assessment they have been assumed to be used for roosting and breeding. A total of 60 hollow bearing trees were recorded across the assessment area, including 34 HBT within the development footprint. Any clearing of native vegetation has the potential to add to the incremental decline of potential habitat available within the region and the removal of trees will be included in the vegetation clearing protocol including any seasonal constraints and monitoring of the hollows prior to removal to avoid impacting any breeding females or juveniles. If this species is confirmed utilising any of the hollow bearing trees, the trees will be left undisturbed until further advice is sought from BCD and a suitably recognised bat expert.</p> <p>Based on the recommended avoidance and mitigation measures outlined within this assessment, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, the proposal is unlikely to remove any key habitats that will impact on the long-term survival of the local population.</p>
(d)	<p><i>whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</i></p> <p>The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.</p>
(e)	<p><i>whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.</i></p> <p>Future development of this site is likely to include the following KTP:</p> <ul style="list-style-type: none"> ■ Clearing and removal of hollow bearing trees as a consequence of firewood collection and agricultural and forestry practices. The proposal will remove HBT to give way to installation of solar panels. ■ Loss of habitat is exacerbated by its apparent low population numbers. ■ Lack of understanding about the species' ecology, distribution and habitat preferences. ■ Loss and degradation of foraging and roosting habitat, including changes in vegetation structure due to weed invasion. ■ Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individual's fat stores. <p>The following mitigation measures will be implemented to minimise the potential of the above listed threats having negative effects on the species:</p> <ul style="list-style-type: none"> ■ A weed management plan will be required to be implemented during the construction and operation phases of the solar farm. ■ Chemical use, such as pesticides and herbicides, will be controlled (or avoided) to prevent reduction of insect populations, a feeding resource for the species. This will also eliminate the possibility of trophic induced toxicity due to bioaccumulation in the bat species.

Species Overview

- Loss of hollow-bearing trees will be mitigated by replacement of nest boxes (short term mitigation measure) and replacement of trees suitable to develop hollows at their mature stage. It is noted that mature trees (i.e. with more than 80cm DBH) were rare at the site. It has been proposed that periods of time in the range of 180 to 238 years (e.g. soft bark *Eucalypt* spp.) or up to 324 years (e.g. ironbarks) are required for hollows suitable for fauna (e.g. bats) to form naturally on trees (e.g. Parnaby *et. al.* 2011). The development footprint area contains mature trees, but not old growth (i.e. trees with DBH greater than 100cm (DEC 2004)). Therefore, replanting trees suitable to naturally develop hollows, e.g. *Eucalypt* spp., has the potential to replace tree hollows in the long-term and provide natural habitat for hollow-dependent species, such as the Bristle-faced Free-tailed Bat. Evidence suggest that lineal planting and remnants are suitable habitat for bats in disturbed landscapes (Lentini *et. al.* 2012).

Conclusion

The conservation value of locations where the Bristle-faced Free-tailed Bat had been recorded is unknown due to the lack of knowledge on the biology and ecological requirements for the species. It is known that the species is rare and, based on the ecology of other species within the same genus, it has been assumed the Bristle-faced Free-tailed Bat to be tree hollow dependent. The pattern of the species being more frequently recorded along creek-lines than in other habitats in the landscape has emerged and the riparian corridors (with a 20-30m buffer) have been avoided.

Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the hollows prior to removal and consultation with BCD in the event that the species is confirmed utilising any of the hollows, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that the local population of the species is likely to be placed at risk of extinction although it is noted that any clearing of native vegetation, including paddock trees has the potential to add to the incremental decline of potential habitat available within the region and will require offsetting in accordance with the offset scheme under the BC Act. The possibility to offset the impact on site by active management and/or enhancing retained areas of habitat might be considered as a viable option in consultation with BCD.

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Eastern Cave Bat (*Vespadelus trougtoni*) – Vulnerable

Species Overview

The Eastern Cave Bat (*Vespadelus trougtoni*) is a microchiropteran bat species listed as vulnerable under the BC Act.

The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tableland and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (OEH 2019).

The profile for the species (OEH 2019) indicates the following with regards to the habitat and ecology of the species:

- Very little is known about the biology of this uncommon species.
- A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.
- Occasionally found along cliff-lines in wet eucalypt forest and rainforest.
- Little is understood of its feeding or breeding requirements or behaviour.

The Eastern Cave Bat was recorded in the following vegetation types:

- 594_Moderate (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 4.10 ha of this vegetation zone is present within the Development Site.
- 594_Low (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion). A total of 9.54 ha of this vegetation zone is present within the Development Site.
- 594_Disturbed Grassland is cleared land allocated as PCT 594 (Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion) for assessment purposes. A total of 49.81 ha of this vegetation zone is present within the Development Site.

In accordance with the TBDC, the Eastern Cave Bat is also found in the other three PCTs recorded at the Development Site, i.e. PCT 516, 544 and 596.

Test of Significance

(a)	<i>in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</i>
	<p>There is not suitable roosting or breeding habitat for the Eastern Cave Bat within the Development Site. The species is known to occur in the four PCTs recorded at the Development Site (i.e. PCT 594, 596, 544 and 516) and is likely that foraging resources for the species are present therein.</p> <p>Clearing within the Development Site will likely reduce potential foraging resources for the species. However, it is considered this is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>

Species Overview	
(b)	<i>in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</i>
	<i>‘(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i>
	Not applicable
	<i>‘(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i>
	Not applicable
(c)	<i>in relation to the habitat of a threatened species or ecological community:</i>
	<i>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</i>
	<p>The Development Site is located in a highly disturbed environment that has undergone extensive clearing. Approximately 29.17 ha of woodland and 11.80 ha of derived grasslands will be cleared within this disturbed environment. None of the vegetation to be cleared or the land where this will occur includes suitable roosting or breeding habitat for the Eastern Cave Bat.</p> <p>Therefore, the project will result in loss of a total of 40.97 ha of potential foraging habitat. However, on a landscape scale, loss of 40.97 ha within a mostly cleared area is not considered significant when considering currently available vegetated resources elsewhere in the Project Boundary and broader locality.</p>
	<i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i>
	<p>The removal of native vegetation has the potential to result in fragmentation of fauna habitat, with resultant effects on fauna species movement, reproduction and gene flow. The impact of this vegetation clearance in an already highly modified landscape is anticipated to be negligible given that no significant fauna movement corridors currently exist within the development site (excluding the riparian corridor which will be avoided).</p> <p>As part of mitigation measures to compensate for loss of trees and vegetation, replacement of trees will be planted along the second and third order streams within the Project Boundary. This will increase the vegetation density along the creek-lines and enhance its value as a linking corridor with remnant vegetation fragments and paddock trees beyond the Development Site. This will also enhance corridors for mobile fauna such as the Eastern Cave Bat and other microbats recorded within the Project Boundary.</p> <p>Therefore, it is considered that the development of this site will not further isolate or fragment the existing landscape.</p>

Species Overview

	<i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality</i>
	<p>The Development Site has been selected as being a suitable site for a solar plant based on its mostly cleared landscape with minimal vegetation removal required. The Development Site does not contain suitable roosting or breeding habitat for the Eastern Cave Bat, only potential foraging habitat is present therein.</p> <p>When considered at a larger spatial scale, loss of 40.97 ha of potential foraging ground in a disturbed land is not significant as more foraging habitat and at better condition is present in the broader locality. Therefore, the proposal is unlikely to remove any key habitats that will impact on the long-term survival of the local population.</p>
(d)	<i>whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</i>
	The proposed development is not located within areas listed as Critical Habitat Declarations in the Register of Declared Areas of Outstanding Biodiversity Value in NSW.
(e)	<i>whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key of a key threatening process.</i>
	<p>Future development of this site is likely to trigger the following KTP:</p> <ul style="list-style-type: none"> ■ Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individual's fat stores. ■ Probable predation by cats and foxes <p>The following mitigation measures will be implemented to minimise the potential of the above listed threats having negative effects on the species:</p> <ul style="list-style-type: none"> ■ Chemical use, such as pesticides and herbicides, will be controlled (or avoided) to prevent reduction of insect populations, a feeding resource for the species. This will also eliminate the possibility of trophic induced toxicity due to bioaccumulation in the bat species. ■ Monitoring and management of invasive pest species. This will minimize the possibility of predation on native species, such as microbats.

Conclusion

	<p>There is no suitable roosting and breeding habitat for the Eastern Cave Bat within the Development Site. The Development Site contains vegetation with potential foraging resources for the species. Given that little is known about the feeding behaviour of the Eastern Cave Bat, the conservation value of locations where the species had been recorded is unknown. Given that microchiropteran bats are considered to be insectivorous, use of pesticides and herbicides at the site will be avoided to prevent indirect impacts on insect populations and bioaccumulation on predators, such as the Eastern Cave Bat.</p>
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Species Overview

Based on the recommended avoidance and mitigation measures outlined above, including the monitoring of the invasive pest species and avoidance in use of herbicides and pesticides, it is unlikely that activity is likely to have an adverse effect on the life cycle of the species such that the local population of the species is likely to be placed at risk of extinction. Although it is noted that any clearing of native vegetation, including paddock trees has the potential to add to the incremental decline of potential habitat available within the region and will require offsetting in accordance with the offset scheme under the BC Act. The possibility to offset the impact on site by active management and/or enhancing retained areas of habitat might be considered as a viable option in consultation with BCD.

References

OEH (2019) Eastern Cave Bat – Profile. NSW Office of Environment and Heritage. On-line resource accessed via:
<https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10829>

Significant Impact Assessment

The following Significant Impact Assessment (SIA) have been prepared in accordance with DoE (2013) *Matters of National Environmental Significance. Significant Impact Guidelines 1.1 under the Environment Protection and Biodiversity Conservation Act 1999*.

Cicadabird (*Coracina tenuirostris*) – EPBC Act status: Marine

Species Overview

The Cicadabird (*Coracina tenuirostris*) is listed as Marine under the EPBC Act (DoEE 2019), whereas the subspecies Melville Cicadabird (*Coracina tenuirostris melvillensis*) is listed as Migratory. Given that Significant Impact Criteria for marine species is not provided in DoE (2013), the SIA for Cicadabird has been based on criteria for migratory species. The Cicadabird is listed as least concern (ALA 2019, BirdLife International 2017).

The Common Cicadabird (*Edolisoma tenuirostre* synonym *Coracina tenuirostris*) is a full migrant bird species found in Australia, Indonesia, New Guinea and the Solomon Islands (BirdLife International 2017, Wikipedia 2019). In Australia, the Cicadabird inhabits the northernmost part of the NT and WA. It also inhabits the eastern coast of Queensland, New South Wales and Victoria (see Screen Shot below). The species is considered native to the Northern Territory (ALA 2019).



Screen shot 1 Distribution of Cicadabird (source BirLife International 2017)

The natural habitat of the Cicadabird are temperate forests and subtropical or tropical moist lowland forests (Wikipedia 2019). The species is found in several habitats, including forest, artificial/terrestrial, savannah and shrubland. Of those habitats, temperate forests and subtropical/tropical moist lowland forests are habitats of major importance (BirdLife International 2017).

The Cicadabird's generation length is 4.6 years (BirdLife International 2017). The Cicadabird is considered part of the frugivorous and insectivorous group of birds which has been observed breeding in February and December (Lavery 1985).

One individual of the Cicadabird was recorded in PCT 594 – Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion moderate condition adjacent to Disturbed Land.

Significant Impact Assessment – Significant Impact Criteria for Migratory Species

(a)	An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.
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Species Overview

	<p>The sole individual of the Cicadabird was recorded in a moderate condition forest within the Development Site. The Cicadabird has a wide distribution along the eastern coast of Australia and it is of least concern. Regarding the habitat where the species was recorded, the Development Site has undergone a long history of disturbance due to clearing, agriculture and grazing practices, including the vegetation where the species was recorded. The disturbed nature of the site along with the fact that only one individual of the Cicadabird was observed suggests that the species would not be a frequent visitor, or be dependant on any of the resources available. Therefore, it is not considered that the proposed development will substantially modify, destroy or isolate an area of important habitat for the Cicadabird.</p>
(b)	<p><i>An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or</i></p>
	<p>Information regarding invasive species harmful to the Cicadabird are not readily available (DoEE 2019). It has been assumed that predatory species feeding on birds (e.g. European Red Fox, Cats and Dogs) or species with aggressive behaviour (e.g. Noisy Miner) have potential to have negative effects on individuals and/or population of birds, such as the Cicadabird.</p> <p>It is not considered that the proposal will result in the establishment of invasive species. Therefore, it is not expected that significant negative effects on the Cicadabird due to interactions with invasive species will result from the proposed solar farm.</p>
(c)	<p><i>An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.</i></p>
	<p>Very little is known about the breeding, feeding, migratory and resting behaviour of the Cicadabird. Given its widespread distribution in eastern Australia, it is considered sufficient feeding and breeding resources for the species occur.</p> <p>Due to the Development Site being in a disturbed condition, it is not considered that critical feeding or breeding resources for the species are found. Therefore, it is not considered that the proposed solar farm will result in a significant impact on feeding or breeding resources for the species, nor will it result in disrupting its lifecycle or migratory behaviour.</p>

Conclusion

	<p>The Cicadabird is widespread in eastern Australia and is a species of least concern. In spite of little knowledge about the species' feeding, breeding, roosting and migratory behaviour being available, the species continues to persist along the eastern coast of Australia, suggesting sufficient resources are present.</p> <p>The Development Site is a disturbed environment with cleared and disturbed vegetation. Remnant vegetation patches are disturbed (moderate to very low condition) and are not considered to represent critical habitat for the species. Therefore, it is considered that the proposed solar farm will not result in significant impacts on the species and that a referral to the Commonwealth is not deemed necessary as significant impacts to migratory/marine Matters of National Significance will not occur.</p>
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Species Overview

References

- ALA (2019) *Coracina (Edolisoma) tenuirostris* (Jardine, 1831) – Cicadabird. Atlas of Living Australia. On-line resource accessed on 15 April 2019 via:
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<https://www.iucnredlist.org/species/103702470/118729711>
- DoEE (2019) SPRAT Profile: *Coracina tenuirostris* – Cicadabird. Australian Government, Department of Environment and Energy. On-line profile accessed via:
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- Wikipedia (2019) Common Cicadabird. On-line resource accessed via:
https://en.wikipedia.org/wiki/Common_cicadabird

Assessment of Significance

The following Assessment of Significance (AoS) have been prepared in accordance with DPI (2008) *Threatened Species Assessment Guidelines*. The DPI (2008) guideline, provide a series of criteria to assess whether a proposed development is likely to have significant effects on aquatic threatened species listed under the FM Act. An AoS has been prepared for three aquatic threatened species whose indicative distributional maps suggest they were likely to occur in creeks within the Development Site. The species are:

- Southern Purple Spotted Gudgeon (Endangered Species)
- Eel Tailed Catfish (Endangered Population)
- Olive Perchlet (Endangered Population)

Southern Purple Spotted Gudgeon, Eel Tailed Catfish & Olive Perchlet

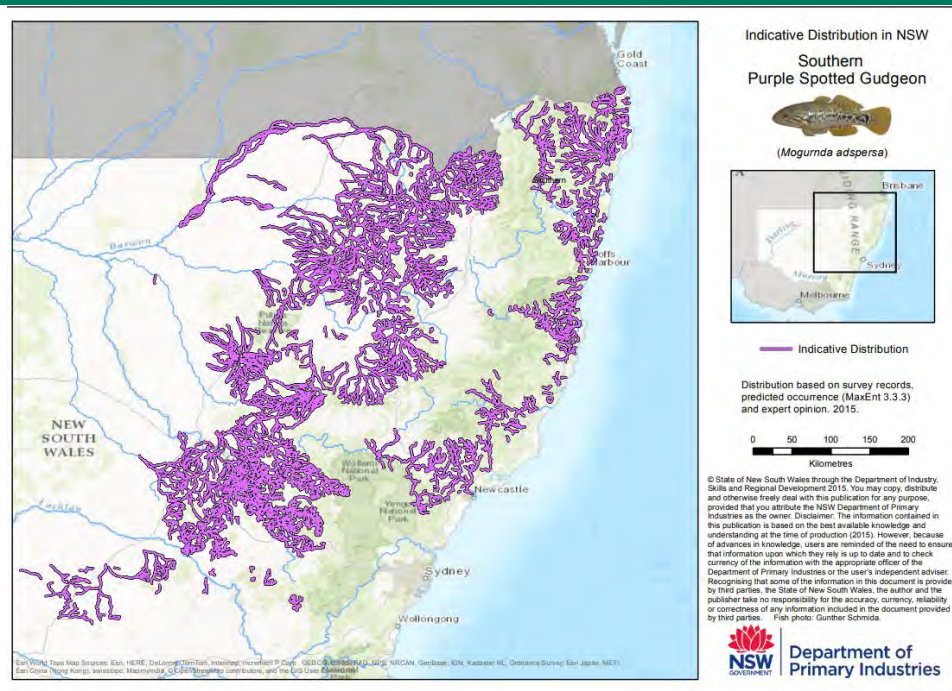
Species Overview

Southern Purple Spotted Gudgeon (*Mogunda adspersa*) – Endangered Species

The Southern Purple Spotted Gudgeon occur in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The western population of the Southern Purple Spotted Gudgeon was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling, but has experienced a significant decline in recent times. Southern Purple Spotted Gudgeons are now extremely rare in inland NSW, having been recorded from this area only once since 1983 (DPI 2019).

The Southern Purple Spotted Gudgeon generally grow to 15 cm in length. The species is found in slow moving or still waters of rivers, creeks and billabongs, often amongst weeds, rocks and snags. They feed mainly on insect larvae, but also consume worms, tadpoles, small fish and some plant matter. Female *Mogunda adspersa* may lay several batches of eggs per season (30-1,300 per batch). The eggs are deposited in clusters on solid objects such as rocks, wood or broad-leaved plants. The male guards and fans the eggs until hatching (3-8 days). The species is part of the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment, the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River and the Endangered Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River (FSC 2008a).

Species Overview



DPI (2019) Indicative Distribution Map for the Southern Purple Spotted Gudgeon

A close review of DPI's indicative distribution map for the Southern Purple Spotted Gudgeon (see Figure 5.4) indicates that none of the creeks within the Project Boundary are mapped as habitat for the species.

Eel Tailed Catfish (*Tandanus tandanus*) – Endangered Population

The Murray-Darling Basin (MDB) population of Eel Tailed Catfish is listed as an Endangered population under the FM Act.

Eel Tailed Catfish is an Australian endemic fish species (DPI 2015). It is naturally distributed throughout the Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle. Eel Tailed Catfish numbers in the Murray-Darling Basin have declined due to a range of impacts including invasive species, habitat degradation, cold water pollution and fishing pressures and are now virtually absent from the Murray, Murrumbidgee and Lachlan catchments (DPI 2019).

Eel Tailed Catfish is a medium-sized fish with a large head and a compressed rear portion of the body. It has a relatively long life span, living for at least 8 years (DPI 2015). It can grow up to 900mm in length and 7kg, however fish over 2kg are exceptional (DPI 2015, 2019). Colour ranges from grey to brown dorsally or laterally, usually mottled with dark brown to black blotchings with a whitish underbelly. Larger fish have less mottlings and can be greener in colour fading to white below (DPI 2019). Catfish are predominantly opportunistic carnivores, feeding mainly on small fish, freshwater prawns, yabbies, zooplankton and insects.

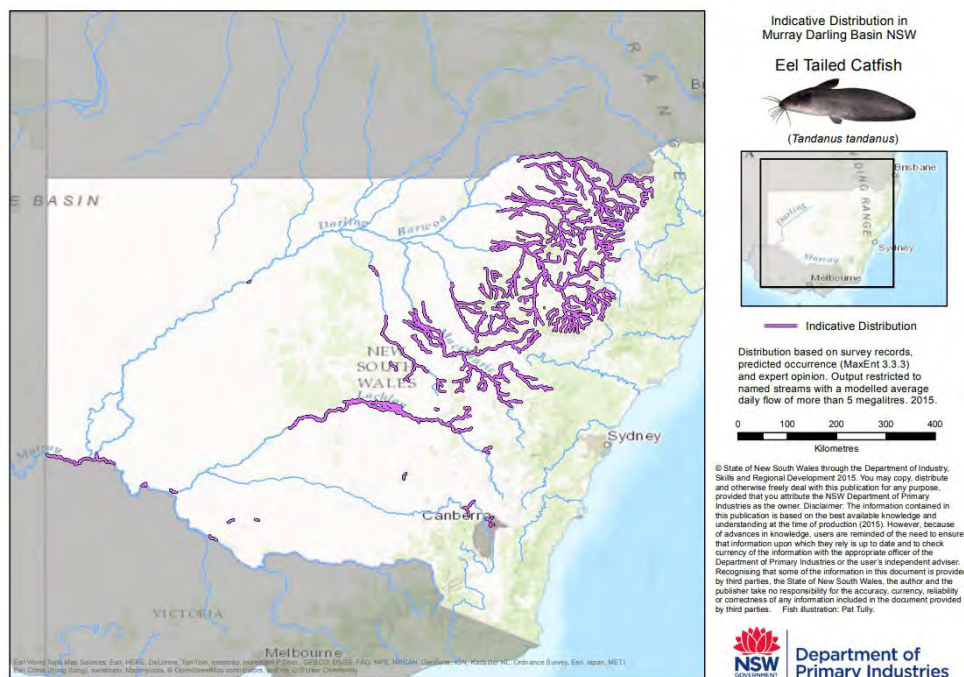
Individuals are sexually mature at 3-5 years of age and spawn in spring/summer when water temperatures are 20-24°C (DPI 2015). Eel Tailed Catfish builds a nest in areas of still water to breed, and their reproduction is not temperature reliant. Males construct and defend a nest up to 2 metres in diameter, made from pebbles and gravel.

Eel Tailed Catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 km range. Individuals are more active at night compared with during the day (DPI 2015, 2019). The species lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock. It is rare in natural riverine habitats but can be found in farm dams through-out inland NSW and southern Queensland (FSC 2008b). The species is relatively inactive and do not migrate for spawning, unlike other inland species such as Golden Perch or Murray Cod (DPI 2015, 2019).

Species Overview

Duncan et. al. (2017) indicated that Eel Tailed Catfish populations were most likely to be present in reaches of the MDB if there is a high cover of Cobble/Gravel, submerged macrophytes and low daily flow. Catfish are thought to prefer slow-moving or still waters and are found in greater abundance in lakes and backwaters. Breeding is more likely to occur at sites with a high abundance of Bedrock/Boulders, Riffle/Rapids, Emergent Macrophytes and low Daily Flow. They also note that in reaches of tributaries of the MDB where the species is currently extinct, it is unlikely that the species would naturally re-colonize and establish itself due to it being a not highly migratory species. Catfish have a relatively high minimum spawning temperature threshold relative to other native fishes in the MDB. Thermal pollution may partly explain their disappearance from some rivers in the MDB subject to cold-water releases from large impoundments.

The indicative distributional map for the species indicates the Project Boundary is within the portion of the Murray-Darling Basin where the species had been recorded (see DPI's image below). A zoom into the Project Boundary (see Figure 5.4) shows that the creeks within the Project Boundary are not mapped as habitat for the Eel Tailed Catfish. Duncan et. al. (2017) indicated that the species has disappeared from the Dumaresq River.



DPI (2019) Indicative Distribution Map for the Eel Tailed Catfish

Olive Perchlet (*Ambassis agassizii*) – Endangered Population

The Western Population of the Olive Perchlet in the Murray-Darling Basin (MDB) is listed as an Endangered population under the FM Act.

Olive Perchlets are a small native fish that occur in both eastern (coastal) and western (Murray-Darling) drainages, but these populations may be genetically distinct. The western population of the Olive Perchlet was once widespread throughout the Murray-Darling system of South Australia, Victoria, western New South Wales and southern Queensland. This population has suffered a serious decline and is now found only at a few sites in the Darling River drainage (DPI 2019).

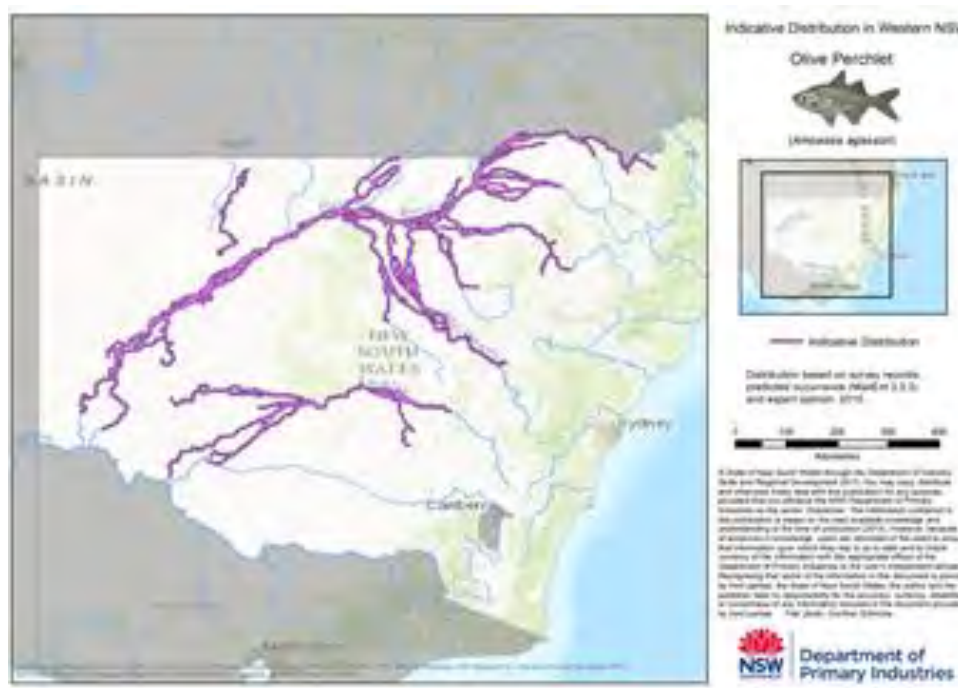
Olive Perchlets have an oval shaped body with a moderately large mouth, very large eyes and a forked tail. They are usually semi-transparent, with dark-edged scales forming a distinct pattern. The fins are generally clear, although there is often a broad, blackish band along the edges of the pelvic and anal fins. Olive Perchlet can grow to about 7080 mm but are more commonly less than 40 mm (DPI 2013, 2019).

Species Overview

Males and females reach sexual maturity at one year of age, and live for 2-4 years. Spawning occurs between October and December when the water temperature reaches 23°C. Females lay 200-700 eggs which attach to aquatic plants and rocks on the streambed. The eggs are scattered among vegetation. Both sexes reach maturity in one year, with some males surviving and breeding for two years and some females breeding in their third year (DPI 2009).

Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slow-flowing or still waters. They are usually found in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night. Olive Perchlet feed on a range of zooplankton and aquatic and terrestrial insects (DPI 2013, 2019).

The indicative distributional map for the species in the Murray-Darling Basin indicates the Project Boundary is within the portion of the Murray-Darling Basin where the species had been recorded (see DPI's image below (DPI 2019)). The current distribution of the species in the MDB has decreased (DPI 2013). A zoom into the Project Boundary (see Figure 5.4) shows that the creeks within the Project Boundary are not mapped as habitat for the Olive Perchlet.



DPI (2019) Indicative Distribution Map for the Olive Perchlet

Assessment of Significance

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

The six first order creeks to be lost as part of the proposed development are currently dry, as such, they do not represent suitable habitat for any of these aquatic fish species. The third, second and first order creeks within the Project Boundary to be retained were also dry at the time of surveys and are isolated from the broader riparian system due to the presence of Bruxner Way.

During period of heavy rain and increase surface flow, the possibility exists for aquatic fauna, such as fish, to occasionally occupy these creeks in association with flooding events whereby they can be carried into the creeks by the flow and remained 'trapped' as waters recede. When such flood-induced occasional use of the creeks might occur, it is unlikely those individuals would establish a local population due to the lack of connectivity with the broader riparian system and ephemerality of the creeks.

Species Overview

	The proposed development is unlikely to result in any impacts to any local population of these aquatic species nor it is predicted that the project or activities associated with it will put the species at risk of extinction.
(b)	<i>in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.</i>
	None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts to any local population of these species or have any effect on the life cycle of any local population.
(c)	<i>in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:</i> <i>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</i> <i>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</i>
	NA
(d)	<i>in relation to the habitat of a threatened species, population or ecological community:</i> <i>(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and</i> <i>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and</i> <i>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality</i>
	None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts or remove any habitat critical to the survival of any local population of these species.
(e)	<i>whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)</i>
	No critical habitat for the three threatened fish species is present at the Development Site.
(f)	<i>whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan</i>
	<p><u>Southern Purple Spotted Gudgeon</u></p> <p>No recovery plan or threat abatement plan is available for the Southern Purple Spotted Gudgeon. The final determination for the species indicates that threatening processes associated with the decline of the species are:</p> <ul style="list-style-type: none"> ■ predation by introduced fish such as gambusia and redfin perch, ■ habitat loss, ■ rapid fluctuations in water levels (due to water regulation) that have deleterious effects on successful reproduction and recruitment. <p>A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Southern Purple Spotted Gudgeon.</p>

Species Overview

Eel Tailed Catfish:

No recovery plan or threat abatement plan is available for the Eel Tailed Catfish. The final determination for the species and its PrimaFace (DPI 2015) indicates that threatening processes associated with the decline of the species are uncertain, but that probably include:

- Historic commercial fishing;
- Loss of habitat (lakes, billabongs, lagoons) through river regulation;
- Interactions with introduced species, such as carp (*Cyprinus carpio*) and Redfin Perch (*Perca fluviatilis*);
- Loss of habitat and spawning sites through siltation;
- Reduced success of spawning and recruitment;
- Loss of habitat due to alterations to flow patterns and flooding regimes;
- Reduced habitat and loss of temperature spawning cues due to cold-water discharge from the base of large dams and high-level weirs;
- Loss of aquatic plants;
- Chemical pollution, including agricultural pesticides.

A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Eel Tailed Catfish.

Olive Perchlet:

No recovery plan or threat abatement plan is available for the Olive Perchlet. The final determination for the species and its PrimaFace (DPI 2013) indicates that threatening processes associated with the decline of the species may include:

- Predation by introduced fish such as Mosquitofish (*Gambusia holbrooki*) and Redfin perch (*Perca fluviatilis*).
- Habitat degradation and loss, including the removal of vegetation, logs and snags.
- Rapid fluctuations in water levels (due to river regulation) that have deleterious effects on successful reproduction and recruitment.
- Cold water pollution from impoundment water release restricting spawning.
- Loss of instream aquatic vegetation through the impacts of river regulation and carp (*Cyprinus carpio*).

A Priorities Action Statement for the species is available in DPI (2019). The proposed development do not contravene any of the provided actions for recovery of the Western Population of the Olive Perchlet.

Conclusion

None of the creeks within the Subject Land provide habitat for any of the species assessed and the proposed development is unlikely to result in any impacts or remove any habitat critical to the survival of any local population of these species.

Species Overview

References

- DPI (2013) **PrimeFact: Olive Perchlet (western population) – *Ambassis agassizii***. NSW Department of Primary Industries, Port Stephens.
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<https://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw>
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- FSC (2008b) **Final Determination: The *Tandanus tandanus* – Eel Tailed Catfish in the Murray/Darling Basin as an Endangered Population**. Listing by the Fisheries Scientific Committee under the NSW Fisheries Management Act 1994 (Ref No.FD41, File No. FSC08/02).
- FSC (2009) **Recommendation *Ambassis agassizii* – (Olive Perchlet)**. Recommendation by the Fisheries Scientific Committee under the NSW Fisheries Management Act 1994 (Ref. No. RF17, File No. FSC 01/09).
- Rourke M. and Gilligan D. (2010) **Population genetic structure of freshwater catfish (*Tandanus tandanus*) in the Murray-Darling Basin and coastal catchments of New South Wales: Implications for future re-stocking programs**. Industry & Investment NSW, Narrandera Fisheries Centre, Narrandera NSW.

APPENDIX F SURVEY METHODS AND EFFORT

Survey Method and Effort

Flora and fauna surveys were undertaken within the Development Site at locations shown in Figure 5.1. Environmental conditions are presented in Table F.1 below. Weather conditions are as per the Bureau of Meteorology's Applethorpe (Station 041175).

Fauna survey methods and effort are presented in Table F.1.

Targeted flora surveys methods and effort are presented in Table F.3.

Table F.1 Weather during Surveys

Date	Min Temp	Max Temp	Rainfall (mm)	Other
10/09/2018	3.1	22.6	0	
11/09/2018	6.0	20.3	0	
12/09/2018	5.1	21.7	0	
13/09/2018	5.1	24.2	0	
14/09/2018	5.2	25.4	0	
10/12/2018	14.0	30.7	0	
11/12/2018	16.0	27.4	0	
12/12/2018	14.2	30.3	0	
13/12/2018	14.2	29.2	0.2	
14/12/2018	17.0	27.7	26	
25/03/2019	19.6	29.9	0	
26/03/2019	19.1	24.1	0	
27/03/2019	14.6	17.8	1.2	
28/03/2019	14.0	21.7	1.2	
21/01/2020	24.4	37	0.2	
22/01/2020	20.5	38	0	

Table F.2 Summary of Fauna Survey Effort

Bird Surveys						
Survey method: A 20 minute point survey was undertaken by one or two ecologists. Survey consisted of listening bird calling, observing birds activity using binoculars. Bird surveys are in general agreement with guidelines such as DEWHA (2010) <i>Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.</i>						
Date	Survey ID	Start Time	Finish Time	Ecologists	Effort (man hours)	Notes
12/09/2018	B0	10:35	11:00	JW	0.40	Diurnal
10/12/2018	B1	19:22	19:42	TC, ACM	0.67	Dusk
11/12/2018	B2	19:25	17:45	TC, ACM	0.67	Dusk
12/12/2018	B3	18:27	18:27	TC, ACM	0.67	Dusk
13/12/2018	B4	10:48	11:08	TC, ACM	0.67	Diurnal
13/12/2018	B5	18:22	18:42	TC	0.33	Dusk
14/12/2018	B6	6:08	6:28	TC	0.33	Dawn
14/12/2018	B7	6:57	7:17	TC	0.33	Dawn
Total Survey Effort					4.07	
Ecologists: ACM – Adriana Corona Mothe; JW – Joanne Woodhouse; TC – Thomas Cotter						
Frog Surveys						
Survey method: Frog surveys were undertaken using playback of the call of Tusked Frog (<i>Adelotus brevis</i>) using a mobile phone and a speaker. Two or three cycles of two minutes playing the call recording followed by two minutes listening for any response.						
Date	Survey ID	Start Time	Finish Time	Ecologists	No Playback events	Playback Duration
12/12/2018	F1	22:15	22:23	TC, ACM	2	2 min call, 2 min listen
13/12/2018	F2	18:58	19:10	TC, ACM	3	2 min call, 2 min listen
14/12/2018	F3	7:30	7:38	TC, ACM	2	2 min call, 2 min listen
Total effort (no call playback events)					7	Survey undertaken at suitable habitat for the targeted species.
Ecologists: ACM – Adriana Corona Mothe; TC – Thomas Cotter						

Reptile Surveys

A total of seven reptile surveys were undertaken within rocky areas.

Reptile surveys were design to target the following:

- General reptile habitats
- Targeting habitat for the Zigzag Velvet Gecko (*Amalosia rhombifer*) in gum trees (e.g. *Eucalyptus blakelyi*) and Whyte Cypress Pine (*Callitris glaucophylla*).
- Targeting habitat for the Border Thick-tailed Gecko (*Uvidicolus sphyrurus*) in rocky habitats, coarse woody debris and leaf litter.
- Targeting habitat for the Pale Headed Snake (*Hoplocephalus bitorquatus*) treed areas, riparian areas and coarse woody debris.

Survey Method: Two ecologist undertook nocturnal spotlight surveys. Searches included turning rocks, searching underneath leaf litter piles and under logs. Spotlighting also targeted tree trunks. No recommended survey effort for the targeted species is readily available, therefore, survey effort was determined based on standard practice for reptiles, habitat availability at the Development site, species profiles and advice for similar species (e.g. geckos) as per DEWHA (2011) *Survey guidelines for Australia's threatened reptiles*.

Date	Survey ID	Start Time	Finish Time	Ecologists	Effort (Man hours)	Notes
10/12/2018	R1	20:21	20:41	TC, ACM	0.67	Rocky Area. Leaf litter, log, rock, granite. Eastern facing
10/12/2018	R2	19:57	10:17	TC, ACM	0.67	Rocky Area. Leaf litter (3cm depth), log and rock turn, granite, eastern slope
11/12/2018	R3	20:50	21:10	TC, ACM	0.67	Rocky Area. Leaf litter (2cm depth), east facing
11/12/2018	R4	21:26	21:46	TC, ACM	0.67	Rocky Area. Leaf litter (2cm depth), west facing
11/12/2018	R5	21:58	22:09	TC, ACM	0.33	Rocky Area
11/12/2018	R6	21:00	21:34	TC, ACM	1.13	Rocky Area
12/12/2018	R7	20:34	20:54	TC, ACM	0.67	Rocky Area
12/12/2018	R8	20:02	20:22	TC, ACM	0.67	Rocky Area
Total Survey Effort					5.48	Survey effort for reptiles at the Development Site is considered sufficient given the extent of suitable habitat .

Ecologists: ACM – Adriana Corona Mothe; TC – Thomas Cotter

Camera Traps

A total of eight camera traps were installed across the Project Boundary. Camera traps used included:

- Four pocket camera SG565F-8M.
- Four UV565 cameras.

Survey method: Camera traps were set up targeting arboreal fauna, particularly that using tree hollows, such as Squirrel Glider (*Petaurus norfolcensis*). Camera traps were set up to record fauna during three or four nights. The cameras were timed to record fauna activity one hour before dusk to hour after dawn. Analysis of photographic records were undertaken by ERM's ecologists.

Unit ID	Date Set up	Date Removed	Recording Start Time	Recording Finish Time	Effort (Trap Nights)	Notes
C1	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on an ironbark. Directed at a hollow in adjacent <i>Angophora floribunda</i> . Lure used: honey water spray
C2	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a <i>Eucalyptus albens</i> at 2m height. Directed at an adjacent <i>E. albens</i> .
C3	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a <i>Callitris glaucophylla</i> and at 1.5m high. Directed towards a <i>Eucalyptus blakelyi</i> which had some arboreal mammal scratch marks.
C4	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Camera set up on a <i>Hakea</i> sp. at 1.5m high. Directed towards a <i>Eucalyptus melanophloia</i> with hollow.
C5	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a <i>Eucalyptus melanophloia</i> and at 2 m high. Directed towards adjacent <i>Eucalyptus melanophloia</i> 's trunk located at the edge of a drainage feature with water present.
C6	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a <i>Dododanea</i> sp. and a 1.5 m high. Directed towards <i>Eucalyptus melanophloia</i> with hollows. Lure used: honey water spray.
C7	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a <i>Callitris glaucophylla</i> and at 1.75m high. Directed towards adjacent a <i>Corymbia dolichocarpa</i> with hollow. Lure used: honey water spray.
C8	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Camera set up on a stag at 1.5m high. Directed towards <i>Eucalyptus dealbata</i> trunk with hollows and scratch marks. Lure used: honey water spray.
Total trap nights					28	Given that the Development Site has undergone intensive disturbance due to its historical and current land use, an intense level of survey (e.g. 14 night traps and using approximately 10 cameras per hectare (DSEWPC (2011) <i>Survey guidelines for Australia's threatened mammals</i>)) was not considered necessary. We targeted the most likely habitats where arboreal species might occur.

SongMeters

Eight SongMeter model SM2+ (Wildlife Acoustics Inc.) were used. A total of 28 trap nights were recorded using eight instruments during three to four nights. The microchiropteran bat recordings were submitted for analyses by recognised bat call analysis expert, Mr Greg Ford (Balance! Environmental). The report is provided in Appendix I.

Unit ID	Date Set up	Date Removed	Recording Start Time	Recording Finish Time	Effort (Trap Nights)	Notes
S1	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an <i>E. albens</i> stag, adjacent dam with water.
S2	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an <i>E albens</i> at 2 m high and directed to adjacent dam.
S3	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an <i>Angophora floribunda</i> , at 1.5m high and along dry drainage feature.
S4	10/12/2018	14/12/2018	18:00 hrs	6:00 hrs	4	Unit set up on an <i>E. melanophloia</i> , at 1.5 m high and along dry drainage feature.
S5	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on an <i>A. floribunda</i> , at 2m high, facing drainage feature with water immediately adjacent. Lure used: honey water spray.
S6	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on an <i>E. melanophloia</i> with hollows, at 1.75m high and adjacent to a dry drainage feature.
S7	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on a <i>C. glaucophylla</i> , at 2m high, directed towards <i>C. glaucophylla</i> regrowth
S8	11/12/2018	14/12/2018	18:00 hrs	6:00 hrs	3	Unit set up on a stag, at 1.75m high, directed towards cleared land adjacent <i>Eucalyptus dealbata</i> with hollows.
Total					28	A total of 28 trap nights were undertaken at the Assessment Area, including the Development Site (approx. 149.24 ha). In accordance with the OEH (2016) ' <i>Species credit threatened bats and their habitats. NSW survey guide for the Biodiversity Assessment Method</i> '. A minimum of 16 bat nights are required for a default 50ha site. For Subject Lands larger than 50 ha, survey effort is to be scaled up. Based on the highly disturbed and heavily modified nature of the Subject Land and the identification of 29.17 ha of Woodland Vegetation and 11.80 ha Derived Native Grasslands, this survey effort is considered appropriate. SongMeters were installed along riparian areas and areas most likely used by microchiropteran bats as potential flyways.

Ecologists: JW = Joanne Woodhouse; TC = Thomas Cotter; ACM = Adriana Corona Mothe.

Targeted flora survey method

Candidate flora species requiring survey were identified early on during Stage 1 of the project. Table F.3 shows the candidate species identified along with their flowering periods and habitats. Survey method consisted of the following:

- Random meander transects (RMT) were undertaken across the Development Site to undertake vegetation ground-truthing. Along RMT, where suitable habitat for a candidate flora species was identified, the corresponding species was searched for. This was undertaken during the spring and summer survey field trips.
- As part of vegetation mapping, habitat observations and vegetation community observation were undertaken at over 150 locations across the Development Site. At each of these locations, candidate species were searched for if suitable habitat was present.
- At BAM plot locations, candidate flora species were looked for within the BAM plot area. A total of 44 BAM plots were undertaken.

Table F.3 Candidate flora species identified during survey design

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat Targeted	Stratum Targeted	Flowering Period	Survey period		
						Spring (September 2018)	Summer (December 2018)	Autumn (March 2019)
Native Milkwort (<i>Polygala linariifolia</i>)	V	-	Grassland, Woodlands with <i>Eucalyptus</i> spp. and <i>Callitris</i> spp.	Groundcover	Spring - Summer	x	x	
Scant Pomaderris (<i>Pomaderris queenslandica</i>)	E	-	Vegetated areas, particularly where gum trees (<i>Eucalyptus</i>) are present	Shrub	Spring - Summer	x	x	
Silky Swainson-pea (<i>Swainsona sericea</i>)	V	-	Grassland, Woodlands with <i>Eucalyptus</i> spp. and <i>Callitris</i> spp.	Groundcover	Spring	x		
Austral Toadflax (<i>Thesium australe</i>)	V	V	Grassland, Grassy Woodlands, areas with Kangaroo Grass (<i>Themeda australis</i>)	Groundcover	Spring	x		
Bluegrass (<i>Dichanthium setosum</i>)	V	V	Grassland, Grassy Woodlands	Groundcover	Summer		x	
Finger Panic Grass (<i>Digitaria porrecta</i>)	E	-	Grassland, Grassy Woodlands, areas with <i>Eucalyptus albens</i>	Groundcover	Summer		x	
Rodd's Star Hair (<i>Astrotricha roddii</i>)	E	E	Woodlands	Shrub	October to February	x	x	
Heath Wrinklewort (<i>Rutidosia heterogama</i>)	V	V	Open Forests, disturbed areas	Groundcover	Mainly Autumn			x

Common Name (Scientific Name)	BC Act	EPBC Act	Habitat Targeted	Stratum Targeted	Flowering Period	Survey period		
						Spring (September 2018)	Summer (December 2018)	Autumn (March 2019)
Ovenden's Ironbark (<i>Eucalyptus caleyi subsp. ovendenii</i>)	V	V	Grassy Woodlands, paddock trees	Canopy	July to September	x		
Narrow-leaved Black Peppermint (<i>Eucalyptus nicholii</i>)	V	V	Grassy Woodlands, paddock trees	Canopy	Autumn	x	x	x

Notes: * Tree identification based on trunk and leave characteristics

APPENDIX G BAM PLOTS DATA AND PHOTOGRAPHS

BAM Plot field data sheets

A total of 44 BAM Plots were undertaken as part of this study. Field data sheets used included:

- Hard Copy: Field data sheet printed in paper were used to collect data in a total of 35 BAM plots (i.e. plot P1 to P5 and P15 to P44). This section presents scanned field data sheets of those BAM plots.
- Electronic: Electronic field data sheets was created in Survey 123 (ArcGIS). A tablet was used in the field to collect data for nine BAM plots (i.e. plots P6 to P14). Data for BAM plots collected with electronic data sheet are presented in tabular form in this Appendix.

Date: 11 Sept 18Recorders: Jo + AdrianaPlot ID: 1

Project No: _____

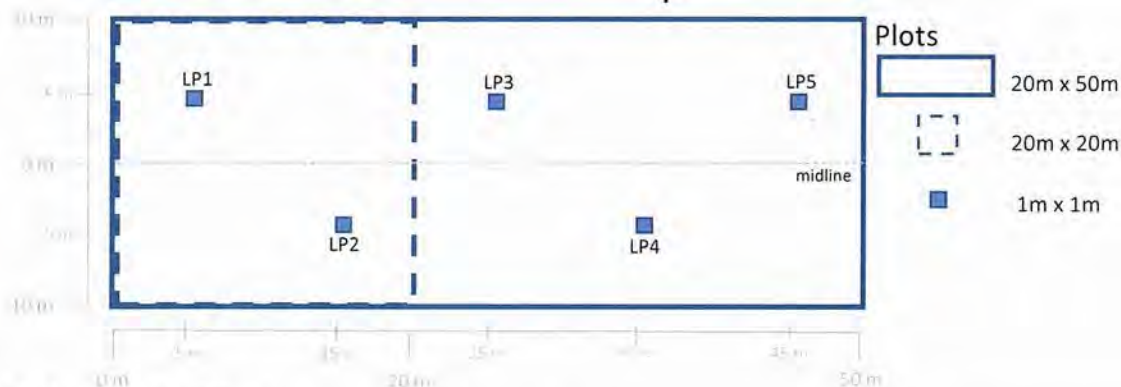
Project Name: Bonshaw Solar

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>	Confidence
Datum:		IBRA sub-region:	<u>Nandewar Northern Complex</u>	H M L
Likely Vegetation Class:				
Plant Community Type (PCT):	<u>Silver Ironbark white cypress</u>	EEC:		Confidence
				H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>A75</u>			<u>86 E</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>A76</u>					

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>LP1</u>	<u>LP2</u>	<u>LP3</u>	<u>LP4</u>		
	Photo						
Litter Cover (%)		<u>5</u>	<u>35</u>	<u>70</u>	<u>80</u>	<u>20</u>	
Bare Ground (%)		<u>85</u>	<u>50</u>	<u>20</u>	<u>15</u>	<u>70</u>	
Cryptogam Cover (%)		<u>2</u>	<u>5</u>	<u>5</u>			
Rock Cover (%)		<u>8</u>	<u>5</u>	<u>5</u>	<u>5</u>	<u>10</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Date: 11/9/18 Recorders: Jo + Adriana Plot ID: 1Project No: _____ Project Name: Bonshaw solar Zone ID: _____Plot 20m x 50m: Tree Classes^a

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc [^]	Euc*	Non-Euc [^]
80+ cm				
50 - 79 cm	1		1	
30 - 49 cm		1		
20 - 29 cm		111 1 = 6		1
10 - 19 cm		20 + 10 = 30		
5 - 9 cm		40		
<5 cm ^b		Callitris ✓	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		120 540 540 230 366 270 120 = 2186		

a - Presence/Absence of trees in each class; b - regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of Eucalyptus, _____)

[^] Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤10. Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

Species Name	DBH (cm)	WP	Easting	Northing	Hollow <20 cm	Hollow >20 cm
Callitris / stag	23	H1			1	-
silver ironbark	59	H2			10	-
stag	38	H3			6	

400 m ² plot: Sheet <u>1</u> of <u> </u>		Survey Name	Plot Identifier	Recorders <u>ACM / JW</u>
Date	<u>11 09 2018</u>	<u>Broadway</u>	<u>Plot 1</u>	

[illegible]

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

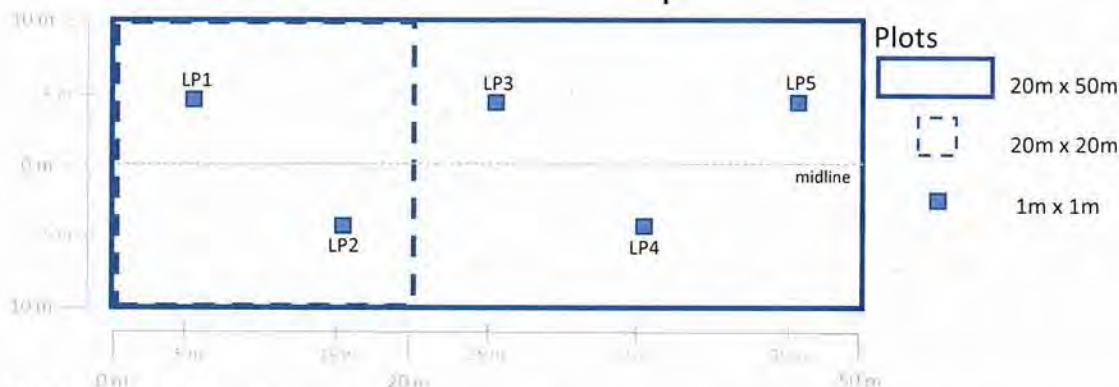
• 500

Date: 11/09/18 Recorders: Jo + Adriana Plot ID: 2Project No: _____ Project Name: Bonsbrun Salal Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	56	IBRA region:	Nandewar	
Datum:		IBRA sub-region:	Nandewar Northern Complex	
Likely Vegetation Class:				Confidence H M L
Plant Community Type (PCT):	Grey Box Grassy Woodland or open forest		EEC:	Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>787</u>	<u>151.33768°</u>	<u>29.20992</u>	<u>344°N</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>788</u>	<u>151.33763°</u>	<u>29.20946</u>	<u>-</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Magnetig bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>LP1</u>	<u>LP2</u>	<u>WP10</u>	<u>11</u>	<u>13</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>100</u>	<u>80</u>	<u>65</u>	<u>70</u>	<u>60</u>	
Bare Ground (%)							
Cryptogam Cover (%)							
Rock Cover (%)							

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture) <input checked="" type="checkbox"/>			
Soil Erosion <input checked="" type="checkbox"/>			
Firewood CWD removal			
Grazing (identify native/stock) <input checked="" type="checkbox"/>			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of _____

Plot ID: 2

Zone ID: _____











DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm	1		1	
50 - 79 cm	11		1	
30 - 49 cm				
20 - 29 cm	11	11		
10 - 19 cm		1		
5 - 9 cm		8		
<5 cm ^b		40	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		350 - 520 810 400 70 - 1080 140 - 990 610. =5670		

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet <u> </u> of <u> </u>		Survey Name	Plot Identifier	Recorders
Date	10 09 2018	0470861-Brothers	2	ACM, JW

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
T	Grey Box <i>Eucalyptus microcarpa</i>	N	30	12		
T	Iron bark → <i>Eucalyptus melanophylla</i> (Silver-leaved Ironbark)	N	20	1		
	Small Tree 1 <i>Ficus</i> sp. 1	N	0.3	7		
	Small Tree 2 <i>Natalaea longifolia</i>	N	30	47		
	Small Tree 3 <i>Natalaea microcarpa</i>	N	0.1	1		
	N1, small shrub up to 8m tall, <i>Pittosporum spinosum</i> / ///	N	0.1	6		
	Grass 1  <i>Tripsacum longiformis</i> * 10; 10; ///	N	0.1	123		
	Close 1  <i>Oxalis perennans</i> *; 5; 10; ///	N	0.1	119		
	Grass 2 <i>Sparganium elongatum</i> ///	N	0.1	2		
	W1  <i>Asteraceae</i> sp. 1 * 10	*	0.1	110		
	W2 5  <i>Asteraceae</i> sp. 2 10; 20	*	0.1	30		
	N2 <i>Euphorbia</i> sp. 1 1 /// ///	B*	0.1	21		
	N3 <i>Pimelea neo-anglica</i> ///	N	0.1	4		
	N4  <i>Melichrus</i> sp. 1 /	N	0.1	1		
	Grass 1 → <i>Callitris glaucophylla</i> (White Cypress Pine) ///	N	0.1	3		
	Grass 3  <i>Schoenus</i> sp. 1 60; ///	N	0.1	62		
	Close 2  <i>Trifolium</i> sp. 1 ///	*	0.1	2		
	N5  <i>Vire</i> <i>Parsonia</i> sp. 1 *; 12; 1; 10	N	0.1	124		
	<i>Opuntia</i> (same as plot 1) <i>Opuntia aurantiaca</i> /	E	0.1	1		
	V1 <i>Hardenbergia violacea</i> /	N	0.1	1		
	V2  <i>Pandanus panderana</i> 10+ /	N	0.1	11		
	N6  <i>Dischandra</i> sp. A ///	N	0.1	3		

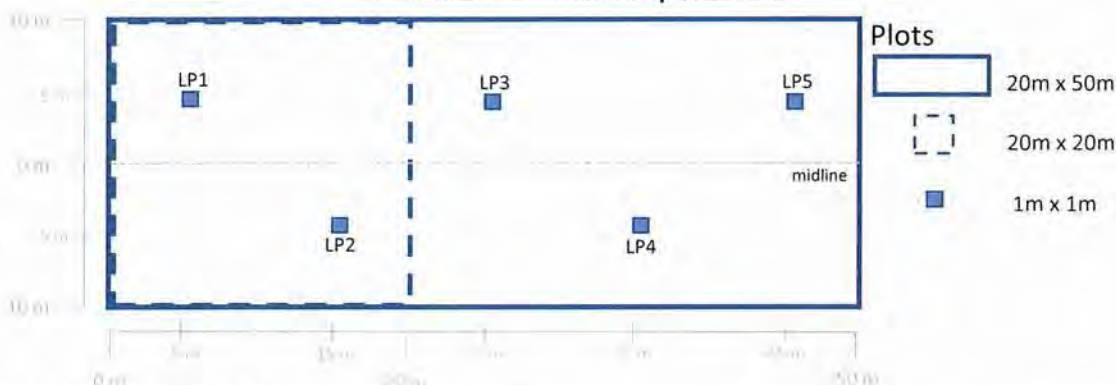
GF Code: see Growth Form definitions in Appendix 1 **N:** native, **E:** exotic, **HTE:** high threat exotic **GF – circle code** if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Date: 11/9/18 Recorders: Jo. Adriana Plot ID: 3Project No: _____ Project Name: Bonshaw Solar Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:		IBRA region:	<u>Nandewar</u>
Datum:		IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			Confidence H M L
Plant Community Type (PCT):	<u>? Rough-barked Apple - White Cypress Pine - Blackbutt Red Gum woodland</u>	EEC:	Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>790</u>	<u>151.390350</u>	<u>29.210240</u>	<u>29° NE</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m						

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>25</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>65</u>	<u>30</u>	<u>20</u>	<u>10</u>	<u>90</u>	
Bare Ground (%)		<u>15</u>	<u>20</u>	<u>40</u>	<u>50</u>	<u>5</u>	
Cryptogam Cover (%)							
Rock Cover (%)		<u>20</u>	<u>40</u>	<u>50</u>	<u>40</u>	<u>5</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yrs); O = old (>10 yrs)

Page 2 of ____

Project No: _____ **Project Name:** _____ **Zone ID:** _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm	1		1	
30 - 49 cm	1			
20 - 29 cm		1		
10 - 19 cm		1		
5 - 9 cm		1		
<5 cm ^b	1	40	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		530 150 400 90 620 330 160 610 = 3710		

^ Non-Euc - Record of living native non eucalypt trees

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

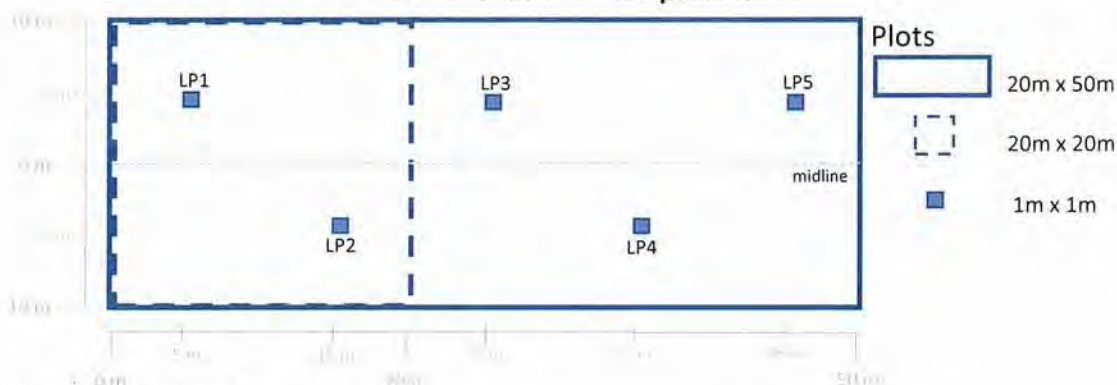
[illegible]

Date: 12-09-2018 Recorders: ACM / JW Plot ID: 4Project No: 0470961 Project Name: Bonsbaw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Desktop Information Requirements for Draft Assessment					
Zone:		IBRA region:	Nundahur		
Datum:		IBRA sub-region:	Nundahur Northern Complex		
Likely Vegetation Class:					Confidence H M L
Plant Community Type (PCT):	Cleared - Non-native		EEC:		Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
50 m	<u>796</u>	<u>0338834</u>	<u>6768241</u>	<u>—</u>	<u>✓</u>	<u>✓</u>
50 m	<u>797</u>	<u>0338827</u>	<u>6768189</u>	<u>1° N</u>	<u>✓</u>	<u>✓</u>

*Magnetig bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>798</u>	<u>799</u>	<u>800</u>	<u>801</u>	<u>802</u>	
	Photo	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	
Litter Cover (%)		<u>15</u>	<u>2</u>	<u>0</u>	<u>85</u>	<u>80</u>	
Bare Ground (%)		<u>60</u>	<u>95</u>	<u>890</u>	<u>5</u>	<u>10</u>	
Cryptogam Cover (%)		<u>5</u>	<u>5</u>	<u>5</u>	<u>0</u>	<u>0</u>	
Rock Cover (%)		<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	<u>Flat</u>
Lithology		Soil Surface Texture		Soil Colour	<u>light orange</u>	Soil Depth	
Slope	<u>gentle <15° down slope to rd</u>	Aspect	<u>N</u>	Site Drainage		Distance to nearest water and type	<u>Creek to East</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of ____

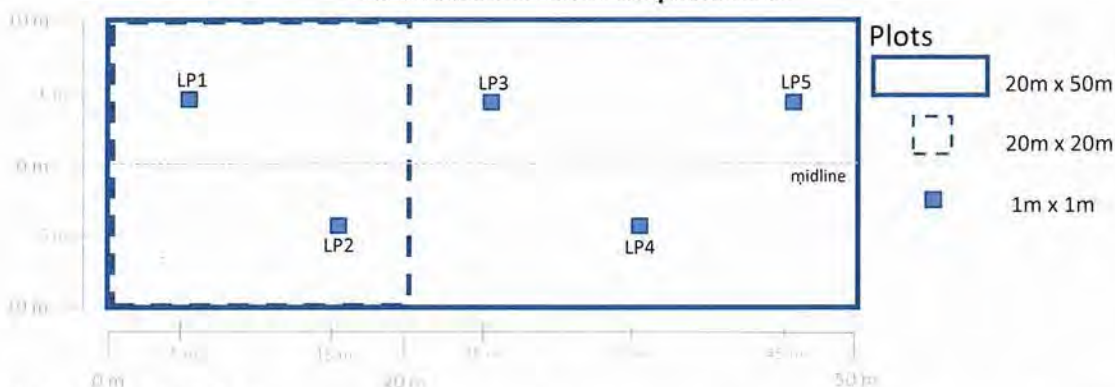
Project No: _____ Project Name: 047 MAGI Zone ID: _____

Date: 12-09-2018 Recorders: AcM / JW Plot ID: 5Project No: 0470861 Project Name: Bonsheer Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:		IBRA region:	Nonlawine				
Datum:		IBRA sub-region:	Nonlawar Northern Complex				
Likely Vegetation Class:						Confidence	
						H M L	
Plant Community Type (PCT):				EEC:		Confidence	
						H M L	

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>804</u>	<u>0339451</u>	<u>6768659</u>	<u>239° SW</u>	✓	✓
50 m	<u>803</u>	<u>0339402</u>	<u>6768675</u>	<u>201° S</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>29</u>	<u>30</u>	<u>31</u>	<u>32</u>	<u>33</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>82</u>	<u>90</u>	<u>85</u>	<u>20</u>	<u>98</u>	
Bare Ground (%)		<u>3</u>	<u>6</u>	<u>15</u>	<u>6</u>	<u>2</u>	
Cryptogam Cover (%)							
Rock Cover (%)		<u>15</u>	<u>4</u>	<u>-</u>	<u>74</u>	<u>-</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type		Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Project No: _____ **Project Name:** _____ **Zone ID:** _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm	 			
10 - 19 cm				
5 - 9 cm				
<5 cm ^b	✓	✓	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		810. 690 900 220 310 420 = 3,350 cm = 33.5m		

^ Non-Euc - Record of living native non eucalypt trees

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

[illegible]

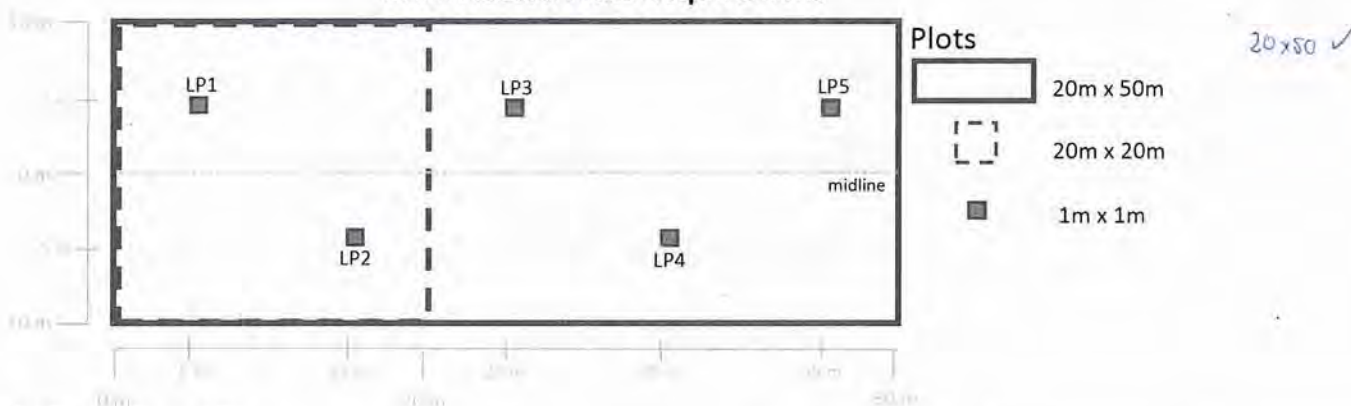
Date: 25-March-2019Recorders: ACM, TZPlot ID: 15Project No: 0470861Project Name: Bonshuur Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
			Confidence H M L
Plant Community Type (PCT):			
			Confidence H M L
			EEC:

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1458</u>	<u>0338451</u>	<u>6767511</u>	<u>193° SE</u>	✓	✓
50 m	<u>1464</u>	<u>0338482</u>	<u>6767439</u>	<u>285° W</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1459</u>	<u>1460</u>	<u>1461</u>	<u>1462</u>	<u>1463</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>60</u>	<u>30</u>	<u>80</u>	<u>80</u>	<u>95</u>	<u>69</u>
Bare Ground (%)		<u>35</u>	<u>70</u>	<u>18</u>	<u>20</u>	<u>5</u>	<u>29.6</u>
Cryptogam Cover (%)		<u>2</u>	<u>0</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>1.4</u>
Rock Cover (%)		<u>5</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>1.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hill slope</u>	Landform Pattern	<u>Low Hill - Plat</u>	Microrelief	
Lithology		Soil Surface Texture	<u>Mod. fine litter</u>	Soil Colour	<u>light brown</u>	Soil Depth	<u>-</u>
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>2</u>	<u>0</u>	<u>Stumps present</u>
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yrs); O = old (>10 yrs)

Page 2 of ____

Plot ID: 15

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm	// = 2		// = 2	
50 - 79 cm	/// 1 = 6		/// = 5	
30 - 49 cm		/// = 3		
20 - 29 cm		/// 1 = 6	\$	
10 - 19 cm		6, //, 5, 4, 4, // = 26	///	
5 - 9 cm		//, 8, 6 = 25	#	
<5 cm ^b		7, 38, 6, 18, 20 = 89	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		3, 2, 3, 1, 4; 9, 7, 3, 4, 9, 10, 5, 6 = 66		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

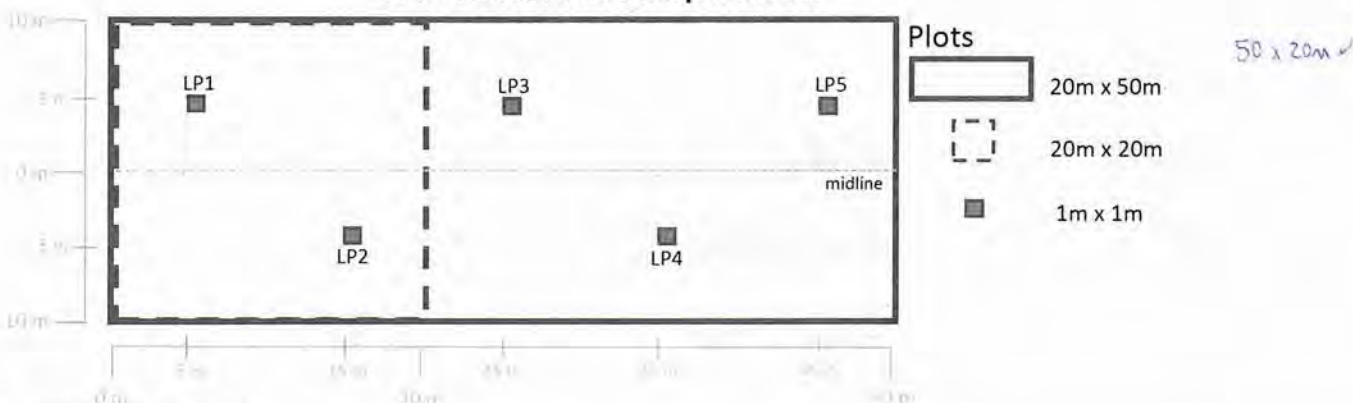
[illegible]

Date: 25-03-2019 Recorders: ACM, TZ Plot ID: 16Project No: 0470861 Project Name: Rainbow Solar Farm Zone ID:

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
			Confidence H M L
Plant Community Type (PCT):	<u>594</u>	EEC:	Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1472</u>	<u>0338659</u>	<u>6767564</u>	<u>255°W</u>	✓	✓
50 m	<u>1473</u>	<u>0338614</u>	<u>6767587</u>	<u>118°SE</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1477</u>	<u>1478</u>	<u>1479</u>	<u>1480</u>	<u>1481</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>80</u>	<u>90</u>	<u>85</u>	<u>10</u>	<u>1</u>	<u>53.2</u>
Bare Ground (%)		<u>20</u>	<u>5</u>	<u>3</u>	<u>90</u>	<u>98</u>	<u>43.6</u>
Cryptogam Cover (%)		<u>1</u>	<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>1.2</u>
Rock Cover (%)		<u>7</u>	<u>5</u>	<u>10</u>	<u>0</u>	<u>51</u>	<u>3.6</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Crest</u>	Landform Element	<u>Hillcrest</u>	Landform Pattern	<u>Hill</u>	Microrelief	<u>Open woodland</u>
Lithology	<u>Shale - clay matrix with pebbles & roots</u>	Soil Surface Texture		Soil Colour	<u>light brown</u>	Soil Depth	<u>-</u>
Slope	<u>100°</u>	Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>O</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R - O</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Page 2 of ____

Plot ID: 16

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm	/ = 1		/ = 1	
30 - 49 cm	/// = 5		// = 2	
20 - 29 cm	4, // = 2	///, //, 5, = 13		
10 - 19 cm	4	10, 4, 3, ///, ///, / = 28		
5 - 9 cm		2, 2, / = 5		
<5 cm ^b		// = 2	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		1, 10, 4, 1, 7, 6, 3, 13, 4, 15, 3, = 70		

E. leucobata (Trumble down Red gum)

E. albino / unicolor
E. red beneath both
Slit-lined / brownish

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders			
Date	25/3/19	Bonshaw	16				
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	<i>Eucalyptus dealbata</i>		15		T		
	<i>Eucalyptus melanophloia</i>		3		T		
	<i>Eucalyptus albens</i>		3	1	T		
	<i>Callitris glaucophylla</i>		20		T		
	<i>Hydrichia</i> sp.		0.1	20			
	<i>Ozothamnus cassinoides</i>		0.2	200			
	<i>Gymnopogon refractus</i>		0.1	15			
	<i>Aristida ramosa</i>		0.3	25			
	<i>Dichandra</i> sp. A		0.3	400			
	<i>Rostellularia ascendens</i>		0.3	200			
	<i>Glycine clandestina</i>		0.3	200			
	<i>Sida corrugata</i>		0.2	200			
	<i>Boerhavia dominii</i>		0.1	40			
	<i>Cyperus gracilis</i>		0.1	40			
	<i>Opuntia aurantiaca</i>		0.1	100			
	<i>Enneapogon gracilis</i>		0.3	200			
	<i>Pimelia stricta</i>		0.2	80			
	<i>Parsonsia eucalyptifolia</i>		0.1	10			
	<i>Vitadlinia sulcata</i>		0.1	5			
	<i>Solegyne belliaides</i>		0.1	40			
	<i>Cheilanthes sieberi</i>		0.1	20			
	<i>Carvosa</i> sp.		0.1	1			

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

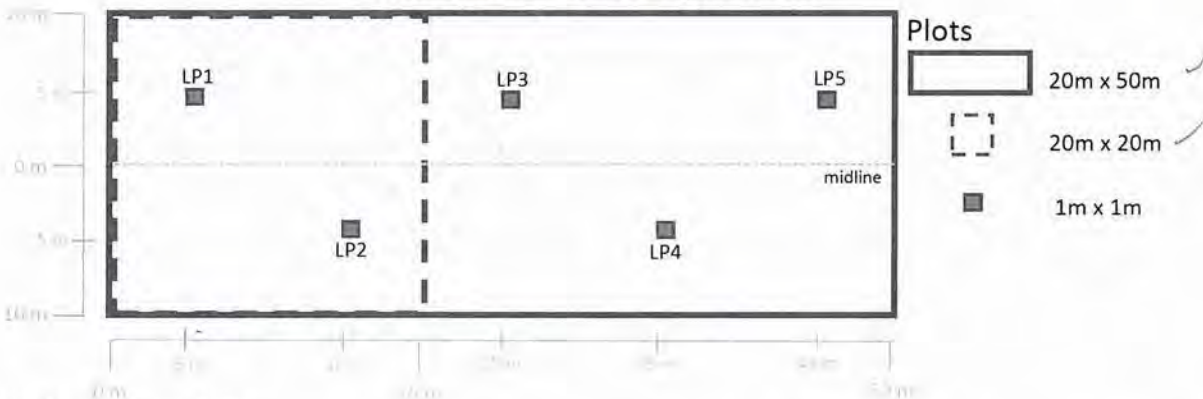
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Date: 25-03-2019 Recorders: ACM, TZ Plot ID: 17Project No: 0470861 Project Name: Bonshuw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandawar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandawar North Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):	<u>S94 - Low (logged)</u>	EEC:	<u>X</u>
			Confidence H M L <u>A</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1485</u>	<u>0338763</u>	<u>6767760</u>	<u>270°W</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>1486</u>	<u>0338720</u>	<u>6767787</u>	<u>124°SE</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1487</u>	<u>1488</u>	<u>1489</u>	<u>1490</u>	<u>1491</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>50</u>	<u>20</u>	<u>30</u>	<u>10</u>	<u>40</u>	<u>30</u>
Bare Ground (%)		<u>30</u>	<u>80</u>	<u>68</u>	<u>50</u>	<u>50</u>	<u>55.6</u>
Cryptogam Cover (%)		<u>25</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5</u>	<u>2</u>
Rock Cover (%)		<u>20</u>	<u>0</u>	<u>2</u>	<u>40</u>	<u>10</u>	<u>14.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Low Hill</u>	Landform Pattern	<u>Hill slope</u>	Microrelief	<u>grassy area</u>
Lithology		Soil Surface Texture		Soil Colour	<u>light orange brown</u>	Soil Depth	<u>-</u>
Slope	<u>< 70°</u>	Aspect	<u>NW</u>	Site Drainage	<u>NW towards creek</u>	Distance to nearest water and type	<u>50m</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>R</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>2</u>	<u>R + O</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 17

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm		1		
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		3, 2, 3, 1, 3, = 12		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

$\text{Cut off } \text{trades} = (\log_2) = 2, 1, 2, 2, 5, 3, 2, 2, 1;$
 \rightarrow Not touching ground. Branches are supporting main trunk.

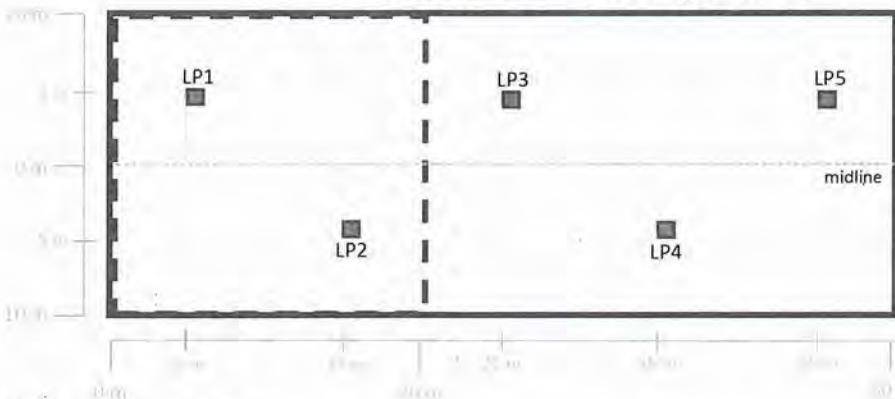
[illegible]

Date: 25-08-2019 Recorders: ACM, TZ Plot ID: 18Project No: 0470861 Project Name: Bangshan Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>Grassland</u>		
Plant Community Type (PCT):	<u>S94-DNG</u>	EEC:	
			Confidence H M L (H) M L

BAM Nested Plots Requirement



Plots

	20m x 50m ✓
	20m x 20m ✓
	1m x 1m ✓

Grassland Bushbush - coll. hdb

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1492</u>	<u>033 83 77</u>	<u>67 67 858</u>	<u>53° NE</u>	✓	✓
50 m	<u>1495</u>	<u>033 84 22</u>	<u>67 67 888</u>	<u>229° SW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1494</u>	<u>1496</u>	<u>1497</u>	<u>1498</u>	<u>1499</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>7.5</u>	<u>60</u>	<u>40</u>	<u>40</u>	<u>30</u>	<u>49</u>
Bare Ground (%)		<u>25</u>	<u>39</u>	<u>60</u>	<u>60</u>	<u>70</u>	<u>50.8</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Plot</u>	Landform Element	<u>Flat</u>	Landform Pattern		Microrelief	<u>grassland</u>
Lithology		Soil Surface Texture		Soil Colour	<u>light - brown</u>	Soil Depth	<u>-</u>
Slope	<u>flat</u>	Aspect	<u>NE</u>	Site Drainage	<u>SW</u>	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R-0</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 18

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		12, 1, 3, 15, 1, 2, 1 = 35		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

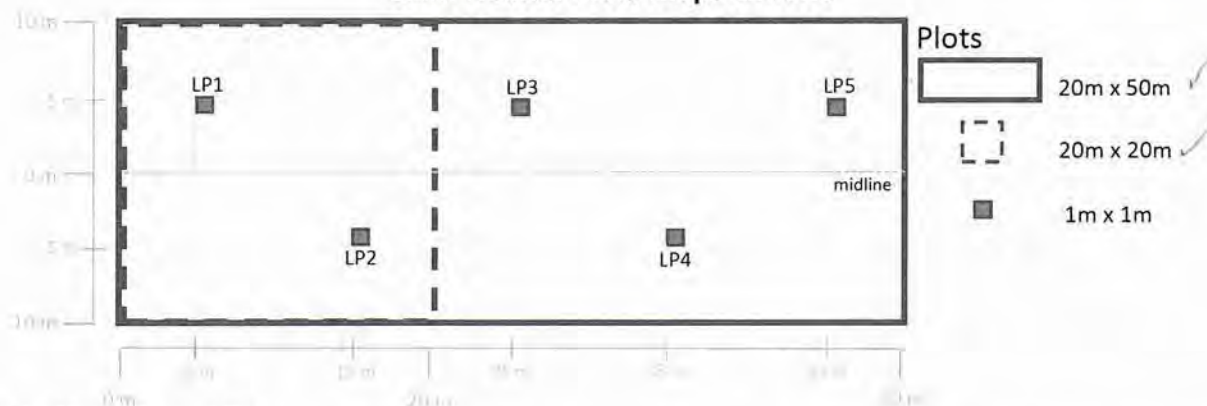
Date: 25.03.2019Recorders: ACM, TZPlot ID: 19Project No: 0470861Project Name: Bonshaw Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
			Confidence H M L
Plant Community Type (PCT):	<u>DNg</u>	EEC:	<u>X</u>
			Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1500</u>	<u>033 83 20</u>	<u>67 68 072</u>	<u>155° SE</u>	✓	✓
50 m	<u>1501</u>	<u>033 83 59</u>	<u>67 68 031</u>	<u>258° W</u>		

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1502</u>	<u>1503</u>	<u>1504</u>	<u>1505</u>	<u>1506</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>30</u>	<u>15</u>	<u>40</u>	<u>80</u>	<u>40</u>	<u>41</u>
Bare Ground (%)		<u>65</u>	<u>85</u>	<u>58</u>	<u>20</u>	<u>60</u>	<u>57.6</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Sloft</u>	Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope	<u>Sloft</u>	Aspect	<u>SE</u>	Site Drainage		Distance to nearest water and type	<u>70m</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>R-O</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 19

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		1.5; 1; 2 = 4.5m		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

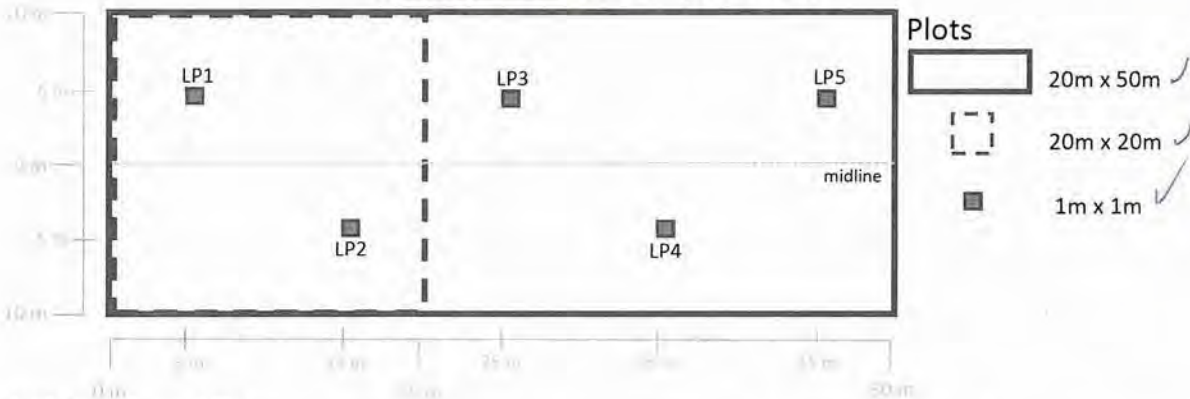
Date: 26-03-2019Recorders: ACM, TZPlot ID: 20Project No: 0470861Project Name: Bonslow Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>Cleared</u>		
Plant Community Type (PCT):	<u>Cleared Land</u>	EEC:	<u>X</u>
			Confidence H M L <u>(H)</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1507</u>	<u>33 7483</u>	<u>67 67 855</u>	<u>321° NW</u>	<u>✓</u>	<u>✓</u>
50 m	<u>1508</u>	<u>33 8003</u>	<u>67 67 809</u>	<u>330° NW</u>	<u>✓</u>	<u>✓</u>

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1509</u>	<u>190</u>	<u>1511</u>	<u>1512</u>	<u>1513</u>	
	Photo	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	
Litter Cover (%)		<u>40</u>	<u>25</u>	<u>50</u>	<u>70</u>	<u>26</u>	<u>31</u>
Bare Ground (%)		<u>60</u>	<u>75</u>	<u>50</u>	<u>80</u>	<u>80</u>	<u>69</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Flood plain</u>	Microrelief	<u>>> bare soils Sparse regrowth</u>
Lithology	<u>Red organic soils</u>	Soil Surface Texture		Soil Colour	<u>Dark brown</u>	Soil Depth	
Slope	<u>flat</u>	Aspect	<u>NW</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	<u>-</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>R-O</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R-O</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 20

Zone ID: _____

Plot 20m x 50m: Tree Classes ^a

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^ Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	26/3/19	Bonsaw	20	TZ

[illegible]

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

Black soil ~ 50% green cover, but dead, not bare soil
0.4% green ~~cover~~ cover

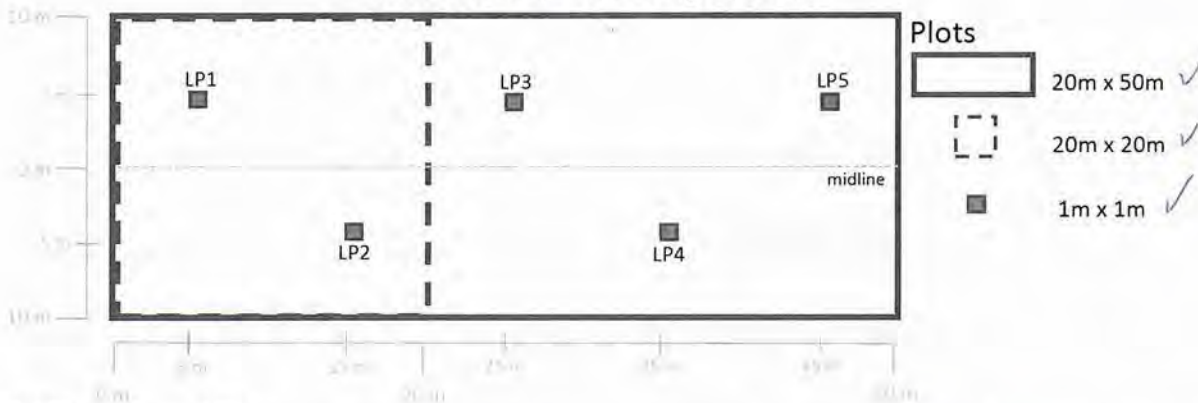
Date: 26-03-2019Recorders: ALM, TZPlot ID: 21Project No: 047080Project Name: Bancharu Salvo Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):	<u>S94-Low</u>	EEC:	<u>X</u>
			Confidence H M L <u>(H)</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1514</u>	<u>337855</u>	<u>6767956</u>	<u>321° NW</u>	✓	✓
50 m	<u>1520</u>	<u>337827</u>	<u>6767947</u>	<u>149° SE</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1515</u>	<u>1516</u>	<u>1517</u>	<u>1518</u>	<u>1519</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>60</u>	<u>35</u>	<u>50</u>	<u>30</u>	<u>5</u>	<u>36</u>
Bare Ground (%)		<u>30</u>	<u>35</u>	<u>20</u>	<u>50</u>	<u>95</u>	<u>46</u>
Cryptogam Cover (%)		<u>20</u>	<u>30</u>	<u>30</u>	<u>30</u>	<u>60</u>	<u>34</u>
Rock Cover (%)		<u>1</u>	<u>1</u>	<u>0</u>	<u>10</u>	<u>0</u>	<u>2.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>open woodland /</u>
Lithology		Soil Surface Texture		Soil Colour	<u>Brown</u>	Soil Depth	<u>-</u>
Slope	<u>Level</u>	Aspect	<u>NW</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>2</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>2</u>	<u>R-D</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yrs); O = old (>10 yrs)

Page 2 of _____

Recorders: ACM, TZ

Plot ID: P21

Project Name: Bonshaw Solar Farm

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm		1 = 1		
10 - 19 cm		11 = 17		
5 - 9 cm		6, 2, 11 = 20		
<5 cm ^b		4, 11, 6; 2, 3 = 17	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		8, 2; 1, 1, 14, 6; 3, 4, 1, = 40		

a - Presence/Absence of trees in each class; b - regeneration is significant

* Euc - Record of living native eucalypt trees (includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^a Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

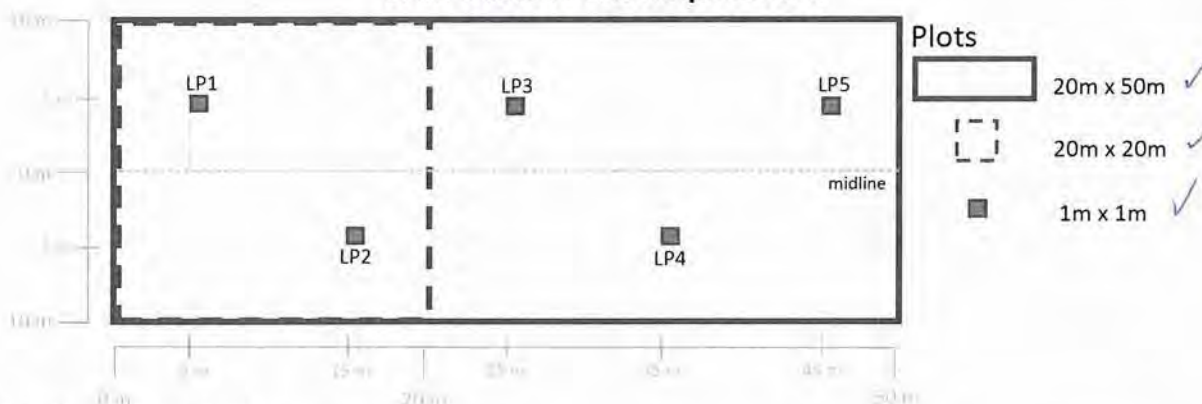
Date: 26-03-2019Recorders: ACM, TZPlot ID: 22Project No: 0470861Project Name: Banshaw Jalavi Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>S6</u>	IBRA region:	<u>Nandawar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandawar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):	<u>S94-Low</u>	EEC:	<u>X</u>
			Confidence H M L (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1522</u>	<u>338024</u>	<u>6768238</u>	<u>248° NW</u>	✓	✓
50 m	<u>1523</u>	<u>337991</u>	<u>6768273</u>	<u>134° SE</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1524</u>	<u>1525</u>	<u>1526</u>	<u>1527</u>	<u>1528</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>60</u>	<u>70</u>	<u>25</u>	<u>15</u>	<u>20</u>	<u>38</u>
Bare Ground (%)		<u>40</u>	<u>30</u>	<u>75</u>	<u>85</u>	<u>80</u>	<u>62</u>
Cryptogam Cover (%)		<u>10</u>	<u>15</u>	<u>20</u>	<u>30</u>	<u>30</u>	<u>21</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>20</u>	<u>4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Crest</u>	Landform Element	<u>1 Plot</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>Soil w/ pebbles</u>
Lithology	<u>Silty-clayey soils</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	-
Slope	<u>Very gently inclined</u>	Aspect	<u>NW</u>	Site Drainage		Distance to nearest water and type	-

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>11-0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of _____

Plot ID: 22

Zone ID:

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm		/// = 3		
<5 cm ^b		/// = 3		n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		11, 2, 8, 2 = 23		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

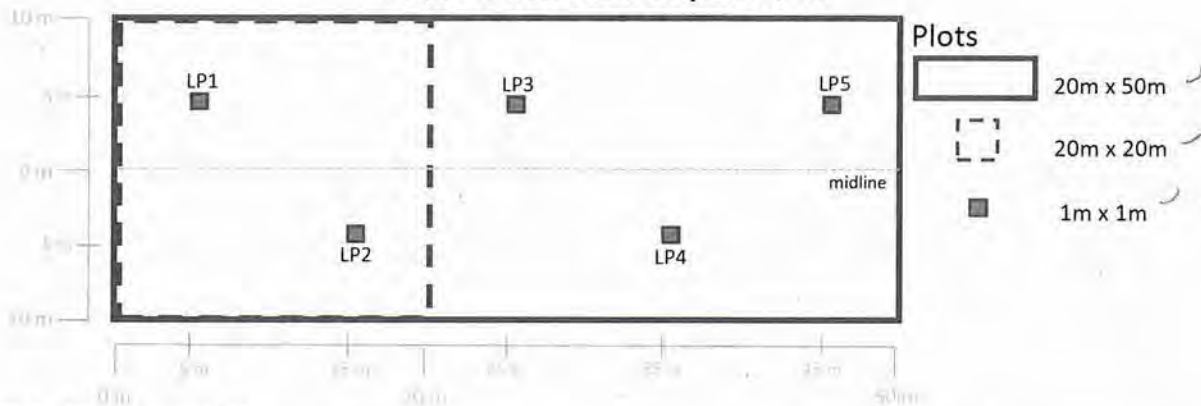
[illegible]

Date: 26-03-2019 Recorders: ALM, TZ Plot ID: 23Project No: 0470861 Project Name: Bamhau Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
			Confidence H M L
Plant Community Type (PCT):			
			Confidence H M L
			EEC:

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1531</u>	<u>033 8440</u>	<u>67 68 126</u>	<u>159° S</u>	✓	✓
50 m	<u>1532</u>	<u>033 8504</u>	<u>67 68 075</u>	<u>331° NW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1533</u>	<u>1534</u>	<u>1535</u>	<u>1536</u>	<u>1537</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>90</u>	<u>30</u>	<u>80</u>	<u>30</u>	<u>80</u>	<u>70</u>
Bare Ground (%)		<u>10</u>	<u>70</u>	<u>20</u>	<u>30</u>	<u>20</u>	<u>30</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hill slope</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>grassland</u>
Lithology	-	Soil Surface Texture		Soil Colour	<u>light - orange - brown</u>	Soil Depth	-
Slope	<u>Gentle inclined</u>	Aspect		Site Drainage	<u>down slope run-off</u>	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R-0</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 23

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm	/		/	
50 - 79 cm				
30 - 49 cm				
20 - 29 cm		1 = 1		
10 - 19 cm		// = 2		
5 - 9 cm		/ = 1		
<5 cm ^b		/ = 1		n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		2, 1, 1 = 4		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders			
Date	26/2/16	Bonshaw	23				
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	Cyperus glaucophyllus shrubs		0.2	2			
	Pimelea stricta		<0.1	3			
	Aristida lanosa		1	100			
	Gymnopus retractive		0.3	40			
	Sida cordata		0.4	100			
	Cassia		<0.1	1			
	Heliotropium		<0.1	28			
	Glycyrrhiza		<0.1	12			
	Soleirolia		<0.1	2			
	Dichondra sp.		10.1	6			
	Boerhaavia decipiens		1	1			
	Cheilanthes		<0.1	7			
	Panicum		<0.1	2			
	Baerhavia		<0.1	6			
	unidentifiable ground		20				
no samples							

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF - circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

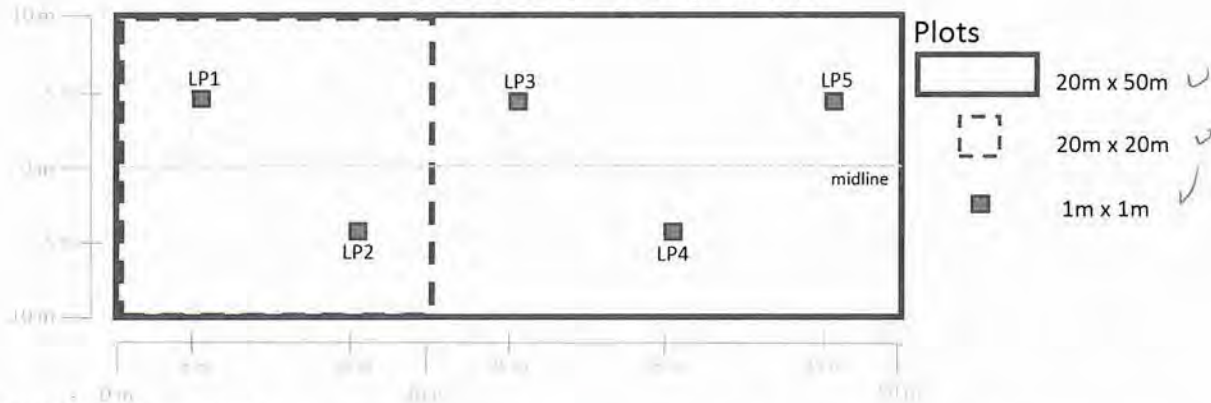
Total veg cover 25.5%
of which decidive 25%

Date: 26-03-2014 Recorders: ACM, T3 Plot ID: 24Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>grass</u>		
Plant Community Type (PCT):	<u>S96 - DNG-Low</u>	EEC:	
			Confidence H M L
			Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1538</u>	<u>33 88 00</u>	<u>67 68 481</u>	<u>170°S</u>	✓	✓
50 m	<u>1539</u>	<u>33 88 13</u>	<u>67 68 430</u>	<u>332°NW</u>		

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1540</u>	<u>1541</u>	<u>1542</u>	<u>1543</u>	<u>1544</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>60</u>	<u>80</u>	<u>80</u>	<u>85</u>	<u>60</u>	<u>73</u>
Bare Ground (%)		<u>40</u>	<u>10</u>	<u>20</u>	<u>15</u>	<u>40</u>	<u>25</u>
Cryptogam Cover (%)		<u>5</u>	<u>30</u>	<u>5</u>	<u>10</u>	<u>5</u>	<u>11</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determinng PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>grassy area</u>
Lithology	<u>silt-clay</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	-
Slope	<u>Level</u>	Aspect		Site Drainage	-	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R</u>	
Fire damage			
Storm damage			
Weediness	<u>2</u>	<u>R-0</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Page 2 of ____

Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b				
Length of logs (m): (≥10 cm diameter, >50cm in length)		7, 1, 2, 5, 6 = 21		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

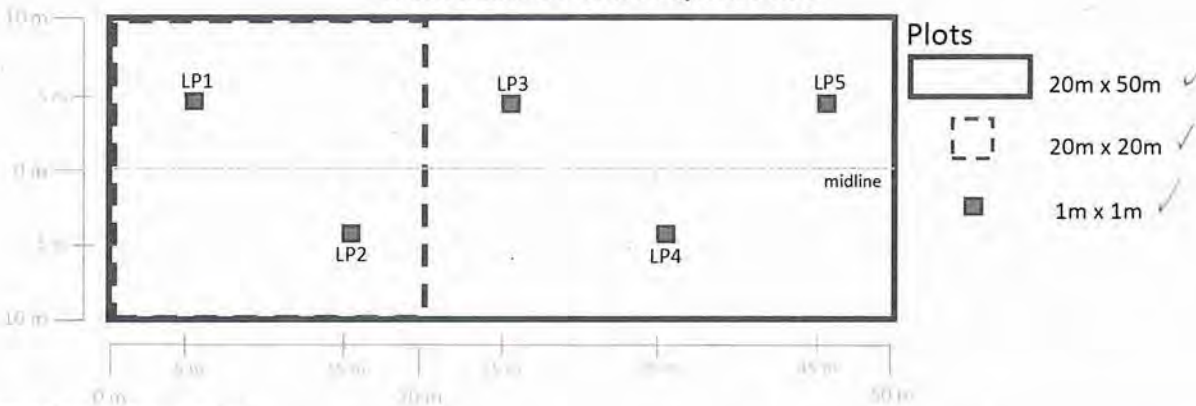
Date: 26-03-2019Recorders: ACM, TZPlot ID: 25Project No: 0470861Project Name: Bonshaw Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandawar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandawar Northern Complex</u>
Likely Vegetation Class:			
			Confidence H M L
Plant Community Type (PCT):			
			Confidence H M L
			EEC:

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1545</u>	<u>33 8687</u>	<u>67 68 607</u>	<u>257°W</u>	✓	✓
50 m	<u>1521</u>	<u>33 8635</u>	<u>67 68 598</u>	<u>67° NE</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1546</u>	<u>1547</u>	<u>1548</u>	<u>1549</u>	<u>1550</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>90</u>	<u>70</u>	<u>90</u>	<u>60</u>	<u>60</u>	<u>74</u>
Bare Ground (%)		<u>10</u>	<u>30</u>	<u>10</u>	<u>40</u>	<u>40</u>	<u>26</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>grassland</u>
Lithology	<u>silt clay</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	<u>-</u>
Slope	<u>level</u>	Aspect	<u>W</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>2</u>	<u>2-0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 25

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		8, 3 = 11		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

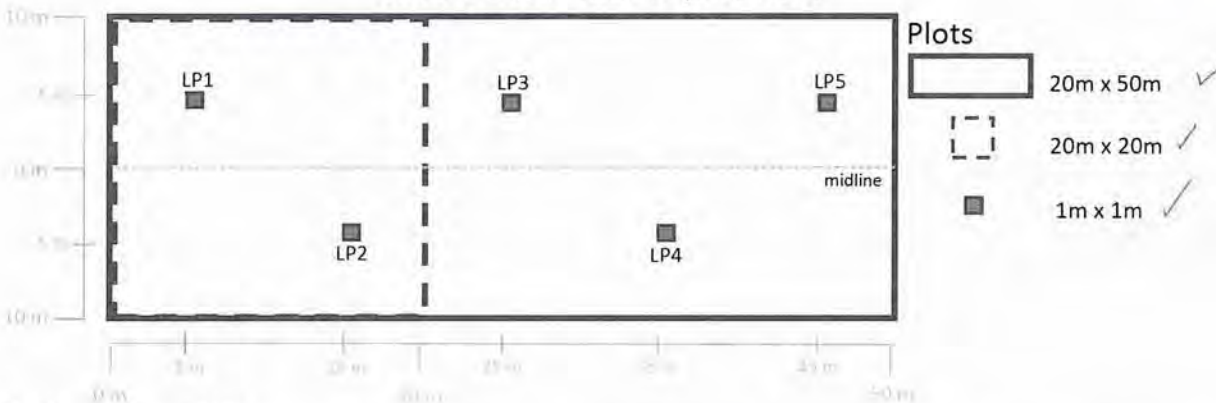
[illegible]

Date: 26-03-2019 Recorders: ACM, TZ Plot ID: 26Project No: 0470861 Project Name: Banshaw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			Confidence H M L
Plant Community Type (PCT):		EEC:	<u>X</u> Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1552</u>	<u>339225</u>	<u>6768408</u>	<u>255°W</u>	✓	✓
50 m	<u>1558</u>	<u>339177</u>	<u>6768412</u>	<u>87°E</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1553</u>	<u>1554</u>	<u>1555</u>	<u>1556</u>	<u>1557</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>25</u>	<u>20</u>	<u>75</u>	<u>30</u>	<u>40</u>	<u>26</u>
Bare Ground (%)		<u>75</u>	<u>80</u>	<u>84</u>	<u>70</u>	<u>60</u>	<u>73.8</u>
Cryptogam Cover (%)		<u>10</u>	<u>5</u>	<u>0</u>	<u>2</u>	<u>2</u>	<u>3.8</u>
Rock Cover (%)		<u>6</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>0.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hill slope</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>grass - cleared</u>
Lithology	<u>Silt - clay</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	-
Slope	<u>Gentle inclined</u>	Aspect	<u>W</u>	Site Drainage		Distance to nearest water and type	-

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>A</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal	<u>3</u>	<u>R-O</u>	
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>O</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Plot ID: 26

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm	11/ = 5			
5 - 9 cm				
<5 cm ^b	1 = 1	11 = 2	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		3, 2, 3, 1, 3, 2, 1, 1, 3, 2 = 21		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF = circle code if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

total cover	5-10%
decid	10-25
rock	ca
soil	50-75

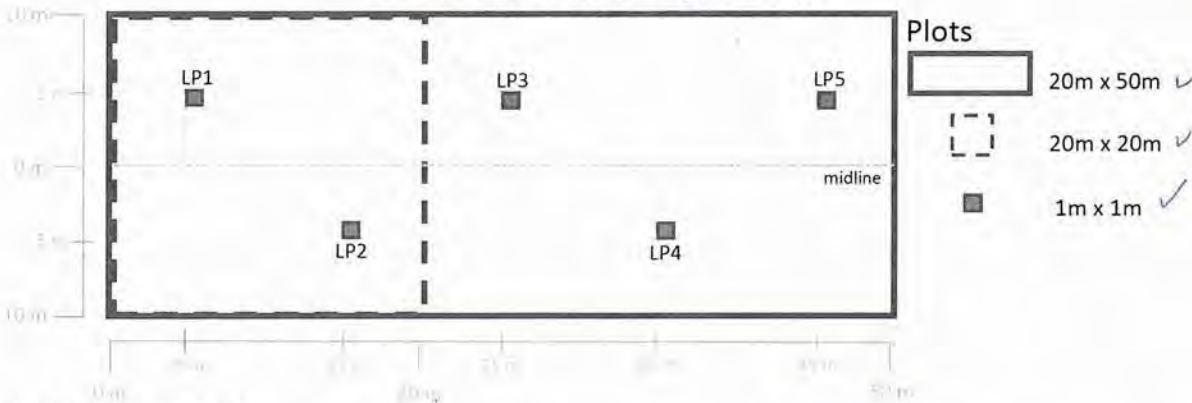
Date: 22-03-2019Recorders: ACM TZPlot ID: 27Project No: 0470861Project Name: Banshaw Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>S6</u>	IBRA region:	<u>Monaro</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Monaro Northern Complex</u>
Likely Vegetation Class:	<u>Grassland (1)</u>		
Plant Community Type (PCT):	<u>DNG</u>	EEC:	<u>X</u>
			Confidence H M L <u>H</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1560</u>	<u>33 83 44</u>	<u>67 68 782</u>	<u>184°S</u>	✓	✓
50 m	<u>1561</u>	<u>33 83 28</u>	<u>67 68 734</u>	<u>3°N</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1562</u>	<u>1563</u>	<u>1564</u>	<u>1565</u>	<u>1566</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>70</u>	<u>60</u>	<u>50</u>	<u>70</u>	<u>80</u>	<u>66</u>
Bare Ground (%)		<u>30</u>	<u>40</u>	<u>40</u>	<u>25</u>	<u>70</u>	<u>31</u>
Cryptogam Cover (%)		<u>5</u>	<u>5</u>	<u>5</u>	<u>0</u>	<u>10</u>	<u>5</u>
Rock Cover (%)		<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Very Low Hill</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>grassland</u>
Lithology	<u>Clayed soils</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	
Slope	<u>Very gently to W</u>	Aspect	<u>W</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID:

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b				
Length of logs (m): (≥10 cm diameter, >50cm in length)				

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders			
Date	21/3/11		27				
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	<i>Arctostaphylos ramosa</i>		60	900			
	<i>Boerhaavia laevis</i>		2	40			
	<i>Sclerolaena birchii</i>		0.1	60			
	<i>Heliotropium amplexicaule</i>		0.1	100			
	<i>Boerhaavia domanii</i>		<0.1	3			
	<i>Cheilanthes sieberi</i>		<0.1	30			
	<i>Einadia nutans</i>		<0.1	50			
	<i>Juncus usitatus</i>		<0.1	8			
	<i>Dichandra repens</i>		<0.1	8			
	<i>Sida coreana</i>		<0.1	4			
	<i>Glynn</i>		<0.1	40			
	<i>Dichandra</i> sp. A		0.1	30			
	<i>Eragrostis brownii</i>		<0.1	15			
	<i>Rumex brownii</i>		<0.1	5			
	unidentifiable grasses / sedges		30				
	<i>Einadia hastata</i>		<0.1	3			

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF - circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

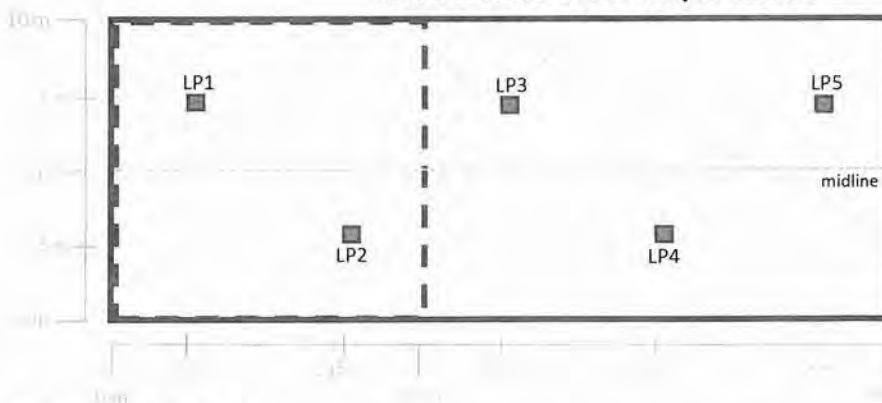
Total veg cover 50%
Sedg 30%
Grass 20%

Date: 27-03-2014 Recorders: ACM, TZ Plot ID: 28Project No: 047086 Project Name: Banshaw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>NNC</u>
Likely Vegetation Class:	<u>DN4</u>		
Plant Community Type (PCT):	<u>516 - DN4 - Mod</u>	EEC:	<u>X</u>
			Confidence H M L <u>(H)</u> M L

BAM Nested Plots Requirement



Plots

	20m x 50m
	20m x 20m
	1m x 1m

Grey - ranging ladder - colling

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1569</u>	<u>33 86 58</u>	<u>67 68 886</u>	<u>18303</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>1570</u>	<u>33 86 43</u>	<u>67 68 787</u>	<u>3500 N</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Magnetit bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1571</u>	<u>1572</u>	<u>1573</u>	<u>1574</u>	<u>1575</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>20</u>	<u>50</u>	<u>23</u>	<u>30</u>	<u>40</u>	<u>33</u>
Bare Ground (%)		<u>80</u>	<u>40</u>	<u>75</u>	<u>70</u>	<u>60</u>	<u>65</u>
Cryptogam Cover (%)		<u>0</u>	<u>5</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>
Rock Cover (%)		<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element		Landform Pattern		Microrelief	
Lithology		Soil Surface Texture		Soil Colour		Soil Depth	
Slope		Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>12-0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs), NR = not recent (3 - 10 yr), O = old (>10 yrs)

Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: _____

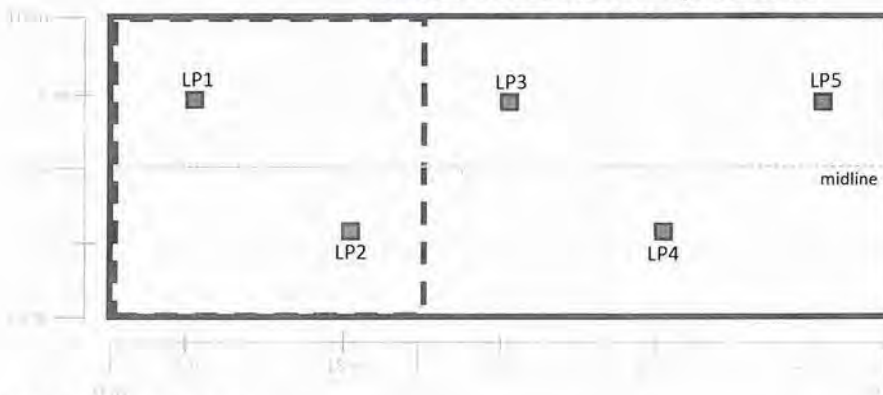
Date: 27-03-2019Recorders: ACM, TZPlot ID: 29Project No: 0470861Project Name: Bonsbaw Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandawur</u>
Datum:	<u>UTM94</u>	IBRA sub-region:	<u>Nandawur Northern Complex</u>
Likely Vegetation Class:	<u>Grassland - cleared land</u>		
Plant Community Type (PCT):	<u>546-DNG-Low</u>	EEC:	<u>X</u>
			Confidence H M L <u>(H)</u> M L

BAM Nested Plots Requirement



Plots

	20m x 50m	✓
	20m x 20m	✓
	1m x 1m	✓

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1576</u>	<u>33 90 52</u>	<u>67 68 750</u>	<u>178°S</u>	✓	✓
50 m	<u>1577</u>	<u>33 90 47</u>	<u>67 68 699</u>	<u>347°N</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1578</u>	<u>1579</u>	<u>1580</u>	<u>1581</u>	<u>1582</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>80</u>	<u>80</u>	<u>60</u>	<u>65</u>	<u>75</u>	<u>72</u>
Bare Ground (%)		<u>10</u>	<u>20</u>	<u>10</u>	<u>10</u>	<u>25</u>	<u>15</u>
Cryptogam Cover (%)		<u>15</u>	<u>10</u>	<u>20</u>	<u>10</u>	<u>5</u>	<u>12</u>
Rock Cover (%)		<u>10</u>	<u>1</u>	<u>30</u>	<u>25</u>	<u>1</u>	<u>13.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>H.V. Slope</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>grassy</u>
Lithology	<u>sub-day</u>	Soil Surface Texture		Soil Colour	<u>light-orange-brown</u>	Soil Depth	-
Slope	<u>very gentle slope</u>	Aspect	<u>247°W</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-6</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (> 10 yrs)

Project No: _____ Project Name: Bong haw Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b	/		n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		4, 1, 2, 4, 5, 3, 5, 7, 8, 1, 2, 1 = 43		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders		
Date	27/3/14		29			
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
	<i>Bristle reed</i>		0.5	20		
	<i>Ernea pagon gracilis</i>		5	200		
	<i>Dichondra sp. A.</i>		0.3	100		
	<i>Rorhavia dominii</i>		0.1	20		
	<i>Vittadinia sulcata</i>		0.1	5		
	<i>Sida corrugata</i>		0.1	20		
	<i>Chamaesyce drummondii</i>		0.1	15		
	<i>Rumex brownii</i>		0.1	20		
	<i>Cheilanthes sieberi</i>		0.1	10		
	<i>Pimelia stricta</i>		0.5	10		
	<i>Cupressus semiglauc</i>		0.1	1		
	<i>Panicum simile</i>		0.1	30		
	<i>Bothriochloa decipiens</i>		10	1000		
	<i>Calotis</i>		0.1	15		
	<i>Convolvulus alsinoides</i>		0.1	4		
	<i>Eragrostis brownii</i>		0.1	6		
	<i>Gymnopogon refractus</i>		0.5	15		
	<i>Chloris truncata</i>		0.1	1		
	<i>Eucalyptus dealbata</i> shrub		0.2	1		
	unidentifiable grasses		15			

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF - circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ..., 100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

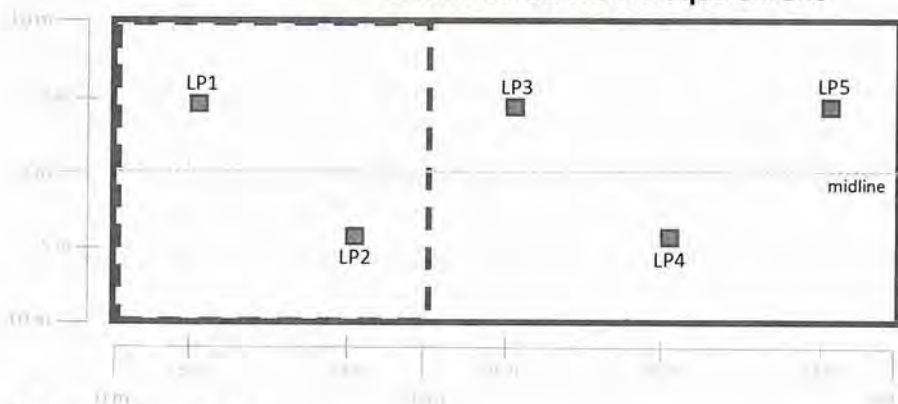
foliage veg 25 %
dead 25 %

Date: 27-03-2019 Recorders: ACM, TZ Plot ID: 30Project No: 0470861 Project Name: Ramhew Sdur farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):	<u>Cleared Land</u>	EEC:	<u>No</u>
			Confidence H M L
			Confidence H M L

BAM Nested Plots Requirement



Plots

	20m x 50m ✓
	20m x 20m ✓
	1m x 1m ✓

Wet - rain

Plot 20m x 50m - midpoint

Point on midpoint	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1583</u>	<u>33 8535</u>	<u>67 69 602</u>	<u>25° NE</u>	✓	✓
50 m	<u>1584</u>	<u>33 8565</u>	<u>67 69 043</u>	<u>211° SW</u>	✓	✓

*Magnetit bearing obtained with compass along the midpoint

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1585</u>	<u>1586</u>	<u>1587</u>	<u>1588</u>	<u>1589</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>20</u>	<u>40</u>	<u>60</u>	<u>30</u>	<u>75</u>	<u>45</u>
Bare Ground (%)		<u>80</u>	<u>60</u>	<u>40</u>	<u>70</u>	<u>25</u>	<u>55</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midpoint of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Flat plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>grassy dunes</u>
Lithology	<u>silt-clay</u>	Soil Surface Texture		Soil Colour	<u>light orange-brown</u>	Soil Depth	<u>-</u>
Slope	<u>Level</u>	Aspect	<u>-</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs), NR = not recent (3 - 10 yrs), O = old (>10 yrs)

Project No: _____ **Project Name:** _____ **Zone ID:** _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

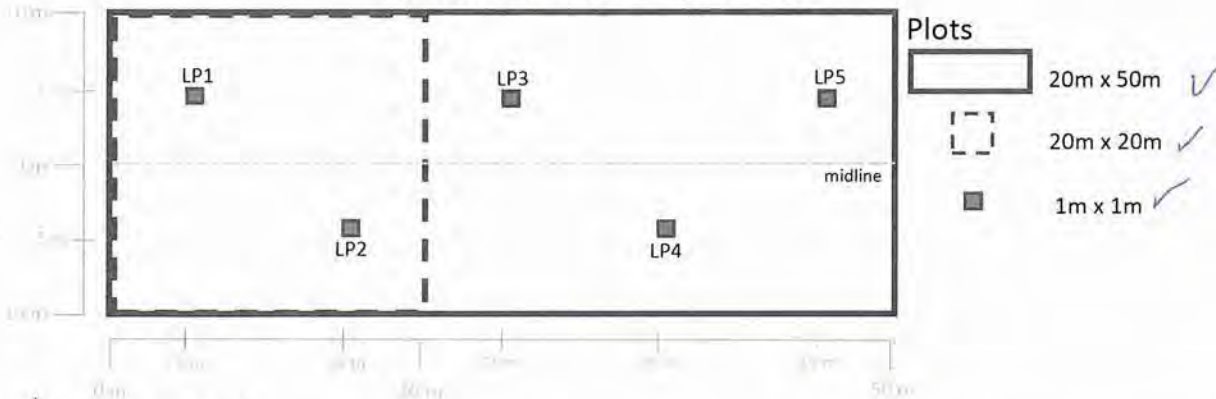
[illegible]

Date: 27-03-2019 Recorders: ACM, T3 Plot ID: 31Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>53</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):	<u>Syde Low</u>	EEC:	<u>X</u>
			Confidence H M L <u>H</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1592</u>	<u>338402</u>	<u>67 69 323</u>	<u>1910S</u>	✓	✓
50 m	<u>1593</u>	<u>338380</u>	<u>67 69 277</u>	<u>110N</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1594</u>	<u>1595</u>	<u>1596</u>	<u>1598</u>	<u>1599</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>20</u>	<u>30</u>	<u>56</u>	<u>10</u>	<u>80</u>	<u>38</u>
Bare Ground (%)		<u>65</u>	<u>50</u>	<u>35</u>	<u>10</u>	<u>10</u>	<u>34</u>
Cryptogam Cover (%)		<u>5</u>	<u>10</u>	<u>2</u>	<u>60</u>	<u>5</u>	<u>16.4</u>
Rock Cover (%)		<u>15</u>	<u>20</u>	<u>15</u>	<u>80</u>	<u>10</u>	<u>28</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hill Grot</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>boulder field</u>
Lithology	<u>Silt-clay soil</u>	Soil Surface Texture	<u>—</u>	Soil Colour		Soil Depth	
Slope	<u>Gentle Inclined</u>	Aspect	<u>120° SE</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Project No: 0470861 Project Name: Bramshaw Solar Farm Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm	/		/	
30 - 49 cm				
20 - 29 cm		/		
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		21		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

Date: 27-03-2019Recorders: Alm, JZPlot ID: 32Project No: 047089Project Name: Bonshaw Solar Farm

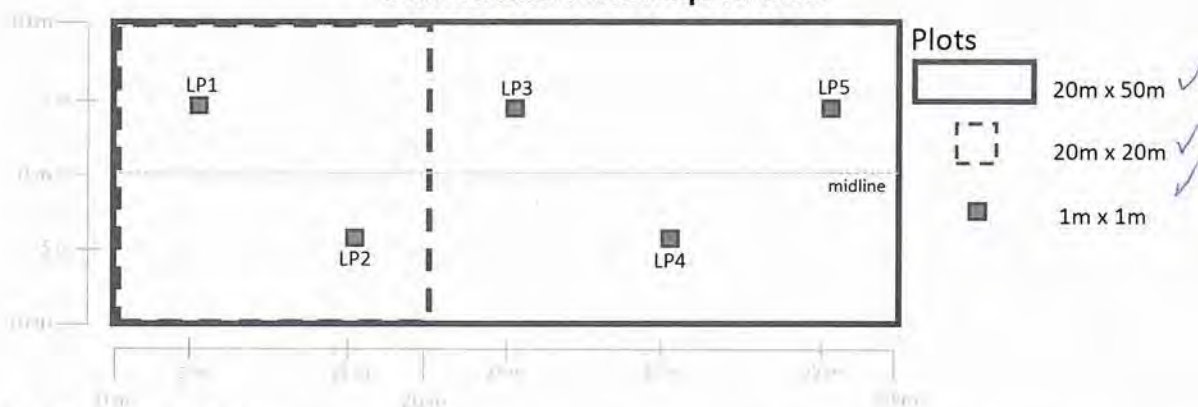
Zone ID: _____

grey-wooded Babbler in the eucalyptus

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>grassy - cleared land</u>		
Plant Community Type (PCT):	<u>516-DNg-Mod</u>	EEC:	<u>X</u>
			Confidence H M L <u>(H)</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1600</u>	<u>53 85 18</u>	<u>67 69 371</u>	<u>173°S</u>	<u>✓</u>	<u>✓</u>
50 m	<u>1601</u>	<u>33 85 17</u>	<u>67 69 320</u>	<u>350°N</u>	<u>✓</u>	<u>✓</u>

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1602</u>	<u>1603</u>	<u>1604</u>	<u>1605</u>	<u>1606</u>	
	Photo	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	
Litter Cover (%)		<u>70</u>	<u>85</u>	<u>80</u>	<u>85</u>	<u>80</u>	<u>76</u>
Bare Ground (%)		<u>30</u>	<u>15</u>	<u>10</u>	<u>25</u>	<u>20</u>	<u>20</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>flat</u>	Landform Element	<u>Hill base</u>	Landform Pattern	<u>Flat</u>	Microrelief	<u>grassy</u>
Lithology	<u>clayey soils</u>	Soil Surface Texture		Soil Colour		Soil Depth	<u>-</u>
Slope	<u>level</u>	Aspect	<u>-</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	<u>to tank adjacent to creek</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 32

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80 ⁺ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	27/3/19		32	

[illegible]

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

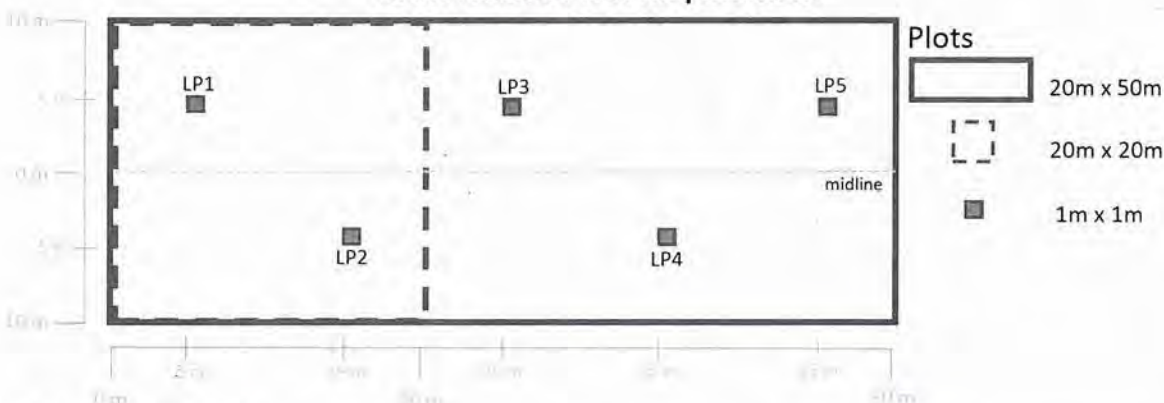
Date: 27-03-2019Recorders: ACH, TzPlot ID: 33Project No: 0470861Project Name: Barrhuu Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandawar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandawar Northern Complex</u>
Likely Vegetation Class:	<u>Cleared → grassy</u>		
Plant Community Type (PCT):	<u>S16 - ONG - Low</u>	EEC:	<u>X</u>
			Confidence H M L <u>H</u> M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1607</u>	<u>33 83 61</u>	<u>67 69 671</u>	<u>326° NW</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>1613</u>	<u>33 83 58</u>	<u>67 69 722</u>	<u>273° W</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1608</u>	<u>1609</u>	<u>1610</u>	<u>1611</u>	<u>1612</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>15</u>	<u>10</u>	<u>5</u>	<u>5</u>	<u>2</u>	<u>7.4</u>
Bare Ground (%)		<u>80</u>	<u>65</u>	<u>90</u>	<u>85</u>	<u>97</u>	<u>83.4</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>5</u>	<u>25</u>	<u>5</u>	<u>10</u>	<u>1</u>	<u>9.2</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	
Lithology	<u>soft-topsoil</u>	Soil Surface Texture		Soil Colour	<u>dark brown</u>	Soil Depth	
Slope	<u>Levelled</u>	Aspect		Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Plot ID: 33

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b				
Length of logs (m): (≥10 cm diameter, >50cm in length)				

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

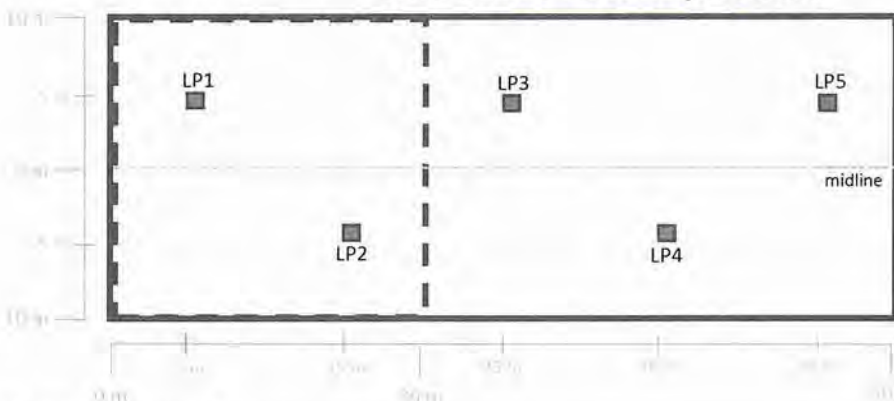
Date: 27-03-2019Recorders: ACM, TZPlot ID: 34Project No: 0470861Project Name: Bonshaw Solar Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandawar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandawar Northern Complex</u>
Likely Vegetation Class:	<u>Cleared Land</u>		
Plant Community Type (PCT):	<u>N/A</u>	EEC:	<u>X</u>
			Confidence H M L (H) M L

BAM Nested Plots Requirement



Plots

	20m x 50m ✓
	20m x 20m ✓
	1m x 1m ✓

Grazed Bonshaw @ 20m
Magpie

Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1614</u>	<u>33 8569</u>	<u>67 69 788</u>	<u>275°W</u>	✓	✓
50 m	<u>1620</u>	<u>33 8592</u>	<u>67 69 743</u>	<u>310° NW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1615</u>	<u>1616</u>	<u>1617</u>	<u>1618</u>	<u>1619</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>40</u>	<u>50</u>	<u>5</u>	<u>25</u>	<u>10</u>	
Bare Ground (%)		<u>60</u>	<u>50</u>	<u>95</u>	<u>75</u>	<u>90</u>	
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>Grazed Fork</u>
Lithology	<u>silty-clayed soil</u>	Soil Surface Texture		Soil Colour	<u>light orange brown</u>	Soil Depth	<u>-</u>
Slope	<u>Level</u>	Aspect	<u>-</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)	<u>3</u>	<u>0</u>	
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yrs); O = old (>10 yrs)

Plot ID: 34

Zone ID:

Plot 20m x 50m: Tree Classes ^a

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

a - Presence/Absence of trees in each class; b -regeneration is size class <5 cm; # Living trees only;

* Euc - Record of living native eucalypt trees (includes all species of *Eucalyptus*, *Corymbia*, *Angophora*, *Lophostemon* and *Syncarpia*)

^a Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

[illegible]

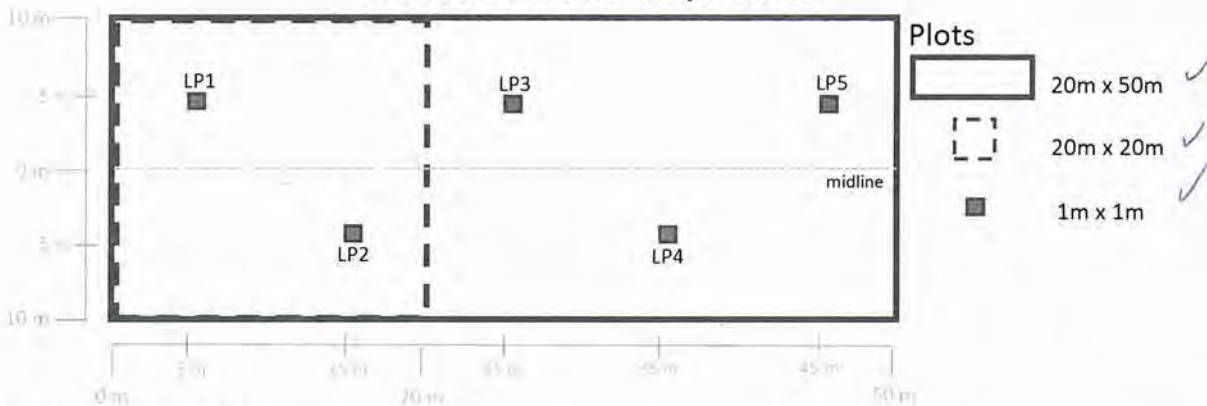
Date: 27-03-2019Recorders: ACM, FZPlot ID: 35Project No: 0470861Project Name: Bonsheaw Solaw Farm

Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>DNG</u>	Confidence	H M L
Plant Community Type (PCT):	<u>S16 - DNG - Low</u>	EEC:	<u>X</u>
		Confidence	(H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1621</u>	<u>33 86 71</u>	<u>67 69 805</u>	<u>262°W</u>	✓	✓
50 m	<u>1627</u>	<u>33 86 67</u>	<u>67 69 756</u>	<u>366°N</u>	✓	✓

*Magnetig bearing obtained with compas along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1622</u>	<u>1623</u>	<u>1624</u>	<u>1625</u>	<u>1626</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>10</u>	<u>85</u>	<u>20</u>	<u>5</u>	<u>1</u>	<u>24.2</u>
Bare Ground (%)		<u>90</u>	<u>15</u>	<u>80</u>	<u>95</u>	<u>99</u>	<u>75.8</u>
Cryptogam Cover (%)		<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0.4</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	
Lithology	<u>Clayed soil</u>	Soil Surface Texture	<u>-</u>	Soil Colour	<u>light - orange - brown</u>	Soil Depth	
Slope	<u>Levelled</u>	Aspect	<u>-</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>S</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-O</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Project No: 0470861 Project Name: Banshaw Solar Farm Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

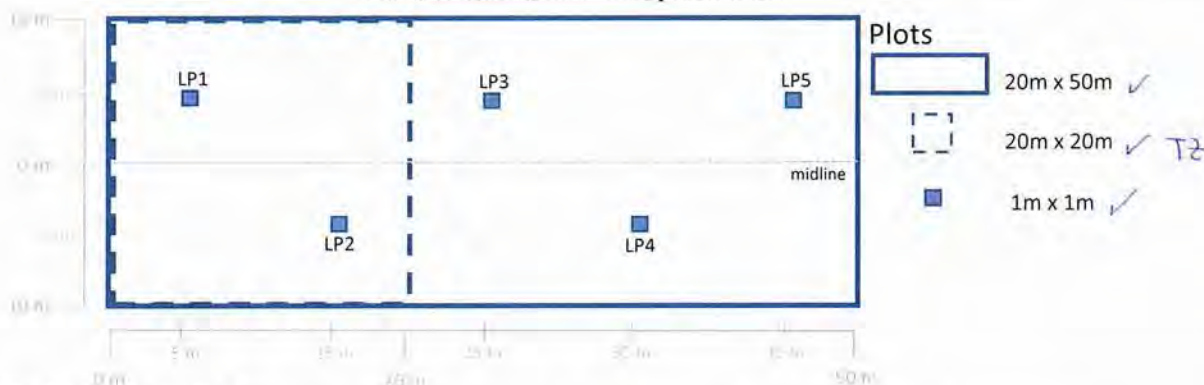
[illegible]

Date: 28-03-2019 Recorders: ACM, T2 Plot ID: 36Project No: 0470861 Project Name: Bonsbawu Sekur Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Namdewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Namdewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):			
		EEC:	
		Confidence	H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1629</u>	<u>33 90 43</u>	<u>67 68 195</u>	<u>315° W</u>	✓	✓
50 m	<u>1630</u>	<u>33 90 15</u>	<u>67 68 237</u>	<u>147° SE</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1631</u>	<u>1632</u>	<u>1633</u>	<u>1634</u>	<u>1635</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>65</u>	<u>68</u>	<u>30</u>	<u>25</u>	<u>45</u>	<u>46.6</u>
Bare Ground (%)		<u>45</u>	<u>30</u>	<u>70</u>	<u>75</u>	<u>50</u>	<u>54</u>
Cryptogam Cover (%)		<u>15</u>	<u>0</u>	<u>5</u>	<u>0</u>	<u>5</u>	<u>5</u>
Rock Cover (%)		<u>0</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>25</u>	<u>1.4</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hillside</u>	Landform Pattern	<u>Low Hill</u>	Microrelief	<u>grassy area</u>
Lithology	<u>clayey soils</u>	Soil Surface Texture	<u>-</u>	Soil Colour	<u>light orange-brown</u>	Soil Depth	
Slope	<u>Gently inclined</u>	Aspect	<u>W</u>	Site Drainage	<u>W, SW to creek</u>	Distance to nearest water and type	<u>≤ 10m S</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>2</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of ____

Plot ID: 36

Zone ID: _____

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

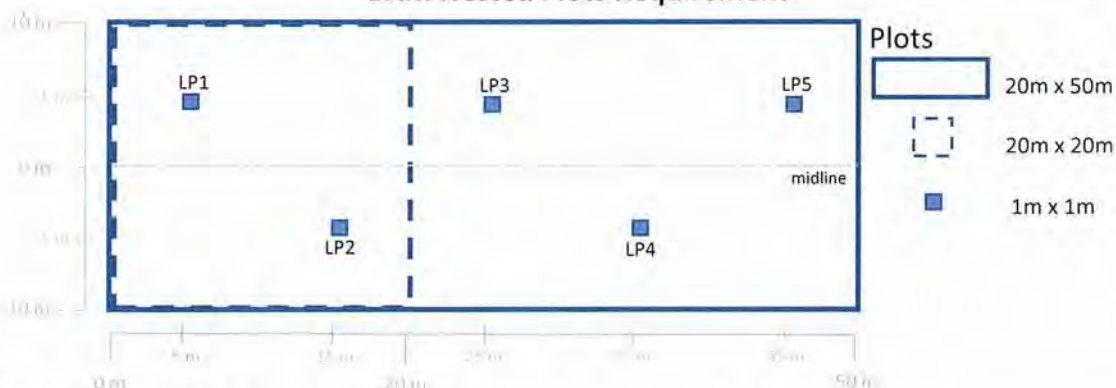
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Date: 28-03-2019 Recorders: ACM, TZ Plot ID: 37Project No: 0470861 Project Name: Bonsbau Sakur Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>	Confidence
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>	H M L
Likely Vegetation Class:				
Plant Community Type (PCT):		EEC:		Confidence
				H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1636</u>	<u>33 85 64</u>	<u>67 68 322</u>	<u>177°S</u>	✓	✓
50 m	<u>1637</u>	<u>33 85 79</u>	<u>67 68 321</u>	<u>323°NW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1638</u>	<u>1639</u>	<u>1640</u>	<u>1641</u>	<u>1642</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>70</u>	<u>90</u>	<u>80</u>	<u>60</u>	<u>60</u>	<u>72</u>
Bare Ground (%)		<u>30</u>	<u>10</u>	<u>20</u>	<u>40</u>	<u>40</u>	<u>18</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>± Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>grassy land</u>
Lithology	<u>clayey soils</u>	Soil Surface Texture	<u>-</u>	Soil Colour	<u>light orange-brown</u>	Soil Depth	
Slope	<u>Very gently incline</u>	Aspect	<u>NW</u>	Site Drainage	<u>W to creek bed</u>	Distance to nearest water and type	<u>~ 50m W</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	<u>stumps of felled trees present</u>
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-O</u>	
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>11</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of ____

Plot ID: 37

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm				
20 - 29 cm				
10 - 19 cm		/		
5 - 9 cm				
<5 cm ^b		/	n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		16, 7, 1, 1, 3, 4, 11, 7, 1, 1, 9, 4, = 64		

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

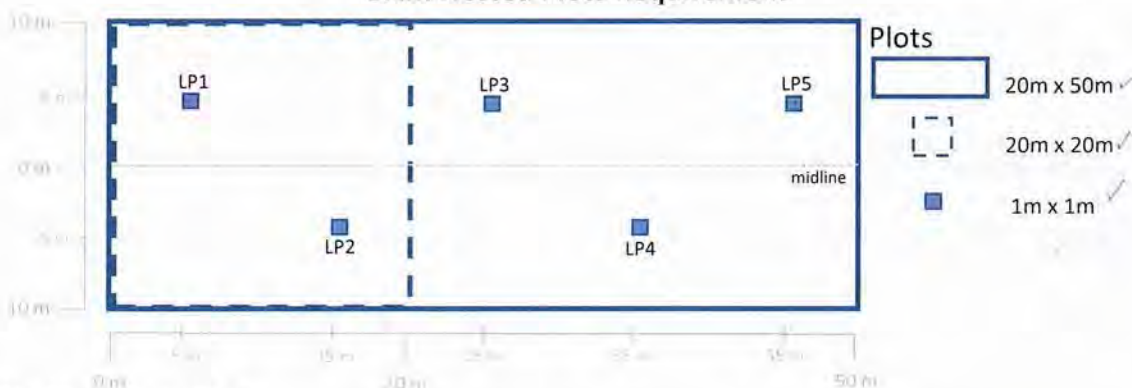
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Date: 28-03-2019 Recorders: ACM, T2 Plot ID: 38Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: 38

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:	<u>Open woodland</u>		
Plant Community Type (PCT):	<u>516 mallee</u>	EEC:	<u>X</u>
			Confidence (H) M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1643</u>	<u>33 8685</u>	<u>61 68 453</u>	<u>235°SW</u>	<u>✓</u>	<u>✓</u>
50 m	<u>1644</u>	<u>33 8640</u>	<u>61 68 645</u>	<u>80°E</u>	<u>✓</u>	<u>✓</u>

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1645</u>	<u>1646</u>	<u>1647</u>	<u>1648</u>	<u>1649</u>	
	Photo	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	<u>✓</u>	
Litter Cover (%)		<u>98</u>	<u>95</u>	<u>60</u>	<u>45</u>	<u>20</u>	<u>63.6</u>
Bare Ground (%)		<u>2</u>	<u>5</u>	<u>40</u>	<u>55</u>	<u>80</u>	<u>36.4</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>woodland</u>
Lithology	<u>Sandstone</u>	Soil Surface Texture		Soil Colour	<u>dark brown</u>	Soil Depth	
Slope	<u>Levelled</u>	Aspect	<u>-</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	<u>~ 30m W</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	<u>stumps left present</u>
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R</u>	<u>Cattle of sheep</u>
Fire damage			
Storm damage			
Weediness	<u>1</u>	<u>R</u>	
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yrs); O = old (>10 yrs)

Project No: 0470861 Project Name: Bonshaw Solar Farm Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm				
30 - 49 cm	= 7			
20 - 29 cm	= 24			
10 - 19 cm	= 11			
5 - 9 cm	= 2			
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		1, 4, 1, 12, 13, 8, 3, = 42		

^ Non-Euc - Record of living native non eucalypt trees

5. 91b 002

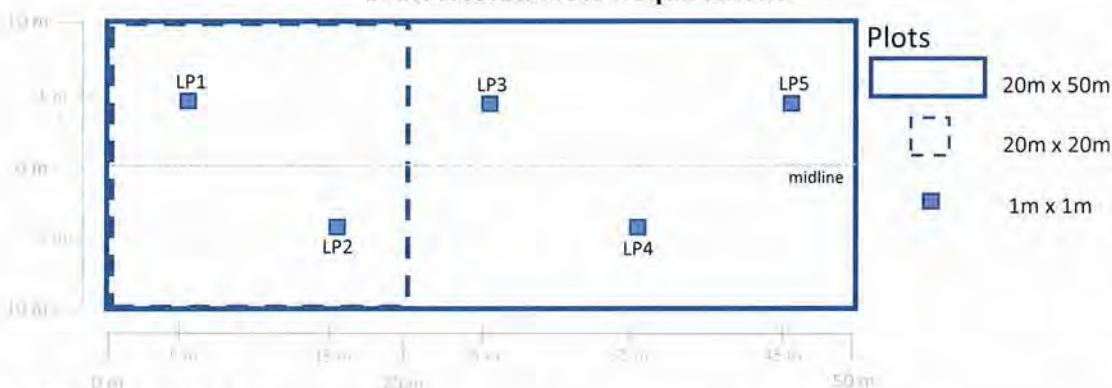
[illegible]

Date: 28-03-2019 Recorders: ACM, TZ Plot ID: _____Project No: 0470861 Project Name: Bonslow Solar Farm Zone ID: 39

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):			
EEC:			Confidence H M L
			Confidence H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1650</u>	<u>33 86 76</u>	<u>67 68 698</u>	<u>55° NE</u>	✓	✓
50 m	<u>1656</u>	<u>33 86 698</u>	<u>67 68 719</u>	<u>225° SW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline 338±20

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1651</u>	<u>1652</u>	<u>1653</u>	<u>1654</u>	<u>1655</u>	
Litter Cover (%)	Photo	✓	✓	✓	✓	✓	
Bare Ground (%)		<u>95</u>	<u>98</u>	<u>85</u>	<u>55</u>	<u>80</u>	
Cryptogam Cover (%)		<u>5</u>	<u>2</u>	<u>15</u>	<u>40</u>	<u>70</u>	
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	
Lithology	<u>Clayd soil</u>	Soil Surface Texture	<u>-</u>	Soil Colour	<u>light orange-brown</u>	Soil Depth	<u>-</u>
Slope	<u>Levelled</u>	Aspect	<u>-</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

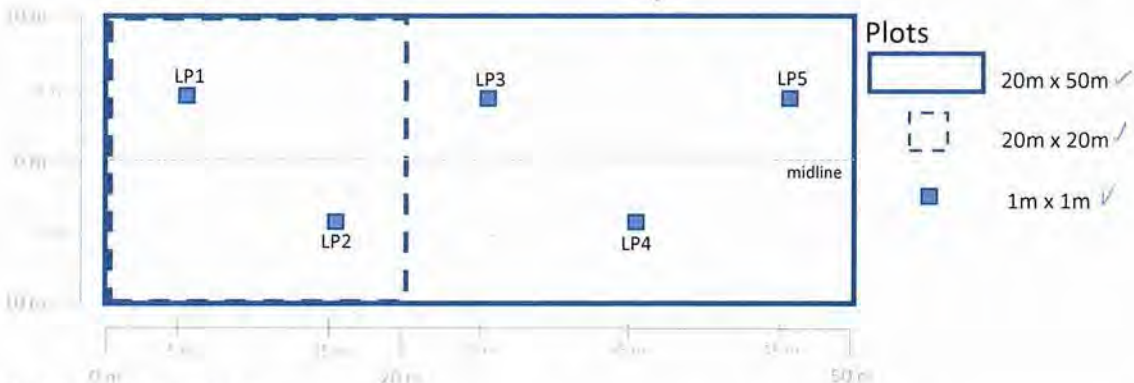
Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Date: 28-03-2019 Recorders: AcM, Tz Plot ID: 40Project No: 0470861 Project Name: Banahaw Lake Farm Zone ID: _____

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>	Confidence
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>	H M L
Likely Vegetation Class:				
Plant Community Type (PCT):		EEC:		Confidence
				H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1657</u>	<u>33 43 05</u>	<u>67 68 405</u>	<u>40° NE</u>	✓	✓
50 m	<u>1663</u>	<u>33 43 50</u>	<u>67 68 429</u>	<u>208° SW</u>	✓	✓

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1658</u>	<u>1659</u>	<u>1660</u>	<u>1661</u>	<u>1662</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>30</u>	<u>30</u>	<u>25</u>	<u>20</u>	<u>40</u>	<u>29</u>
Bare Ground (%)		<u>55</u>	<u>55</u>	<u>70</u>	<u>70</u>	<u>60</u>	<u>64</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>5</u>	<u>5</u>	<u>5</u>	<u>10</u>	<u>0</u>	<u>5</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Slope</u>	Landform Element	<u>Hill slope</u>	Landform Pattern	<u>Hill</u>	Microrelief	<u>rocky ridge</u>
Lithology	<u>Silt-clay</u>	Soil Surface Texture	-	Soil Colour	<u>light orange brown</u>	Soil Depth	-
Slope	<u>Slope</u>	Aspect	<u>315° NW</u>	Site Drainage	<u>downslope</u>	Distance to nearest water and type	<u>± 50 m NW</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood / CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>RTD</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of _____

Plot ID: 40

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm	///		/	
30 - 49 cm	//		/	
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		14, 4, 3, 2, = 23		

^ Non-Euc - Record of living native non eucalypt trees

BAM Attributes: Tree DBH & Hollows (Plot 20m x 50m)

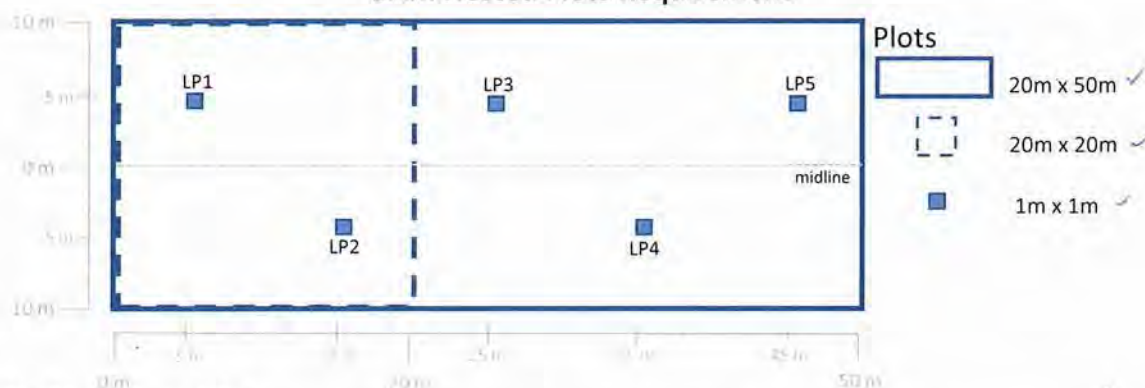
[illegible]

Date: 28-03-2019 Recorders: ACM, TZ Plot ID: 7Project No: 0470861 Project Name: Bonsbaw Solar Farm Zone ID: 41

Desktop Information Requirements for BAM Plot survey

Zone:	<u>56</u>	IBRA region:	<u>Nandewar</u>
Datum:	<u>94</u>	IBRA sub-region:	<u>Nandewar Northern Complex</u>
Likely Vegetation Class:			
Plant Community Type (PCT):			
		EEC:	
		Confidence	H M L
		Confidence	H M L

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1667</u>	<u>33 85 92</u>	<u>67 68 534</u>	<u>259° W</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
50 m	<u>1673</u>	<u>33 83 41</u>	<u>67 68 541</u>	<u>82° E</u>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

*Magnetig bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1668</u>	<u>1669</u>	<u>1670</u>	<u>1671</u>	<u>1672</u>	
	Photo	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Litter Cover (%)		<u>45</u>	<u>10</u>	<u>5</u>	<u>1</u>	<u>5</u>	<u>23.2</u>
Bare Ground (%)		<u>5</u>	<u>40</u>	<u>5</u>	<u>99</u>	<u>95</u>	<u>58.8</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>60</u>	<u>0</u>	<u>0</u>	<u>12</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>90</u>	<u>0</u>	<u>0</u>	<u>18</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>Crest</u>	Landform Element	<u>Hill crest</u>	Landform Pattern	<u>High crest</u>	Microrelief	<u>rocky bold</u>
Lithology	<u>clayey soils</u>	Soil Surface Texture	<u>-</u>	Soil Colour	<u>light orange-brown</u>	Soil Depth	<u>-</u>
Slope	<u>Very gently inclined</u>	Aspect	<u>340° N</u>	Site Drainage	<u>-</u>	Distance to nearest water and type	<u>-</u>

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>0</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>NR-0</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of _____

Plot ID: 241

Zone ID: _____

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm				
50 - 79 cm	/		/	
30 - 49 cm				
20 - 29 cm		X/1		
10 - 19 cm	/	/		
5 - 9 cm		/		
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)		3, 2, =5		

Cultures of glycolytic

[^] Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

[illegible]

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ... 100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

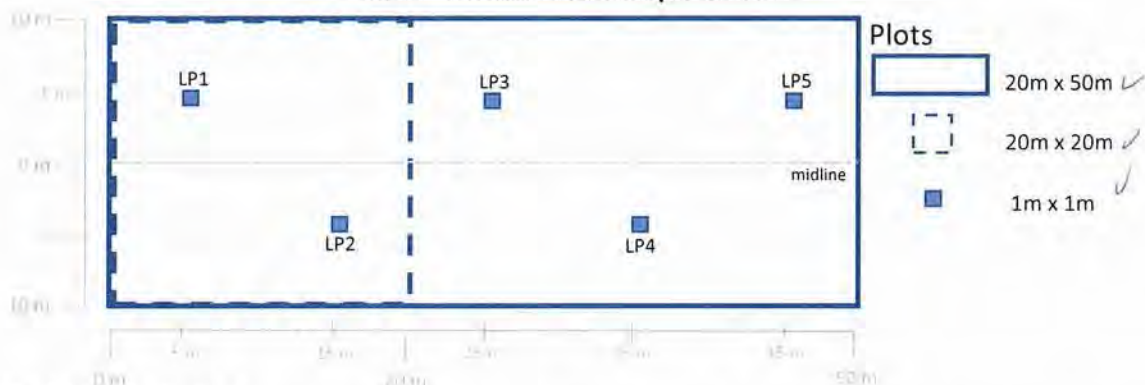
g/c veg 20
demand / manure 40
tech 25 %
cost 15

Date: 28-03-2019 Recorders: ACM, TZ Plot ID: 42Project No: 0470861 Project Name: Banshaw Solar Farm Zone ID: 42

Desktop Information Requirements for BAM Plot survey

Zone:	56	IBRA region:	Nandewar	
Datum:	94	IBRA sub-region:	Nandewar Northern Complex	
Likely Vegetation Class:				Confidence H M L
Plant Community Type (PCT):				Confidence H M L
		EEC:		

BAM Nested Plots Requirement



Plot 20m x 50m - midline

Point on midline	Way Point	Easting	Northing	Orientation*	Photo - Horizontal	Photo - Vertical
0 m	<u>1675</u>	<u>33 85 33</u>	<u>67 68 664</u>	<u>18°N</u>	✓	✓
50 m	<u>1681</u>	<u>33 85 34</u>	<u>67 68 715</u>	<u>169°S</u>		

*Magnetic bearing obtained with compass along the midline

BAM Attribute (1m x 1m plots)

Attribute	LP	1	2	3	4	5	Average
	WP	<u>1676</u>	<u>1677</u>	<u>1678</u>	<u>1679</u>	<u>1680</u>	
	Photo	✓	✓	✓	✓	✓	
Litter Cover (%)		<u>40</u>	<u>30</u>	<u>5</u>	<u>90</u>	<u>60</u>	<u>55</u>
Bare Ground (%)		<u>10</u>	<u>70</u>	<u>45</u>	<u>10</u>	<u>40</u>	<u>45</u>
Cryptogam Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Rock Cover (%)		<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots centered at 5, 15, 25, 35 and 45m along the midline of the 20m x 50m plot.

LP = Litter Plot (1m x 1m plot); WP = Waypoint;

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	<u>flat</u>	Landform Element	<u>Plain</u>	Landform Pattern	<u>Plain</u>	Microrelief	<u>grass</u>
Lithology	<u>Clayey soils</u>	Soil Surface Texture		Soil Colour	<u>orange, brown</u>	Soil Depth	
Slope	<u>Very Gentle Silted</u>	Aspect	<u>N</u>	Site Drainage		Distance to nearest water and type	

Plot Disturbance	Severity Code	Age Code	Observational Evidence
Clearing (incl. logging)	<u>3</u>	<u>A</u>	
Cultivation (incl. pasture)			
Soil Erosion			
Firewood CWD removal			
Grazing (identify native/stock)	<u>3</u>	<u>R-D</u>	
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3 yrs); NR = not recent (3 - 10 yr); O = old (>10 yrs)

Page 2 of

Project No: 0470861 Project Name: Banshaw Solar Farm Zone ID: 4E

DBH Class [#]	Tree Stems Count #		Stems with Hollows	
	Euc*	Non-Euc^	Euc*	Non-Euc^
80+ cm	1		1	
50 - 79 cm	\$			
30 - 49 cm				
20 - 29 cm				
10 - 19 cm				
5 - 9 cm				
<5 cm ^b			n/a	n/a
Length of logs (m): (≥10 cm diameter, >50cm in length)				

* Euc - Record of living native eucalypt trees (includes all species of *Eucalyptus*).

[^] Non-Euc - Record of living native non eucalypt trees

Count apply when the number of tree stems within a size class is ≤ 10 . Estimates can be used when >10 (eg 10, 200, 30, ..., 100, 200, 300). For a multi-stemmed tree, only the largest living stem is included in the count/estimate. Tree Stems must be living.

[illegible]

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders			
Date							
	28/3/19	Bongshaw	42				
GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher	
	Glycer		20.1	30			
	Sida corrugata		0.1	40			
	Eriosema nutans		20.1	20			
	Eucalyptus melanophloea tree		20	1			
	Maireana microphylla		0.1	2			
	Aristida praeformosa		3	300			
	Heliotropis amplexicaula		20.1	13			
	Dichondra sp A		20.1	3			
	Pinellia strobilata		20.1	1			
	Rostellularia adscendens		20.1	15			
	Baerhavia dominii		20.1	16			
	Opuntia aurantiaca		20.1	2			
	Sclerolaena birchii		0.1	40			
	Tribulus terrestris		20.1	60			
	Portulaca oleracea		20.1	3			
	Vittadinia sulcata		20.1	1			
	unidentifiable grasses		4				

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); **Note:** 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

g/l - total veg 7
dead \$3
rock 0.1
soil 40

+ tree trunk 0.2%

BAM Plot Data

Table G.1 - Summary of BAM Plot Data

					Composition						Structure						Function											
					Native Richness (count no spp)						Cover (Sum cover of spp in each growth form group)						Large Tree (P/A)	HBT	Litter Cover	Logs	Tree DBH (Tree stems - native species only) (P/A)							HTE
Plot	Zone	Easting	Northing	Bearing	Trees	Shrubs	Grasses	Forbs	Ferns	Other	Trees	Shrubs	Grasses	Forbs	Ferns	Other	>80 cm DBH	(P/A)	(average)	(m)	5-9cm DBH	10-19cm DBH	20-29cm DBH	30-49cm DBH	50-79cm DBH	<5cm DBH	(number)	
1	56	337831	6767626	86 E	2	1	1	4	0	0	45.0	0.1	0.2	0.5	0.0	0.0	0	1	42	21.86	1	1	1	1	1	1	1	
2	56	338406	6767613	344 N	6	3	3	2	0	3	80.5	0.3	0.3	0.2	0.0	0.3	1	1	75	49.7	1	1	1	0	1	1	1	
3	56	338667	6767581	24 NE	3	3	0	2	1	0	45.2	0.4	0.0	0.2	0.1	0.0	0	1	43	37.1	1	1	1	1	1	1	1	
4	56	338827	6768189	1 N	1	4	4	4	1	0	0.1	0.4	0.5	0.4	0.1	0.0	0	0	36.4	10	0	0	0	0	0	0	2	
5	56	339451	6768659	239 W	3	3	2	3	1	1	35.2	0.3	0.2	0.3	0.1	0.1	0	1	75	33.5	1	1	1	1	1	1	1	
6	56	339229	6768505	196 S	0	2	3	7	0	1	0.0	5.1	25.5	0.7	0.0	0.1	0	1	60	0	0	0	0	0	0	0	1	
7	56	339300	6768650	236 SW	2	3	3	10	0	3	72.0	0.3	17.1	1.0	0.0	0.3	0	0	50	53	1	1	1	1	0	1	1	
8	56	338603	6768514	252 W	4	6	7	7	0	1	68.5	1.9	5.6	2.0	0.0	0.1	0	1	57	54	1	1	1	1	0	1	1	
9	56	338079	6768264	294 NW	1	3	9	10	1	1	35.1	0.3	2.7	1.0	0.1	0.1	0	1	24	16	1	1	1	1	0	1	1	
10	56	338759	6768130	162 S	3	4	6	9	1	3	43.0	0.4	15.5	0.9	0.1	0.3	0	1	65	80	1	1	1	1	0	1	0	
11	56	338572	6767919	247 SW	3	3	6	10	1	2	38.0	0.3	1.0	1.0	0.1	0.3	0	1	50	32	1	1	0	0	1	1	0	
12	56	338521	6767776	207 SW	2	4	6	8	0	1	47.3	0.4	0.7	0.8	0.0	0.1	0	0	36	21	1	1	1	1	0	1	1	
13	56	338198	6768336	81 E	0	2	4	5	0	1	0.0	0.2	0.9	0.5	0.0	5.0	0	0	7.4	0	0	0	0	0	0	0	1	
14	56	338663	6768348	260 W	0	3	11	14	1	1	0.0	0.3	1.3	2.3	0.3	0.1	0	0	35	6	0	0	0	0	0	0	1	
15	56	338451	6767511	143 SE	4	3	9	6	1	3	40.1	0.3	1.3	0.6	0.1	0.3	1	1	69	66	1	1	1	1	1	1	1	
16	56	338659	6767569	255 W	4	2	4	6	1	3	41.0	0.4	0.8	1.1	0.1	0.5	0	1	53.2	70	1	1	1	1	1	1	1	
17	56	338763	6767760	270 W	1	3	4	10	1	1	0.1	0.3	15.1	1.5	0.1	0.2	0	0	30	12	0	1	0	0	0	0	3	
18	56	338377	6767858	53 NE	0	2	6	6	1	1	0.0	0.2	6.9	0.7	0.2	0.2	0	0	49	35	0	0	0	0	0	0	0	
19	56	338320	6768072	155 SE	0	2	2	5	1	1	0.0	20.2	5.0	0.5	0.1	0.2	0	0	41	4.5	0	0	0	0	0	0	2	
20	56	337983	6767855	321 NW	1	1	3	1	0	2	0.1	0.1	0.5	0.1	0.0	0.2	0	0	31	0	0	0	0	0	0	0	1	
21	56	337855	6767956	321 NW	1	2	4	10	0	1	3.0	0.2	5.6	1.1	0.0	0.1	0	0	36	40	1	1	1	0	0	1	1	
22	56	338024	6768238	298 NW	1	2	3	9	0	2	0.1	0.2	2.1	0.9	0.0	0.3	0	0	38	23	1	0	0	0	0	1	2	
23	56	338490	6768126	159 S	1	2	4	4	1	1	0.2	0.2	2.4	0.4	0.1	0.1	0	0	26	4	1	1	1	0	0	1	1	
24	56	338800	6768481	170 S	0	1	5	4	1	1	0.0	0.1	2.0	0.8	0.1	0.1	0	0	73	21	0	0	0	0	0	0	0	
25	56	338687	6768607	257 W	0	0	5	5	1	1	0.0	0.0	1.3	0.5	0.1	0.1	0	0	74	11	0	0	0	0	0	0	2	
26	56	339225	6768408	255 W	2	1	7	5	0	1	0.2	0.1	3.9	0.5	0.0	0.1	0	0	26	21	0	1	0	0	0	1	0	
27	56	338344	6768782	184 S	0	1	3	5	1	1	0.0	0.1	40.4	0.5	0.1	0.1	0	0	66	0	0	0	0	0	0	0	1	
28	56	338658	6768836	183 S	0	2	1	6	0	1	0.0	0.4	25.0	0.6	0.0	0.1	0	0	33	0	0	0	0	0	0	0	1	
29	56	339052	6768750	178 S	2	1	7	8	1	1	0.2	0.1	16.3	8.0	0.1	0.1	0	0	72	43	0	0	0	0	0	1	0	
30	56	338535	6769002	25 NW	0	2	3	7	0	3	0.0	0.3	1.1	0.7	0.0	0.3	0	0	45	0	0	0	0	0	0	0	0	
31	56	338402	6769323	191 S	2	3	3	8	1	0	3.1	0.4	1.3	0.8	0.1	0.0	0	1	38	2	0	0	1	0	1	0	2	
32	56	338518	6769371	173 S	0	2	4	2	1	1	0.0	0.2	40.3	0.2	0.1	0.1	0	0	76	0	0	0	0	0	0	0	1	
33	56	338361	6769671	326 NW	0	1	2	2	0	1	0.0	0.1	0.2	0.2	0.0	0.1	0	0	7.4	0	0	0	0	0	0	0	2	
34	56	338569	6769788	275 W	0	1	2	4	0	1	0.0	0.3	0.3	0.5	0.0	0.2	0	0	26	0	0	0	0	0	0	0	2	
35	56	338671	6769805	262 W	0	2	6	4	0	1	0.0	5.0	3.0	0.4	0.0	0.1	0	0	24.2	0	0	0	0	0	0	0	0	
36	56	339043	6768195	315 W	1	1	6	4	0	1	0.1	0.1	3.1	0.4	0.0	0.1	0	0	46.6	22	0	0	0	0	0	0	1	
37	56	338564	6768372	177 S	0	1	6	7	1	1	0.0	0.1	4.4	0.7	0.1	0.1	0	0	72	64	0	1	0	0	0	1	1	
38	56	338685	6768653	235 SW	1	3	2	1	0	0	50.0	0.3	0.2	0.1	0.0	0.0	0	0	63.6	42	0	1	1	1	1	0	1	
39	56	338676	6768698	56 NE	0	2	3	4	0	0	0.0	0.4	1.8	0.5	0.0	0.0	0	0	81.6	0	0	0	0	0	0	0	1	
40	56	339305	6768405	40 NE	1	3	5	4	0	2	25.0	0.3	0.8	0.4	0.0	0.2	0	1	29	23	0	0	0	1	1	0	1	
41	56	338392	6768534	259 W	1	2	3	4	1	1	10.0	0.5	20.5	0.4	0.1	0.1	0	1	23.2	5	1	1	1	0	1	0	1	
42	56	338533	6768664	18 N	1	3	1	7	0	1	20.0	0.3	3.0	0.7	0.0	0.1	1	1	55	0	0	0	0	0	0	0	2	

Notes:

x = present
HTE = High Threat Exotic
HBT = Hollow-bearing Tree

P/A = Presence / Absence
1 = Present; 0 = Absent

DBH = Diameter at Breast Heght;
Logs = Length of logs with more than 10cm diameter

BAM Plot photographs



Plot 1: horizontal view from 0m midline (11 Sep 2018)



Plot 1: vertical view from 0m midline (11 Sep 2018)



Plot 2: horizontal view from 0m midline (11 Sep 2018)



Plot 2: vertical view from 0m midline (11 Sep 2018)



Plot 3: horizontal view from 0m midline (11 Sep 2018)



Plot 3: vertical view from 0m midline (11 Sep 2018)



Plot 4: horizontal view form 0m midline (12 Sep 2018)



Plot 4: vertical view from 0m midline (12 Sep 2018)



Plot 5: horizontal view from 0m midline (12 Sep 2018)



Plot 5: vertical view from 0m midline (12 Sep 2018)



Plot 6: horizontal view from 0m midline (11 Dec 2018)



Plot 6: vertical view form 0m midline (11 Dec 2018)



Plot 7: horizontal view from 0m midline (12 Dec 2018)



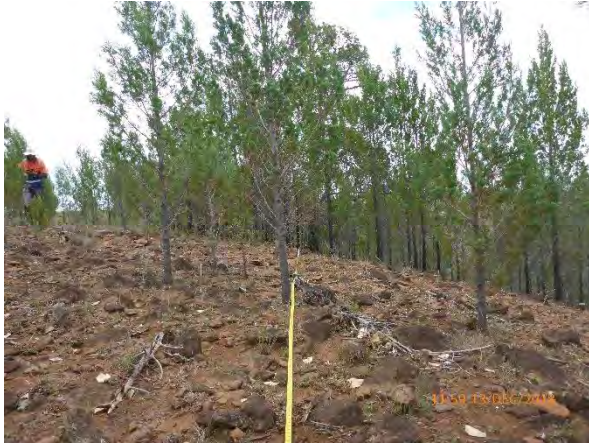
Plot 7: vertical view from 0m midline (12 Dec 2018)



Plot 8: horizontal view from 0m midline (13 Dec 2018)



Plot 8: vertical view from 0m midline (13 Dec 2018)



Plot 9: horizontal view from 0m midline (13 Dec 2018)



Plot 9: vertical view from 0m midline (13 Dec 2018)



Plot 10: horizontal view from 0m midline (13 Dec 2018)



Plot 10: vertical view from 0m midline (13 Dec 2018)



Plot 11: horizontal view from 0m midline (13 Dec 2018)



Plot 11: vertical view from 0m midline (13 Dec 2018)



Plot 12: horizontal view from 0m midline (13 Dec 2018)



Plot 12: vertical view from 0m midline (13 Dec 2018)



Plot 13: horizontal view from 0m midline (14 Dec 2018)



Plot 13: vertical view from 0m midline (14 Dec 2018)



Plot 14: horizontal view from 0m midline (14 Dec 2018)



Plot 14: vertical view from 0m midline (14 Dec 2018)



Plot 15: horizontal view from 0m midline (25 Mar 2019)



Plot 15: vertical view from 0m midline (25 Mar 2019)



Plot 16: horizontal view from 0m midline (25 Mar 2019)



Plot 16: vertical view from 0m midline (25 Mar 2019)



Plot 17: horizontal view from 0m midline (25 Mar 2019)



Plot 17: vertical view from 0m midline (25 Mar 2019)



Plot 18: horizontal view from 0m midline (25 Mar 2019)



Plot 18: vertical view from 0m midline (25 Mar 2019)



Plot 19: horizontal view from 0m midline (25 Mar 2019)



Plot 19: vertical view from 0m midline (25 Mar 2019)



Plot 20: horizontal view from 0m midline (26 Mar 2019)



Plot 20:horizontal view from 0m midline (26 Mar 2019)



Plot 21: horizontal view from 0m midline (26 Mar 2019)



Plot 21: horizontal view from 0m midline (26 Mar 2019)



Plot 22: horizontal view from 0m midline (26 Mar 2019)



Plot 22: horizontal view from 0m midline (26 Mar 2019)



Plot 23: horizontal view from 0m midline (26 Mar 2019)



Plot 23: horizontal view from 0m midline (26 Mar 2019)



Plot 24: horizontal view from 0m midline (26 Mar 2019)



Plot 24: horizontal view from 0m midline (26 Mar 2019)



Plot 25: horizontal view from 0m midline (26 Mar 2019)



Plot 25: horizontal view from 0m midline (26 Mar 2019)



Plot 26: horizontal view from 0m midline (26 Mar 2019)



Plot 26: horizontal view from 0m midline (26 Mar 2019)



Plot 27: horizontal view from 0m midline (27 Mar 2019)



Plot 27: horizontal view from 0m midline (27 Mar 2019)



Plot 28: horizontal view from 0m midline (27 Mar 2019)



Plot 28: horizontal view from 0m midline (27 Mar 2019)



Plot 29: horizontal view from 0m midline (27 Mar 2019)



Plot 29: horizontal view from 0m midline (27 Mar 2019)



Plot 30: horizontal view from 0m midline (27 Mar 2019)



Plot 30: horizontal view from 0m midline (27 Mar 2019)



Plot 31: horizontal view from 0m midline (27 Mar 2019)



Plot 31: horizontal view from 0m midline (27 Mar 2019)



Plot 32: horizontal view from 0m midline (27 Mar 2019)



Plot 32: horizontal view from 0m midline (27 Mar 2019)



Plot 33: horizontal view from 0m midline (27 Mar 2019)



Plot 33: horizontal view from 0m midline (27 Mar 2019)



Plot 34: horizontal view from 0m midline (27 Mar 2019)



Plot 34: horizontal view from 0m midline (27 Mar 2019)



Plot 35: horizontal view from 0m midline (27 Mar 2019)



Plot 35: horizontal view from 0m midline (27 Mar 2019)



Plot 36: horizontal view from 0m midline (28 Mar 2019)



Plot 36: horizontal view from 0m midline (28 Mar 2019)



Plot 37: horizontal view from 0m midline (28 Mar 2019)



Plot 37: horizontal view from 0m midline (28 Mar 2019)



Plot 38: horizontal view from 0m midline (28 Mar 2019)



Plot 38: horizontal view from 0m midline (28 Mar 2019)



Plot 39: horizontal view from 0m midline (28 Mar 2019)



Plot 39: horizontal view from 0m midline (28 Mar 2019)



Plot 40: horizontal view from 0m midline (28 Mar 2019)



Plot 40: horizontal view from 0m midline (28 Mar 2019)



Plot 41: horizontal view from 0m midpoint (28 Mar 2019)



Plot 41: horizontal view from 0m midpoint (28 Mar 2019)



Plot 42: horizontal view from 0m midpoint (28 Mar 2019)



Plot 42: horizontal view from 0m midpoint (28 Mar 2019)

APPENDIX H FLORA AND FAUNA SPECIES LISTS

Table H.1 Bird Species Records

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Acanthizidae	Weebill	<i>Smicrornis brevirostris</i>				1	2					I
Acanthizidae	White-throated Gerygone	<i>Gerygone albogularis</i>										II
Acanthizidae	Inland Thornbill	<i>Acanthiza apicalis</i>										I
Acanthizidae	Speckled Warbler^	<i>Pyrrholaemus sagittatus</i>										I
Acanthizidae	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>										I
Accipitridae	Wedge-tailed Eagle^	<i>Aquila audax</i>										I
Accipitridae	Whistling Kite	<i>Haliastur sphenurus</i>										I
Aegothelidae	Australian Owlet-nightjar	<i>Aegotheles cristatus</i>										I
Anatidae	Pacific Black-duck	<i>Anas superciliosa</i>								10		I
Artamidae	Australian Magpie	<i>Cracticus tibicen</i>			2	1		1		2	3	I
Artamidae	Grey Butcherbird	<i>Cracticus torquatus</i>			1	1	1	1			1	I
Artamidae	Pied Butcherbird	<i>Pied Butcherbird</i>								1		I
Artamidae	Pied Currawong	<i>Strepera graculina</i>			1		1	1				I
Cacatuidae	Galah	<i>Eolophus roseicapillus</i>						1		5	4	I
Cacatuidae	Little Corella	<i>Cacatua sanguinea</i>								30		
Cacatuidae	Sulphur-crested Cockatoo	<i>Cacatua galerita</i>								6		I
Campephagidae	Cicadabird	<i>Coracina tenuirostris</i>		Ma		1						I
Campephagidae	Black-faced Cuckooshrike	<i>Coracina novaehollandiae</i>										I
Campephagidae	White-winged Triller	<i>Lalage sueurii</i>										I
Charadriidae	Masked Lapwing	<i>Vanellus miles</i>										I

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Climacteridae	Brown Treecreeper^ (eastern subspecies)	<i>Climacteris picumnus victoriae</i>	V									I
Columbidae	Crested Pigeon	<i>Ocyphaps lophotes</i>			2	2	1	1		1		I
Columbidae	Common Bronzewing	<i>Phaps chalcoptera</i>										I
Columbidae	Peaceful Dove	<i>Geopelia striata</i>										II
Corcoracidae	Apostlebird	<i>Struthidea cinerea</i>			6	2				3	2	I
Corcoracidae	White-winged Chough	<i>Corcorax melanorhamphos</i>			4							I
Corvidae	Australian Raven	<i>Corvus coronoides</i>			2							I
Corvidae	Torresian Crow	<i>Corvus orru</i>				3		1				I
Cuculidae	Channel-billed Cockoo	<i>Scythrops novaehollandiae</i>								1		I
Cuculidae	Eastern Koel	<i>Eudynamys orientalis</i>			1						1	
Estrildidae	Double-barred Finch	<i>Taeniopygia bichenovii</i>										I
Falconidae	Nankeen Kestrel	<i>Falco cenchroides</i>										I
Meliphagidae	Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>						1				
Meliphagidae	Lewin's Honeyeaater	<i>Meliphaga lewinii</i>					1				1	
Meliphagidae	Little Friarbird	<i>Philemon citreogularis</i>			2	3	1		1		3	I
Meliphagidae	Noisy Miner	<i>Manorina melanocephala</i>			5	4	4	11		2	4	I
Meliphagidae	Striped Honeyeater	<i>Plectorhyncha lanceolata</i>					1					I
Meliphagidae	Brown Honeyeater	<i>Lichmera indistincta</i>										I
Monarchidae	Magpie-lark	<i>Grallina cyanoleuca</i>			2	2		1		9	1	I
Motacillidae	Australasian Pipit	<i>Anthus novaeseelandiae</i>						1			1	I
Nectariniidae	Mistletoebird	<i>Dicaeum hirundinaceum</i>										I

Family	Common Name	Scientific Name	BC Act	EPBC Act	B1	B2	B3	B4	B5	B6	B7	Incidentals
Oriolidae	Olive-backed Oriole	<i>Oriolus sagittatus</i>										I
Pachycephalidae	Grey Shrike-thrush^	<i>Colluricincla harmonica</i>										I
Pachycephalidae	Rufus Whistler	<i>Pachycephala rufiventris</i>										I
Pardalotidae	Striated Pardalote	<i>Pardalotus striatus</i>			1			1		2	1	I
Petrocidae	Eastern Yellow Robin^	<i>Eopsaltria australis</i>										I
Petrocidae	Jacky Winter^	<i>Microeca fascians</i>										I
Petrocidae	Red-capped Robin^	<i>Petroica goodenovii</i>										I
Pomatostomidae	Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	V							1	4	
Psittacidae	Pale-headed Rosella	<i>Platycercus adscitus</i>			1	5					1	I
Psittacidae	Red-rumped Parrot	<i>Psephotus haematonotus</i>				10	4	1	1			I
Psittacidae	Red-winged Parrot	<i>Aprosmictus erythropterus</i>				6	1					
Psittacidae	Eastern Rosella	<i>Platycercus eximius</i>										I
Rhipiduridae	Grey Fantail	<i>Rhipidura albiscapa</i>										I
Rhipiduridae	Willie Wagtail	<i>Rhipidura leucophrys</i>			1	1		1			2	I

Notes: # = number of individuals; I - one record; II = two records; ^ - recorded adjacent to the Subject Land only; V – Vulnerable; Ma - Marine

Table H.2 Reptile species records

Family	Common Name	Scientific Name	BC Act	EPBC Act	R1	R2	R3	R4	R5	R6	R7	R8	Incidentals
Agamidae	Eastern Bearded Dragon	<i>Pogona barbata</i>											I
Varanidae	Monitor Lizard	<i>Varanus varius</i>											I
Gekkonidae	Bynoe's Gecko	<i>Heteronotia binoei</i>											I
Scincidae	Tree Skink	<i>Egernia striolata</i>											I
Scincidae	Tree-base Litter-skink, Rainbow Skink	<i>Lygisaurus foliorum</i>											I
Gekkonidae	A Gecko	Gehyra sp.						1					
	Small brown gecko												I
	Skink												I
	Turtle												I

Table H.3 Mammal species records

Family	Common Name	Scientific Name	BC Act	EPBC Act	Incidentals
Bovidae	European Cattle*	<i>Bos taurus</i>			x
Bovidae	Sheep*	<i>Ovis aries</i>			x
Canidae	Dog*	<i>Canis lupus familiaris</i>			x
Leporidae	European Rabbit*	<i>Oryctolagus cuniculus</i>			scat, x
Macropodidae	Common Wallaroo	<i>Macropus robustus</i>			x
Macropodidae	Eastern Grey Kangaroo	<i>Macropus giganteus</i>			x
Macropodidae	Red-necked Wallaby	<i>Macropus rufogriseus</i>			x
Peramelidae	Northern Brown Bandicoot	<i>Isododon macrourus</i>			x
Phalangeridae	Common Brushtail Possum	<i>Trichosurus vulpecula</i>			x
Suidae	Feral Pig*	<i>Sus scrofa</i>			x
Tachyglossidae	Short-beaked Echidna	<i>Tachyglossus aculeatus</i>			Scat, diggings

*Introduced species

Table H.4 Amphibian species list

Family	Common Name	Scientific Name	F1	F2	F3	Incidentals
Hyalidae	Desert Tree Frog	<i>Litoria rubella</i>	C			
Hylidae	Broad-palmed Frog	<i>Litoria latopalmata</i>				O
Hylidae	Peron's Tree Frog	<i>Litoria peronii</i>				O

Notes: C = heard calling; O = observed;

Table H.5 Microchiropteran Bat Species List

Family	Common Name	Scientific Name	BC Act	EPBC Act	S2	S3	S4	S5	S6	S7	S8
Molossidae	<i>Austronomus australis</i>	White-striped Freetail-bat	-		D	D	D	D	D	D	D
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			D	D	D	D	D	D	D
Vespertilionidae	<i>Chalinolobus morio</i>	Chocolate Wattled Bat			D	D	D	D	D	D	D
Vespertilionidae	<i>Chalinolobus picatus</i>	Little Pied Bat	V		D	D	D	D	P	D	D
Miniopteridae	<i>Miniopterus orianae oceanensis</i>	Eastern Bent-winged Bat	V		D	D	D	D	D	D	D
Molossidae	<i>Ozimops planiceps</i> / <i>O. petersi</i>	South-eastern Free-tailed Bat / Inland Free-tailed Bat	-	-	P	P	P	P	P	P	P
Molossidae	<i>Ozimops ridei</i>	Ride's Free-tailed Bat			D	D	D	D	D	D	D
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	V		D	D	D	D	D	D	D
Vespertilionidae	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat			D	D	D	D	D	D	P
Vespertilionidae	<i>Scotorepens greyii</i>	Little Broadnosed Bat			17	15	46	210	26	10	27
Molossidae	<i>Mormopterus eleryi</i> *	Bristle-faced Free-tailed Bat	E		5		11	25	1	12	
Vespertilionidae	<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V		P	P	P	P	P	P	P
Vespertilionidae	<i>Vespadelus vulturnus</i>	Little Forest Bat			D	D	D	D	D	D	D
Nyctophilus species - group formed by the three species below					D	D	D	D	D	D	
Vespertilionidae	<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	V	V							
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat									
Vespertilionidae	<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat									
Vespertilionidae/ Molossidae	<i>Scotorepens greyii</i> or <i>Chalinolobus nigrogriseus</i> ^V	Little Broad-nosed Bat or Hoary Wattled Bat	V		P	P	P	P	P	P	P
Vestertilionidae /	<i>Scotorepens greyii</i> or <i>Falsistrellus tasmaniensis</i> ^V	Little Broad-nosed Bat or Eastern False Pipistrelle	V		P	P	P	P	P	P	

D = Definite call identification, i.e. at least one call attributed unequivocally to the species; P = Possible call identification, i.e. calls like those of the species were recorded, but were not reliably identified; V = Vulnerable; * reported as *Setirostris eleryi* by Balance! Environmental (see Appendix I)

Table H.6 Flora Species List

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG										X	X		
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG												0.1	4
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A													
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG		0.2	2000										
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													X
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X												
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG				0.1	124								
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A		0.5	1000	0.1	110	0.1	1						
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A				0.1	30								
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG													
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A													
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG													
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A		0.1	20										
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A		0.1	112										
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG						0.2	173						
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A						0.1	6	0.1	1				
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG													
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG													
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG												0.1	8
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG													
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A													
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG				0.1	11					0.1	1		
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A													
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X	0.1	17	0.1	1	0.1	2	0.1	4			0.1	1
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X							-	X	0.1	4		
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG								0.1	3				
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X											0.1	44
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG		0.1	1										
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG													
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X	-	X			0.1	28	0.1	16			0.1	1
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG													
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG								0.1	20	0.1	222		
Convolvulaceae	<i>Dichondra sp. A</i> Sensus Harden (1992)	-	N	FG	X			0.1	3								
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X												
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X	30	30	0.1	3	0.2	44	0.1	1	0.2	166		
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG				0.1	62			0.1	1				
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG				0.1	1								
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG								0.1	1				
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG													
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A				0.1	21								
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG								0.1	3				
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG										0.1	4		
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG												0.1	40
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG												0.1	378
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG				0.1	1								
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A		0.1	24	0.1	2	0.1	6	0.1	3				
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A		0.1	122										
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG													
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A		0.1	1										
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG						0.1	7	0.1	2	0.1	3		
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A													
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A												0.1	5
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG		0.1	1										
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG				0.3	7								
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG										X			
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X			30	1								
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG						20	3			15	2		
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X	15	1	20	1	25	1						
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X									20	18		
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG												0.1	5
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG				30	47								
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG				0.1	1								
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG		0.1	62	0.1	119	0.1	8	0.1	37	0.1	2		
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG													
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG				0.1	6								
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG												0.1	27
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A						0.1	1						
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG													
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X											25	633

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG												0.3	336
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG													
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG								0.2	305				
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG													
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X												
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG													
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG													
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG													
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG												0.2	476
Poaceae	<i>Eragrostis sp.</i>	-	N	GG						0.1	10						
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A						0.1	10						
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG													
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A		0.1	1										
Poaceae	<i>Paspalidium distans</i>	-	N	GG													
Poaceae	<i>Poa sp. 1</i>	-	E	N/A						0.1	600						
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG													
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG				0.1	2			0.1	5	0.1	12		
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG		0.2	470					0.1	200				
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG		0.1	400	0.1	123					0.1	1000		
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A													
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG												0.1	16
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG													
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG													
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X					0.1	22						
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG								0.1	240	0.1	133		
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X			30	47								
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X									0.1	1		
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG													
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A		0.1	12										
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG													
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG		0.1	1	0.1	4	0.1	3	0.1	17	0.1	2	5	15
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X												
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A		0.1	145			0.1	32	0.1	27				
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A										0.1	2		
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG		0.1	8			0.1	20			0.1	12	0.1	8
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG													
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A													
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X	0.1	2										
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG												0.1	8
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG		0.1	2			0.1	2			0.1	4	0.1	12
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A													
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG				1	7	0.1	1	0.1	1			0.1	6
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG								0.1	14	0.1	7		
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG								0.1	2				
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A						0.1	2						
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A						0.1	2						
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG													
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG													
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG				0.1	2	0.1	1	0.1	2				
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG										0.1	3	0.1	3
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG													
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A													
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG		0.1	4					0.1	1				
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A													
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X	0.1	19	0.1	3	0.1	4					0.1	1
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X												
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X	0.1	27			0.1	52	0.1	14	0.1	8	0.1	2
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG				1	216					0.1	9		
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG													
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG													
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X									0.1	1		
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG													
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Sensus Harden (1992)	-	N	FG	X	0.1	200			0.1	4	0.1	73	0.1	30	0.1	1
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X	0.1	1	0.1	1								
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X			10.6	22								
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X	41	21	27.1	40	35.1	247	3.5	41	0.7	18	0.1	6
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG				0.1	40	0.1	3	15	1040	0.3	320	0.1	23

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG				0.5	9			0.1	1				
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG													
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG						0.1	1	0.1	6				
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG						0.1	31	0.1	6	0.1	2	0.1	32
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG		0.1	86			0.1	2	0.1	20	0.2	21	0.1	2
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG				0.1	2								
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG													
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A				0.1	15	0.1	2						
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A													
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG								0.1	10	0.1	3		
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG		0.1	4	0.5	80			0.1	4	0.1	12		
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X												
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG				30.6	8			36.5	89	37.2	57	0.1	6
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X	31	8	0.2	2			3	2	0.1	2		
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG		0.1	3			0.1	5	0.1	5	0.1	6		
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG													
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG		0.1	2	0.1	2	0.1	11						
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG				0.1	1	0.1	12	0.1	6				
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG				0.1	1								
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG						0.1	37						
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG		0.1	4	0.1	5							0.1	24
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG													
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	0.1	4			1	124	0.1	1	0.1	9	0.1	13

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG		2	200	5	309	0.1	70	0.1	92	0.3	354		
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG				0.1	1								
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG						0.1	2					2.2	16
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG													
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X			0.1	56	0.1	11	0.1	7	0.1	9	0.2	120
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG						0.1	1						
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG				0.1	3								
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG		15	1400	0.1	16	1	251	0.1	9	0.1	1	45.1	20
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG													
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG													
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG						0.1	5						
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG													
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG													
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG				0.1	6	0.1	8	0.1	4	0.1	19	0.1	11
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A						0.1	2						
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A						0.1	9						
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG													
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG													
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG													
Proteaceae	<i>Hakea laevipes</i>	-	N	SG												0.1	4
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X					0.1	1	0.1	1	0.1	1		
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG													
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG													
Solanaceae	<i>Solanum sp.</i>	-	N	FG		0.1	1										
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG				0.1	3			0.1	3	0.1	22	0.1	6
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG												0.1	5
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG		0.1	22	0.1	2	0.1	1	0.1	7	0.1	4	0.1	4
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X												
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG				0.1	1								
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG		0.1	12					0.1	3				
Rubiaceae	Rubiaceae	-	N	SG		0.1	2					0.1	1				
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG						0.1	100	0.3	200	0.1	30		
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG				0.1	4								
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A													
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A		0.1	1	0.1	2								
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG						0.1	5	0.1	1				
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A		0.1	8										
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X							0.1	10				
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG				0.1	5					0.1	5		
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A													
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG				0.1	20								
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A		0.1	23										
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG								0.2	200				
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG								0.1	40	0.1	30	0.1	15
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG				0.1	8								
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG				0.1	3								
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG						0.1	1	0.1	5	0.1	20	0.1	70
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A										0.1	1		
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG						0.1	1						
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A				0.1	10					0.1	1		
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X	0.1	1			0.1	4	0.1	100	0.1	20		
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X												
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X			0.1	76								
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG						0.1	10					0.2	200
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG													
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X			0.1	3	0.1	1			0.1	2	0.1	200
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG													
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Sensu Harden (1992)	-	N	FG	X			1	206	0.1	3	0.3	400	0.2	100	0.1	200
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X	0.1	2	0.1	2					0.1	20		
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X					15		20		0.1	30		
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG				0.1	26	0.1	50	0.1	40	0.1	20	0.1	70

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG													
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG										0.1	20		
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG		0.1	1										
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG		5	6	0.1	16								
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG						0.1	26	0.3	200	0.2	70	0.2	500
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG		0.1	19										
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG				0.1	68								
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A								0.1	20	0.1	40	0.1	30
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A													
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG				0.1	133	0.1	50	0.2	200	0.5	600	0.1	30
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X					5	1	3	1				
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG								15					
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X					20	3	3	0				
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG		0.1	26	0.1	4	0.1	1	0.1	40	0.1	60		
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG						0.1	6						
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG										0.1	16	0.1	100
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG		0.1	6										
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG													
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG		0.2	316			0.1	5						
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	0.1	3	0.1	11	0.1	10	0.3	20	5	50	5	120

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG				0.1	72								
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG		0.5	635									0.1	3
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG		0.1	8	0.3	60	0.1	7			5	50	1.5	200
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG				0.1	6	0.1	10	0.1	15				
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG				0.1	1								
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X			0.1	23	0.2	10						
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG						0.1	20						
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG				0.1	15	0.3	600	0.3	200	5	200		
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG						0.2	50						
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG				0.1	2								
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG				0.1	8								
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG												0.1	2
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG												0.1	2
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG				0.1	19								
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A		0.1	21										
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG				0.1	15								
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG													
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG													
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X			0.3	290								
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG						0.1	7	0.1	20	0.1	5	0.2	500
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG						0.1	1			0.1	5	0.1	10
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG		0.1	4	0.1	23								
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG		0.1	15	0.1	8								
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X					0.1	21	0.2	80	0.1	5		
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 13		Plot 14		Plot 15		Plot 16		Plot 17		Plot 18	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG				0.1	9								
Unknown	Unidentified Forb C	-	N	FG				0.1	1								
Unidentified	unidentified species	-	-	-												25	

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot 24	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG						0.1	4	0.1	8				
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG													
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A		0.1	1										
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X												
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG								0.1	1				
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A		0.1	1										
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG													
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG										0.1	1		
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG										0.1	2	0.1	12
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG													
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG													
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG						0.1	8					0.1	2
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A		0.1	2	0.1	4								
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG													
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A								0.1	2	0.1	18		
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X					0.1	2	0.1	2				
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X												
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X												
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG		0.1	100			0.1	20						
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG		0.2	4	0.1	1								
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X	20	600			0.1	4	0.1	40				
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG				0.1	1								
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Sensu Harden (1992)	-	N	FG	X	0.1	5			0.1	20			0.1	9	0.5	200
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X					0.1	3	0.1	8				
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X					3	15	0.1	2	0.2	2		
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot 24	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG													
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG		0.1	15					0.1	8				
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG													
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG								0.1	3				
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG		0.2	100			0.1	30	0.2	50	0.1	12	0.1	16
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG				0.1	10								
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG													
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A													
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A													
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG						0.2	100	0.1	50	0.1	200	0.1	30
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X												
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG													
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG		0.1	1			0.1	80	0.1	12	0.1	6		
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG				0.1	1								
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG						0.1	4	0.1	16				
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG													
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG													
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG				0.2	13								
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	4	300			3	200	1	25	1	40	0.1	1

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot 24	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG													
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG				0.2	13								
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG		1	100			0.5	15			1	200	1.5	500
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG													
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X					0.1	2	0.1	3	0.3	40	0.2	4
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG													
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG						2	300	1	100				
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG												0.1	3
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG													
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG										0.1	2	0.1	3
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG				0.1	1								
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG													
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A													
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG		0.1	1	0.1	5	0.1	8						
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG						0.1	20	0.1	50				
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG						0.1	5	0.1	2				
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X												
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG		0.1	8							0.1	7	0.1	5
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG													
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG													
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG													
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X					0.1	4	0.1	20	0.1	3	0.1	3
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A				0.1	1	0.1	4						

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 19		Plot 20		Plot 21		Plot 22		Plot 23		Plot 24	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-		5								20		25	

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG													
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG													
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A													
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X												
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG								0.1	14				
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A													
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG													
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG													
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG		0.1	16										
Asteraceae	<i>Vittadinia cuneata var. cuneata</i>	-	N	FG													
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG													
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG		0.1	1									0.1	40
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A													
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG												0.1	400
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A		0.1	3			0.1	100	0.5	2200				
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X												
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X	0.1	1										
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X												
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG						0.1	50	0.1	100			0.1	90
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG								0.1	2			0.1	2
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X					0.1	60	0.3	100			0.2	100
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG												0.1	30
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Ssensu Harden (1992)	-	N	FG	X	0.1	200	0.1	90	0.1	30	0.1	7			0.1	20
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X			0.1	8								
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X			0.1	11								
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG													
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG				0.1	3								
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG													
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG													
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG		0.1	20	0.1	7	0.1	40	0.1	20			0.1	50
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG												0.1	1
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A				0.1	8								
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A						0.1	8						
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG				0.1	300	0.1	4					0.1	40
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X												
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG				0.1	1								
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG		0.1	3	0.1	80	0.1	3	0.1	3	0.1	28	0.1	90
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG													
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG								0.1	3				
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG													
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG													
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG		0.1	3										
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	0.5	7	0.5	150	40	900	25	500	0.5	20	0.5	20

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG													
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG													
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG		0.5	300	2	200	0.3	40			10	1000	0.5	200
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG				0.1	1					0.1	1	0.1	3
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X	0.1	15	0.1	10					0.5	16		
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG													
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG				1	100					5	200		
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG		0.1	2	0.1	1	0.1	15			0.1	6		
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG													
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG				0.1	1					0.1	30		
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG													
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG													
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A													
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG		0.1	2			0.1	5	0.1	3	0.1	20	0.1	7
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG													
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG													
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X												
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG		0.1	2			0.1	30			0.1	14		
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG													
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG													
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG													
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X			0.1	10					0.1	10		
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A								0.1	20			0.1	60

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 25		Plot 26		Plot 27		Plot 28		Plot 29		Plot 30	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-		25				30		10		15			

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 31		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG													
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG													
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A								0.2	150				
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X												
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG													
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A						0.1	10	0.1	7				
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG													
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG													
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG													
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG													
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG													
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG		0.1	3										
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A													
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG													
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A				0.1	4	0.1	65	0.2	200			0.1	4
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X	0.1	3										
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X	1.5	1										
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X												
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG		0.1	300					0.1	100	0.1	10		
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG		0.2	4	0.1	1					3	18		
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X	0.1	40	0.1	5	0.1	4	0.3	200	2	150		
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG						0.1	3	0.2	200	0.1	6		
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Sensus Harden (1992)	-	N	FG	X	0.1	8	0.1	6			0.1	100			0.1	100
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X												
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X	0.1	6									0.1	4
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 31		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG													
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG		0.1	80			0.1	6	0.2	60				
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG													
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG													
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG				0.1	17							0.1	70
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG						0.1	3	0.1	20				
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A													
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A													
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG				0.1	40					0.1	25		
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG		0.1	200	0.1	16					0.1	29	0.1	90
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X												
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG													
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG		0.1	30									0.1	14
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG		3	1										
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG													
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG													
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG													
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG													
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	0.2	25	40	1200	0.1	3			2	29	0.2	15

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 31		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG													
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG													
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG		1	100	0.1	1	0.1	35	0.2	100	0.2	200	1.5	600
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG										0.1	2		
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X											0.1	30
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X												
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG													
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG		0.1	20							0.5	50	1	600
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG								0.1	2	0.1	3	0.1	24
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG													
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG				0.1	1								
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG												0.2	50
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG													
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG													
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A													
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG										0.1	10	0.1	8
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG		0.1	4										
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG		0.1	2							0.1	18		
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X												
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG		0.1	8	0.1	12								
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG		0.1	1										
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG													
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG													
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X											0.1	1
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A													

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 31		Plot 32		Plot 33		Plot 34		Plot 35		Plot 36	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-		9				0.5	900	1	80	1		7	

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 37		Plot 38		Plot 39		Plot 40		Plot 41		Plot 42	
						C	A	C	A	C	A	C	A	C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG				0.1	3								
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG													
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A													
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG													
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A													
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG													
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A													
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X												
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG													
Asteraceae	<i>Asteraceae</i>	-	N	FG													
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A													
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A													
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG													
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A													
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG													
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG													
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A													
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A													
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG													
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A													
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A													
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A													
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X												
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG													
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A													
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG						0.1	40						
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG													
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG													
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG													
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A													
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG													
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A													
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X			0.1	3	0.1	2						
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X												
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG													
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X												
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG													
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG						0.1	6						
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG				0.1	2	0.1	1			0.3	7		
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X			0.1	12	0.3	200			0.2	100		
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG													
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG													
Convolvulaceae	<i>Dichondra sp. A</i> Sensus Harden (1992)	-	N	FG	X					0.2	90						
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X												
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X												
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X									10	13		
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG		0.1	3										

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 37		Plot 38		Plot 39		Plot 40		Plot 41		Plot 42	
						C	A	C	A	C	A	C	A	C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG													
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG													
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG													
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG								0.1	3				
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG													
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A													
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG													
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG													
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG													
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG								0.1	20	0.1	8		
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG													
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG													
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A													
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG													
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X												
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG													
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A													
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG													
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG													
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A								0.1	8				
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A		0.1	6										
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG													
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG													
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG		0.1	50			0.1	200	0.1	100	0.1	50	0.1	40
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG													
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG													
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X												
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X												
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG													
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X			50									
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X												
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG													
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X							25				20	1
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X												
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X												
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG										0.1	30	0.1	16
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG													
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG													
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG													
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG		0.1	1							0.1	15		
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG													
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG													
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG													
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG													
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A													
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG								0.1	5				
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	1	20	0.1	20	1.5	100	0.3	100	0.4	30	3	300

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 37		Plot 38		Plot 39		Plot 40		Plot 41		Plot 42	
						C	A	C	A	C	A	C	A	C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG						0.1	4			0.1	40		
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X												
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG													
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG		3	700			0.2	200	0.1	50				
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG													
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG													
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X	0.1	20					0.1	10				
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X									20	1		
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG													
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG													
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG		0.1	4					0.2	50				
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG													
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG		0.1	11	0.1	2								
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG													
Poaceae	<i>Eragrostis sp.</i>	-	N	GG													
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A													
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG													
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG													
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG													
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG		0.1	11										
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A													
Poaceae	<i>Paspalidium distans</i>	-	N	GG													
Poaceae	<i>Poa sp. 1</i>	-	E	N/A													
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG													
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG													
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A													
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG													
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG													
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A													
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG		0.1	8										
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X												
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG													
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG												0.1	3
Proteaceae	<i>Hakea laevipes</i>	-	N	SG													
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X												
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG										0.1	20		
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X												
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X												
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG													
Solanaceae	<i>Solanum sp.</i>	-	N	FG													
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A													
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG													
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG													
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG													
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X	0.1	1	0.1	3			0.1	4			0.1	1
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A													
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X												
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG													
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A												0.1	60

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 37		Plot 38		Plot 39		Plot 40		Plot 41		Plot 42	
						C	A	C	A	C	A	C	A	C	A	C	A
Unknown	Undetermined exotic	-	E	N/A													
Unknown	Unidentified Forb B	-	N	FG													
Rubiaceae	Rubiaceae	-	N	SG													
Unknown	Unidentified Forb A	-	N	FG													
Unknown	Unidentified Forb C	-	N	FG													
Unidentified	unidentified species	-	-	-		5		0.5		5		5				4	

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 43		Plot 44	
						C	A	C	A
Acanthaceae	<i>Rostellularia adscendens</i>	-	N	FG					
Amaranthaceae	<i>Alternanthera sp.</i> A Flora of New South Wales (M.Gray 5187) J. Palmer	-	N	FG					
Amaranthaceae	<i>Gomphrena celosioides</i>	Gomphrena Weed	E	N/A					
Apiaceae	<i>Actinotus sp. 1</i>	-	N	FG					
Apiaceae	<i>Cyclospermum leptophyllum</i>	Slender Celery	E	N/A					
Apocynaceae	<i>Carissa ovata</i> (i.e. <i>Carissa spinarum</i>)	-	N	OG					
Apocynaceae	<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton B	E	N/A					
Apocynaceae	<i>Parsonsia eucalyptophylla</i>	Gargaloo	N	OG	X				
Apocynaceae	<i>Parsonsia sp. 1</i>	-	N	OG					
Asteraceae	<i>Asteraceae</i>	-	N	FG					
Asteraceae	<i>Asteraceae sp. 1</i>	-	E	N/A					
Asteraceae	<i>Asteraceae sp. 2</i>	-	E	N/A					
Asteraceae	<i>Calotis lappulacea</i>	Yellow Burr-daisy	N	FG					
Asteraceae	<i>Carthamus lanatus</i>	Saffron Thistle	HTE	N/A					
Asteraceae	<i>Cassinia arcuata</i>	Siffon Bush	N	SG					
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting, Ye	N	FG					
Asteraceae	<i>Cirsium vulgare</i>	Spear Thistle	E	N/A					
Asteraceae	<i>Gamochaeta sp. 1</i>	a Cudweed	E	N/A					
Asteraceae	<i>Glossocardia bidens</i>	Cobbler's Tack	N	FG					
Asteraceae	<i>Hypochaeris glabra</i>	Smooth Catsear	E	N/A					
Asteraceae	<i>Hypochaeris radicata</i>	Flatweed	E	N/A					
Asteraceae	<i>Lactuca serriola</i>	Prickly Lettuce	E	N/A					
Asteraceae	<i>Leiocarpa brevicompta</i>	Flat Billy-buttons	N	FG	X				
Asteraceae	<i>Ozothamnus cassinioides</i>	-	N	SG					
Asteraceae	<i>Senecio sp. 1</i>	a Fireweed	E	N/A					
Asteraceae	<i>Solenogyne bellioides</i>	-	N	FG					
Asteraceae	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	-	N	FG					
Asteraceae	<i>Vittadinia sp.</i>	-	N	FG					
Asteraceae	<i>Vittadinia sulcata</i>	-	N	FG					
Asteraceae	<i>Xanthium spinosum</i>	Bathurst Burr	HTE	N/A					
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Wonga Vine	N	OG					
Boraginaceae	<i>Heliotropium amplexicaule</i>	Blue Heliotrope	HTE	N/A					
Cactaceae	<i>Opuntia aurantiaca</i>	Tiger Pear	HTE	N/A	X				
Cactaceae	<i>Opuntia tomentosa</i>	Velvet Tree Pear	HTE	N/A	X				
Campanulaceae	<i>Wahlenbergia graniticola</i>	Granite Bluebell	N	FG					
Campanulaceae	<i>Wahlenbergia sp.</i>	-	N	FG	X				
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	N	FG					
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush	N	FG					
Chenopodiaceae	<i>Maireana microphylla</i>	Small-leaf Bluebush	N	SG					
Chenopodiaceae	<i>Sclerolaena birchii</i>	Galvanized Burr	N	SG	X				
Convolvulaceae	<i>Convolvulus erubescens</i>	Blushing Bindweed	N	OG					
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	N	FG					
Convolvulaceae	<i>Dichondra sp. A</i> Sensus Harden (1992)	-	N	FG	X				
Convolvulaceae	<i>Evolvulus alsinoides</i>	Dwarf Monring Glory	N	FG	X				
Cupressaceae	<i>Callitris endlicheri</i>	Black Cypress Pine	N	TG	X				
Cupressaceae	<i>Callitris glaucophylla</i>	White Cypress Pine	N	TG	X				
Cyperaceae	<i>Cyperus gracilis</i>	Slender Flat-sedge	N	GG					

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 43		Plot 44	
						C	A	C	A
Cyperaceae	<i>Schoenus sp. 1</i>	a Bog-rush	N	GG					
Ericaceae (Epacridoideae)	<i>Melichrus urceolatus</i>	Urn-heath	N	SG					
Euphorbiaceae	<i>Euphorbia dallachyana</i>	Mat Spurge	N	SG					
Euphorbiaceae	<i>Euphorbia drummondii</i>	Mat Spurge	N	FG					
Euphorbiaceae	<i>Euphorbia sp.</i>	-	N	FG					
Euphorbiaceae	<i>Euphorbia sp. 1</i>	-	E	N/A					
Fabaceae (Faboideae)	<i>Bossiaea scortechinii</i>	-	N	SG					
Fabaceae (Faboideae)	<i>Bossiaea sp.</i>	-	N	SG					
Fabaceae (Faboideae)	<i>Desmodium sp.</i>	-	N	FG					
Fabaceae (Faboideae)	<i>Desmodium varians</i>	Slender Tick-trefoil	N	OG		0.1	10	0.1	3
Fabaceae (Faboideae)	<i>Glycine clandestina</i>	-	N	OG		0.1	50		
Fabaceae (Faboideae)	<i>Hardenbergia violaceae</i>	Purple Coral Pea	N	OG					
Fabaceae (Faboideae)	<i>Rhynchosia minima</i>	-	N	OG					
Fabaceae (Faboideae)	<i>Trifolium sp. 1</i>	a Clover	E	N/A					
Fabaceae (Faboideae)	<i>Trifolium sp. 2</i>	a Clover	E	N/A					
Fabaceae (Faboideae)	<i>Zornia dyctiocarpa</i>	Zornia	N	FG					
Fabaceae (Mimosoideae)	<i>Acacia decora</i>	Western Silver Wattle, S	N	SG	X				
Fabaceae (Mimosoideae)	<i>Neptunia gracilis</i>	Native Sensitive Plant	N	FG					
Geraniaceae	<i>Geranium molle</i>	Cranesbill Geranium	E	N/A					
Goodeniaceae	<i>Goodenia sp. 1</i>	-	N	FG					
Haloragaceae	<i>Haloragis sp.</i>	-	N	FG					
Hypericaceae	<i>Hypericum sp.</i>	-	E	N/A					
Juncaceae	<i>Juncus sp.</i>	a Rush	E	N/A					
Lomandraceae	<i>Lomandra filiformis</i>	Wattle Mat-rush	N	GG					
Loranthaceae	<i>Amyema miquelii</i>	-	N	OG					
Malvaceae	<i>Sida corrugata</i>	Corrugated Sida	N	FG		0.1	10	0.1	3
Malvaceae	<i>Sida rhimbifolia</i>	Arrowleaf sida	N	FG		0.1	10		
Moraceae	<i>Ficus sp. 1</i>	a Fig	N	TG					
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple	N	TG	X	45			
Myrtaceae	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	N	TG	X				
Myrtaceae	<i>Corymbia sp.</i>	-	N	TG					
Myrtaceae	<i>Eucalyptus albens</i>	White Box	N	TG	X				
Myrtaceae	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	N	TG	X				
Myrtaceae	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	N	TG					
Myrtaceae	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	N	TG	X			5	1
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	N	TG	X			33	
Myrtaceae	<i>Eucalyptus prava</i>	Orange Gum	N	TG	X				
Nyctaginaceae	<i>Boerhavia dominii</i>	Tarvine	N	FG					
Oleaceae	<i>Notelaea longifolia</i>	Large-leaved Olive	N	TG					
Oleaceae	<i>Notelaea microcarpa</i>	Native Olive	N	TG		0.2	30	0.1	5
Oleaceae	<i>Notelaea sp.</i>	an olive	N	SG					
Oxalidaceae	<i>Oxalis perennans</i>	-	N	FG					
Phyllanthaceae	<i>Breynia sp.</i>	-	N	SG					
Phyllanthaceae	<i>Phyllanthus virgatus</i>	-	N	FG				0.1	1
Pittosporaceae	<i>Pittosporum spinescens</i>	Wallaby Apple	N	SG					
Plantaginaceae	<i>Plantago debilis</i>	-	N	FG		0.1	4	0.1	1
Plantaginaceae	<i>Plantago sp. 1</i>	a Plantain	E	N/A					
Poaceae	<i>Aristida leptopoda</i>	White Speargrass	N	GG					
Poaceae	<i>Aristida ramosa</i>	Purple Wiregrass	N	GG	X	10		0.1	

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 43		Plot 44	
						C	A	C	A
Poaceae	<i>Austrostipa scabra subsp. scabra</i>	Speargrass	N	GG					
Poaceae	<i>Austrostipa verticillata</i>	Slender Bamboo Grass	N	GG	X	20		10	
Poaceae	<i>Bothriochloa biloba</i>	-	N	GG					
Poaceae	<i>Bothriochloa decipiens</i>	Red Grass, Redleg Grass	N	GG					
Poaceae	<i>Chloris truncata</i>	Windmill Grass	N	GG					
Poaceae	<i>Chloris ventricosa</i>	Plump Windmill Grass	N	GG					
Poaceae	<i>Cymbopogon refractus</i>	Barbed Wire Grass	N	GG	X				
Poaceae	<i>Cynodon dactylon</i>	Couch, Bermudagrass	N	GG	X				
Poaceae	<i>Digitaria brownii</i>	Cotton Panic Grass	N	GG					
Poaceae	<i>Digitaria diffusa</i>	Open Summer-grass	N	GG					
Poaceae	<i>Enneapogon gracilis</i>	Slender Bottle-washers	N	GG					
Poaceae	<i>Entolasia stricta</i>	Wiry Panic	N	GG					
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass	N	GG					
Poaceae	<i>Eragrostis leptostachya</i>	Paddock Lovegrass	N	GG					
Poaceae	<i>Eragrostis sp.</i>	-	N	GG					
Poaceae	<i>Eragrostis sp. 1</i>	-	E	N/A					
Poaceae	<i>Eulalia aurea</i>	Sliky Browntop	N	GG					
Poaceae	<i>Heteropogon contortus</i>	Bunch Speargrass	N	GG					
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	N	GG		0.1			
Poaceae	<i>Panicum simile</i>	Two Colour Panic	N	GG					
Poaceae	<i>Panicum sp. 1</i>	a Panic Grass	E	N/A					
Poaceae	<i>Paspalidium distans</i>	-	N	GG					
Poaceae	<i>Poa sp. 1</i>	-	E	N/A					
Poaceae	<i>Sporobolus creber</i>	Western Rat-tail Grass	N	GG					
Poaceae	<i>Sporobolus elongatus</i>	Slender Rat's Tail Grass	N	GG					
Poaceae	<i>Sporobolus sp.</i>	-	E	N/A					
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	N	GG					
Poaceae	<i>Tripogon loliiformis</i>	Fiveminute Grass	N	GG					
Poaceae	<i>Urochloa panicoides</i>	Urochloa Grass, Liverse	E	N/A					
Polygonaceae	<i>Rumex brownii</i>	Swamp Dock	N	FG		0.1	4		
Polygonaceae	<i>Rumex sp.</i>	-	N	FG	X				
Portulacaceae	<i>Portulaca bicolor</i>	-	N	FG		0.1	2		
Portulacaceae	<i>Portulaca oleracea</i>	Pigweed	N	FG					
Proteaceae	<i>Hakea laevipes</i>	-	N	SG					
Pteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern	N	EG	X				
Pteridaceae	<i>Cheilanthes sieberi</i>	-	N	EG					
Rutaceae	<i>Geijera parviflora</i>	Wilga	N	SG	X				
Sapindaceae	<i>Dodonaea viscosa subsp. spatulata</i>	-	N	SG	X			0.1	3
Solanaceae	<i>Solanum ferocissimum</i>	Spiny Potato Bush	N	SG					
Solanaceae	<i>Solanum sp.</i>	-	N	FG					
Solanaceae	<i>Solanum sp. 1</i>	-	E	N/A					
Solanaceae	<i>Solanum sturtianum</i>	Thargomindah Nightsha	N	SG					
Stackhousiaceae	<i>Stackhousia viminea</i>	Slender Stackhousia	N	FG					
Thymelaeaceae	<i>Pimelea neo-anglica</i>	Poison Pimelea	N	SG		0.1	8	0.1	4
Thymelaeaceae	<i>Pimelea stricta</i>	-	N	SG	X				
Urticaceae	<i>Urtica urens</i>	Small Nettle	E	N/A		0.1	6		
Verbenaceae	<i>Glandularia aristigera</i>	Mayne's Pest	E	N/A	X				
Xanthorrhoeaceae	<i>Xanthorrhoea johnsonii</i>	Johnson's Grass Tree	N	OG					
Zygophyllaceae	<i>Tribulus terrestris</i>	Caltrop	E	N/A					

Family	Scientific Name	Common Name	N, E or THE	Growth Form	I	Plot 43		Plot 44	
						C	A	C	A
Unknown	Undetermined exotic	-	E	N/A					
Unknown	Unidentified Forb B	-	N	FG					
Rubiaceae	Rubiaceae	-	N	SG					
Unknown	Unidentified Forb A	-	N	FG					
Unknown	Unidentified Forb C	-	N	FG					
Unidentified	unidentified species	-	-	-					

Table H.7 Summary of Hollow Bearing Trees Observations

No	Latitude	Longitud	Scientific Name	Common Name	Type	DBH	No Hollows	Size (cm)	Notes
1	-29.1927	151.3394	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	15	-
2	-29.194	151.3394	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	S	-	1	20	-
3	-29.1943	151.3403	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	5	-
4	-29.1952	151.3413	<i>Angophora floribunda</i>	Rough-barked Apple	T	-	1	45	-
5	-29.1942	151.3419	<i>Angophora floribunda</i>	Rough-barked Apple	T	-	1	15	-
6	-29.1968	151.3438	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	30	-
7	-29.1972	151.3441	-	-	S	-	1	40	-
8	-29.1973	151.3444	-	-	S	-	1	40	-
9	-29.197	151.3446	-	-	S	-	1	-	Large top opening
10	-29.1982	151.3432	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	S	-	1	10	-
11	-29.2062	151.345	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	25	-
12	-29.2053	151.3453	-	-	S	-	1	25	-
13	-29.2098	151.3414	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	10	-
14	-29.2098	151.3415	-	-	S	-	1	35	-
15	-29.2056	151.3366	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	5	-
16	-29.2084	151.3373	-	-	S	-	1	10	-
17	-29.2095	151.3375	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	5	-
18	-29.2097	151.3378	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	10	-
19	-29.21	151.3331	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	T	-	1	20	-
20	-29.2095	151.3336	-	-	S	-	1	10	-
21	-29.2094	151.3335	-	-	S	-	1	5	-
22	-29.2093	151.3301	-	-	S	-	1	-	Split at base to 1.75m
23	-29.2086	151.3311	-	-	S	-	1	10	-
24	-29.2058	151.3318	-	-	S	-	1	5	-
25	-29.2014	151.3478	-	-	S	-	1	35	-
26	-29.2022	151.3479	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	35	-
27	-29.2018	151.3485	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	T	-	1	20	-
28	-29.2019	151.3485	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	T	-	1	25	-
29	-29.2019	151.3454	-	-	S	-	1	25	-
30	-29.2068	151.3424	<i>Eucalyptus moluccana</i>	Grey Box	S	-	1	40	-
31	-29.2073	151.3423	<i>Eucalyptus moluccana</i>	Grey Box	S	-	1	15	-
32	-29.205	151.3368	-	-	S	-	1	15	-
33	-29.1968	151.3401	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	15	-

No	Latitude	Longitud	Scientific Name	Common Name	Type	DBH	No Hollows	Size (cm)	Notes
34	-29.2095	151.3319	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	T	-	1	20	-
35	-29.194	151.3377	<i>Eucalyptus moluccana</i>	Grey Box	T	-	3	20	Largest hollow 20cm D
36	-29.194	151.3381	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	10	-
37	-29.1961	151.3387	<i>Eucalyptus moluccana</i>	Grey Box	S	-	1	30	-
38	-29.1977	151.3399	-	-	S	-	1	5	-
39	-29.1983	151.3399	<i>Eucalyptus moluccana</i>	Grey Box	S	80	1	30	-
40	-29.2005	151.3376	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	20	-
41	-29.2029	151.3369	<i>Eucalyptus moluccana</i>	Grey Box	T, S	-	1	10	-
42	-29.2022	151.336	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	15	-
43	-29.201	151.3385	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	10	-
44	-29.2022	151.3378	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T, S*	-	1	<10	-
45	-29.2095	151.332	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	30	-
46	-29.2018	151.3426	-	-	S	-	1	15	-
47	-29.2011	151.3451	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	15	-
48	-29.2016	151.3383	-	-	S	-	1	15	-
49	-29.2056	151.3399	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	40	Hollow at approx 6m above ground level
50	-29.2068	151.3395	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	7	-
51	-29.2087	151.3384	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	10	-
52	-29.2107	151.3358	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	10	-
53	-29.21	151.3415	<i>Corymbia dolichocarpa</i>	Long-fruited Bloodwood	T	-	1	30	-
54	-29.2077	151.3418	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	20	-
55	-29.2074	151.3411	-	-	T	-	1	15	-
56	-29.2071	151.3409	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	35	-
57	-29.2062	151.3415	-	-	T	-	1	10	-
58	-29.2063	151.3446	<i>Eucalyptus dealbata</i>	Tumbledown Red Gum	T	-	1	15	-
59	-29.2	151.344	<i>Eucalyptus melanophloia</i>	Silver-leaved Ironbark	T	-	1	15	-
60	-29.1996	151.3393	<i>Eucalyptus moluccana</i>	Grey Box	T	-	1	40	-

APPENDIX I MICROCHIROPTERAN BAT CALL REPORT



Microbat Call Identification Report

Prepared for ("Client"):	ERM
Survey location/project name:	Bonshaw area (NSW)
Survey dates:	10-14 December 2018
Client project reference:	0470861
Job no.:	ERM-1901
Report date:	22 February 2019

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Methods

Data received

Balance! Environmental received 8351 full-spectrum (WAV format) audio files, recorded using Song Meter SM2BAT detectors at seven sites (S2-S8) over four consecutive nights (10-13 December 2018). A file note included with the submitted data indicated that another site ("S1") was sampled but no data was obtained.

Call identification

Data were analysed in *Kaleidoscope Pro* (Version 5.1.7; Wildlife Acoustics, Maynard MA, USA). The first-pass analysis utilised the "Cluster Analysis" function, to scan all WAV files and automatically group recognised bat calls into clusters with similar call characteristics (based on zero-crossing analysis). Clusters were then assigned species identifications by manually reviewing call spectrograms and derived metrics and comparing them with those of regionally-relevant reference calls and/or with published call descriptions (Reinhold et al. 2001; Pennay *et al.* 2004). Consideration was also given to the probability of species' occurrence based on published distribution information (e.g. Churchill 2008; van Dyck *et al.* 2013) and on-line database records (e.g. <http://www.ala.org.au>).

Species identification was based largely on search-phase call sequences; however, where good-quality foraging sequences were available (*i.e.* a call sequence with contiguous search-phase, attack-phase and feeding-buzz components), those calls were used to provide additional evidence of some species' presence. The feeding buzzes of *Miniopterus* species (bent-winged bats) and some Molossids (free-tailed bats) are quite distinctive, compared with those of Vespertilionids (vesper bats) with which they often share search-phase characteristics (Corben 2010).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at <http://www.ausbats.org.au/>.

Species nomenclature follows Jackson & Groves (2015), which uses several new genus/species names compared with common field guides (e.g. Churchill 2008; Van Dyck *et al.* 2013). New names used in this report include:

Ozimops ridei (Ride's Free-tailed Bat) – formerly *Mormopterus ridei* and *M.* 'species 2';

O. petersi (Inland Free-tailed Bat) – formerly *M. petersi* and *M.* 'species 3';

O. planiceps (Southern free-tailed Bat) – formerly *M. planiceps* and *M.* 'species 4';

Setirostris eleryi (Bristle-faced Free-tailed Bat) – formerly *M. eleryi* and *M.* 'species 6'; and

Miniopterus orianae (Large or Eastern Bent-winged Bat) – formerly *M. schreibersii*.

Results & Discussion

Cluster analysis output

The Cluster Analysis recognised 7705 bat calls and grouped them into 54 clusters; however, many clusters contained slight variants of the same species' calls. Three-quarters of the recognised calls were positively identified, with the other 25% unable to be allocated reliably to a single species. These were assigned to "unresolved species" groups. A breakdown of the numbers of calls attributed to species or unresolved groups for each site is provided at **Appendix 1**.

Species recorded

At least 12 and up to 16 species were recorded during the Bonshaw survey (see **Table 1**). Eleven call types were positively identified to individual species, while one call type was attributed to the genus *Nyctophilus*, within which species cannot be reliably differentiated using call characteristics. Three *Nyctophilus* species potentially occur in the study area: *N. corbeni*; *N. geoffroyi*; and *N. gouldi*. Half (3907) of the total recorded calls were reliably attributed to just three species: *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat); *Ozimops ridei* (Eastern Free-tailed Bat); and *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat).

Several call types that potentially represented multiple species were allocated to "unresolved" species groups. Where calls were allocated to one these "unresolved" groups, all group members are listed as "possibly present" in **Table 1** unless other, more typical calls from one or more members were also observed for the relevant site. Three of the "unresolved" species groups included species that were not otherwise found in the positively-identified call data. These include:

- *Ozimops ridei* / *O. petersi* / *O. planiceps*
 - *O. ridei* was positively identified where calls had typical *Ozimops* pulse-shape characteristics (predominantly flat search-phase pulses) and characteristic frequency (Fc) of 30-35 kHz
 - Calls allocated to this "unresolved" group had similar pulse shapes but Fc 27-30 kHz
 - It is likely these were all low-frequency variants of *O. ridei*, but it is possible that *O. planiceps* and (remotely possible) *O. petersi* also occur in the study area
- *Vespadelus vulturnus* / *V. troughtoni*
 - *V. vulturnus* positively identified from numerous calls having typical steep, curvilinear pulses with hooked bodies (up-swept tail) and Fc ~46-48 kHz
 - A number of calls with the same typical *Vespadelus* pulse-shape had Fc ~48-50 kHz may have been from either of these species
- *Vespadelus* spp. / *Chalinolobus morio*
 - Calls were similar to above group but had mixed pulse shape and duration, varying from the shorter, hooked *Vespadelus* pulse-shape to longer, flatter pulse bodies with no tail or down-swept tail more typical of *C. morio*
 - *C. morio* calls were reliably identified only where all pulses showed consistent shape with flatter characteristic section and obvious down-swept tail

Sample spectrograms of all call-types are shown at Appendix 1.

Threatened species

Several of the identified species are listed as threatened under State and Commonwealth nature conservation legislation (Environment Protection and Biodiversity Conservation Act 1999 [EPBC Act] – Cwlth; Biodiversity Conservation Act 2016 [BCA] – New South Wales; Nature Conservation Act 1992 [NCA] – Queensland). These include:

- *Chalinolobus picatus* (Little Pied Bat) – Vulnerable, BCA
- *Nyctophilus corbeni* (Corben's Long-eared Bat) – Vulnerable, EPBC, BCA, NCA
 - Note that this species was not positively identified, but may have been responsible for some of the calls allocated to the *Nyctophilus* genus
- *Vespadelus troughtoni* (Eastern Cave Bat) – Vulnerable, BCA
 - Note that this species was not positively identified but may have been responsible for some of the unresolved calls allocated to two multi-species groups (see previous section)
- *Miniopterus orianae oceanensis* (Eastern Bent-winged Bat) – Vulnerable, BCA
- *Setirostris eleryi* (Bristle-faced Free-tailed Bat) – Endangered, BCA
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat) – Vulnerable, BCA

Table 1. Microbat species recorded during the ERM Bonshaw survey, 10-14 December 2018.

- ◆ = 'definite' - at least one call was attributed unequivocally to the species
 □ = 'possible' - calls like those of the species were recorded, but were not reliably identified

Site code:	S2	S3	S4	S5	S6	S7	S8
<i>Chalinolobus gouldii</i>	◆	◆	◆	◆	◆	◆	◆
<i>Chalinolobus morio</i>	◆	◆	◆	◆	◆	◆	◆
<i>Chalinolobus picatus</i>	◆	◆	◆	◆	□	◆	◆
<i>Nyctophilus</i> species	◆	◆	◆	◆	◆	◆	
<i>Scotorepens balstoni</i>	◆	◆	◆	◆	◆	◆	□
<i>Scotorepens greyii</i>	◆	◆	◆	◆	◆	◆	◆
<i>Vespadelus vulturus</i>	◆	◆	◆	◆	◆	◆	◆
<i>Vespadelus troughtoni</i>	□	□	□	□	□	□	□
<i>Miniopterus orianae oceanensis</i>	◆	◆	◆	◆	◆	◆	◆
<i>Austronomus australis</i>	◆	◆	◆	◆	◆	◆	◆
<i>Ozimops ridei</i>	◆	◆	◆	◆	◆	◆	◆
<i>Ozimops planiceps</i> / <i>O. petersi</i>	□	□	□	□	□	□	□
<i>Setirostris eleryi</i>	◆	◆	◆	◆	◆	◆	◆
<i>Saccolaimus flaviventris</i>	◆	◆	◆	◆	◆	◆	◆

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Glossary

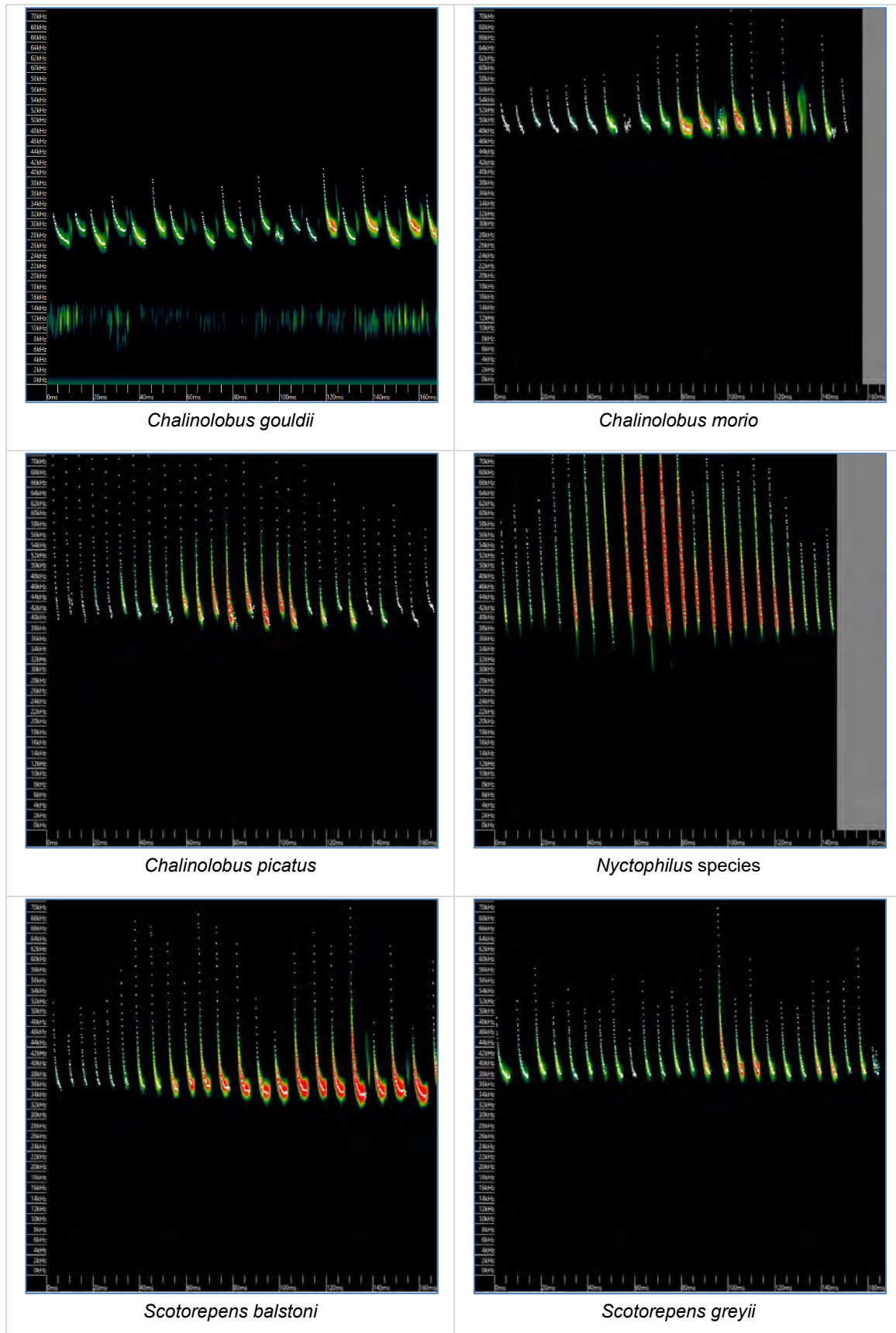
Technical terms used in this report are described in the following table.

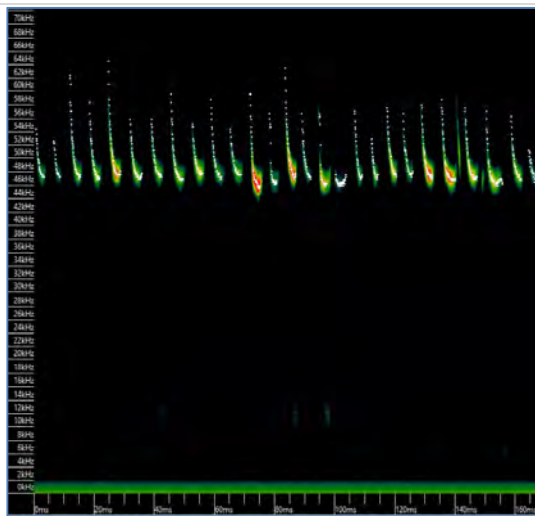
Approach phase	The part of a bat <i>call</i> emitted as the bat starts to home in on a detected prey item; a transitional series of <i>pulses</i> between the <i>search phase</i> and <i>feeding buzz</i> , that become progressively steeper and shorter in duration.
Call	Refers to a single bat call, made up of a series of individual sound <i>pulses</i> in one or more <i>phases</i> (<i>search, approach, feeding buzz</i>).
CF (=Constant Frequency)	A type of <i>pulse</i> in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with <i>shape</i> appearing flat on the sonogram. Often also contains a brief <i>FM</i> component at the beginning and/or end of the CF component (<i>viz.</i> FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a <i>pulse</i> ; usually the lowest frequency reached in the <i>qCF</i> component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a <i>pulse</i> to the end of the pulse.
Feeding buzz	The terminal part of a <i>call</i> , following the <i>approach phase</i> , emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of <i>pulse</i> in which there is substantial change in frequency from beginning to end; <i>shape</i> ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the <i>characteristic frequency</i> section of <i>pulses</i> within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a <i>pulse</i> sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a <i>pulse</i> between the initial (usually steeper) frequency sweep and the <i>characteristic frequency</i> section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat <i>call</i> ; the <i>shape, duration</i> and <i>characteristic frequency</i> of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the <i>pulse</i> between the <i>knee</i> and <i>tail</i> and containing the <i>characteristic frequency</i> section.
Pulse shape	The general appearance of a <i>pulse</i> on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also <i>CF, qCF</i> and <i>FM</i> .
qCF (=quasi Constant Frequency)	A type of <i>pulse</i> in which there is very little change in frequency from beginning to end; <i>shape</i> appears to be almost flat. Some pulses also contain an <i>FM</i> component at the beginning and/or end of the qCF component (<i>viz.</i> FM-qCF).
Search phase	The part of a bat <i>call</i> generally required for reliable species diagnosis. A consistent series of <i>pulses</i> emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than <i>approach phase</i> and <i>feeding buzz</i> pulses.
Sequence	Literally, a sequence of <i>pulses</i> that may be from one or more bats; but generally refers to a <i>call</i> or part (e.g. <i>phase</i>) of a call.
Tail	The final component of a <i>pulse</i> , following the <i>characteristic frequency</i> section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

Appendix 1 Bats recorded during the Bonshaw survey: number of calls allocated to each species or unresolved group.

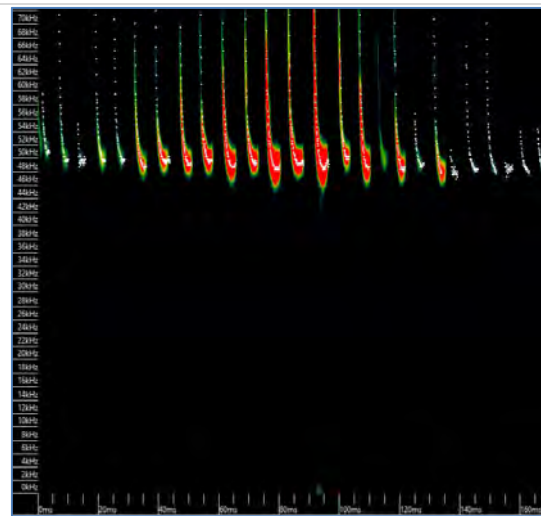
Site code:	S2	S3	S4	S5	S6	S7	S8	Species totals
Positively identified calls								
Chalinolobus gouldii	46	44	33	267	43	9	13	455
Chalinolobus morio	1	3	1	3	1	3	3	15
Chalinolobus picatus	10	12	3	54		5	7	91
Nyctophilus species	5	2	1	11	5	13		37
Scotorepens balstoni	2	1	2	15	12	2		34
Scotorepens greyii	19	6	32	273	17	8	18	373
Vespadelus vulturnus	11	8	15	62	2	7	3	108
Miniopterus orianae oceanensis	69	150	10	390	19	52	67	757
Austronomus australis	24	38	13	16	62	26	14	193
Ozimops ridei	351	227	98	440	216	163	158	1653
Setirostris eleryi	70	40	79	270	31	48	26	564
Saccolaimus flaviventris	343	491	104	377	79	30	73	1497
Unresolved calls								
C. gouldii/O. ridei	181	106	64	257	97	60	60	825
C. gouldii/S. balstoni	16	8	20	111	42	2	6	205
S. balstoni/O. ridei	26	11	4	44	9	4		98
S. greyii/C. picatus	1	5	4	31	3	5		49
S. greyii/S. eleryi		4	7	44	5	6		66
Ozimops species	59	31	15	31	25	31	34	226
V. vulturnus/M. o. oceanensis	32	27	10	75	5	13	3	165
V. vulturnus/V. trougtoni	11	10	117	66	10	10	5	229
V. vulturnus/V. trougtoni/C. morio	6	22	16	12	4	3	2	65
Total calls from site:	1283	1246	648	2849	687	500	492	7705

Appendix 2 Representative call sequences from the Bonshaw survey, 10-14 December 2018.
Kaleidoscope spectrograms with zero-crossing overlay (white); time between pulses removed

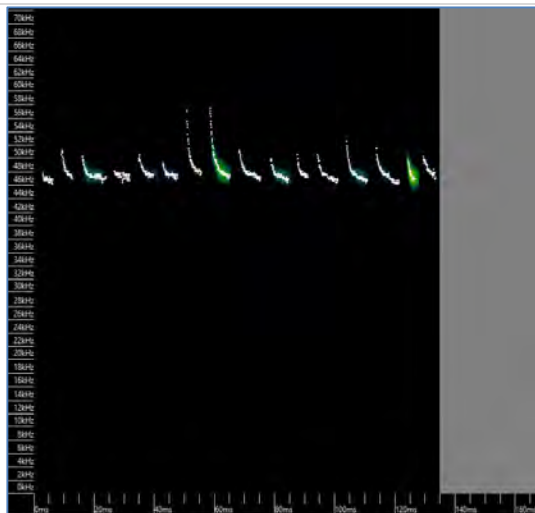




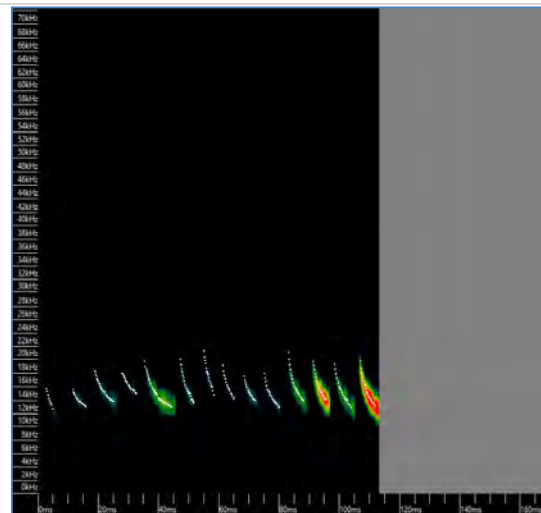
Vespadelus vulturnus



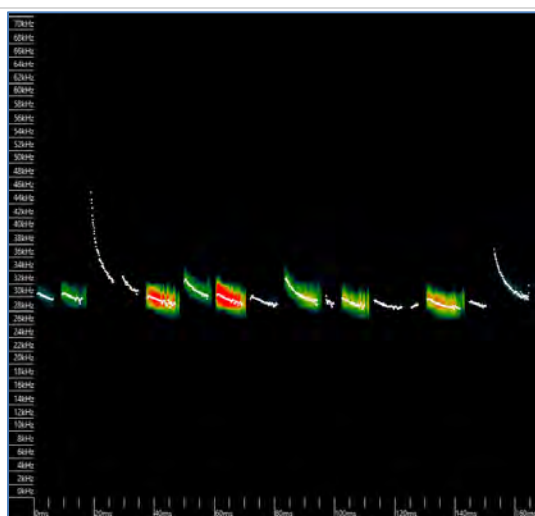
V. vulturnus / V. troughtoni



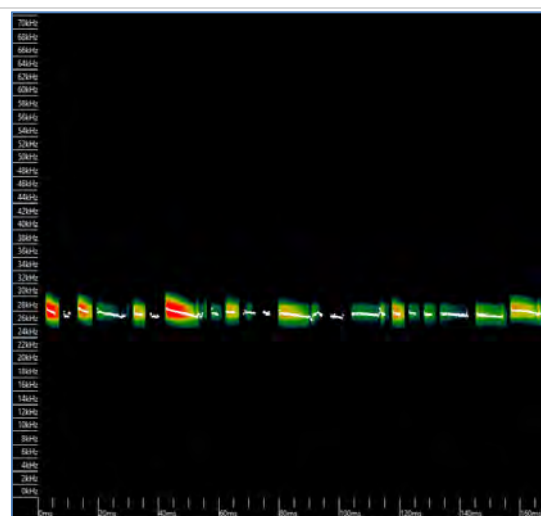
Miniopterus orianae oceanensis



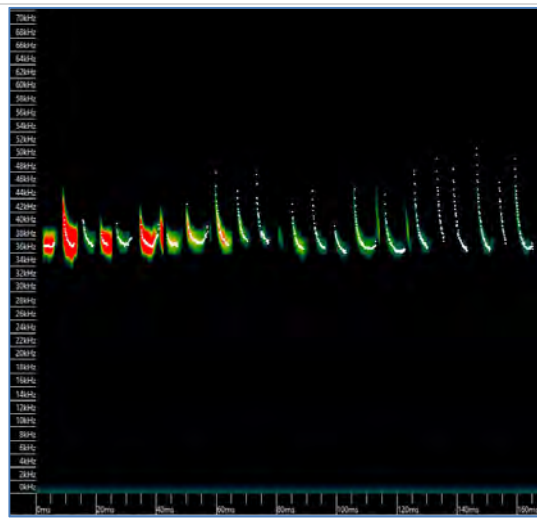
Austronomus australis



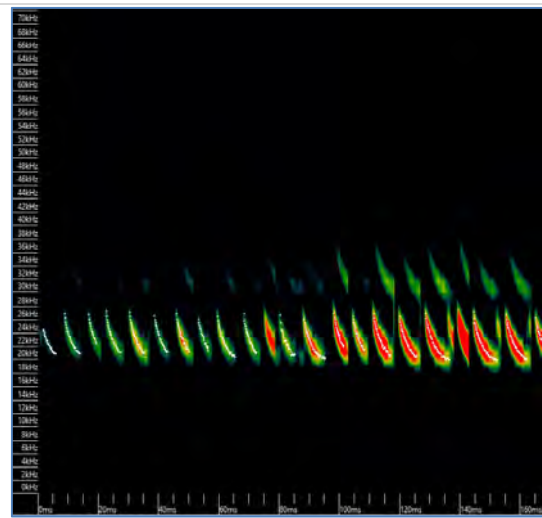
Ozimops ridei



O. ridei / O. petersi / O. planiceps



Setirostris eleryi



Saccolaimus flaviventris



Microbat Call Identification Report

Prepared for ("Client"):	ERM
Survey location/project name:	Bonshaw supplementary analysis
Survey dates:	10-14 December 2018
Client project reference:	0470861
Job no.:	ERM-1901
Report date:	15 April 2019

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Background

The initial results of bat-call analysis on the Bonshaw Solar Farm December 2018 data set were provided to ERM in the *Balance! Environmental* report dated 22 February 2019. That report indicated the presence of the Bristle-faced Free-tailed Bat (*Setirostris eleryi*) in the study area, with calls identified from every detector. Subsequent reporting by ERM was reviewed by the regulator (Office of Environment & Heritage), with feedback from an “OEH expert” suggesting that “...*Mormopterus eleryi* (a.k.a *Setirostris eleryi*) can’t be distinguished from *Scotorepens greyii* (Little Broad-nosed Bat) by Anabat call.”

Balance! Environmental was therefore requested by ERM to review the initial results and provide supporting evidence for the conclusion that *S. eleryi* was recorded during the Bonshaw surveys.

Approach

Overview

While it is accepted that the search-phase calls of *S. eleryi* and *S. greyii* are difficult to distinguish, Corben (2010) reported that the characteristics of foraging calls (i.e. sequence of “attack-phase” pulses followed immediately by “feeding buzz” pulses) can be used as a diagnostic tool to differentiate free-tailed bats from vespertilionid bats calling in the same frequency range. Unfortunately, where only zero-crossing type data are recorded (such as with ‘traditional’ Anabat detectors), feeding buzzes are often missed, or poorly represented in recorded calls. In full-spectrum data, however, such as that recorded at Bonshaw using Song Meter detectors, calls with feeding buzzes are much more obvious.

Analysis by *Balance! Environmental* of numerous full-spectrum data-sets from several regions where *S. eleryi* and *S. greyii* are known to co-exist has consistently found examples of two distinctive foraging sequence types that concur with the diagnostic descriptions of Corben (2010). An overview of these findings and promotion of the inclusion of feeding buzz analysis in call identification reporting was presented recently at the International Society of Ecoacoustics Congress (Ford 2018). Support for the use of this approach has also been received from several bat-call analysis experts based throughout eastern Australia.

Foraging call characteristics (after Corben 2010)

Vespertilionidae (“evening bats”) – see **Figure 1**

- **Attack-phase** has gradual increase in pulse characteristics of slope, characteristic frequency (Fc), maximum frequency (Fmax) and pulse repetition rate (PRR)
- **Feeding buzz (stage 1)** – similar pulse-shapes to attack, but rapid increase in PRR and marked drop in Fmax
- **Feeding buzz (stage 2)** – dramatic increase in PRR, further drop in Fmax, showing a tapered effect

Molossidae (“free-tailed bats”) – see **Figure 2**

- **Attack-phase** – gradual increase in pulse slope, Fc, Fmax and PRR

- **Feeding buzz (stage 1)** – absent or much reduced (few pulses) and similar to attack with increased PRR
- **Feeding buzz (stage 2)** – prominent with dramatic increase in PRR and sudden, significant drop in Fmax, which remains fairly constant through buzz, resulting in a “flat-topped” appearance of the buzz section.

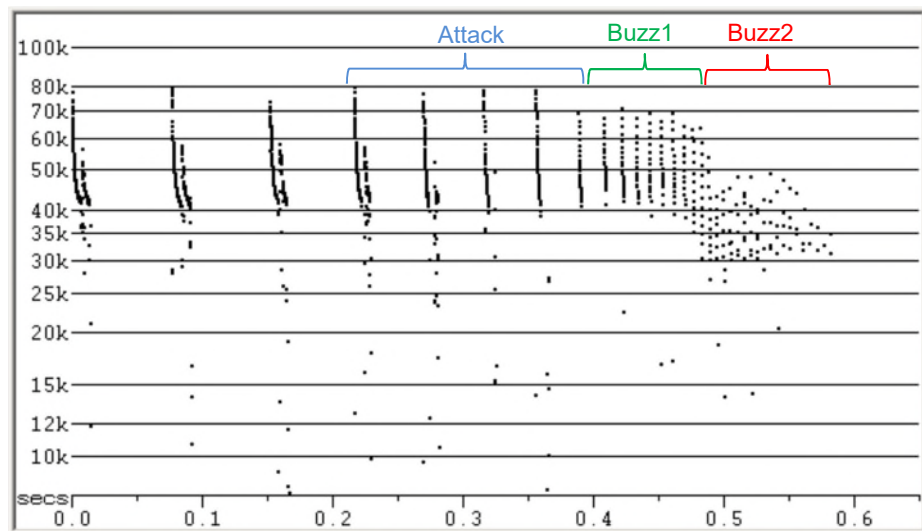


Figure 1 Foraging sequence of ‘typical’ vespertilionid bat (from Corben 2010).

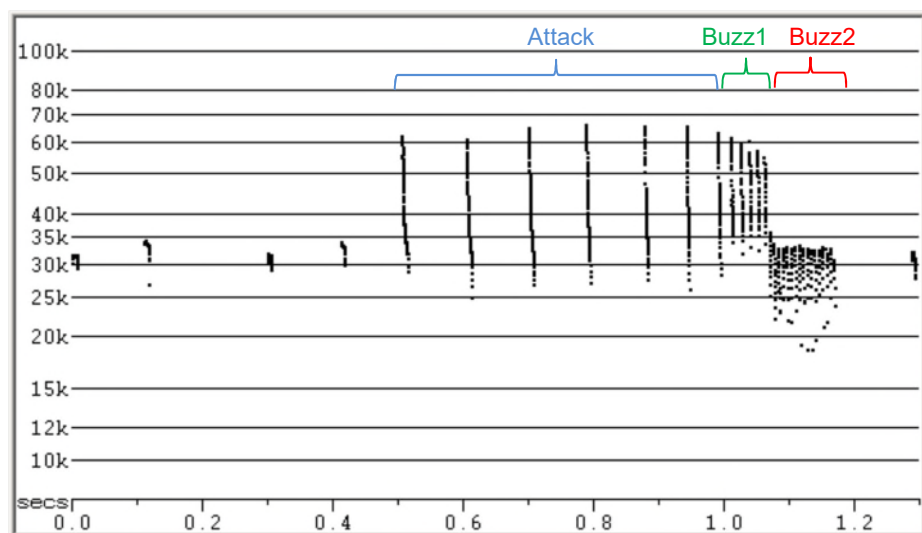


Figure 2 Foraging sequence of ‘typical’ molossid bat (from Corben 2010).

Method

The original data set (>8000 WAV files) was re-analysed with *Anabat Insight* (version 1.8.3; Titley Scientific, Brisbane), with the results for the relevant calls compared with the original results from the Cluster Analysis output from *Kaleidoscope*.

A two-step filtering process was applied with *Insight* to first exclude all non-bat noise from the data set and then select all calls within the relevant frequency range for *S. eleryi* and *S. greyii* (i.e. 35–41 kHz). Selected calls were then analysed manually by viewing spectrograms in *Insight* to search for calls containing attack-phase and feeding buzz sequences. These were allocated to the relevant species based on the characteristics described by Corben (2010).

Where foraging sequences were absent or only partially-recorded, species identity was allocated based on comparing search-phase pulse characteristics with the search-phase pulses present in those calls with foraging components.

Reference calls and published call descriptions (Reinhold et al. 2001; Pennay et al. 2004) were also used to support the call identifications, particularly for those calls that did not appear to belong to either of the target species.

Results & Discussion

Based on the more detailed analysis undertaken here, the *Kaleidoscope* cluster analysis process used for the original report resulted in erroneous species labels for some of the calls in the relevant frequency range. However, the supplementary analysis has confirmed the presence of both *S. eleryi* and *S. greyii*, with clear differentiation achieved using feeding buzz characteristics as well as search-phase differences derived from those components of the calls with positively-identified feeding buzzes. In addition to confirming these two species' presence, the revised analysis also identified the possible occurrence of two other threatened species that produce calls in the same frequency range: Eastern Falsistrelle (*Falsistrellus tasmaniensis*); and Hoary Wattled Bat (*Chalinolobus nigrogriseus*).

The *Insight* filtering process extracted 714 calls potentially belonging to *S. eleryi* or *S. greyii*. Identification of those calls revealed a total of 54 positive records of *S. eleryi*, 26 of which included definitive feeding buzz components. These were recorded on five of the seven detectors (S2, S4, S5, S6, S7). *Scotorepens greyii* was recorded on all detectors and contributed 352 of the observed calls, about 20% of which included reliable feeding buzzes. **Table 1** provides a breakdown of the numbers of calls allocated to each species per detector. Sample call spectrograms illustrating the characteristic feeding buzzes of each species are provided in **Figure 3 & Figure 4**; while **Figure 5** and **Figure 6** show typical search-phase pulses with clear differences in pulse-shapes on the spectrograms and also in the oscillogram trace of amplitude change through each pulse.

The large discrepancy between this and the previous analysis for number of calls attributed to *S. eleryi* is due mainly to the allocation of cluster identities in *Kaleidoscope* based on manual verification of only a sub-set of calls within each cluster. Evidently, some clusters contained numerous calls that varied substantially from the reviewed sub-set.

The erroneously identified calls from the *Kaleidoscope* analysis were mostly allocated to two unresolved species pairs in the supplementary analysis, viz. *S. greyii* / *Falsistrellus tasmaniensis* and *S. greyii* / *Chalinolobus nigrogriseus*. Sample calls allocated to these two entities are shown in **Figure 7** and **Figure 8**. It is likely that these calls all represented variants of *S. greyii*, but the NSW BioNet Atlas (<http://www.bionet.nsw.gov.au/>) contains records for both alternative species within about 30km of Bonshaw.

Table 1. Bonshaw bat survey, December 2018: supplementary analysis for *Setirostris eleryi*.

Number of calls identified to two species and two unresolved species groups in the 35-41 kHz range

Detector:	S2	S3	S4	S5	S6	S7	S8	Total
<i>Scotorepens greyii</i>	17	15	46	210	26	10	27	352
<i>Setirostris eleryi</i>	5		11	25	1	12		53
<i>S. greyii</i> or <i>Chalinolobus nigrogriseus</i>	7	14	26	28	3	18	9	105
<i>S. greyii</i> or <i>Falsistrellus tasmaniensis</i>	3	4	21	153	15	8		204

References

- Churchill, S. (2008). *Australian Bats*. Jacana Books, Allen & Unwin; Sydney.
- Corben, C. (2010). Feeding Buzzes. *Australasian Bat Society Newsletter* **35**, 40-44.
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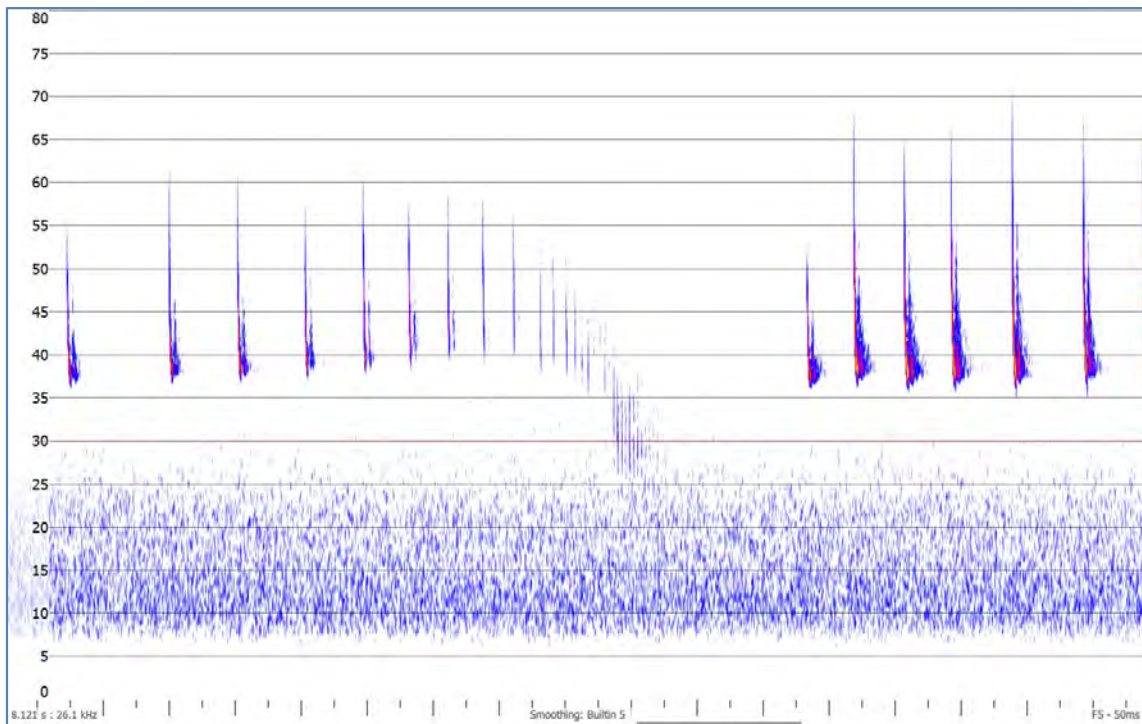


Figure 3 *Scotorepens greyii* call showing typical feeding buzz structure. WAV spectrogram in true-time mode at “F5” time expansion.

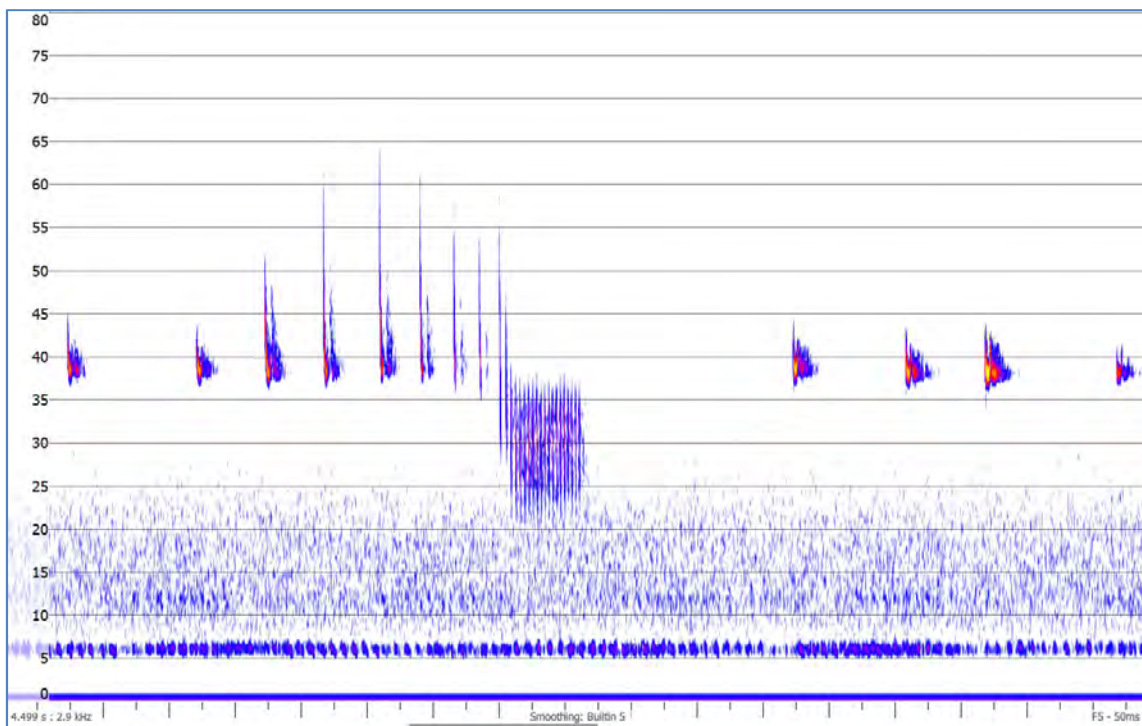


Figure 4 *Setirostris eleryi* call showing typical feeding buzz structure. WAV spectrogram in true-time mode at “F5” time expansion.

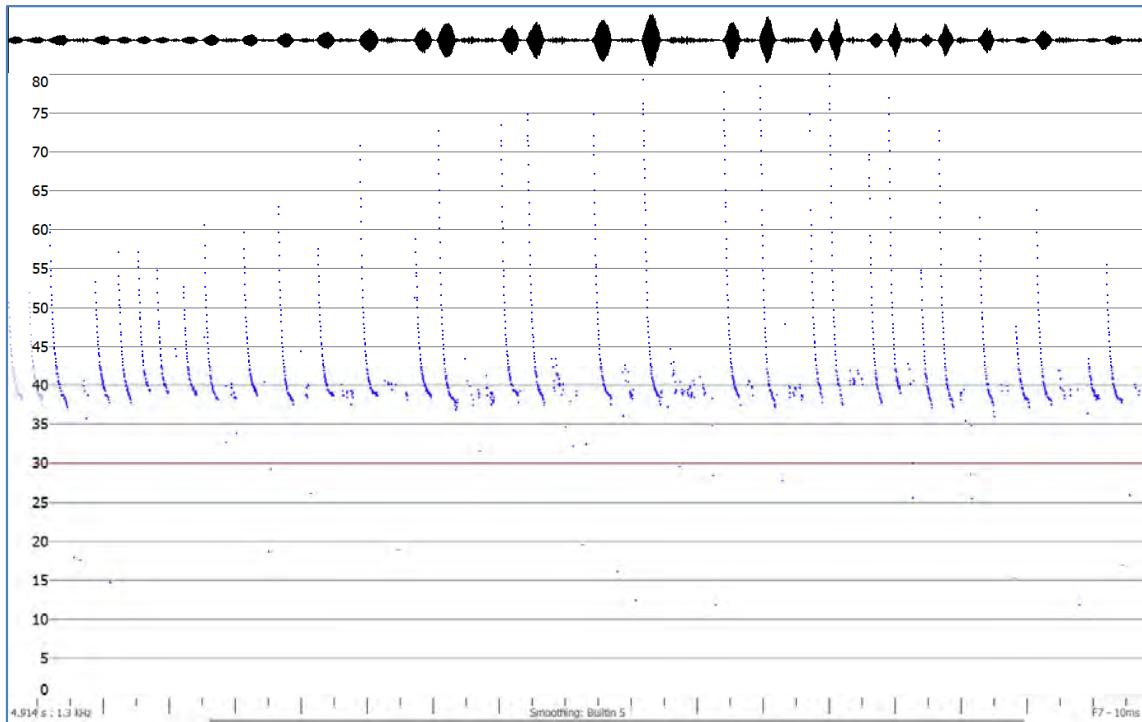


Figure 5 *Scotorepens greyii* call without feeding buzz, showing typical search-phase pulse structure. ZC spectrogram in compressed-time mode at "F7" time expansion.

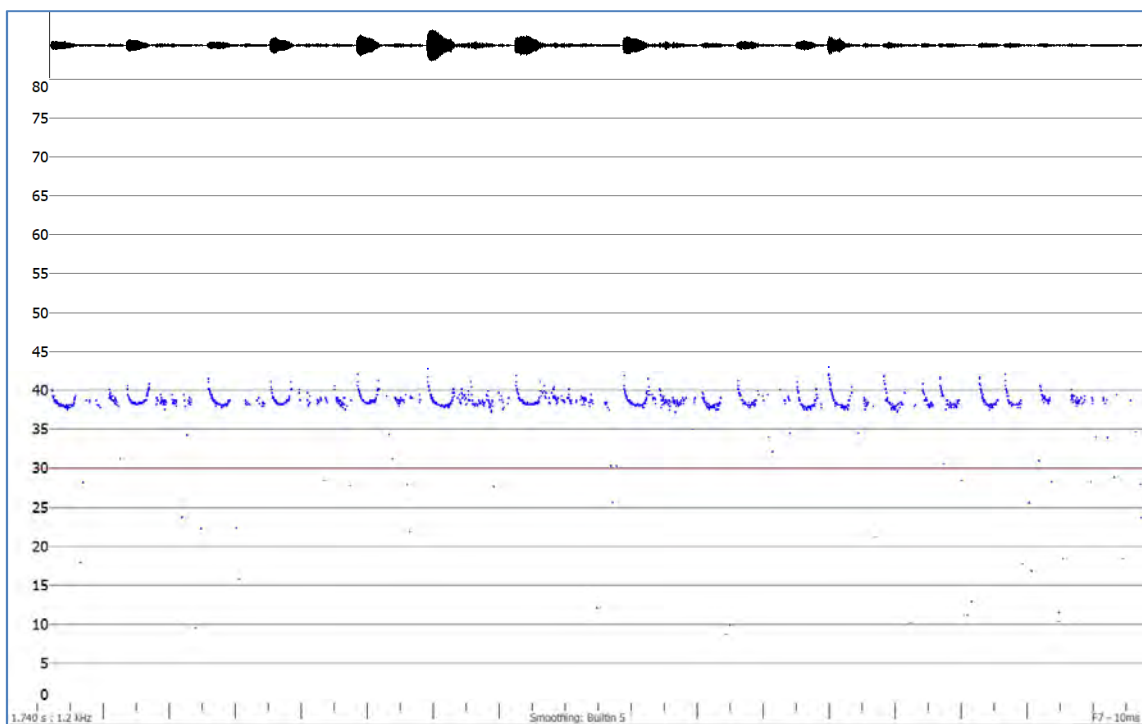


Figure 6 *Setirostris eleryi* call without feeding buzz, showing typical search-phase pulse structure. ZC spectrogram in compressed-time mode at "F7" time expansion.

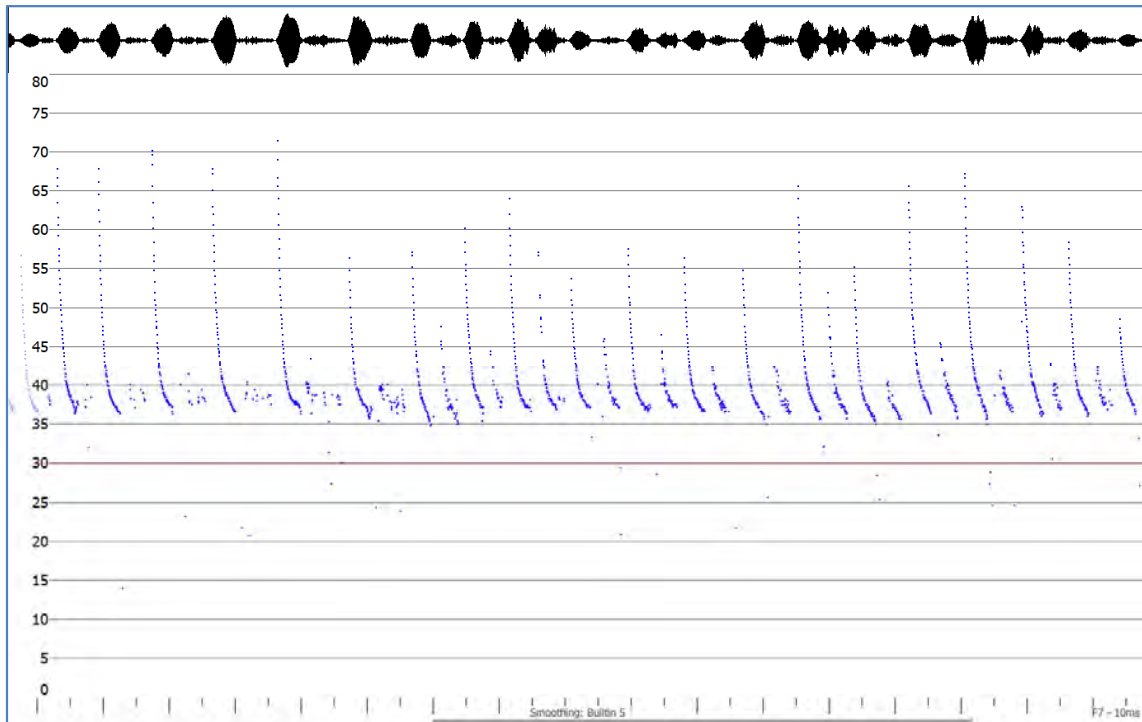


Figure 7 Unresolved call potentially attributable to *Falsistrellus tasmaniensis* but may also represent *Scotorepens greyii* flying in 'cluttered' air-space. ZC spectrogram in compressed-time mode at "F7" time expansion.

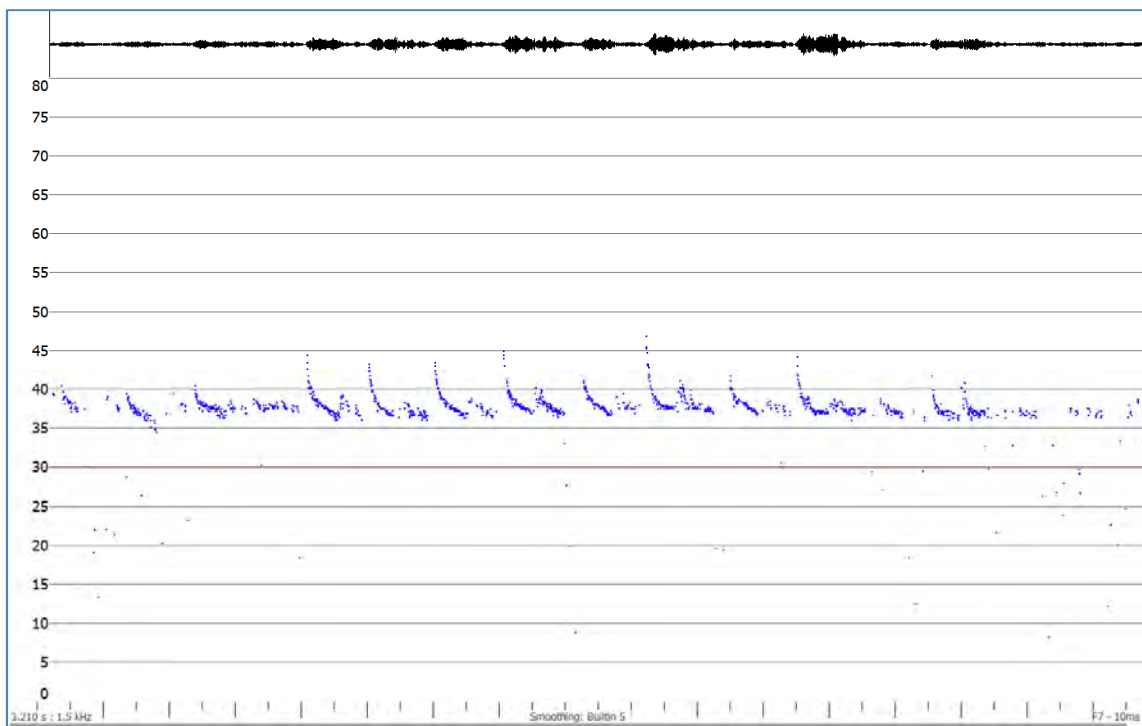


Figure 8 Unresolved call potentially attributable to *Chalinolobus nigrogriseus* but may also represent *Scotorepens greyii* flying in very open, uncluttered air-space. ZC spectrogram in compressed-time mode at "F7" time expansion.

Glossary

Technical terms used in this report are described in the following table.

Approach phase	The part of a bat <i>call</i> emitted as the bat starts to home in on a detected prey item; a transitional series of <i>pulses</i> between the <i>search phase</i> and <i>feeding buzz</i> , that become progressively steeper and shorter in duration.
Call	Refers to a single bat call, made up of a series of individual sound <i>pulses</i> in one or more <i>phases</i> (<i>search, approach, feeding buzz</i>).
CF (=Constant Frequency)	A type of <i>pulse</i> in which the dominant component consists of a more-or-less 'pure tone' of sound at a Constant Frequency; with <i>shape</i> appearing flat on the sonogram. Often also contains a brief <i>FM</i> component at the beginning and/or end of the CF component (viz. FM-CF-FM).
Characteristic frequency (Fc)	The frequency of the flattest part of a <i>pulse</i> ; usually the lowest frequency reached in the <i>qCF</i> component of a pulse. This is often the primary diagnostic feature for species identification.
Duration	The time period from the beginning of a <i>pulse</i> to the end of the pulse.
Feeding buzz	The terminal part of a <i>call</i> , following the <i>approach phase</i> , emitted as the bat catches a prey item; a distinctive, rapid series of very steep, very short-duration pulses.
FM (=Frequency Modulated)	A type of <i>pulse</i> in which there is substantial change in frequency from beginning to end; <i>shape</i> ranges from almost vertical and linear through varying degrees of curvature.
FC range	Refers to the range of frequencies occupied by the <i>characteristic frequency</i> section of <i>pulses</i> within a call or set of calls.
Frequency sweep or "band-width"	The range of frequencies through which a <i>pulse</i> sweeps from beginning to end; Maximum frequency (Fmax) – minimum frequency (Fmin).
Knee	The transitional part of a <i>pulse</i> between the initial (usually steeper) frequency sweep and the <i>characteristic frequency</i> section (usually flatter); time to knee (Tk) and frequency of knee (Fk) can be diagnostic for some species.
Pulse	An individual pulse of sound within a bat <i>call</i> ; the <i>shape, duration</i> and <i>characteristic frequency</i> of a pulse are the key diagnostic features used to differentiate species.
Pulse body	The part of the <i>pulse</i> between the <i>knee</i> and <i>tail</i> and containing the <i>characteristic frequency</i> section.
Pulse shape	The general appearance of a <i>pulse</i> on the sonogram, described using relative terms related to features such as slope and degree of curvature. See also <i>CF, qCF</i> and <i>FM</i> .
qCF (=quasi Constant Frequency)	A type of <i>pulse</i> in which there is very little change in frequency from beginning to end; <i>shape</i> appears to be almost flat. Some pulses also contain an <i>FM</i> component at the beginning and/or end of the qCF component (viz. FM-qCF).
Search phase	The part of a bat <i>call</i> generally required for reliable species diagnosis. A consistent series of <i>pulses</i> emitted by a bat that is searching for prey or and/or navigating through its habitat. Search phase pulses generally have longer duration, flatter slope and more consistent shape than <i>approach phase</i> and <i>feeding buzz</i> pulses.
Sequence	Literally, a sequence of <i>pulses</i> that may be from one or more bats; but generally refers to a <i>call</i> or part (e.g. <i>phase</i>) of a call.
Tail	The final component of a <i>pulse</i> , following the <i>characteristic frequency</i> section; may consist of a short or long sweep of frequencies either upward or downward from the Fc; or may be absent.

APPENDIX J BAM REPORTS – VEGETATION INTEGRITY ASSESSMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015157/BAAS18113/19/00015159	Bonshaw Solar Farm	26/11/2019
Assessor Name	Report Created	BAM Data version *
Matt Jenkins	17/03/2020	22
Assessor Number	BAM Case Status	Date Finalised
BAAS18029	Open	To be finalised
Assessment Revision	Assessment Type	
1	Part 4 Developments (General)	

* 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 SAI	Ecosystem credits
Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion								
1	516_Very_Low	20.7	3.0	0.25	High Sensitivity to Potential Gain	2.00		31
2	516_Derived_Moderate	24.7	2.8	0.25	High Sensitivity to Potential Gain	2.00		34

BAM Credit Summary Report

3	516_Disturbed_Grassland	15.8	7.4	0.25	High Sensitivity to Potential Gain	2.00		0
						Subtotal		65
Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion								
12	544_Low	35.0	0.8	0.25	High Sensitivity to Potential Gain	2.00	TRUE	15
						Subtotal		15
Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion								
4	594_Moderate	61.3	4.1	0.25	High Sensitivity to Potential Gain	1.75		110
5	594_Low	33.3	9.5	0.25	High Sensitivity to Potential Gain	1.75		139
6	594_Disturbed_Grassland	11.8	49.8	0.25	High Sensitivity to Potential Gain	1.75		0
						Subtotal		249
Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion								
7	596_Moderate	62.6	11.2	0.25	High Sensitivity to Potential Gain	1.50		262
8	596_Low	38.2	0.3	0.25	High Sensitivity to Potential Gain	1.50		4
9	596_Very_Low	23.6	0.3	0.25	High Sensitivity to Potential Gain	1.50		3
10	596_Derived_Low	8.0	9.0	0.25	High Sensitivity to Potential Gain	1.50		0

BAM Credit Summary Report

11	596_Disturbed_Grassland	5.6	50.6	0.25	High Sensitivity to Potential Gain	1.50		0
							Subtotal	269
							Total	598

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAIL	Species credits
<i>Ninox connivens</i> / Barking Owl (Fauna)						
516_Very_Low	20.7	3	0.25	2	False	31
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159
596_Moderate	62.6	11.15	0.25	2	False	349
544_Low	35.0	0.83	0.25	2	False	15
					Subtotal	680
<i>Setirostris eleryi</i> / Bristle-faced Free-tailed Bat (Fauna)						
516_Very_Low	20.7	3	0.25	2	False	31
516_Disturbed_Grassland	15.8	7.39	0.25	2	False	58
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159

BAM Credit Summary Report

594_Disturbed_Grassland	11.8	49.81	0.25	2	False	293
596_Moderate	62.6	11.15	0.25	2	False	349
596_Low	38.2	0.25	0.25	2	False	5
596_Very_Low	23.6	0.3	0.25	2	False	4
596_Disturbed_Grassland	5.6	50.34	0.25	2	False	140
544_Low	35.0	0.83	0.25	2	False	15
Subtotal						1180
<i>Tyto novaehollandiae / Masked Owl (Fauna)</i>						
516_Very_Low	20.7	3	0.25	2	False	31
594_Moderate	61.3	4.1	0.25	2	False	126
594_Low	33.3	9.54	0.25	2	False	159
596_Moderate	62.6	11.15	0.25	2	False	349
544_Low	35.0	0.83	0.25	2	False	15
Subtotal						680
<i>Vespadelus troughtoni / Eastern Cave Bat (Fauna)</i>						
516_Very_Low	20.7	3	0.25	3	True	46
594_Moderate	61.3	4.1	0.25	3	True	189
594_Low	33.3	9.54	0.25	3	True	238
596_Moderate	62.6	11.15	0.25	3	True	523



BAM Credit Summary Report

596_Low	38.2	0.25	0.25	3 True	7
596_Very_Low	23.6	0.3	0.25	3 True	5
544_Low	35.0	0.83	0.25	3 True	22
				Subtotal	1030

APPENDIX K BAM CALCULATOR CREDIT REPORT



BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00015157/BAAS18113/19/00015159	Bonshaw Solar Farm	26/11/2019
Assessor Name	Assessor Number	BAM Data version *
Matt Jenkins	BAAS18029	22
Proponent Names	Report Created	BAM Case Status
GAIA Australia	17/03/2020	Open
Assessment Revision	Assessment Type	Date Finalised
1	Part 4 Developments (General)	To be finalised

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
White Box Yellow Box Blakely's Red Gum Woodland	Endangered Ecological Community	544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion

Species
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat
Vespadelus troughtoni / Eastern Cave Bat

BAM Biodiversity Credit Report (Like for like)

Vespadelus troughtoni / Eastern Cave Bat

Vespadelus troughtoni / Eastern Cave Bat

Vespadelus troughtoni / Eastern Cave Bat

Vespadelus troughtoni / Eastern Cave Bat

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

Predicted Threatened Species Not On Site

Name

Calyptorhynchus lathami / Glossy Black-Cockatoo

Haliaeetus leucogaster / White-bellied Sea-Eagle

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	Number of credits to be retired
516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Not a TEC	13.2	65.00
594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Not a TEC	63.5	249.00

BAM Biodiversity Credit Report (Like for like)

596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Not a TEC	71.1	269.00
544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	White Box Yellow Box Blakely's Red Gum Woodland	0.8	15.00

516-Grey Box grassy woodland or open forest of the Nandewar Bioregion and New England Tableland Bioregion	Like-for-like credit retirement options			
	Class	Trading group	HBT	IBRA region
	Western Slopes Grassy Woodlands This includes PCT's: 201, 202, 266, 267, 274, 275, 276, 277, 278, 280, 282, 283, 286, 301, 337, 383, 426, 433, 437, 441, 444, 483, 509, 516, 589, 590, 593, 599, 847, 955, 1303, 1304, 1315, 1329, 1383, 1695	Western Slopes Grassy Woodlands - $\geq 70\%$ - $<90\%$ cleared group (including Tier 4 or higher).	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

544-Rough-barked Apple - White Cypress Pine - Blakely's Red Gum riparian open forest / woodland of the Nandewar Bioregion and New England Tableland Bioregion	Like-for-like credit retirement options			
	Name of offset trading group	Trading group	HBT	IBRA region
	White Box Yellow Box Blakely's Red Gum Woodland This includes PCT's: 2, 74, 75, 83, 250, 266, 267, 268, 270, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 298, 302, 312, 341, 342, 347, 350, 352, 356, 367, 381, 382, 395, 403, 421, 433, 434, 435, 436, 437, 451, 483, 484, 488, 492, 496, 506, 508, 509, 510, 511, 528, 538, 544, 563, 567, 571, 589, 590, 597, 599, 618, 619, 622, 633, 654, 702, 703, 704, 705, 710, 711, 796, 797, 799, 840, 847, 851, 921, 1099, 1103, 1303, 1304, 1307, 1324, 1329, 1330, 1331, 1332, 1333, 1334, 1383, 1401, 1512, 1601, 1606, 1608, 1611, 1691, 1693, 1695, 1698	-	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

594-Silver-leaved Ironbark - White Cypress Pine shrubby open forest of Brigalow Belt South Bioregion and Nandewar Bioregion	Like-for-like credit retirement options			
	Class	Trading group	HBT	IBRA region
	North-west Slopes Dry Sclerophyll Woodlands This includes PCT's: 228, 429, 435, 517, 527, 529, 564, 588, 594, 595, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1586, 1607	North-west Slopes Dry Sclerophyll Woodlands - ≥ 50% - < 70% cleared group (including Tier 6 or higher).	Yes	Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
596-Tumbledown Red Gum - White Cypress Pine - Silver-leaved Ironbark shrubby woodland mainly in the northern Nandewar Bioregion	Like-for-like credit retirement options			
	Class	Trading group	HBT	IBRA region

BAM Biodiversity Credit Report (Like for like)

	<p>North-west Slopes Dry Sclerophyll Woodlands</p> <p>This includes PCT's:</p> <p>228, 380, 381, 382, 384, 385, 386, 389, 390, 391, 393, 394, 412, 413, 418, 429, 432, 435, 453, 506, 517, 527, 529, 543, 549, 555, 562, 563, 564, 573, 587, 588, 591, 594, 595, 596, 597, 598, 856, 1165, 1306, 1308, 1317, 1387, 1560, 1586, 1587, 1605, 1606, 1607, 1611, 1613</p>	<p>North-west Slopes Dry Sclerophyll Woodlands - < 50% cleared group (including Tier 7 or higher).</p>	Yes	<p>Nandewar Northern Complex, Binghi Plateau, Inverell Basalts, Northern Basalts, Severn River Volcanics, Stanthorpe Plateau and Tenterfield Plateau.</p> <p>or</p> <p>Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.</p>

Species Credit Summary

Species	Area	Credits
Ninox connivens / Barking Owl	28.6	680.00
Setirostris eleryi / Bristle-faced Free-tailed Bat	136.7	1180.00
Tyto novaehollandiae / Masked Owl	28.6	680.00
Vespadelus troughtoni / Eastern Cave Bat	29.2	1030.00

Ninox connivens / Barking Owl	516_Very_Low	Like-for-like credit retirement options	
		Spp	IBRA region

BAM Biodiversity Credit Report (Like for like)

		Ninox connivens /Barking Owl	Any in NSW
	544_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Ninox connivens /Barking Owl	Any in NSW
	594_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Ninox connivens /Barking Owl	Any in NSW
	594_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Ninox connivens /Barking Owl	Any in NSW

BAM Biodiversity Credit Report (Like for like)

	596_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Ninox connivens /Barking Owl	Any in NSW
Setirostris eleryi / Bristle-faced Free-tailed Bat	516_Disturbed_Grass land	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi /Bristle-faced Free-tailed Bat	Any in NSW
	516_Very_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi /Bristle-faced Free-tailed Bat	Any in NSW
	544_Low	Like-for-like credit retirement options	
		Spp	IBRA region

BAM Biodiversity Credit Report (Like for like)

		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Disturbed_Grass land	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	594_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW

BAM Biodiversity Credit Report (Like for like)

	596_Disturbed_Grass land	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi /Bristle-faced Free-tailed Bat	Any in NSW
	596_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi /Bristle-faced Free-tailed Bat	Any in NSW
	596_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Setirostris eleryi /Bristle-faced Free-tailed Bat	Any in NSW
	596_Very_Low	Like-for-like credit retirement options	

BAM Biodiversity Credit Report (Like for like)

Tyto novaehollandiae/ Masked Owl		Spp	IBRA region
		Setirostris eleryi/Bristle-faced Free-tailed Bat	Any in NSW
	516_Very_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	544_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	594_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Tyto novaehollandiae/ Masked Owl	594_Low		
	594_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
	596_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Tyto novaehollandiae/Masked Owl	Any in NSW
Vespadelus trougtoni/ Eastern Cave Bat	516_Very_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus trougtoni/Eastern Cave Bat	Any in NSW

BAM Biodiversity Credit Report (Like for like)

Vespadelus troughtoni/ Eastern Cave Bat	544_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	594_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus troughtoni/Eastern Cave Bat	Any in NSW
	596_Low	Like-for-like credit retirement options	
		Spp	IBRA region

BAM Biodiversity Credit Report (Like for like)

		Vespadelus troughtoni /Eastern Cave Bat	Any in NSW
	596_Moderate	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus troughtoni /Eastern Cave Bat	Any in NSW
	596_Very_Low	Like-for-like credit retirement options	
		Spp	IBRA region
		Vespadelus troughtoni /Eastern Cave Bat	Any in NSW

APPENDIX L PERSONNEL

Personnel involved in preparation of this BDAR and their contribution is summarised in Table L1 below.

Table L.1 Summary of Personnel and Duties

Name	Position	Tasks and Responsibilities
Joanne Woodhouse	Principal Ecologist and Project Manager	<ul style="list-style-type: none"> ■ Project Management including liaison with client, BCD and other stakeholders ■ Technical review ■ Bird survey and BAM plot support (Spring 2018)
Matt Jenkins North Coast Ecology	Project Ecologist Accredited BAM Assessor	<ul style="list-style-type: none"> ■ Field ecologist: Summer 2020 survey ■ Additional field work design and BAM plots ■ Report writing and BAM Calculator report to support Response to Submission (RTS) and revised BDAR
Dr Adriana Corona Mothe	Field Ecologist Accredited BAM Assessor	<ul style="list-style-type: none"> ■ Field ecologist: fauna survey and BAM plots (2018-2019 survey periods) ■ Field work design and BAM plots ■ Report writing and BAM Calculator reports to support EIS submission
Tom Cotter	Biodiversity and GIS Consultant	<ul style="list-style-type: none"> ■ Field Ecologist: fauna and BAM plots (summer 2018). ■ Vegetation mapping, species polygon ■ Draft figures
Dr Toivo Zoete	Senior Environmental Consultant	<ul style="list-style-type: none"> ■ Flora assessment in the 20m x 20m sub-plot of BAM plots (Autumn 2019).
Georgina Race	GIS Consultant	<ul style="list-style-type: none"> ■ Vegetation mapping and area calculations ■ GIS Support
Viet Nguyen	GIS Consultant	<ul style="list-style-type: none"> ■ GIS Support ■ Vegetation area calculations ■ Figure preparation
Danielle Robinson	GIS Consultant	<ul style="list-style-type: none"> ■ GIS Support ■ Field figure preparation ■ Field map layers preparation

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APPENDIX D UPDATED CULTURAL HERITAGE ASSESSMENT



GAIA Australia

Bonshaw Solar Farm

Cultural Heritage Assessment

13 February 2020

Project No.: 0464261

Document details	
Document title	Bonshaw Solar Farm
Document subtitle	Cultural Heritage Assessment
Project No.	0464261
Date	13 February 2020
Version	3.0
Author	Katherine Deverson
Client Name	GAIA Australia

Document history

Version	Revision	Author	Reviewed by	ERM approval to issue		Comments
				Name	Date	
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Final	03	Stephanie Moore	Erin Finnegan	David Dique	13 February 2020	Response to Submission

Signature Page

13 February 2020

Bonshaw Solar Farm

Cultural Heritage Assessment



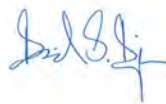
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Acronyms and Abbreviations

AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
BP	Before Present
BSS	Battery Storage System
Burra Charter	The Australia ICOMOS Charter for Places of Cultural Significance
CHA	Cultural Heritage Assessment
CHL	Commonwealth Heritage List
CIV	Capital Investment Value
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECCW	Department of Environment, Climate Change and Water
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERM	Environmental Resources Management Australia Pty Ltd
ESD	Ecologically Sustainable Development
GAIA	GAIA Australia
IHO	Interim Heritage Orders
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
MW	Megawatts
MWh	Megawatt hour
NNTT	National Native Title Tribunal
NP&W Act	National Parks and Wildlife Act 1974
NPWS	NSW National Parks and Wildlife Service
NTS Corp	Native Title Services corporation
OEH	Office of Environment and Heritage
PA	Project Area
PAD	Potential Archaeological Deposit
PV	Photovoltaic
QA	Quality Assurance
RAP	Registered Aboriginal Party
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
SHR	State Heritage Register
SSD	State Significant Development
SU	Survey Unit

1. INTRODUCTION

1.1 Overview

ERM was commissioned to undertake a heritage assessment to support an Environmental Impact Statement (EIS) being prepared for the proposed Bonshaw Solar Farm (the 'Project'), located off the Bruxner Highway, Bonshaw NSW.

This work has been conducted to conform to the Secretary's Environmental Assessment Requirements (SEARs) for the Project. In line with the SEARs, this Cultural Heritage Assessment (CHA) has been prepared in accordance with the *Code of Practice for Archaeological Investigations of Aboriginal Objects in New South Wales (Code of Practice)* (DECCW 2010a), the *Aboriginal Cultural Heritage Consultation requirements for Proponents* (DECCW 2010b), *The Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter, 2013* (Burra Charter), and the NSW Heritage Manual.

1.2 Objectives

This CHA assesses the potential impacts of the Project on Aboriginal and historic cultural heritage, and prepares strategies to manage risks to identified heritage values during construction and operation.

This report documents:

- the consultation process undertaken with Aboriginal communities for the Project and their involvement in the Project;
- the landscape and natural resources of the Project Area (PA) in order to establish background parameters;
- a synthesis of local and regional Aboriginal archaeological research to develop a contextual basis for predictive models;
- a review of relevant heritage databases including Australian Heritage Database, the NSW Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) database; the NSW State Heritage Inventory, and Schedule 5 of the Inverell Local Environmental Plan 2013;
- a review of the PA's non-Aboriginal history to gain an understanding and appreciation of past land uses and associated historical ground disturbance;
- a predictive model for Aboriginal and historic site types and location relevant to the PA;
- the archaeological methodology implemented during the study;
- the cultural and archaeological sensitivity of landforms that may be subject to impacts;
- the field survey results;
- the significance of any located Aboriginal objects and places;
- a description of the Project and whether or not it has the potential to result in impacts to Aboriginal cultural heritage and historic heritage items; and
- provision of management and mitigation measures based on the results of the investigation.

1.3 Description of the Proposed Development

1.3.1 Location

The proposed Bonshaw Solar Farm is located in the Inverell Local Government Area (LGA) approximately 16 km south of Bonshaw and 66 km north of Inverell. The PA, as shown in *Figure 1.1*, is approximately 352 ha with elevations ranging from 329 m to 500 m Australian Height Datum (AHD) and is located on Lot 2, DP1039185 (the 'Site').

The landholder has been consulted and provided in principle support to be finalised with a landholder agreement. Lot subdivision is not proposed.

The PA is partially bounded on its northern boundary by the Bruxner Highway. The eastern boundary is partially bounded by Glenrock Road. An unsealed road extends perpendicularly from Bruxner Highway towards the southern end of the PA then bends westerly towards the existing 330kV TransGrid Dumaresq Substation located to the south-western from the Subject Land.

The PA consists of open space, and creek and bush areas. Aerial imagery suggests that a significant proportion of the land across the PA had previously been cleared with portions historically being used for agriculture purposes.

1.3.2 Proposed Development

GAIA is proposing to develop a large scale solar photovoltaic (PV) generation facility and associated infrastructure with a capacity of 500 MW within the PA.

The Project will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure, supplying electricity to the national electricity grid. The development footprint is approximately 700 ha within the PA. The proposed development footprint is shown in *Figure 1.2*.

The Project would include:

- a network of PV modules in a fixed or tracking arrangement;
- a site office (two proposed options);
- a access tracks from Bruxner Highway;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- parking and internal access tracks;
- perimeter security fencing;
- battery storage; and
- two grid connection options to the 330kV TransGrid Dumaresq Substation, on the boundary of the PA.

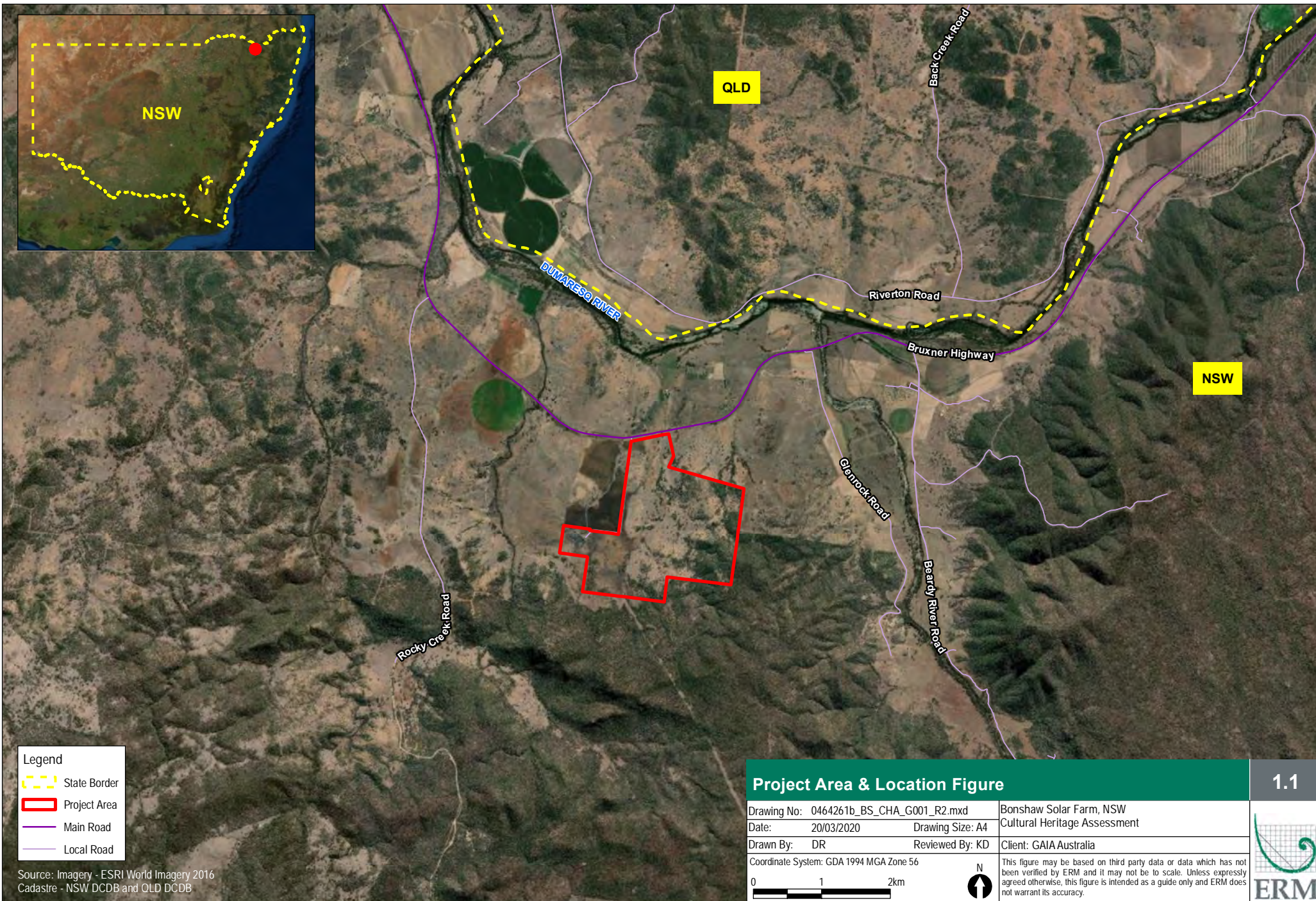
The location within the PA of the PV modules, cabling, battery storage and substation and switchyard infrastructure is subject to further detailed design during the preparation of the EIS.

1.4 Authorship

Katherine Deverson (ERM Heritage Consultant) authored the report and Erin Finnegan (Principal Heritage Consultant) undertook a technical review. Amanda Antcliff (ERM Project Manager) and Paul Douglass (ERM Partner) undertook quality assurance (QA) reviews of the report.

1.5 Report Structure

<i>Chapter 1</i>	Introduction;
<i>Chapter 2</i>	Legislative framework and statutory requirements;
<i>Chapter 3</i>	Aboriginal community consultation process undertaken for the CHA;
<i>Chapter 4</i>	Environmental and landscape background relating to the PA;
<i>Chapter 5</i>	Archaeological context of the PA, including known and potential heritage sites within and in near vicinity to the PA;
<i>Chapter 5</i>	Aboriginal heritage predictive model;
<i>Chapter 6</i>	Historical background of the PA;
<i>Chapter 7</i>	Survey methodology and results;
<i>Chapter 8</i>	Significance assessment of heritage sites located within the PA;
<i>Chapter 9</i>	Impact assessment; and
<i>Chapter 10</i>	Conclusions and Recommendations.
<i>Appendix A</i>	Aboriginal Stakeholder Consultation Log
<i>Appendix B</i>	Survey Methodology
<i>Appendix C</i>	AHIMS Database Search Results



Project Area & Location Figure

1.1

Drawing No: 0464261b_BS_CHA_G001_R2.mxd

Date: 20/03/2020

Drawing Size: A4

Drawn By: DR

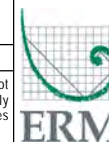
Reviewed By: KD

Coordinate System: GDA 1994 MGA Zone 56

Bonshaw Solar Farm, NSW
Cultural Heritage Assessment

Client: GAIA Australia


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Source: Imagery - ESRI World Imagery 2016
Cadastre - NSW DCDB and QLD DCDB


Bruxner Highway

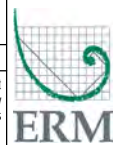
Legend

 Project Area

 Development Footprint

Project Footprint

Drawing No: 0464261b_BS_CHA_G002_R3.mxd	Bonshaw Solar Farm, NSW
Date: 20/03/2020	Drawing Size: A4
Drawn By: DR / KV	Reviewed By: KD
Client: GAIA Australia	
Coordinate System: GDA 1994 MGA Zone 56	
0 250 500m	
	This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



Source: Imagery - ESRI World Imagery 2016
Cadastral, Roads - NSW DCDB and QLD DCDB 2017

2. RELEVANT LEGISLATION

Together with best practice principles outlined in documents such as *The Burra Charter* (Australia ICOMOS 2013a), the following legislative and regulatory context forms the basis of the framework within which the historic and Aboriginal heritage values of the PA must be considered.

Aboriginal cultural heritage in NSW is protected by the *National Parks and Wildlife Act 1974* (NP&W Act). Land managers are required to consider the effects of their activities, or proposed development, on the environment under several pieces of legislation, principally the *Environmental Planning and Assessment Act 1979* (EP&A Act). Cultural heritage, which includes Aboriginal and historical heritage, is subsumed within the definition of “environment”. In certain circumstances, Commonwealth legislation protecting heritage may also apply to heritage places in NSW. The key legislation applying to the Project is summarised below in *Table 2.1*.

Table 2.1 Key Legislation

State Legislation
<p><i>Environmental Planning and Assessment Act 1979 (NSW)</i></p> <p>The principal NSW planning legislation is the <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act). The EP&A Act provides a system of environmental planning and assessment administered by the NSW Department of Planning and Environment (DP&E). The EP&A Act establishes when and how a development or activity is to be assessed and who is the relevant approval or determining authority.</p> <p>Section 4.36 (2) of the EP&A Act states that “a State environmental planning policy may declare any development, or any class or description of development, to be State significant development”.</p> <p>Part 2 Clause 8 of the State Environmental Planning Policy (State and Regional Development) 2011 (State and Regional Development SEPP) states that:</p> <ol style="list-style-type: none"> 1. <i>Development is declared to be State significant development for the purposes of the Act if:</i> <ol style="list-style-type: none"> a. <i>the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and</i> b. <i>the development is specified in Schedule 1 or 2.</i> <p>Schedule 1 and 2 of the State and Regional Development SEPP contains an extensive list of developments that are considered State Significant Development (SSD). Schedule 1 Cl 20 identifies the following as SSD:</p> <p><i>Electricity generating works and heat or co-generation</i></p> <p><i>Development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that:</i></p> <ol style="list-style-type: none"> a. <i>has a capital investment value of more than \$30 million, or</i> b. <i>has a capital investment value of more than \$10 million and is located in an environmentally sensitive area of State significance.</i> <p>The project is a development for the purpose of electricity generation using a solar energy source with a capital investment value (CIV) of more than \$30 million. The Site is not located in an environmentally sensitive area of State Significance (as defined in the State and Regional Development SEPP).</p> <p>Solar Energy Systems are considered permissible with consent through clause 34 (7) of State Environmental Planning Policy (Infrastructure) 2007.</p> <p>The project meets both the requirements of clause 8 of the State and Regional Development SEPP as it is not permissible without development consent and is development specified in Schedule 1. Therefore, the project is SSD for the purposes of the EP&A Act.</p>

State Legislation

National Parks and Wildlife Act 1974 (NSW)

The NSW National Parks and Wildlife Services (NPWS) provide guidelines for Aboriginal heritage assessment, including those conducted under the EP&A Act. Where Aboriginal heritage assessment is conducted under the Integrated Development Approval process, a more detailed set of NPWS guidelines applies.

All Aboriginal objects within the State of New South Wales are protected under Part 6, and particularly Section 90, of the NPW Act.

Under Section 5 of the Act, "Aboriginal Object" means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Indigenous habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

Sites of traditional significance that do not necessarily contain archaeological materials may be gazetted as 'Aboriginal places' and are protected under Section 84 of the Act. This protection applies to all sites, regardless of their significance or land tenure. Under Section 90, a person who, without first obtaining the consent of the Director-General, knowingly destroys, defaces or damages, or knowingly causes or permits the destruction or defacement of or damage to, an Aboriginal object or Aboriginal place is guilty of an offence.

Heritage Act 1977 (NSW)

The NSW *Heritage Act 1977* establishes the NSW Heritage Council and the State Heritage Register (SHR). The aim of the Act is to conserve the heritage of New South Wales. The aim of heritage management is not to prevent change and development, but to ensure that the heritage significance of recognised heritage items is not harmed by changes.

The SHR is a separate listing to the State Heritage Inventory and includes items which are accorded SHR listing through gazettal in the NSW Government Gazette. Nominated items are considered by the NSW Heritage Council which then makes a recommendation to the Minister for Heritage. The Minister is empowered to place Interim Heritage Orders (IHO) on an item of potential State significance on the basis of advice received from the Heritage Council:

- a. An item is important in the course, or pattern, of NSW's cultural or natural history.
- b. An item has strong or special association with the life or works of a person, or group of persons of importance in NSW's cultural or natural history.
- c. An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW.
- d. An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons.
- e. An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history.
- f. An item possesses uncommon, rare, or endangered, aspects of NSW's cultural or natural history.
- g. An item is important in demonstrating the principal characteristics of a class of NSW's a) cultural or natural places: or b) cultural or natural environments.

Refer to *Section 6.2* of this CHA for results of SHR search relating to the PA.

Commonwealth Legislation

Environment Protection And Biodiversity Conservation Act 1999 (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the Act as matters of national environmental significance. The EPBC Act focuses on the protection of matters of national environmental significance, with the states and territories having responsibility for matters of state and local significance.

The Commonwealth Heritage List (CHL) is established under the EPBC Act and comprises places on Commonwealth land or owned by Commonwealth Agencies that are determined to have "significant" heritage value to Australia. The Act also establishes the National Heritage List, comprising places considered to be of "outstanding" heritage value to Australia.

State Legislation

Refer to *Section 6.2* of this CHA for results of CHL search relating to the PA.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth)

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* protects areas and/or objects which are of significance to Aboriginal people and which are under threat of destruction. The Act can, in certain circumstances override state and territory provisions, or it can be implemented in circumstances where state or territory provisions are lacking or are not enforced. A significant area or object is defined as one that is of particular importance to Aboriginal people according to Aboriginal tradition. The Act must be invoked by or on behalf of an Aboriginal or Torres Strait Islander or organisation.

3. ABORIGINAL COMMUNITY CONSULTATION

This chapter contains details of the Aboriginal community consultation undertaken regarding the Aboriginal cultural heritage of the PA. In accordance with the guideline Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW, 2010b), consultation with Aboriginal people is an essential part of the heritage assessment process to:

- determine potential harm on Aboriginal cultural heritage from proposed activities; and
- inform decision making for any management and mitigation measures where it is determined that harm cannot be avoided.

The guideline also sets out four stages of consultation requirements. Fulfilment of these requirements is outlined below.

3.1 Stage 1: Notification of Project Proposal and Registration of Interest

On behalf of the Proponent, ERM has actively sought to identify stakeholder groups or people wishing to be consulted about the Project and has invited them to register their interest as follows.

To identify relevant stakeholders, letters about the Project (dated 3 July 2018) were supplied to the following bodies:

- Moombahlene Local Aboriginal Land Council (LALC);
- Local Land Services (LLS) South-East Region;
- National Native Title Tribunal (NNTT);
- Native Title Services Corporation (NTS Corp);
- NSW OEH Regional Operations Coffs Harbour Branch;
- Office of the Registrar, Aboriginal Land Rights Act (1983);
- Tenterfield Shire Council; and
- Inverell Shire Council.

The results from the letters indicated two Aboriginal parties with potential interest in the PA. A Project notification letter was sent to each of the identified parties on 24 July 2018. Correspondence from the LLS has suggested that the Site is located within the Toomelah LALC boundaries. Our review of the boundaries placed the Site within Moombahlene LALC. ERM contact the Toomelah LALC to confirm that it is not in Toomelah region, a map with the known LALC boundaries and PA location was generated and forward to the LALC for their review and comment. No response was received following this correspondence.

A local press advertisement requesting Aboriginal party participation was placed in the Inverell Times and Tenterfield Star on 3 July 2018, the advertisements were published on 6 July 2018 and 11 July 2018 respectively (refer to *Appendix A*). The response period for Aboriginal stakeholders to register an interest in the Project was open for two consecutive weeks.

3.2 Stage 2: Presentation of Information about the Proposed Project

The Aboriginal parties that registered an interest in being consulted are presented in *Table 3.1*.

Table 3.1 Registered Aboriginal Parties (RAPs)

Organisation
Aboriginal Cultural Sites Services
Edgerton Kwiambal
Moombahlene LALC

A study methodology was sent to each of the registered parties (dated 9 August 2018). The letter included:

- an outline of proposed works;
- the proposed methodology and dates for pedestrian survey;
- a request for Aboriginal parties to identify any particular areas of interest within the PA to survey; and
- an invitation to attend a site survey between 11 to 13 September 2018.

No comments were received in relation to the proposed methodology. All three groups agreed to attend the site survey.

3.3 Stage 3: Gathering Information about Cultural Significance

All Registered Aboriginal Parties (RAPs) were invited to participate in the field survey on Tuesday 11, Wednesday 12, and Thursday 13 September 2018. Emails and telephone calls were made to each party to confirm attendance and clarify any potential questions or issues about the methodology, and to determine meeting locations and times for each survey day (refer to *Appendix A*).

Information was also sought regarding cultural knowledge of the PA. All groups expressed that the PA holds or possesses potential cultural sensitivity, through historic family connection to and knowledge of the area.

ERM recognise and value the input of all Aboriginal stakeholders in the consultation process. All RAPs were invited to discuss the Project and the results of the field survey during and following the site survey. The aim of this was to ensure that management actions and consultation commitments are developed in full consultation and are based on the recognised cultural heritage values of the sites.

3.4 Stage 4: Review of Draft Cultural Heritage Assessment Report

A draft copy of the CHA report was provided to all Aboriginal parties who registered an interest in the project on 9 May 2019, for the purposes of receiving written or oral general comments and more specific comments on the cultural significance of the PA and the identified sites and the recommended management and mitigation measures.

Feedback was received from two of the RAPs (also refer to *Appendix A*):

- Edgerton Kwiambal endorsed the draft ACHA.
- Aboriginal Cultural Sites Services provided the comments below that highlight the cultural importance of the area:

Yes comment on site I recommend that an AHIP BE ON the sites that they will construct the solar panels .Remove to a safe spot, or find another area for farmers the area is a high occupancy area that was used my Ancestors.

4. ENVIRONMENTAL BACKGROUND

4.1 Environmental Context

Interactions between people and their surroundings are of integral importance in both the initial formation and the subsequent preservation of the archaeological record. The nature and availability of resources, including water, flora, fauna, and stone materials had (and continues to have) a significant influence over the way in which people utilise the landscape.

Alterations to the natural environment also impact upon the preservation and integrity of cultural materials within that environment. Current vegetation and erosional regimes also affect the visibility and detectability of archaeological evidence. For these reasons, it is essential to consider environmental factors as a component in any cultural heritage assessment.

4.1.1 The Northern Highlands Bioregion

Bioregions and sub-bioregions are large, geographically distinct areas of land with common characteristics such as geology, landform patterns, climate, ecological features and plant and animal communities. The Interim Biogeographic Regionalisation for Australia (IBRA) provides a regional and national planning framework for the systematic development of a comprehensive, adequate and representative National Reserve System. Bioregions delineate salient environmental characteristics which can highlight patterns in Aboriginal site patterning.

The PA is located within the Nandewar Bioregion, which is located inland from the coastal regions and bordered by the North Coast, New England Tablelands and Brigalow Belt South. The region includes parts of NSW, and extends into Queensland. The total area of this bioregion is 2,700,313 hectares (equating to 2.59% of NSW) (NSW NPWS 2003).

Table 4.1 Nandewar Bioregion Attributes

Characteristic	Description
Geology	<p>The bioregion overlies part of the New England Fold Belt. The New England Fold Belt is the youngest structural feature in NSW and is separated from the Lachlan Fold Belt by the Sydney-Bowen Basin that is filled with Mesozoic sediments. The oldest rocks in the sequence are Devonian sedimentary and volcanic rocks, formed in an island arc environment. The youngest are Triassic sandstones and shales deposited by rivers on the edge of the Gunnedah Basin, about 250 million years ago, at a time when New England was being lifted by intrusions of granite.</p> <p>Major volcanic eruptions occurred in two phases: in the lava field flood basalts of the Inverell area (34-32 and 22-19 millions of years ago), and in a central volcano similar to that in the Nandewar Ranges (21-17 million years ago). The maximum preserved thickness of the flows is 800m in the variety of lavas present. Only the core of the Nandewar volcano remains as exposed plugs and dykes. Flows from the New England centres buried river gravels and lake sediments that are now being exposed and contain deposits of tin, sapphires and diamonds.</p> <p>A narrow strip of ultrabasic rocks, including serpentinites that are derived from a deep ocean floor, marks the suture where a former island arc complex was linked to the Australian mainland. These rocks pass through Woodsreef and Tamworth where they are associated with limestones in which karst landscapes are formed. The composition of these rocks is so unusual that they always have distinct soils and vegetation</p>

Characteristic	Description
Landforms	The Nandewar Bioregion is formed on Palaeozoic sedimentary rocks on the western edge of the New England Tablelands and includes the Tertiary basalts of Inverell and Kaputar. The hilly landscapes are warmer but drier than the tablelands and carry vegetation communities more typical of the western slopes, with some tableland species.
Soils	<p>The bioregion is characterised by clay or loam soils, but siliceous soils derived from acid volcanic rocks are also found. On the sedimentary rocks, shallow stony soils occur on ridges passing to texture contrast soils on almost all slopes. These change in colour from red brown subsoils on upper slopes to yellow subsoils on lower slopes. They support diverse vegetation communities that are also affected by altitude. The granites develop gritty shallow profiles between outcrops and tors on the crests, grading to harsh texture contrast soils with yellow clay subsoils that are prone to gully development on the lower slopes.</p> <p>Basalt areas on Kaputar have frequent rock outcrops interspersed with shallow, stony, brown loams. Black earths are found on lower slopes and in valleys. In the Inverell area the basalts develop black earth profiles that thicken downslope and, where the underlying sands and gravels are exposed, the coarse sandy soils may develop podsol pans and support different vegetation. Alluvial loams and clays with moderate to high fertility are found in the valleys. Dark, alkaline, pedal clays develop on limestone, and the serpentinites have shallow stony profiles with concentrations of elements that are toxic to many plants.</p>
Vegetation	The vegetation of the Nandewar Bioregion is influenced primarily by geology and the influence of altitude on temperature and rainfall. The bioregion is characterised by box woodlands that occur on clay or loam soils, typically at low to mid elevation in agriculturally productive areas. The principal dominants of these box woodlands are white box (<i>Eucalyptus albens</i>), yellow box (<i>Eucalyptus melliodora</i>), Blakely's red gum (<i>Eucalyptus blakelyi</i>) and grey box (<i>Eucalyptus mollucana</i>). Bimbil box (<i>Eucalyptus populnea</i> subsp. <i>bimbil</i>), fuzzy box (<i>Eucalyptus conica</i>) and western grey box (<i>Eucalyptus microcarpa</i>) also occur, particularly in the western half of the bioregion.

Source: Taken directly from <https://www.environment.nsw.gov.au/bioregions/NandewarBioregion.htm>

4.1.2 Topography and Landforms

The topographical setting incorporates a variety of landforms which have been classified in this assessment according to the definitions set out in Speight (2009). Speight (2009) states that a landscape can be classified by its landform pattern, and then further classified by individual landform elements. The wider landform pattern, for instance, could be one of flood plains or hills. These landscapes can be further categorised into individual landform elements within the wider landform pattern, for instance cliff, foot slopes or valley flats.

According to these definitions, topographic mapping conducted for the Project indicates that the PA is comprised of several landforms that include gentle slopes, upper flats, crests and open depressions. These landforms would have provided suitable areas for hunter gatherers to undertake a range of subsistence activities (for example camping, hunting and tool making). Certain landforms such as flat or gently sloping raised areas near a water source or ridge flats may have been more frequently occupied than others such as areas away from water, where land use may have been more transient in nature.

4.1.3 Flora and Fauna

Prior to European initiated land clearance, the PA would have supported a range of flora and fauna that would have been utilised by Aboriginal people for subsistence purposes. A broad range of plants would have been available such as white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*), Blakely's red gum (*Eucalyptus blakelyi*) and grey box (*Eucalyptus mollucana*). Bimbil box (*Eucalyptus populnea* subsp. *bimbil*), fuzzy box (*Eucalyptus conica*) and western grey box (*Eucalyptus microcarpa*). "Riparian forests of river oak (*Casuarina cunninghamiana*), sometimes with river red gum (*Eucalyptus camaldulensis*), occur along the major watercourses, with Blakely's red gum and rough-barked apple (*Angophora floribunda*) forming the common association along minor drainage lines. Forest and woodlands of northern smooth-barked apple (*Angophora leiocarpa*) and dirty gum (*Eucalyptus chloroclada*) are associated with sandstone parent material on the north-western edge of the bioregion" (NSW NPWS 2003).

There is a high diversity of fauna within the bioregion including, woodland birds, diurnal birds such as regent honeyeaters, lorikeets, and little corellas, nocturnal birds such as several owls and bush stone curlews, frogs, turtles, lizards, snakes, koalas, squirrel gliders, greater gliders, and various bats.

4.1.4 Land Use and Disturbance

The PA generally consists of a cleared pastoral landscape primarily utilised for sheep and cattle grazing. Some areas of the upper soil horizon within the PA have been affected by ploughing. Ploughing generally disturbs the upper 300mm of soil horizons (i.e. 300mm is the maximum plough depth), however, depending on ploughing method, it is possible that up to 600mm could be disturbed. Therefore, deeper soil deposits may retain *in situ* Aboriginal archaeological sites. For this reason, the plough zone is not considered as an area of significant disturbance, however, any artefacts located within the top 300-600mm of the soil horizon may be considered as not to be *in situ*, depending on ploughing methods applied in that area in the past.

Other land disturbances to the PA include the construction of roads, land clearance and fencing. Other ground disturbances have also occurred within the PA such as soil erosion and bioturbation (bioturbation is the reworking of soils and sediments by animals and plants). These post depositional processes have likely adversely affected the archaeological record in the PA.

5. ARCHAEOLOGICAL BACKGROUND

The preliminary archaeological and cultural landscape context discussed in this report has been established through a review of documentation relating to regional ethnographic accounts, information from the AHIMS database, and previously conducted archaeological projects and reports. It is noted that there are several limitations to the use of this existing information such as:

- Aboriginal people involved in previous studies may not have disclosed relevant cultural knowledge and the cultural significance of certain areas due to sensitivities in Aboriginal politics;
- no responsibility can be taken by ERM for errors or omissions in primary and secondary source material cited in this report; and
- the AHIMS search results presented below are based on previous archaeological work and is therefore limited to specific locations and field conditions (visibility, time constraints, etc.) and therefore may not necessarily be a true reflection of the archaeological record.

5.1 Ethno-History

Ethnographic information relating to the Aboriginal occupation of the PA has been obtained from sources containing knowledge that has been passed down from Aboriginal people, as well as documentation written by early European settlers and government officials during the mid to late 18th century (Barwick 1984). Human occupation of south east Australia dates from at least 20,000 years BP. Evidence of early Aboriginal occupation of the State has been provided by sites such as the Burrill Lake rock shelter (Lampert 1971), Cloggs Cage (Flood 1980) and New Guinea 2 (Ossa 1995). The major Aboriginal groups thought to traditionally occupy the wider Nandewar Bioregion were the Anaiwan, the Kamilaroi, the Weraera, and the Kwaimbul (NSW NPWS 2003).

ERM recognises that Indigenous people are the primary source of information on their heritage and culture; the Anaiwan, Kamilaroi, Weraera, and the Kwaimbul people are the Aboriginal traditional owners of the wider area. This brief history of the region has been compiled through desktop research, regional studies and historical documents. It should be recognised that most of the available ethnographic information relating to the early Aboriginal occupation of the area comes predominantly from historical documentation written by early European settlers and government officials during the mid to late 19th century. However, the Aboriginal ties to the land and cultural significance of the broader region is recognised within this CHA.

The broader area around the PA forms part of the New England Ranges encompassing eastern and western river systems. Walker describes the region as being dominated by undulating uplands, extending as a tableland belt of varying width, with gently rolling country with shallow valleys terminating in the eastern escarpment east of Walcha (1977, pp.11). Australian Aboriginal people occupied the land according to a complex system of spatial organisation and landscape use (Clark 1990, pp.11-14). Individual groups were intimately familiar with their own geographical regions and the seasonal availability of resources within it. Sutton (1989, pp.7-8) writes that Aboriginal people of the area utilised the surrounding natural resources and landscape formations as a part of their subsistence procurement strategies in addition to more traditional hunting methods; for example, they used the trees to trap macropods via nets strung between them and then herded the animals into the nets and they used traps, nets and baskets in the swamps to catch fish, crayfish, hunt water birds and collect their eggs (Rosen 2009). Indigenous people were also able to supplement their diet by digging for yams, roots and foraging for other edible plants, berries and seeds. Grasslands were maintained by burning or 'fire stick farming' to regenerate local plants and vegetation as well as attract large game into the area for hunting (Rosen 2009). Of the flowering and fruiting plants available as food a large number of them grew in spring and summer including geebung, wild parsnip, Apple Berry, spreading *brachyloma* and Honey Pots (Rosen 2009). A number of these species are encouraged to grow and flower by fire, including the *Xanthorrhoea* species, and the *Imperata cylindrical* (Rosen 2009).

Tools used by Aboriginal people of the Northern Tablelands region included spears, clubs, waddies, boomerangs, shields, paddy-melon sticks and fire sticks made of wood; stone was also utilised to create tools including knives, scrapers, ground-edge axes and even composite technologies like hafted stone chisels (McBryde 1974). Spears were both hand-thrown and thrown with the aid of woomeras (spear throwers). Stone axes were sharpened by pulling or rubbing the axe head through cracks or gaps in other stone outcrops or on bedrock material such as granite or sandstone (Rosen 2009).

Norman Tindale (1974) in his landmark analysis of the 'Aboriginal Tribes of Australia' cites the PA area as the traditional home of the Kwiambal people (refer to *Figure 5.1*).



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5.2 Regional Archaeological Background

While many archaeological studies have been carried out in the region, much is focused on the coastal areas of northern NSW rather than the regional area containing the PA. A significant and early example of these studies was carried out by McBryde in 1974 (OzArk EHM 2011). This study dated a rockshelter site to 6,400±300BP, which is the oldest occupation date so far recorded in the coastal region.

Most hinterland studies in the region have been related to development related assessments, these include a series of transmission line assessments carried out by OzArk in the 2000s and at least once by Navin Offer in the 1990s (OzArk EHM 2011). These studies as well as others in the region suggest that the most common Aboriginal site type is an 'open site' (or stone artefact scatter), although art sites, modified trees, rockshelters, grinding grooves, and quarry sites have also been recorded. It has been noted that sites are most likely to appear on ridgelines, spurs, and slopes rather than along creek lines (Navin Officer 1990).

In 2013 Tenterfield Shire Council commissioned an Aboriginal Heritage Study (AMBS 2013) which aimed to identify places of significance within the LGA and to inform the listing of heritage items on the LEP. The study was carried out in consultation with Aboriginal stakeholders in the area. It identified 174 previously recorded Aboriginal cultural heritage sites within the LGA, noting that sites generally occurred near watercourses in elevated areas. The study also noted that the distribution of sites that had been recorded reflected locations of previous studies, carried out as part of development activities or for academic purposes, rather than reflecting an accurate or complete distribution of sites likely to be found across the landscape (AMBS 2013).

5.3 Local Archaeological Context

There has been limited previous archaeological research within the PA; however at least one development project has been undertaken in its proximity which has required cultural heritage assessment. The results of this investigation helps to provide an indication of the range, nature and distribution of archaeological sites within the local area.

5.3.1 *Dumaresq to Lismore Transmission Line Aboriginal and Historic Heritage Assessment*

Between 2009 and 2011 OzArk EHM undertook Aboriginal and Historic heritage assessments as part of a project which proposed a transmission line between the Dumaresq Switching Station (approximately 75m from the PA's western boundary) and the Lismore Substation in far north NSW (OzArk 2011). In 2011, an assessment was carried out on the section of the proposed transmission line easement. Prior to completing the assessment information about previously recorded sites in proximity were gathered from AHIMS, it was noted that 49.2% of previously recorded sites in the area were open sites / artefacts scatters, and 15.2% were modified (scarred) trees. The assessment identified 50 previously unrecorded Aboriginal cultural heritage sites. The assessment found that most cultural heritage sites were located near a water source and that sites in the area are likely to be artefact scatters or modified trees.

5.3.2 *OEH AHIMS Register*

The AHIMS database provides information concerning previously recorded Aboriginal sites in NSW. AHIMS stores data regarding a site's location, site type, site features and a unique site identification number for all registered Aboriginal heritage sites in NSW. Mapping of an AHIMS database search results will identify any known sites which could be impacted by proposed works as well as help to determine the overall pattern of Aboriginal sites in an area. A summary of the various site types that could be located in the PA can be found in *Table 5.1* and will aid in the development of a site prediction model for the PA.

Table 5.1 Cultural Heritage Site Types Definitions

Site types	Definition
Stone artefact scatters (or open camp sites)	Stone artefact scatter sites, also known as open camp sites, are usually indicated by surface scatters of stone artefacts and sometimes fire blackened stones and charcoal. Where such sites are buried by sediment they may not be noticeable unless exposed by erosion or disturbed by modern activities. The term camp site is used as a convenient label which, in the case of open sites, does not necessarily imply that Aboriginal people actually camped on the sites; rather it indicates only that some type of activity was carried out there.
Isolated finds	Sites consisting of only one identified stone artefact, isolated from any other artefacts or archaeological evidence. They are generally indicative of sporadic past Aboriginal use of an area.
Shell middens	Middens consist of accumulations of shell that represent the exploitation and consumption of shellfish by Aboriginal people. Shell species may be marine, estuarine or freshwater depending on the environmental context and middens may also include other faunal remains, stone artefacts, hearths and charcoal.
Shelter sites	Sandstone shelters and overhangs were used by Aboriginal people to provide camp sites sheltered from the rain and sun. The deposits in such sites are commonly very important because they often contain clearly stratified material in a good state of preservation.
Grinding grooves	Grooves resulting from the grinding of stone axes or other implements are found on flat areas of suitable sandstone. They are often located near waterholes or creek beds as water is necessary in the sharpening process. In areas where suitable outcrops of rock were not available, transportable pieces of sandstone were used.
Quarries	These are areas where stone was obtained for flaked artefacts or ground-edge artefacts, or where ochre was obtained for rock paintings, body decoration or decorating wooden artefacts.
Art sites	Aboriginal paintings, drawings and stencils are commonly to be found where suitable surfaces occur in sandstone shelters and overhangs. These sites are often referred to as rock shelters with painted art.
	Rock engravings, carvings or peckings are also to be found on sandstone surfaces both in the open and in shelters. These are referred to as rock engraving sites.
Scarred trees	Scarred trees bear the marks of bark and wood removal for utilisation as canoes, shields, boomerangs or containers. It is commonly very difficult to confidently distinguish between Aboriginal scars and natural scars or those made by Europeans.
Burial sites	Burials may be of isolated individuals, or they may form complex burial grounds.
Stone arrangements, carved trees and ceremonial grounds	<p>These site types are often interrelated. Stone arrangements range from simple cairns or piles of rocks to more elaborate arrangements; patterns of stone laid out to form circles and other designs, or standing slabs of rock held upright by stones around the base.</p> <p>Carved trees are trees with intricate geometric or linear patterns or representations of animals carved into their trunks. Ceremonial grounds and graves were often marked by such trees. Bora grounds are a common type of ceremonial site and they are generally associated with initiation ceremonies. They comprise two circles, generally edged with low banks of earth but sometimes of stone, a short distance apart and connected by a path.</p>

A targeted AHIMS search conducted for the PA on 5 March 2018 and again on 28 February 2019 revealed that one site had been previously recorded within the PA, and another nine sites had been previously recorded within 1.5 km of the PA.

The results of the AHIMS searches are shown in *Tables 5.2 and 5.3*, and *Figure 5.2*.

Table 5.2 AHIMS Extensive Search Details

Date	Client Service ID	Latitude	Longitude	Number of Sites
5 March 2018	331690	From: -29.2336 To: -29.1502	From: 151.2741 To: 151.4063	10

Table 5.3 AHIMS Registered Sites

Site ID	Site Name	Site Features	Site Types	Approximate Distance to Project Area	Status
11-3-0083	Tenterfield-Dumaresq OS14	Artefact	Open Site	Within PA	Valid
11-3-0041	S19	Artefact (Isolated Find)	Open Site	>1.5 km	Valid
11-3-0047	EL35	Artefact	Open Site	>1.5 km	Valid
11-3-0063	EL34	Artefact	Open Site	>1.5 km	Valid
11-3-0064	EL33	Art (Pigment or Engraved)	Open Site	>1.5 km	Valid
11-3-0065	EL32	Artefact	Open Site	>1.5 km	Valid
11-3-0066	EL36	Artefact	Open Site	>1.5 km	Valid
11-3-0080	TSR Dumaresq River OCS	Artefact (500)	Open Site	>1.5 km	Valid
11-3-0084	Tenterfield-Dumaresq OS15	Artefact	Open Site	>1.5 km	Valid
11-3-0093	Tenterfield Dumaresq OS 4 & PAD	Artefact	Open Site	>1.5 km	Valid

5.3.2.1 Discussion of AHIMS Site #11-3-0083

Only one previously registered site was identified within the PA. The site, identified as AHIMS #11-3-0083 (Tenterfield-Dumaresq OS14) is recorded as an open artefact scatter, containing at least one culturally modified tree. Details from the site recording card indicate that the site covers six (6) discrete scatters, identified within 50 m of each other. The size of the site complex is estimated to be 100 m by 80 m (see *Figure 5.2*). The following description of the site is provided in the site card:

TD-OS14 is located at the confluence of two unnamed water courses 750m to the east of the Dumaresq Switching Station. Artefacts were recorded on both the east bank, central promontory between the water courses and on the west bank of the water courses. Artefact densities appear to be greater on the east bank and to the south of the easement: although, within the proposed transmission line easement, artefacts are present on both banks of the water courses, albeit in lower densities. Across TD-OS14 there appeared to be very little soil depth and it is assessed that there is a low probability of subsurface archaeological deposits being present. The site is also affected by erosion and stock movement. Recorded artefacts were of a local dark chert (that was noted in the water courses adjacent to TD-OS14), quartz, quartzite and a fine-grained indurated mudstone. Modified tree at Northern end.

The description provided in the site recording card suggests that AHIMS Site #11-3-0083 consists of an open camp site, comprised of a number of discrete scatters that may represent activity areas. Considering the location of the site at the confluence of two smaller creeks, there is a possibility that the site extends beyond the recorded boundary.

AHIMS #11-3-0083 was assessed as having moderate to high cultural significance and moderate to low scientific significance at the time of recording.

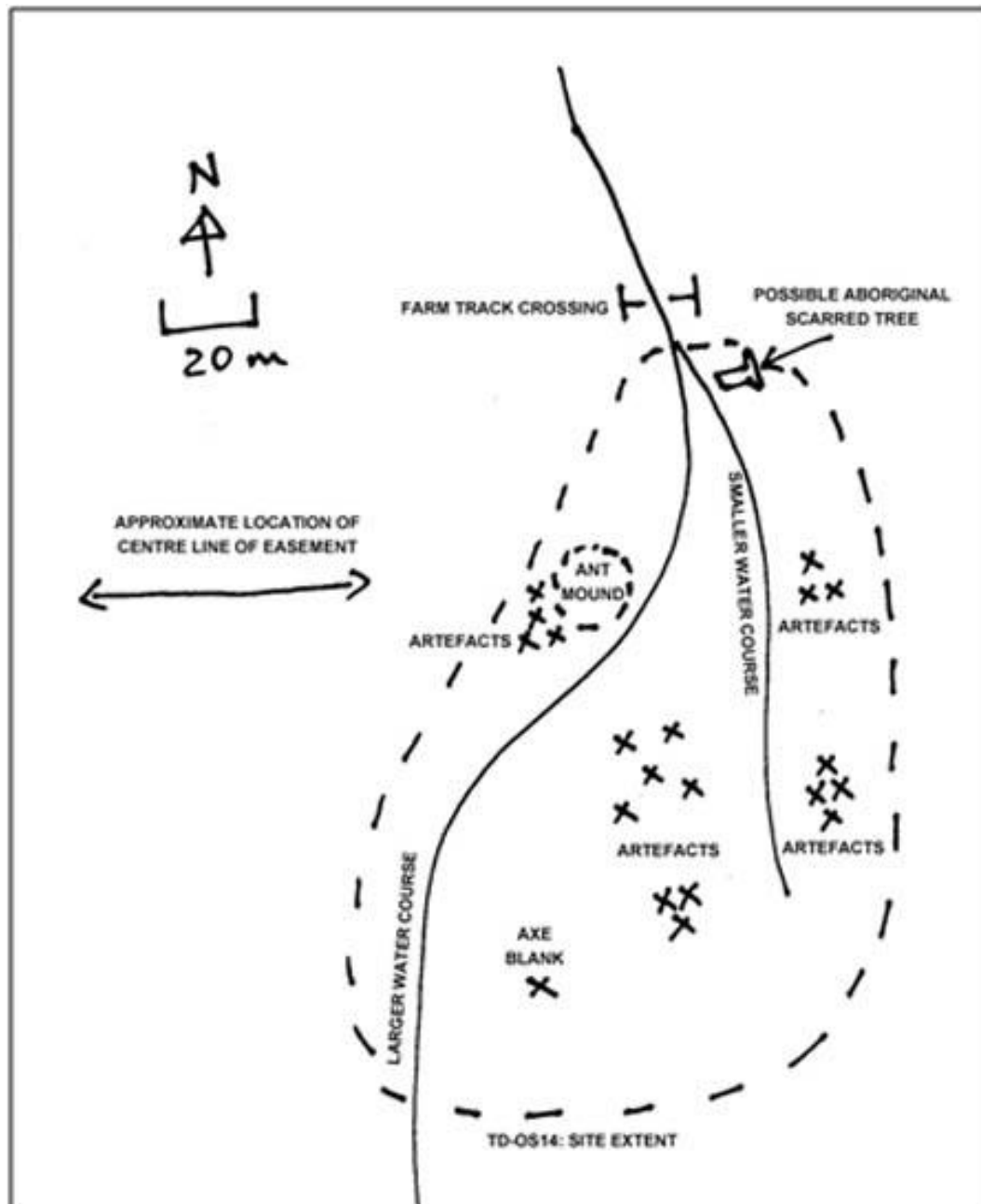
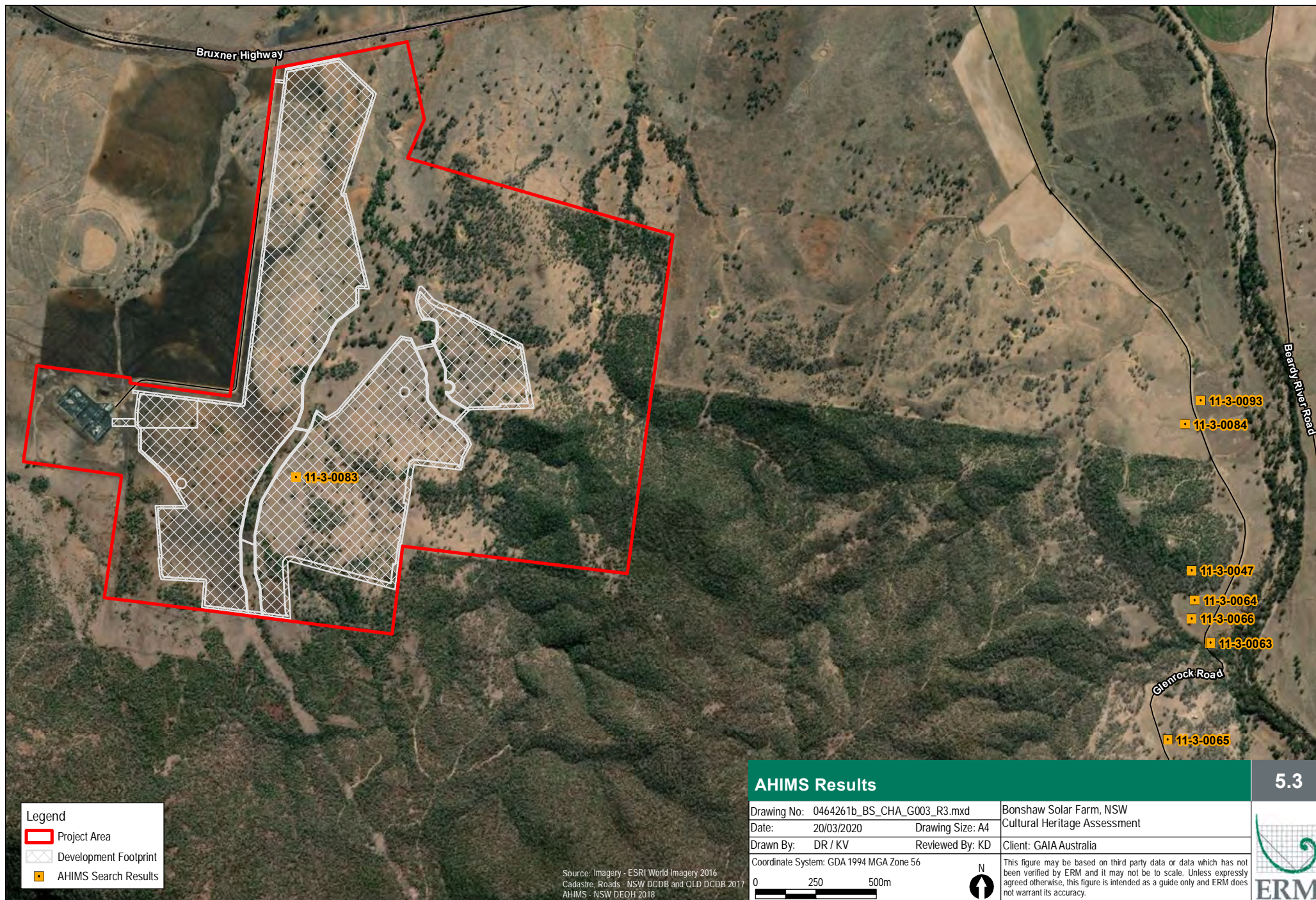


Figure 5.2 Reference Map from Site Recording Card #11-3-0083 (OzArk 2011)



5.4 Implications for the Project Area – Predictive Model

It is important to note that the level of archaeological potential relates to the likelihood of discovering an Aboriginal object or site, within a location. Further description should then be made as to the potential condition and integrity of the soil matrix and potential site itself. Only once all these factors have been considered, can scientific value start to be assessed for an area with potential. Therefore, whilst scientific value and potential are linked, it must be noted that these values and potentials are not the same and can differ substantially for any single site or area with potential.

Areas with archaeological potential were assessed according to the definitions in *Table 5.4* and includes a consideration of landforms, distance to resources, historic disturbances and past land use, and the results of previous surveys. Proximity to a permanent water supply and landform is the primary factor appearing to determine the location of Aboriginal campsites within the region and scar trees can occur anywhere that trees of a suitable age remain.

Table 5.4 Definitions of Archaeological Potential

Rank	Definition	Example
Very Low potential	Artefacts are very unlikely to occur in situ.	Eroded landforms, reconstructed landscapes, hazardous landscape, developed areas.
Low potential	Artefacts are not normally found in comparable contexts but could occur in low densities making detection unlikely.	Landforms with no specific focus for use, i.e. areas not associated with or in proximity to water sources.
Moderate potential	Artefacts are known to occur in comparable landforms in detectable densities (~1 artefact/m ²) and there is an unknown possibility for detection.	Landforms with an environmental focus which may have seen seasonal visitation.
High potential	Artefacts are consistently found in comparable landforms or similar environmental contexts and thus will certainly be found in any ground breaking works.	Landforms with known environmental focus encouraging repeat visitation to specific locale, i.e. margins of swamp or near high order creeks.

Archaeological site formation is a complex combination of factors, such as bioturbation and environmental conditions like erosion or the burial of sites through soil movement. Once discarded on the grounds surface, artefacts are often readily incorporated into the topsoil horizons through the process of bioturbation. It is common for dense artefact deposits to exist hidden beneath the grounds surface (cf. Wandsnider and Camilli 1992). Archaeological assessments that do not employ appropriate methods for prediction cannot reliably define an area's archaeological content.

Frequently, only the eroded component of a larger subsurface deposit is detected and recorded as a site. Where soils are soft, sandy or in boggy conditions, artefacts can occur at greater depths below surface level. Therefore, it is crucial that the nature of an area's soils, sands and geomorphology are defined correctly in an archaeological assessment and the resulting archaeological implications identified. An understanding of these factors, linked further to the notions of site integrity and condition, results in an understanding of an area or site's archaeological potential.

The knowledge gained from examining landforms, geology, regional archaeological patterns, and prior archaeological reports have enabled a set of parameters to be established to predict the potential location of Aboriginal sites within the PA. The topographical nature, geology, flora and fauna of the PA would have provided shelter from the elements and a range of subsistence and lithic resources to Aboriginal people. The PA's proximity to a permanent water source, the Dumaresq River and its numerous associated tributaries that run through the PA would have made it a prime source of water and food resources for Aboriginal groups in the area. In line with this and the archaeological context as discussed above, the PA is likely to contain low density stone artefact scatters across all of its landform units. Although the upper layers of soil horizons across the PA have likely been disturbed by non-Aboriginal agricultural activities such as ploughing, *in situ* archaeological deposits may be present within deeper stratigraphic layers. It is also likely that stone artefacts have not been moved far from their original depositional position by ploughing.

5.4.1 Predictive Model

Based on the background studies and comparative analysis, the following predictions are made for Aboriginal cultural heritage within the PA:

- Aboriginal sites are most likely to be stone artefact sites;
- stone artefact sites are most likely to occur within 400 m of a permanent water course, although smaller creek margins may display scatters of stone artefacts, particularly if near to larger water courses;
- surface expressions of artefacts are most likely to be found on flat or gently sloping terrain;
- surface expressions of artefacts are most likely to be found within proximity of water, or within elevated landforms such as ridge crests or spur line crests, or within proximity of open drainage depressions;
- high density open camp sites will likely be representative of a permanent or seasonal occupational camp, and will likely be located within flat raised terrain that is defensible and sheltered from the elements and has access to resources (water, food, wood and potentially stone);
- lower density sites or isolated finds are likely to contain a 'background scatter' and be representative of a more transient movement throughout the landscape, or intermittent activities (hunting, food procurement, etc.);
- elevated areas that afford views of the surrounding landscape are likely to contain stone artefact sites;
- cultural modifications or scars may occur on mature trees with the PA;
- areas of subsurface stone artefact deposits (with or without a display of surface level stone artefacts) may be present in the PA. Such sites are likely to be located at depths of between 0 and 30 cm below ground surface level;
- human burials are rare, and are not likely to be present in the PA, but if present would most likely be in the alluvial soils that make up the PA's flood plain, creek and river terraces or found in crests and hill tops;
- ceremonial sites (bora grounds) may be present on hill tops in the PA, though are very unlikely due to their rarity and previous disturbances across the landscape; and
- the most common stone materials used for the manufacturing of artefacts within the local region of the PA are likely to be silcrete, chert and quartz (with some quartzite and volcanic material).

Much of the material used by Aboriginal people to produce survival equipment (such as wood, bone, shell and fibre material) is highly perishable and does not often survive in the archaeological record. Material culture that has survived, often found in locations where Aboriginal people camped, are generally stone artefacts and scarred trees. Stone artefacts, and to a lesser extent scarred trees, are the most likely artefact types to be located within the PA. Aboriginal archaeological sites within the PA are likely to have been impacted upon (disturbed) due to past European farming practices, the development of transport infrastructure (such as road constructions) and trenching for utility services.

6. HISTORICAL CONTEXT

This chapter considers the potential non-Aboriginal heritage values for the PA. It includes a review of primary and secondary resources including available heritage assessments, reports, publications, historical maps and aerial imagery for the local area. This material will be used to help the PA's history and development over time. The following databases were also searched to determine whether known non-Aboriginal ('historic') heritage sites are located within the PA:

- Commonwealth Heritage List (CHL);
- NSW State Heritage Register and Inventory;
- Inverell Local Environmental Plan (LEP) 2012; and
- The National Trust of Australia.

6.1 Historical Overview

The New England region and Inverell district's first European explorers were Allan Cunningham (1827) and John Oxley (1818), who entered the area on separate expeditions (OzArk 2011). Squatters then moved into the Inverell area around 1835, some establishing large holdings throughout the area, including Campbell in 1837, a significant landholder in Inverell (OzArk 2011; Inverell Shire Council 2018). Campbell, having arrived in Australia from Scotland in 1824 and named the area "Inv" a meeting place and "Ell" meaning swans, as a large amount of these birds were in the area at the time (Inverell Shire Council 2018).

In June 1838 the Myall Creek massacre occurred 35 km from Inverell, becoming a famous case in Australia as the first time that Europeans were hanged for killing Aborigines (Inverell Shire Council 2018). Unfortunately it was not the only massacre in the region at this time, however subsequent massacres and violent episodes went unreported or punished (Inverell Shire Council 2018).

The town of Inverell was incorporated as a municipality in 1872 and tin mining in the region ensured the town's economic growth and remained an important industry in the area for the next century (Inverell Shire Council 2018). The Closer Settlements Acts introduced in NSW between 1901 and 1909 helped to create new small towns in the area in an effort to break large landholding squatter's dominance in country areas (Inverell Shire Council 2018).

6.1.1 Township of Bonshaw

It is not clear when the small township of Bonshaw was formed, however it was built to support local agricultural holdings. The earliest cattle station is thought to have been established in the Bonshaw area in the early 1840s and a track from Bonshaw to Ashford developed in the 1850s (Main Roads 1968). A hotel was constructed at Bonshaw prior to 1867, in time for the bushranger, Captain Thunderbolt (Fred Ward) to rob it in May that year (The Armidale Express 1867). Other community buildings were also built in the town including a church, school, and memorial hall (refer to *Photographs 6.1* and *6.2*). In 1878 £750 was provided for the construction of a track from Tenterfield to Bonshaw (Main Roads 1968). Further roads from Bonshaw to other large towns in the area were established and upgraded over the following decades, including to Ashford, Texas, and Inverell, leading to the formation of State Highway No. 16 in 1938 which became NSW's most northern highway from the coast to the Queensland border at Goondiwindi, it was later renamed Bruxner Highway in 1959 (Main Roads 1968).



Photograph 6.1 **School at Maidenhead Station, Bonshaw, c. 1880s (Trove Item #48117813)**



Photograph 6.2 **Memorial Hall, Bonshaw (Trove Item #252402940)**

6.1.2 The Project Area

While little is known about the history of the PA, historical parish maps dating from at least 1909 show that the land was used for pastoral purposes. In 1909, a Charles Strathley Jr was the landholder (refer to *Figure 6.1*). No further detail is included on the map (or any later parish maps) to indicate that any buildings or dwellings were present on the site. Strathley is shown to hold a number of titles within this parish and it is possible that he resided elsewhere and used the land purely for grazing purposes. Strathley is listed as a grazier in several historical sources including the Sydney Stock and Station Journal (5 April 1918). According to later parish maps Strathley was still the landholder in 1939. By 1967 a B.F. Hartley held the land title and continued to do so until at least 1979 (NSWLRS 1965; 1979).



Figure 6.1 1909 Parish of Bowman map, PA is indicated in red (NSWLRS 1909)

6.2 Historical Heritage Database Searches

A search of heritage databases was undertaken in August 2018 and again on 27 February 2019 to determine whether any historical heritage items have previously been recorded within the Project Area. The results are outlined below.

6.2.1 Commonwealth Heritage List

There are no places listed on the CHL within or near the Project Area.

6.2.2 State Heritage Register

A search of the State Heritage Inventory (SHI) indicated that there are no places listed under the NSW Heritage Act (NSW State Heritage Register) within or near the Project Area.

6.2.3 *Local Environmental Plan*

There are hundreds of places of heritage significance items located within the Inverell Council area that are listed on the LEP Schedule 5: Part 1 Heritage Items. In Bonshaw itself, three places are listed, all of which are located in Bonshaw village approximately 16 km NNW of the PA, and these are:

- Bonshaw Cemetery, Spark Street (Item #I019);
- Church, 10986 Bruxner Highway (Item #I018); and
- Memorial Hall, Miller Street (Item #I021).

No items of local historic heritage are located within or near the general Project Area.

6.3 **Historical Heritage Predictive Model**

There are no registered or known significant historic heritage sites in or near the PA. There may be evidence of early agricultural activities, timber harvesting, domestic dwellings and domestic remains in the PA. However, the historical background suggests that the PA was used as grazing land. Given the long term pastoral grazing and ongoing site disturbance associated with the installation of and maintenance of the transmission line through the southern section of the PA, it is unlikely that there will be substantial historical remains identified within the AP.

7. SURVEY METHODOLOGY AND RESULTS

This chapter provides an overview of the archaeological surveys of the PA that were undertaken between the 11 and 13 September 2018.

7.1 Field Survey Methodology

The September 2018 field survey was conducted according to the survey methodology developed and sent to RAPs on 9 August 2018 (*Appendix B*). The archaeological survey aimed to assess the ground surface of the PA and targeted all soil exposures and zones with low vegetation such as areas of erosion and any tracks or paths.

Where Aboriginal cultural heritage sites were identified, these were mapped and recorded by the survey team for content, GPS location, landscape features and digitally photographed. Notes were made of soil conditions, evidence of ground disturbance and possible spatial extent of sites.

Visibility refers to the amount of ground upon which artefacts could be seen. The presence of vegetation, leaf litter and other variables can obscure visibility, which is expressed as a percentage. An exposure is defined as an area in which ground surface disturbance (usually in the form of erosion) results in the removal of ground cover and soils and permits the detection of archaeological material that was formerly contained within a surface or subsurface context. The level of exposure is determined as a percentage. As a descriptive tool, *Table 7.1* has been devised which indicates the level of ground surface visibility. It is a subjective method of assessment, but provides a useful tool when attempting to describe the level of ground surface visible during field surveys or inspection.

Table 7.1 Ground Surface Visibility Rating

	Description	GSV Rating %
Very Poor	Heavy vegetation, scrub foliage or debris cover, dense tree or scrub cover. Soil surface of the ground very difficult to see.	0-9%
Poor	Moderate level of vegetation, scrub, and / or tree cover. Some small patches of soil surface visible in the form of animal tracks, erosion, scalds, blow outs etc., in isolated patches. Soil surface visible in random patches.	10-29%
Fair	Moderate levels of vegetation, scrub and / or tree cover. Moderate sized patches of soil surface visible, possibly associated with animal, stock tracks, unsealed walking tracks, erosion, blow outs, etc. Soil surface visible as moderate to small patches across a larger section of the PA.	30-49%
Good	Moderate to low level of vegetation, tree or scrub cover. Greater amount of areas of soil surface visible in the form of erosion, scalds, blow outs, recent ploughing, grading or clearing.	50-59%
Very Good	Low levels of vegetation / scrub cover. Higher incidence of soil surface visible due to recent or past land-use practices such as ploughing, grading, mining, etc.	60-79%
Excellent	Very low to non-existent levels of vegetation/scrub cover. High incidence of soil surface visible due to past or recent land use practices, such as ploughing, grading, mining, etc.	80-100%

Each of the different landforms identified in the PA were surveyed, which included slopes, upper flats, crests and plains (refer to *Table 7.3*). Creek lines, mature trees, erosion scours, and vehicle and animal access tracks were all inspected. In order to ensure the highest likelihood of finding Aboriginal sites, the field survey focussed on areas of highest ground visibility although it is noted that the ground surface visibility was poor (10-29%) to fair (30-49%) across the majority of the survey area.

7.2 Field Survey Results

The PA was surveyed over three days in September 2018 by Katherine Deverson and representatives of the RAPs as outlined in *Table 7.2*. The field survey methodology was adopted to pursue the discovery of new archaeological sites, ensure the accurate recording of such sites and provide sufficient information to provide an assessment of the PA's cultural significance. Discussion also included Aboriginal intangible values and the importance of Aboriginal sites to the local community.

Table 7.2 Field Survey Attendees

Name	Organisation
Vicky Duncan	Aboriginal Cultural Sites Services
Samantha Duncan	Edgerton Kwiambal
Darren Daley	Moombahlene LALC

7.2.1 Description of the Project Area

The PA generally consisted of grazing paddocks with dense grass traversing gently undulating terrain, plains, and crest landforms (refer to *Table 7.3* and *Photographs 7.1* and *7.2*). There was generally a low level of ground surface visibility with some ground exposures under trees, in areas of soil erosion and along tracks. Disturbances observed include the development of fencing, farm dams and vegetation clearance. Several woodland areas, along with a number of small unnamed creeks were also located in the PA (*Photograph 7.3*). Exposures associated with tracks, dams, woodland areas and other disturbances were examined for artefacts.

Soils across the PA range from alluvial soils adjacent to watercourses with thin sandy-silty Aeolian soil in colours of deep orange and red, to a light yellow/brown and dark brown. Disturbance to the soil profile has occurred during past episodes of vegetation clearance.

Table 7.3 Landform Summary

Landform	% of landform effectively surveyed	Number of Sites
Slope	1.5%	6
Upper Flat/Crest	1.75%	1
Plain/Open Depression	2.88%	28



Photograph 7.1 **Densely grassed paddock in PA, view to creek line (ERM 2018)**



Photograph 7.2 **Area of exposure along creek to the left, view to south of PA (ERM 2018)**



Photograph 7.3 View to north, along unnamed creek (ERM 2018)

7.2.2 Survey Coverage

The PA was examined in 32 survey units, based on fenced paddocks/areas throughout the PA for ease of recording and analysis. These survey units are identified as Survey Unit (SU) 1 to SU32. The location of these survey units is shown in *Figure 7.1* and detailed in *Table 7.4*.

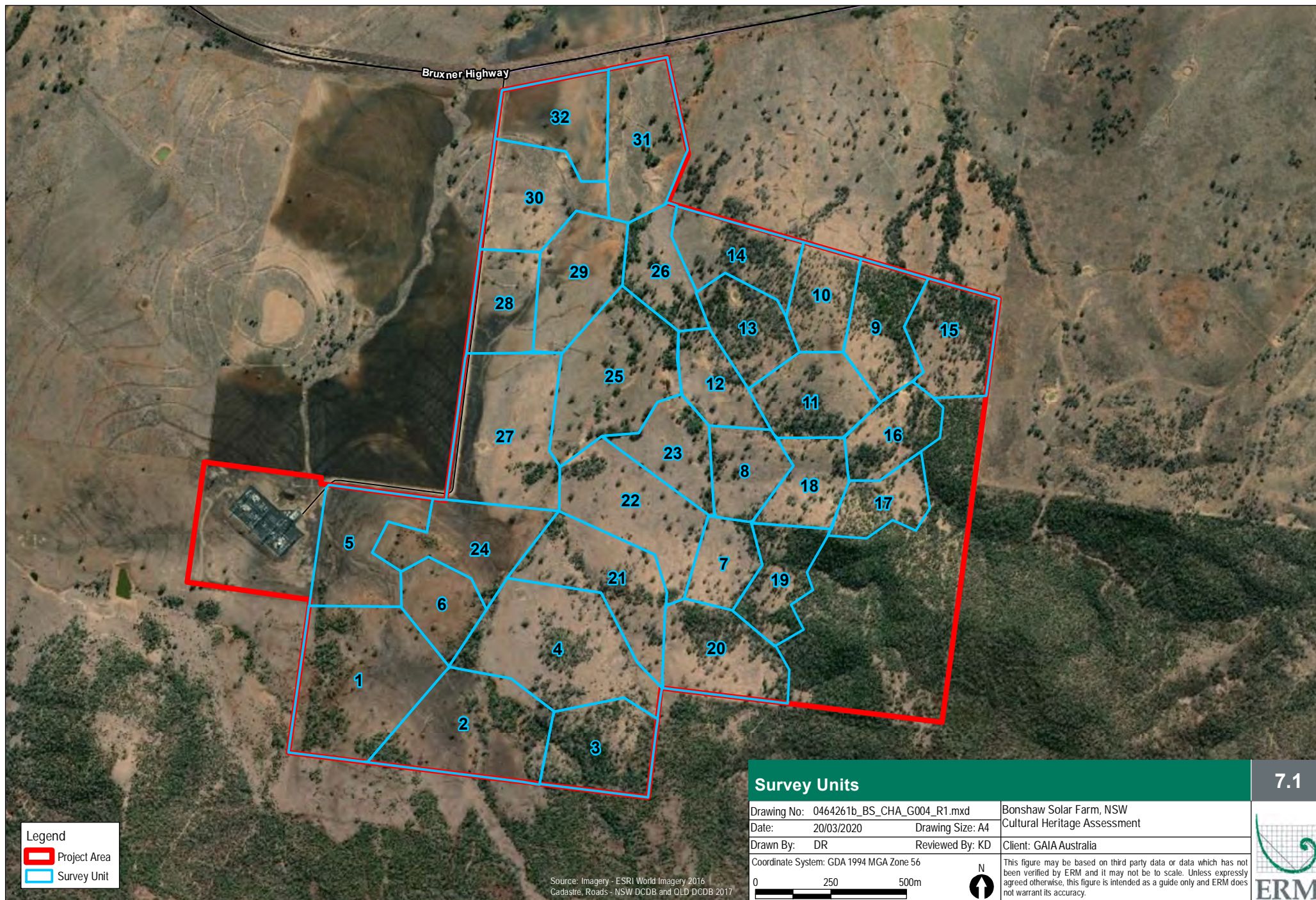


Table 7.4 Survey Coverage

Survey Unit	Landform	Visibility %	Exposure %	Effective Coverage %	Number of Sites
SU1	Plain	Poor 10%	10%	1%	2
SU2	Plain/Mid Slope	Poor 15%	10%	1.5%	2
SU3	Upper Slope/Crest	Poor 10%	10%	1%	0
SU4	Plain/Open Depression	Poor 20%	10%	2%	2
SU5	Plain/Mid Slope	Poor 10%	10%	1%	2
SU6	Plain/Mid Slope	Poor 10%	10%	1%	0
SU7	Plain	Poor 20%	10%	2%	1
SU8	Plain	Poor 15%	10%	1.5%	1
SU9	Upper Slope/Crest	Poor 25%	10%	2.5%	0
SU10	Mid Slope	Poor 10%	10%	1%	0
SU11	Mid Slope	Poor 10%	10%	1%	0
SU12	Plain	Poor 20%	10%	2%	0
SU13	Plain	Poor 10%	10%	1%	0
SU14	Plain	Poor 10%	10%	1%	2
SU15	Plain	Poor 10%	10%	1%	1
SU16	Plain/Mid Slope	Poor 15%	10%	1.5%	1
SU17	Mid Slope	Poor 10%	10%	1%	0
SU18	Plain	Poor 10%	10%	1%	0
SU19	Plain/Mid Slope	Poor 10%	10%	1%	0
SU20	Plain/Open Depression/Mid Slope	Poor 15%	10%	1.5%	0
SU21	Plain	Poor 15%	10%	1.5%	1
SU22	Plain	Poor 10%	10%	1%	2
SU23	Mid Slope	Poor 10%	10%	1%	1
SU24	Plain/Slope/Upper Flat	Good 50%	30%	15%	4
SU25	Plain	Fair 30%	10%	3%	2
SU26	Plain	Poor 10%	10%	1%	1
SU27	Plain	Fair 40%	30%	12%	1
SU28	Plain/Mid Slope	Poor 20%	15%	3%	1
SU29	Plain	Fair 40%	20%	8%	4
SU30	Mid/Upper Slope	Fair 30%	15%	4.5%	2
SU31	Plain	Poor 25%	15%	3.75%	2
SU32	Plain	Poor 25%	15%	3.75%	1

7.2.3 Survey Results

7.2.3.1 Aboriginal Heritage

During the field survey 35 previously unidentified Aboriginal heritage sites were recorded. The sites were located within 3 km of the Dumaresq River to the north, often along small creek lines (*Figure 7.2*). 29 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. The proximity to water sources and prevalence of artefact scatters or open sites is in line with the predictive model developed in *Section 5.4* and are representative of previously recorded sites in the area. It should be noted that while early studies suggest that sites in the region are less likely to occur along creek lines, this is not the case here and many artefact scatters were located along creeks, rather than in elevated areas or on ridgelines. These sites are described below in *Table 7.5*. Previously unrecorded Aboriginal cultural heritage sites located during the survey were recorded and artefacts and features identified were left *in situ*.

AHIMS Site #11-3-0083

AHIMS Site #11-3-0083 was identified within the PA in 2011 during surveys for the Dumaresq to Lismore 330kV Transmission Line. The 2018 survey conducted by ERM attempted to relocate site #11-3-008; however, this attempt was not successful. As noted in *Table 7.4* above, ground surface visibility across the PA was generally poor, averaging 10-15% visibility and 1-3% effective survey coverage. In consideration of the poor visibility and the significant passage of time between initial recording and the 2018 survey, it is not surprising that the original objects could not be relocated. It is possible that some or all of the site remains in-situ at the recorded location, although there is a small likelihood that some movement of artefact material has occurred since recording.

Additionally, as the site complex was recorded as a large series of artefact scatters (measuring 100 m by 80 m), high likelihood that sites located in the general area (between 50-100 m from the edges of the recording) may form part of the same greater site. With this in mind, BSF27, BSF28 and BSF32 may form part of AHIMS #11-3-0083.

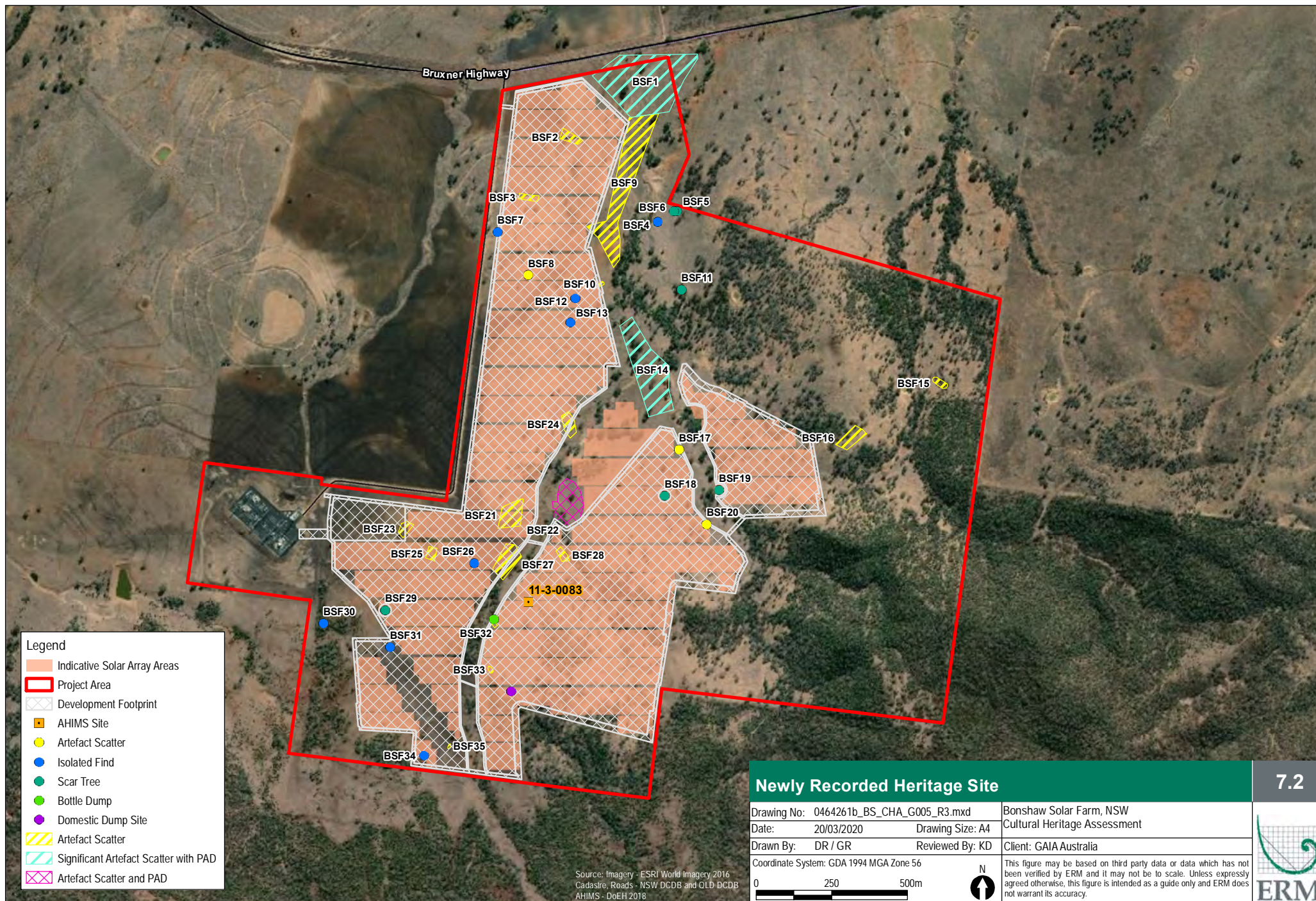













Table 7.5 Aboriginal Cultural Heritage Field Survey Results



Site	Survey Unit	Landform	Description		Associated PAD
BSF1	SU31	Plain	<p>Large Artefact Scatter / Open Camp</p> <p>This site comprises a high number of stone artefacts. It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an area of approximately 350 m (east to west) by 200 m (north to south).</p> <p>The site is located at northern boundary of property along small creek line and vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills. BSF1 is considered to have a moderate potential for further archaeological deposits due to the number of artefacts found with a corresponding low ground surface visibility, as well as its landscape setting and association with the nearby water course.</p> <p>Artefacts located included chert, tuff, basalt and quartz material, a silcrete retouched axe head and quartz round grindstone.</p> <p>Given its location on the creek that (to the south) contains a site also considered to be an occupation site (BSF14) indicating extended or repeated use, and its subsurface potential, it is considered likely that BSF1 may be part of a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22.</p>	 	Yes
BSF2	SU32	Plain	<p>Artefact Scatter</p> <p>This small artefact scatter of approximately six stone artefacts, including silcrete and basalt flakes and cores, and potentially a quartzite grindstone is located across an area of approximately 75 m (east to west) by 25 m (north to south).</p> <p>The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
			The site may have been formed as a result of wash down from the nearby hill to the south.		
BSF3	SU30	Upper Slope	<p>Artefact Scatter</p> <p>This small artefact scatter of four stone artefacts, including dilite/diorite flakes was identified by RAPS on a slope near the hillcrest on a track. It is located across an area of approximately 75 m (east to west) by 25 m (north to south).</p> <p>The site is located on an upper slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from the nearby hill top.</p>		No
BSF4	SU31	Plain	<p>Isolated Find</p> <p>Broken Granite manuport artefact. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF5	SU14	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a felled scarred tree located within proximity to another standing but dead scarred tree (BSF6). The oval shaped scar was approximately 1.4 m in length and 40 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
BSF6	SU14	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing (but dead) scarred tree, with an oval shaped scar. Within proximity to another felled scarred tree (BSF5). The oval shaped scar was approximately 1.2 m in length and 25 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No
BSF7	SU30	Mid Slope	<p>Isolated Find</p> <p>Silcrete core located on slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF8	SU28	Mid Slope	<p>Artefact Scatter</p> <p>Small artefact scatter consisting of at least seven blue chert flakes scattered within a 3 m x 5 m area may have been formed as the result of a single knapping event. The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
BSF9	SU29	Plain	<p>Large Artefact Scatter / Open Camp</p> <p>This site comprises a widespread surface artefact scatter evident along a track and yard across an area of approximately 500 m (north to south) by 100 m (east to west), the site also contains an associated scar tree. There is no evidence for subsurface material and it is possible that the site could have been caused by wash down from the nearby hill to the west of from the nearby occupation sites at BSF1 and BSF14. It is located near creek line and on a vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills.</p> <p>The site contains more than 40 artefacts which are mostly flakes including silcrete, chert, and quartz, flakes; basalt and tuff artefacts were also identified. The site associated with a scar tree identified by RAPs during survey which has been recorded as part of the site.</p> <p>Given its location near the creek that (to the north and south) contains a sites that are considered to be occupation sites (BSF1 and BSF14), it is considered likely that BSF9 may form part of an area of wider occupation sites at BSF1 and continuing south through BSF 9, BSF14, and BSF22.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
BSF10	SU29	Plain	<p>Artefact Scatter</p> <p>Small artefact scatter, comprising 2 x basalt hammerstones. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No




Site	Survey Unit	Landform	Description		Associated PAD
BSF11	SU26	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree. The roughly oval shaped scar was approximately 1 m in length, 40 cm wide, and very close to the ground.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No
BSF12	SU29	Plain	<p>Isolated Find</p> <p>Silcrete core located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No




Site	Survey Unit	Landform	Description		Associated PAD
BSF13	SU29	Plain	<p>Isolated Find</p> <p>Silcrete core located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF14	SU25	Plain	<p>Large Artefact Scatter / Open Camp</p> <p>This site comprises a high number of stone artefacts. It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an area of approximately 110 m (east to west) by 330 m (north to south).</p> <p>Located along and extending between two small creek lines and vehicle access track. The site is located on a plain set in a wider landscape context of rolling hills. The site is considered to have a high potential for further archaeological deposits due to the number of artefacts found with a corresponding low ground surface visibility, as well as its landscape setting and association with the nearby water course. Sub-surface artefacts were visible in the soil profile along eroded creek line at southern end of site.</p> <p>Artefacts located included chert, granite, basalt and quartz material.</p> <p>Given its location on the creek that (to the south) contains a site also considered to be an occupation site (BSF14) indicating extended or repeated use, and its subsurface potential, it is considered likely that BSF1 may be part of a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22.</p> <p>It is not likely that all surface artefacts were identified and recorded at this site, however more than 50 artefacts were noted, across an</p>		Yes




Site	Survey Unit	Landform	Description		Associated PAD
			area of approximately 350 m (east to west) by 200 m (north to south).		
BSF15	SU15	Plain	<p>Artefact Scatter</p> <p>This site comprises 1 x silcrete flake and 1 x broken silcrete hammerstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF16	SU16	Plain	<p>Artefact Scatter</p> <p>This site comprises 1 x silcrete flake and 1 x silcrete hammerstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
BSF17	SU23	Mid Slope	<p>Artefact scatter</p> <p>This site comprises approximately eight stone artefact including blue chert flakes, silcrete flakes and one core, across an area of approximately 80 m (NW to SE) by 30 m (SW to NE). The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from BSF14 which is nearby to the north.</p>		No
BSF18	SU22	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No




Site	Survey Unit	Landform	Description		Associated PAD
BSF19	SU8	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No
BSF20	SU7	Plain	<p>Artefact Scatter</p> <p>This site comprises a three chert flakes. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from larger sites, such as BSF14 which is along the same creek line to the north.</p>		No



Site	Survey Unit	Landform	Description		Associated PAD
BSF21	SU24 & SU 27	Plain	<p>Artefact Scatter</p> <p>This site comprises five stone artefacts, including a quartz flake, a large coarse grained flake with evidence for retouch, a large blue/grey coarse grained flake, a chert flake displaying at least 50% cortex, and a basalt axe. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14) or from a small lightly wooded rise immediately to its north, although no artefacts were identified on the rise.</p>		No
BSF22	SU22	Plain	<p>Artefact Scatter</p> <p>This site comprises a small artefact scatter with approximately 20 artefacts across a ground surface area on approximately 50 m (NW to SE) by 30 m (SW to NE). The site contains mostly basalt flakes and cores, and at least one chert flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site is considered to have potential for further archaeological deposits due to noted evidence for sub-surface artefacts in the soil profile in the eroded creek line along the western edge of site.</p> <p>The presence of the site on the high bank of a creek that (further to the north) contains occupation sites indicating extended or repeated use, and its noted subsurface potential means that it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22.</p>	 	Yes

Site	Survey Unit	Landform	Description		Associated PAD
BSF23	SU5	Crest/Upper Flat	<p>Artefact Scatter</p> <p>This site comprises two artefacts a smooth grained modified stone artefact and a granite hammerstone. The site is located on a rocky upper flat set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF24	SU25	Plain	<p>Artefact Scatter</p> <p>This site comprises a small artefact scatter of four fine grained (possibly chert) flakes across an area 75 m 40 m. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14).</p>		No
BSF25	SU24	Mid Slope	<p>Artefact Scatter</p> <p>This site comprises two artefacts, 1 x basalt hammerstone and 1 x granite axe. The site is located on a slope set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from nearby sites and terraced landforms to the west.</p>		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF26	SU24	Plain	<p>Isolated Find</p> <p>This site comprises a silcrete flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF27	SU24	Plain	<p>Artefact Scatter</p> <p>This site comprises a small artefact scatter of eight stone artefacts including five chert flakes, two basalt flakes and a hammerstone granite. The site is located in a ploughed field across an area of approximately 25 m (SW to NE) by 50 m (NW to SE), on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF28	SU21	Plain	<p>Artefact Scatter</p> <p>This site comprises a small artefact scatter of three artefacts with a chert, and quartz flakes identified and a quartzite core, across an area of approximately 110 m (SW to NE) by 50 m (NW to SE). The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p> <p>The site may have been formed as a result of wash down from nearby sites along the creek to the north (such as BSF14).</p>		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF29	SU5	Plain	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>		No
BSF30	SU1	Plain	<p>Isolated Find</p> <p>This site comprises a granite artefact. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF31	SU1	Plain	<p>Isolated Find</p> <p>This site comprises a grindstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF32	SU4	Plain	<p>Artefact scatter –</p> <p>This site comprises a small artefact scatter, 1 x basalt scraper and 1 x basalt flake. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF33	SU4	Plain	<p>Artefact scatter –</p> <p>This site comprises a small artefact scatter, 1 x fine-grained core and 1 x basalt core. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No

Site	Survey Unit	Landform	Description		Associated PAD
BSF34	SU2	Mid Slope	<p>Isolated Find</p> <p>This site comprises a grindstone. The site is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No
BSF35	SU2	Plain	<p>Artefact scatter</p> <p>This site comprises a small artefact scatter comprising 3 x blue chert flakes identified in ploughed field located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for additional artefacts, though none were identified.</p>		No

7.2.3.2 Historic Heritage

Two areas with historical items were observed during the field survey:

- A surface scatter of several miscellaneous historical items; and
- A smaller surface scatter of glass bottles to the north of the first surface scatter.

The surface scatter of historical items (refer to *Photographs 7.4 to 7.7*) included three small ceramic fragments, car parts, bottle fragments, and other metal domestic items. The items were sparsely strewn across an area of approximately 25 m x 20 m on the high bank side of an unnamed small creek. Items appeared to approximately date from (after) the 1940s, which is evidenced by the presence of bottles labelled as property of the Australasian Pickle Company Ltd. There was no evidence of any previous structure at the site nor any indication of a PAD.



Photograph 7.4 Domestic dump site (ERM2018)



Photograph 7.5 Ceramic fragments at domestic dump site (ERM 2018)



Photograph 7.6 Car parts at domestic dump site (ERM 2018)



Photograph 7.7 Discarded bottle, inscriptions says "This bottle always remains the property of the Australasian Pickle Company Ltd" (ERM 2018)

The separate surface scatter of bottles, located approximately 230 m NNW of the domestic dump, consists of five complete bottles sitting on the ground surface (refer to *Photograph 7.8*). The bottles include:

- one brown glass long necked beer bottle;
- one clear cylindrical bottle labelled "Pick-me-up (regd trade mark)" "this bottle is the property of Pick-Me-Up Condiment Co. Ltd Sydney 1946"; and
- three oblong shaped clear bottles, one of which is labelled as "Clements Tonic" (refer to *Photograph 7.9*).

Given the date on the cylindrical bottle it is likely that this smaller bottle dump dates to a similar period as the domestic dump to the south (from/after the late 1940s). Frederick Moore Clements began manufacturing Clements Tonic in Newtown, Sydney in c.1886 and was commercially successful (Haines 1981). The product is still available today (though very likely uses a different formula than the original). The bottles were laying directly on top of the ground surface with no indication of further sub-surface items.



Photograph 7.8 **Small bottle dump (ERM 2018)**



Photograph 7.9 **Clements Tonic bottle (ERM 2018)**

8. SIGNIFICANCE ASSESSMENT

The heritage values significance assessment for the PA has been assessed in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011), the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010) and the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010). This assessment encompasses the four values outlined in the *Burra Charter* (social, historical, scientific and aesthetic) (Australia ICOMOS 2013), as shown in *Figure 8.1*.

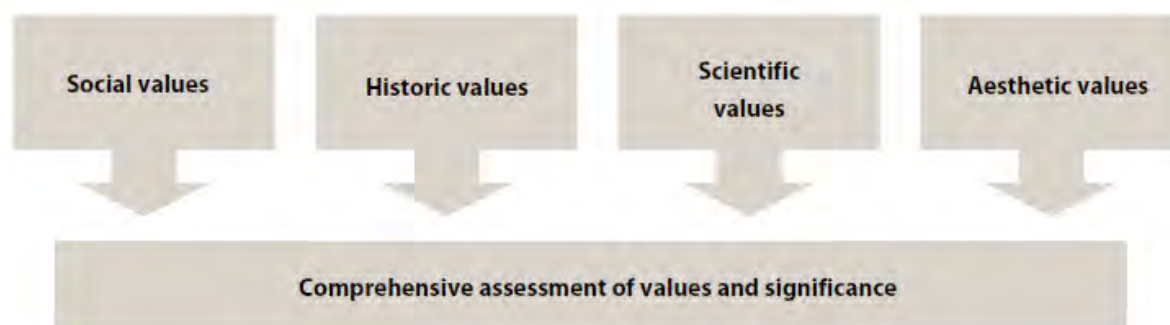


Figure 8.1 Diagrammatic Presentation of the Significance Assessment Process (OEH 2011)

8.1 Assessment of Aboriginal Cultural Significance

Aboriginal heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding how to manage a heritage site, object or place and balance competing land use options. Assessing the cultural significance of a place means identifying the reasons why a place is culturally important.

The OEH *Guideline for investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (2011) states that analysing cultural heritage significance involves two main steps:

- identifying the range of values present, including social, historic, scientific and aesthetic values; and
- assessing why they are important.

The Australia ICOMOS Burra Charter provides seven key criteria against which significance can be assessed, providing information about why sites are significant for the community. These criteria are identified as:

- **Rarity:** whether any or all aspects of a site (type, location, integrity, content and archaeological potential) can be considered common or rare within a local, regional or national context;
- **Representativeness:** the comparative rarity of the site when considered and contrasted against other similar sites conserved at the local and/or regional level;
- **Archaeological landscapes:** the study of the cultural sites relating to Aboriginal peoples within the context of their interactions in the wider social and natural environment they inhabited. Landscapes can be large or small depending upon specific contexts (i.e. local or regional conditions); they may also may be influenced by Aboriginal social and demographic factors (which may no longer be apparent);

- **Connectedness:** whether the site can be connected to other sites at the local or regional level through aspects such as type, chronology, content (i.e. materials present, manufacturing processes), spatial patterning or ethno-historical information;
- **Integrity & condition:** integrity refers to the level of modification a site has been subject to (the cultural and natural formation process) and whether the site could yield intact archaeological deposits, which could be spatially meaningful. Condition takes into account the state of the material, which is especially relevant for organic materials;
- **Complexity:** the demonstrated or potential ability of a site to yield a complex assemblage (stone, bone and/or shell) and/or features (hearths, fire pits, activity areas); and
- **Archaeological potential:** the potential to yield information (from sub-surface materials which retain integrity, stratigraphical or not) that will contribute to an understanding of contemporary archaeological interest, or which could be saved for future research potential.

The significance assessment presented in *this Section* and summarised in *Table 8.1* utilises these criteria.

8.1.1 Social Significance

Cultural/social significance concerns the value/s of a place, feature or site to a particular community group/s, in this case the local Aboriginal communities. Aspects of cultural or social significance are relevant to sites, objects and landscapes that are important or have become important to local Aboriginal communities. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for sites and their continued protection. As such, Aboriginal cultural significance can only be determined by the Aboriginal community.

During the field survey component of this assessment and in accordance with the relevant Aboriginal consultation guidelines, Aboriginal representatives were queried about the cultural significance (to individuals and the community more broadly) of the PA generally, specific locations within it and at identified sites. It was indicated by all RAP representatives that the PA holds a high level of cultural significance to Aboriginal people as it is situated within areas that were used for hunting, gathering and camping by past Aboriginal groups and therefore represents Aboriginal occupation of the region, a past way of life and a direct link to their ancestors. The wider landscape, particularly the flora, fauna and water courses associated with the PA are significant as they formed part of an economic resource environment.

The large and somewhat dense artefact scatters BSF1, BSF9, and BSF14 close to and extending along creek lines are thought by RAPs to represent large camping sites or meeting places.

8.1.2 Historic Significance

The PA has not demonstrated historic values of significance to the local Aboriginal community, as identified through consultation. Although the PA has been identified as holding cultural/social significance for the local Aboriginal community, the PA cannot be linked to specific historical events which are significant to the community.

8.1.3 Scientific Significance

The majority of areas of archaeological interest occurring in the PA are common site types within the region. Stone artefact sites including open camp sites (or artefact scatters) and isolated finds are the most common regional sites types, and that is reflected in the results of the field survey undertaken for the Project. The description of the low density scatters do not place them as of exceptionally high standard in terms of condition or content. They are therefore assessed as having a low archaeological significance.

The three largest artefact scatter / open camp sites are fairly artefact dense sites that all extend along and near creek lines and could represent extended or repeated occupation of the area. The sites may also be closely related and possibly represent one large occupation site. BSF1 and BSF14 are associated with Potential Archaeological Deposits (PADs) and are particularly dense and contain stone artefacts that are not only the by-product of stone tool making and tool use but also several tools themselves, including hammerstones and a retouched axe head found at BSF1. BSF1 and BSF14 are therefore assessed as having moderate significance.

Scarred trees, while less common, are known to be found in the area. Seven scarred trees were identified by RAPs (during the surveys) (refer to *Figure 7.2* and *Table 7.5*), however they do not present high scientific value due to the apparent age of the trees and relative commonness of the site type, and are assessed as having a low archaeological significance.

8.1.4 Aesthetic Significance

The stone artefact scatters identified within the PA do not reach the threshold of aesthetic significance and do not contribute to the aesthetic value of the broader landscape. The scarred trees identified have a moderate aesthetic value, as visual representations of cultural heritage practices of the local Aboriginal people.

8.2 Aboriginal Heritage Statement of Significance

The PA contains 36 Aboriginal sites and three associated PADs (35 recorded as part of this assessment). The majority of these sites are stone artefact sites including open camp sites and isolated finds. The sites recorded during this study have been assigned scientific significance in terms of rarity, representativeness, archaeological landscape, connectedness, integrity and condition, complexity, and archaeological sensitivity.

The significance rating of the identified stone artefact sites is higher or lower based on the presence of particular stone artefact types, formal tool types, diverse or unusual raw stone materials and the potential for stratified subsurface deposits. The sites identified within the PA are common site types at a local and regional level. Stone artefact sites are the main site type represented in the region and those located within the PA have not demonstrated a significantly greater diversity or complexity in comparison to other known sites within the region. Scarred tree sites have also been identified as part of this assessment.

It is for this reason that all but two sites (BSF1 and BSF14) located within the PA have been assessed as having low archaeological significance (separate to cultural significance). Additionally, AHIMS Site #11-3-0083 (within the development footprint) was previously assessed as having moderate to low archaeological significance.

BSF1, BSF14, BSF22 and AHIMS #11-3-0083 are all within close proximity to watercourses and located within flat terrain with relative shelter from the elements (areas of known Aboriginal occupation) were identified as having moderate potential for subsurface archaeological deposits based on observations of possible subsurface artefacts in soil profiles. These areas incorporate prominent landscape types within the PA (i.e. flat terrain and slightly sloping areas near a water source). Such areas are likely to contain as yet unrecorded Aboriginal sites and/or objects. Careful detailed design of the solar farm following initial heritage survey results has successfully avoided these two sites, however BSF22 and AHIMS #11-3-0083 may still be impacted by the Project. Given the BSF22's proximity to other significant sites (BSF1 and BSF14) thought to indicate extended or repeated occupation on the banks of the same creek as BSF22 to the north, it is possible that though the surface expression of artefacts at BSF22 is less dense than at sites to the north (BSF1, BSF9, and BSF14), it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek.

Table 8.1 Summary Significance of Aboriginal Heritage Sites

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF1	It is considered that all Aboriginal sites are significant to the local Aboriginal community. No specific comments have been received regarding the social significance of this site. Significance: High	BSF1 does not meet the threshold for significance under this criterion.	BSF1 is a large artefact scatter containing formal tool types and has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. It has been identified in proximity two other large scatters long a creek line indicating it may be part of a larger complex. Significance: Moderate	BSF1 does not meet the threshold for significance under this criterion.	Moderate
BSF2	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF2 does not meet the threshold for significance under this criterion.	BSF2 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF2 does not meet the threshold for significance under this criterion.	Low
BSF3	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF3 does not meet the threshold for significance under this criterion.	BSF3 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF3 does not meet the threshold for significance under this criterion.	Low
BSF4	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF4 does not meet the threshold for significance under this criterion.	BSF4 consists of a single manuport stone, transported in the landscape by human action. Significance: Low	BSF4 does not meet the threshold for significance under this criterion.	Low

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF5	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF5 does not meet the threshold for significance under this criterion.	BSF5 is a felled scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF5 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate	Moderate
BSF6	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF6 does not meet the threshold for significance under this criterion.	BSF6 is a scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF6 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate.	Moderate
BSF7	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF7 does not meet the threshold for significance under this criterion.	BSF7 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF7 does not meet the threshold for significance under this criterion.	Low
BSF8	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF8 does not meet the threshold for significance under this criterion.	BSF8 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF8 does not meet the threshold for significance under this criterion.	Low
BSF9	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF9 does not meet the threshold for significance under this criterion.	BSF9 is a large artefact that has been identified in proximity (between) two other large scatters near a creek line indicating it may be part of a larger complex. Significance: Low	The scarred tree at BSF9 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate	Moderate

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF10	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF10 does not meet the threshold for significance under this criterion.	BSF10 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF10 does not meet the threshold for significance under this criterion.	Low
BSF11	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF11 does not meet the threshold for significance under this criterion.	BSF11 is a scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF 11 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate	Moderate
BSF12	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF12 does not meet the threshold for significance under this criterion.	BSF12 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF12 does not meet the threshold for significance under this criterion.	Low
BSF13	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF13 does not meet the threshold for significance under this criterion.	BSF13 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF13 does not meet the threshold for significance under this criterion.	Low
BSF14	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF14 does not meet the threshold for significance under this criterion.	BSF14 is a large artefact scatter containing formal tool types and has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. It has been identified in proximity two other large scatters long a creek line indicating it may be part of a larger complex. Significance: Moderate	BSF14 does not meet the threshold for significance under this criterion.	Moderate

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF15	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF15 does not meet the threshold for significance under this criterion.	BSF15 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF15 does not meet the threshold for significance under this criterion.	Low
BSF16	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF16 does not meet the threshold for significance under this criterion.	BSF16 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF16 does not meet the threshold for significance under this criterion.	Low
BSF17	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF17 does not meet the threshold for significance under this criterion.	BSF17 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF17 does not meet the threshold for significance under this criterion.	Low
BSF18	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF18 does not meet the threshold for significance under this criterion.	BSF18 is a scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF18 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate	Moderate
BSF19	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF19 does not meet the threshold for significance under this criterion.	BSF19 is a scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF19 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate	Moderate

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF20	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF20 does not meet the threshold for significance under this criterion.	BSF20 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF20 does not meet the threshold for significance under this criterion.	Low
BSF21	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF21 does not meet the threshold for significance under this criterion.	BSF21 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF21 does not meet the threshold for significance under this criterion.	Low
BSF22	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF22 does not meet the threshold for significance under this criterion.	BSF22 presents a common low density scatter which has low potential to contribute to archaeological research in the region, however it has been assessed as having potential to contain subsurface archaeological material, and therefore may have some research value. Significance: Moderate - Low	BSF22 does not meet the threshold for significance under this criterion.	Moderate to Low
BSF23	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF23 does not meet the threshold for significance under this criterion.	BSF23 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF23 does not meet the threshold for significance under this criterion.	Low
BSF24	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF24 does not meet the threshold for significance under this criterion.	BSF24 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF24 does not meet the threshold for significance under this criterion.	Low

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF25	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF25 does not meet the threshold for significance under this criterion.	BSF25 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF25 does not meet the threshold for significance under this criterion.	Low
BSF26	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF26 does not meet the threshold for significance under this criterion.	BSF26 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF26 does not meet the threshold for significance under this criterion.	Low
BSF27	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF27 does not meet the threshold for significance under this criterion.	BSF27 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF27 does not meet the threshold for significance under this criterion.	Low
BSF28	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF28 does not meet the threshold for significance under this criterion.	BSF28 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF28 does not meet the threshold for significance under this criterion.	Low
BSF29	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF29 does not meet the threshold for significance under this criterion.	BSF29 is a scarred tree identified by RAPs. The site type is relatively common in the region. Significance: Low	BSF29 is a visual representation of cultural heritage practices of the local Aboriginal people. Significance: Moderate.	Moderate

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF30	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF30 does not meet the threshold for significance under this criterion.	BSF30 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF30 does not meet the threshold for significance under this criterion.	Low
BSF31	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF31 does not meet the threshold for significance under this criterion.	BSF31 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF31 does not meet the threshold for significance under this criterion.	Low
BSF32	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF32 does not meet the threshold for significance under this criterion.	BSF32 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF32 does not meet the threshold for significance under this criterion.	Low
BSF33	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF33 does not meet the threshold for significance under this criterion.	BSF33 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF33 does not meet the threshold for significance under this criterion.	Low
BSF34	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF34 does not meet the threshold for significance under this criterion.	BSF34 consists of an isolated stone artefact, which holds very little research potential and is unlikely to assist in demonstrating depositional processes or land usage. Significance: Low	BSF34 does not meet the threshold for significance under this criterion.	Low

Site ID	Social Significance	Historical Significance	Scientific Significance	Aesthetic Significance	Overall Significance Level
BSF35	It is considered that all Aboriginal sites are significant to the local Aboriginal community. Significance: High	BSF35 does not meet the threshold for significance under this criterion.	BSF35 presents a common low density scatter which has low potential to contribute to archaeological research in the region. Significance: Low	BSF35 does not meet the threshold for significance under this criterion.	Low
AHIMS Site #11-3-0083	It is considered that all Aboriginal sites are significant to the local Aboriginal community. The 2011 report (OzArk EHM) assessed this site as being of moderate to high cultural significance. Significance: Moderate - High	11-3-0083 does not meet the threshold for significance under this criterion.	The 2011 report (OzArk EHM) assessed this site as being of low to moderate scientific cultural significance. Significance: Moderate - Low	11-3-0083 does not meet the threshold for significance under this criterion.	Moderate

8.3 Assessment of Historic Heritage Significance

Two surface scatters of historical items were identified during the 2018 surveys, however no research into these sites has been undertaken. As these sites are fairly sparse scatter with limited historic artefacts and no evidence for structures or subsurface expressions were noted during the survey, it is considered that these are dumpsites that were utilised once (or twice) by a local household sometime in the last 70 years. No items identified are considered rare or representative, or of containing any value for further research. It is considered likely that other properties in the area contain similar sites. Although the identification of five complete historic glass bottles is interesting, these sites are not considered to reach the threshold for local historic heritage significance.

9. IMPACT ASSESSMENT

The proposed works involve the following actions that have the potential to impact on Aboriginal heritage sites and values:

- site establishment including the provision of access and construction compounds and laydown areas/material storage facilities;
- topsoil stripping and stockpiling in windrows along the edge of the trench;
- trench excavation and stockpiling of the spoil on the opposite side to the topsoil;
- installation of a sand bed layer;
- laying of conductor and earth cables, incorporating direct bury of cable joints (located approximately every 500 m to 1000 m) and marking of those with electronic marker devices; and
- trench reinstatement consisting of placement of sand coverage of cables, installation of a hard cover, then backfilling/compaction of spoil and respread of topsoil;
- the grading of roads and upgrading of existing access roads;
- vehicle movement across eroded tracks;
- the development of new access roads;
- clearance of vegetation;
- the construction of hardstands and laydown areas; and
- on-site equipment storage areas for the construction period.

36 Aboriginal heritage sites (and three associated PADs) have been recorded within the PA. 30 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. Careful detailed design of the Project footprint has successfully avoided several of these sites, including BSF1 and BSF14 which are considered to have moderate archaeological significance (refer to *Table 9.1* and *Figure 9.1*).

As the Project is still at concept design phase, and no detailed positioning of solar arrays has been developed, there remains some uncertainty around impact to a number of identified Aboriginal heritage sites. It is evident that these sites are within the Project footprint; however, careful avoidance measures applied and integrated at detailed design phase could avoid smaller artefact scatters or isolated finds. In order to facilitate this process, a detailed methodology for avoidance and procedures for surface collection, test excavation and archaeological salvage will be written into the Cultural Heritage Management Plan. Where impact to sites is possible, but has not been confirmed, these sites have been identified as 'Potentially Impacted'.

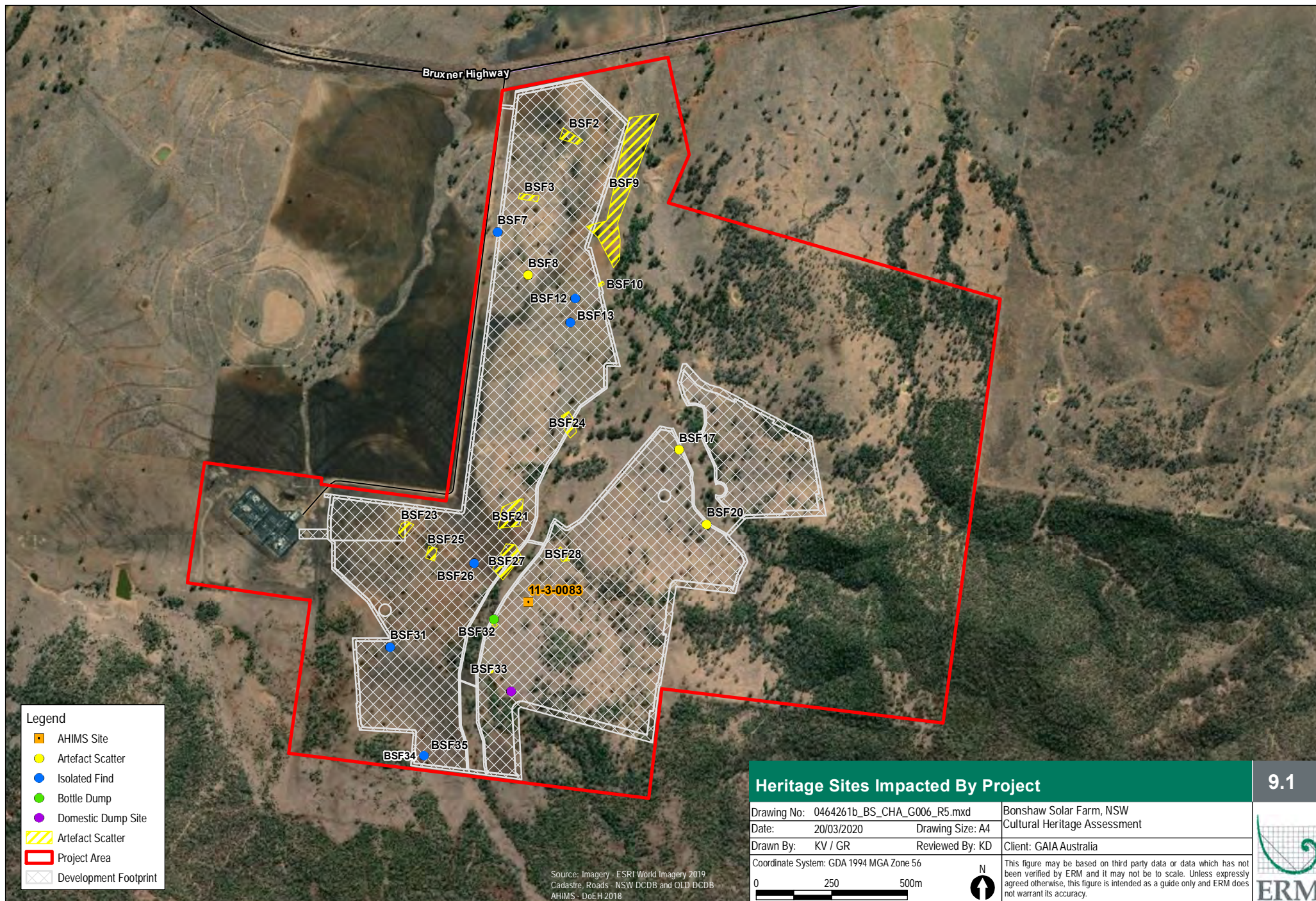
All scarred trees within the Project footprint will be avoided during detailed design phase and no harm will result from proposed works.

Table 9.1 Summary Impact Assessment of Aboriginal Heritage Sites

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF1	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site and PAD
BSF2	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF3	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF4	TBD	Low	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site
BSF5	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF6	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF7	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF8	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF9	TBD	Moderate	<u>Partial Impact</u> Careful detailed design of the development footprint has successfully avoided most of this site, however a small section of the site may be impacted
BSF10	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF11	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF12	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF13	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF14	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site and PAD
BSF15	TBD	Low	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site
BSF16	TBD	Low	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF17	TBD	Low	<u>Partial Impact</u> Careful detailed design of the development footprint has successfully avoided most of this site, however a small section of the site may be impacted
BSF18	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF19	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF20	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF21	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF22	TBD	Low	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site
BSF23	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF24	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF25	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF26	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF27	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF28	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF29	TBD	Moderate	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this scarred tree
BSF30	TBD	Low	<u>No Impact</u> Careful detailed design of the development footprint has successfully avoided this site
BSF31	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF32	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF33	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.

Site ID	AHIMS	Overall Significance Level	Assessment of Potential Impact
BSF34	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
BSF35	TBD	Low	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.
Tenterfield-Dumaresq OS14	11-3-0083	Moderate	<u>Potential Impact</u> Artefact scatter may be impacted by project works. Avoidance measures have been recommended.



Heritage Sites Impacted By Project

9.1

Drawing No: 0464261b_BS_CHA_G006_R5.mxd

Date: 20/03/2020

Drawing Size: A4

Drawn By: KV / GR

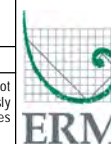
Reviewed By: KD

Coordinate System: GDA 1994 MGA Zone 56

0 250 500m



This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



10. CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

36 Aboriginal heritage sites and three associated PADs have been recorded within the PA. 30 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified, one of the scarred trees was identified as part of an artefact scatter site. Careful detailed design of the Project footprint has successfully avoided nine of these sites, including BSF1 and BSF14 which are considered to have moderate archaeological significance.

10.2 Recommendations

The following recommendations are made to assist in ongoing management of identified heritage sites. The management recommendation statements are made in light of:

- the results of background desktop investigation as outlined in this report;
- predictive modelling;
- results of the field survey;
- a heritage significance assessment;
- legislative requirements as outlined in this report; and
- consultation with the relevant Aboriginal organisations.

10.2.1 Aboriginal Heritage

Based on the information presented in this report, specific recommendations for each identified Aboriginal site is detailed in *Table 10.1* and the following general recommendations have been developed:

- personnel involved with ground breaking activities in the PA should undertake cultural awareness training in line with the recommendations below;
- during works, the location of all recorded Aboriginal heritage sites should be clearly marked on all construction plans for the PA, physically and visibly demarcated on the ground, and site foremen informed of their presence and the need to avoid disturbance;
- if suspected Aboriginal heritage objects are found during works, the Unexpected Find Procedure outlined below should be followed and applies to the entire PA;
- continuing Aboriginal involvement in the Bonshaw Solar Farm project. Ongoing consultation with the Aboriginal community and registered Aboriginal stakeholders for the Project should occur during the construction of the Project. The triggers for consultation with the community during construction may include:
 - Additional heritage assessments for any changes in Project scope;
 - The implementation of the Unexpected Finds Procedure;
 - Preparation of a Cultural Heritage Management Plan (CHMP) for implementation during construction;
 - Endorsement by RAPs of the heritage information to be contained in the Project induction material;
- a copy of this report should be provided to each of the Aboriginal organisations who expressed an interest in the Project; and
- a copy of this report should be provided to the relevant OEH regional branch.

10.2.1.1 *Cultural Awareness Training*

In order to comply with best practice principles, it is recommended that any personnel involved with ground breaking activities in the PA undertake basic cultural awareness training. This training should be carried out in the form of a pre-work workshop by a qualified heritage specialist in consultation with a Aboriginal Stakeholders, or by a relevant Aboriginal Stakeholder. The heritage induction material, including an unexpected finds procedure should be developed by an appropriately qualified heritage specialist. This training should:

- include information on the Aboriginal archaeological and cultural heritage values of the PA;
- legal responsibilities and statutory obligations for heritage under the NPW Act and the Heritage Act;
- outline the location and type of archaeological sites within the PA including significant landforms and give instructions not to disturb these sites;
- outline the procedures for the discovery of previously unrecorded Aboriginal objects, through the chance finds procedure; and
- only information endorsed for sharing by the registered Aboriginal stakeholders should be included within the induction package for all workers.

10.2.1.2 *Unexpected Finds Procedure*

If any heritage objects and/or relics, as protected under NSW legislation, are uncovered during the Project, then the following steps should be followed:

- all activity in the immediate area should cease;
- an area of 2 m surrounding the find should be cordoned off with hazard tape to avoid further disturbance;
- an appropriately qualified archaeologist should be consulted;
- OEH should be immediately contacted;
- If the find consists of Aboriginal cultural heritage, the local Aboriginal stakeholder groups should be notified; and
- an appropriately qualified archaeologist should record the location and attributes of the site and determine the significance of the find.

Additional unexpected finds protocols relating to Historical Heritage finds are detailed in *Section 10.2.2*.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the PA the following steps should be followed:

- all activities and/or works in the immediate area must cease;
- the NSW Police must be contacted along with the OEH; and
- any sand/soils removed from the near vicinity of the find must be identified and set aside for assessment by the investigating authorities.

10.2.1.3 *Aboriginal Community Endorsement and Recommendations*

A draft copy of the CHA report was provided to all Aboriginal parties who registered an interest in the project on 9 May 2019, for the purposes of receiving written or oral general comments and more specific comments on the cultural significance of the PA and the identified sites and the recommended management and mitigation measures in the ACHA. Feedback was received from two of the RAPs (also refer to *Section 3.4* and *Appendix A*).

10.2.1.4 *Cultural Heritage Management Plan*

In addition to the cultural heritage induction for contractors, ERM recommends that a Cultural Heritage Management Plan (CHMP) be prepared prior to construction commencing. The CHMP would respond to statutory requirements and Conditions of Consent to ensure appropriate management of cultural heritage during the course of construction and operation of the Project. The CHMP would include protocol for surface collection and salvage, test or salvage excavations, and construction monitoring (as required). The CHMP would also provide a methodology for physical demarcation of sites prior to construction commencing, allowing for RAP participation in this process to ensure all significant cultural heritage sites are appropriately managed.

The CHMP should be prepared in consultation with the RAPs and should be endorsed by all RAP groups prior to finalisation.

10.2.1.5 *Dissemination of Information*

It is recommended that a copy of the final report be provided to each of the Aboriginal organisations who participated in the project. A copy of this report is to be provided to OEHL upon finalisation.

10.2.1.6 *Identified Aboriginal Heritage Sites*

Direct harm to some sites listed in *Table 10.1* is considered unavoidable. A large number of individual artefacts were identified in the sites listed in *Table 10.1*. It is considered that the cumulative impacts resulting from harm to the sites has the potential to significantly and negatively impact on the Aboriginal cultural heritage values of the area. Therefore, it is considered essential to develop management strategies to minimise this impact as far as possible.

The management measures proposed in *Table 10.1* were formulated during discussions on site with Aboriginal representatives. The recommended mitigation of these direct impacts is to facilitate salvage of artefacts prior to harm occurring, followed by reburial (return to country) outside of impact areas, as close to original location as possible. This management strategy has been formulated with consideration of principles of Ecologically Sustainable Development (ESD), in particular intergenerational equity that holds that various aspects of the environment (including cultural heritage) are available for the benefit of future generations.

If impact to BSF22 is unavoidable it is recommended that subsurface testing be carried out to identify the nature and extent of sub-surface Aboriginal objects at the site in accordance with the *Code of Practice*. The presence of the site on the high bank of a creek that (further to the north) contains occupation sites indicating extended or repeated use, and its noted subsurface potential means that it may also be an occupation site and a southern extension of what may be a complex of occupation sites along the creek beginning at BSF1 and continuing south through BSF14 to BSF22. Test excavations at this site may contribute to the understanding of site characteristics and local and regional prehistory. It may also be used to better inform mitigation measures within the PA.

Where there is a time lapse between collection of artefacts and associated reburial, it is proposed that the Project archaeologist undertaking the artefact collection retain any collected artefacts until such time as they can be reburied.

Note that management measures would be carried out in accordance with the SEARS, and any requirements of the RAPs and the OEHL, and therefore the specifics may differ from that presented below.

Table 10.1 Management Measures for identified Aboriginal Heritage Sites

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF1	Moderate	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF2	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF3	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF4	Low	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF5	Moderate	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF6	Moderate	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF7	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF8	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF9	Moderate	Partial	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected, around the section of the site that will not be impacted by project works and the scarred tree, by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended that if proposed project works cannot avoid the entire site that surface collection/salvage of the section of the site that will be impacted be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF10	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF11	Moderate	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF12	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF13	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF14	Moderate	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF15	Low	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF16	Low	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF17	Low	Partial	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected, around the section of the site that will not be impacted by project works and by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended that if proposed project works cannot avoid the entire site that collection/salvage of the section of the site that will be impacted be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF18	Moderate	No	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF19	Moderate	No	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF20	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF21	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF22	Moderate to Low	No	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed. It is recommended if proposed project works cannot avoid the entire site that subsurface testing be carried out to identify the nature and extent of subsurface Aboriginal objects at the site. Further to this, surface collection/salvage of the section of the site that will be impacted should be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF23	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF24	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF25	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF26	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF27	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF28	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

Site ID	Overall Significance Level	Potential Impact?	Management Measure
BSF29	Moderate	No	Avoidance. Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF30	Low	No	Avoidance. Prior to construction commencing, if works, access tracks or laydowns areas are planned in the same paddock, exclusion fencing and exclusion signage should be erected around the site by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.
BSF31	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF32	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF33	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF34	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
BSF35	Low	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.
11-3-0083	Moderate	Yes	It is recommended that surface collection/salvage be undertaken by Aboriginal stakeholder groups and an appropriately qualified archaeologist prior the commencement of works.

10.2.2 Historic Heritage

While the historic items identified during this assessment have been assessed as not meeting the threshold for local historic heritage significance, the items at these sites should be carefully collected and offered to a local heritage museum or organisation prior to commencement of project works.

10.2.2.1 Unexpected Historic Heritage Finds Procedure

If any heritage objects and/or relics, as protected under NSW legislation, are uncovered during the Project, then the following steps should be followed:

- all activity in the immediate area should cease;
- and an appropriately qualified heritage professional should be consulted;
- OEH should be immediately contacted; and
- an appropriately qualified heritage professional should record the location and attributes of the site and determine the significance of the find.

In the event of the discovery of human skeletal material (or suspected human skeletal material) during project activities in the PA the following steps should be followed:

- all activities and/or works in the immediate area must cease;
- the NSW Police must be contacted along with the OEH; and
- any sand/soils removed from the near vicinity of the find must be identified and set aside for assessment by the investigating authorities.

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APPENDIX A ABORIGINAL STAKEHOLDER CONSULTATION LOG

AGENCIES CONTACTED

Body/Group	Contact Details	Date Sent	Response	Date
OEH Branch : Coffs Harbour	NSW Office of Environment and Heritage Federation House, 24 Moonee Street, Coffs Harbour NSW 2450 info@environment.nsw.gov.au	3/7/18 Via email and post	Refers ERM to contact Mr Craig Archibald and Mr Aaron Broad	11 th July Via post
The Registrar, <i>Aboriginal Lands Right Act</i>	Office of the Registrar, Aboriginal Land Rights Act PO Box 112 Glebe NSW 2037 adminofficer@oralra.nsw.gov.au	3/7/18 Via email and post	No Registered Aboriginal Owners within project Area on the Register of Aboriginal Owners. Refers ERM to contact Toomelah Local Aboriginal Land Council	11 th July Via email
National Native Title Tribunal (NNTT)	enquiries@nntt.gov.au	3/7/18 Via email and post	Overlap report	5/7/18 Via email
Native Title Services Corporation (NTS Corp)	Native Title Services Corporation PO Box 2105 Strawberry Hills NSW 2012 information@ntscorp.com.au	3/7/18 Via email and post		
Inverell Shire Council	Inverell Shire Council Administration Centre 144 Otho Street PO Box 138 Inverell NSW 2360	3/7/18 Via email and post	Referred to LALCs in the Inverell LGA	17 th July 2018 Via post

Body/Group	Contact Details	Date Sent	Response	Date
Tenterfield Shire Council		3/7/18 Via email and post	Links to councils Aboriginal Heritage Study lists and relevant groups. Refers ERM to Moombahlene LALC	4/7/18 Via email
Local Land Services – Northern Tablelands	Local Land Services Northern Tablelands 15 Vivian Street PO Box 411 Inverell NSW harry.white@lls.nsw.gov.au	3/7/18 Via email and post	Refers ERM to Toomelah Local Aboriginal Land Council (in their region) Interested in providing quote to conduct detailed assessment.	4 th July Via post
Moombahlene Local Aboriginal Land Council	299 Rouse St, Tenterfield NSW 2372 moombahlenelalc1@bigpond.com	3/7/18 Via email and post	Helen Duroux (CEO) Interested in taking part in the cultural assessments.	4/7/18 Email response

NEWSPAPER ADVERTISEMENT

Newspaper	Contact	Date Sent	Date Published
Inverell Times	The Inverell Times t 0267 200 100 classifieds.invtimes@fairfaxmedia.com.au 166 Byron Street, Inverell, NSW 2360	03/07/2018	06/07/2018
Tenterfield Star	The Tenterfield Star t 02 6776 0501 classifieds.tentstar@fairfaxmedia.com.au	03/07/2018	11/07/2018

Newspaper	Contact	Date Sent	Date Published
	115 Faulkner Street, Armidale, NSW 2350 www.tenterfieldstar.com.au		

LIST OF STAKEHOLDERS GROUPS IDENTIFIED & PROJECT NOTIFICATION SENT

Organisation/Person	Contact Provided	Date Sent	Comment
Mr Craig Archibald	27 Margaret Street Teralba NSW 2284	24 July 2018	No Response – Letter returned 30/08/2018 marked as “RTS no longer as this address”
Aaron Broad	1 Waratah Ave Albion Park Rail NSW 2527 minnamunnung@gmail.com	24 July 2018	No Response
Toomelah Local Aboriginal Land Council	Toomelah LALC 0746762348 toomelahlandcouncil@gmail.com	Phone call and follow up email 7 August 2018	Correspondence from the LLS has suggested that the site is located within the Toomelah LALC boundaries. Our review of the boundaries places the site within Moombahlene LALC. Request was sent to confirm that it is not in Toomelah region.

REGISTERED ABORIGINAL PARTIES

Organisation/Person	Contact	Date Registered	How the registration was received & any comments
Aboriginal cultural sites services	Vicky Duncan Diane MARLOW acsworknsw@gmail.com	8 July 2018	Email response registering an interest in being consulted

Edgerton Kwiambal	Samantha Duncan and Liza Talbot. PH: 0422098648 6 Bala st, Ashford N.S.W 2361 duncans528@gmail.com	9 July 2018	Email response registering an interest in being consulted
Helen Duroux (CEO)	Moombahlene LALC PO Box 70 Tenterfield ,2372 Ph : 0267363219 Fax : 0267361486 Helen Duroux moombahlenelalc1@bigpond.com	4 July 2018 and 17 July 2018	Email response registering an interest in being consulted

Presentation of information about the proposed project

Presentation of proposed project information

Aboriginal Organisation/Person	Date Sent	Date Reply	Comments, outcomes and/or issues	Notes
Aboriginal cultural sites services	09/08/2018	10/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	VD & DM responded via email accepting invitation to the survey, no comments on methodology or known cultural heritage values in email.
Edgerton Kwiambal	09/08/2018	13/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	SD responded via email accepting invitation to the survey, no

Aboriginal Organisation/Person	Date Sent	Date Reply	Comments, outcomes and/or issues	Notes
				comments on methodology or known cultural heritage values in email.
Moombahlene LALC	09/08/2018	03/09/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology and invitation to survey included in letter.	ERM called on 30/08/18 to enquire if LALC was available for fieldwork on these dates or had any feedback on methodology and project information. No answer, left message. Followed up with email stating the same. HD responded via email 03/09/2018.

The record of agreed outcomes and/or contentious issues should be supplied to all registered Aboriginal parties.

Provision of the proposed assessment methodology to the RAP

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
Aboriginal cultural sites services	09/08/2018	10/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and invitation to survey included in letter.	VD & DM responded via email accepting invitation to the survey, no

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
				comments on methodology or known cultural heritage values in email.
Edgerton Kwiambal	09/08/2018	13/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and invitation to survey included in letter.	SD responded via email accepting invitation to the survey, no comments on methodology or known cultural heritage values in email.
Moombahlene LALC	09/08/2018	03/09/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop details included in letter.	ERM called on 30/08/18 to enquire if LALC was available for fieldwork on these dates or had any feedback on methodology and project information. No answer, left message. Followed up with email stating the same. HD responded via email 03/09/2018, stating that they were interested in the methodology

Aboriginal Organisation/Person	Date Sent	Date Reply	Comment and details of how input has been considered	Notes
				and looking forward to fieldwork.

Field Survey or opportunity for RAP to visit the proposed project site

RAP	Representative	Date	Comments
Aboriginal cultural sites services	Vicky Duncan	11/09/2018, 12/09/2018 & 13/09/2018	
Edgerton Kwiambal	Samantha Duncan	11/09/2018, 12/09/2018 & 13/09/2018	
Moombahlene LALC	Darren	11/09/2018, 12/09/2018 & 13/09/2018	

Seek information from RAP on (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value

RAP	Date	Comments	Cultural values identified
Aboriginal cultural sites services	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of	No values identified to heritage consultation

		Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	
Edgerton Kwiambal	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	
Moombahlene LALC	09/08/2018	Presentation of project information sent with information on known heritage background, proposed survey methodology, cultural heritage assessment workshop and a request to be provided with any information on the (a) the presence of Aboriginal objects of cultural value and (b) places of cultural value, if known or appropriate to divulge.	

ONGOING CONSULTATION

RAP	Contact Made by	Date	Comments	Notes / Follow up
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	03/09/2018	KD called VD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. VD	KD sent follow up email to confirm extension of fieldwork.

			confirmed availability to attend.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	03/09/2018	KD called SD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. No answer message left	KD sent follow up email to invite Edgerton Kwiambal to two further fieldwork days.
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	03/09/2018	KD called VD to advise that following further desktop it was believed that further fieldwork days were needed and invited RAP to attend fieldwork one day earlier (Tuesday 11 September) and advised likely that fieldwork would now extend to Friday 14 September. HD advised she would contact LALC heritage officer and advise ERM of their availability.	KD sent follow up email to confirm extension of fieldwork.
Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	04/09/2018	SD emailed to advise she would attend all fieldwork days from 11/09/2018, and email Insurance information	KD emailed to thank SD for her response.
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their	

			participation in fieldwork and advise of invoicing details	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their participation in fieldwork and advise of invoicing details	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	18/09/2018	KD emailed to thank everyone for their participation in fieldwork and advise of invoicing details	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	09/05/2019	KD emailed draft ACHA to RAPs requesting any comments by 07/06/2019.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	12/06/2019	KD emailed checking if VD had any comments on the draft ACHA.	
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	12/06/2019	KD emailed checking if SD had any comments on the draft ACHA.	SD emailed endorsement of the ACHA 12/06
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	12/06/2019	KD emailed checking if HD had any comments on the draft ACHA.	
Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	12/06/2019	SD replied to KD's email advising 100% endorsement of the ACHA draft	KD emailed reply thanking SD for her response.

Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	21/06/2019	KD emailed checking if VD had any comments on the draft ACHA.	VD replied with comment on project recommendations.
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	21/06/2019	KD emailed checking if HD had any comments on the draft ACHA.	
Aboriginal cultural sites services – Vicky Duncan	Aboriginal cultural sites services – Vicky Duncan	21/06/2019	VD replied with comment on project recommendations, that sites should be avoided otherwise salvaged, and that the area appeared to be a high occupancy area used by her ancestors.	KD emailed replied thanking VD for her response, advising that comments would be included in the ACHA.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	VD replied on 13/07/2019, see entry below
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	10/07/2019	KD emailed on behalf of the proponent to advise that	HD replied 11/07/2019, see below entry

			three sites (scarred trees) BSF18, BSF19 and BSF29 were currently within the projects impact area and to ask for comment on the possibility of the removal of these trees.	
Moombahlene LALC – Helen Duroux	Moombahlene LALC – Helen Duroux	11/07/2019	HD emailed to advise that LALC did not support the removal of any scarred trees.	KD replied thanking HD for her response.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Aboriginal cultural sites services – Vicky Duncan	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the	

			aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Moombahlene LALC – Helen Duroux	ERM – Katherine Deverson	12/07/2019	KD emailed to advise that significance of scarred trees sites BSF5, BSF6, BSF9, BSF11, BSF18, BSF9, and BSF29 had been revised from low overall significance to moderate significance as a result of corrections in the draft ACHA to reflect the aesthetic and social/cultural values of the sites. Updated version of ACHA also sent.	
Aboriginal cultural sites services – Vicky Duncan	Aboriginal cultural sites services – Vicky Duncan	13/07/2019	VD emailed to advise that ACSS did not support the removal of any live scarred trees and that in the event the removal of dead scarred trees notify Kwiambal Elders Group ,Edgerton Kwiambal environment cultural heritage aboriginal corporation also local land Council must be notified for salvage.	KD replied thanking VD for her response.
Edgerton Kwiambal – Samantha Duncun	ERM – Katherine Deverson	25/07/2019	KD emailed checking if SD had any comments on the email regarding possible removal of scarred trees.	

Edgerton Kwiambal – Samantha Duncun	Edgerton Kwiambal – Samantha Duncun	25/07/2019	SD emailed to advise the EK agreed with comments provided by other RAPs that removal of scarred trees should be avoided, however if removal was to occur that it should be done in consultation with RAPs and with them present for salvage.	KD replied thanking SD for her response.
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Elise Caldwell

From: Katherine Deverson
Sent: Friday, 21 June 2019 12:38 PM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review
Attachments: 0464261 - Bonshaw SF ACHA Draft.pdf

Hi Helen,

I am just checking in again to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have had a chance to review it, and are able to email back an endorsement of the report and/or any comments you may have, that would be great!

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Tench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com



From: Katherine Deverson
Sent: Wednesday, June 12, 2019 1:13 PM
To: Helen Duroux <moombahlenelalc1@bigpond.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Helen,

I am just checking in to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,
Kat

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E katherine.deverson@erm.com | W www.erm.com



From: Katherine Deverson

Sent: Thursday, May 9, 2019 3:15 PM

To: Helen Duroux <moombahlenelalc1@bigpond.com>

Subject: 0464261 - Bonshaw ACHA Draft report for you review

Hi Helen,

Please find attached the Draft Bonshaw Solar Farm ACHA report which was completed following the surveys we carried out in September 2018.

Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,
Kat

Katherine Deverson

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Elise Caldwell

From: Katherine Deverson
Sent: Friday, 21 June 2019 2:23 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff
Subject: RE: 0464261 - Bonshaw ACHA Draft report for you review

Hi Vicky,

Thanks so much for your comment, I will include it in the draft ACHA. As a State Significant Development the Bonshaw Wind Farm does not go through the approvals process that requires an AHIP, however this ACHA will inform the governing body during their development application consideration process and it is expected that the recommendations from the ACHA will be incorporated into the approval, so it is similar to an AHIP in the mitigation requirements for the proponents.

For this project we have recommended, as you have suggested, that the project area be moved where possibly to avoid impacting cultural heritage sites, and so far this has successfully occurred in those high occupancy sites along the creek line at sites like BSF1 (which you will probably remember is the one up near the road where we found lots of artefacts including the retouched axe head).

The draft ACHA recommends avoidance of all sites where possible however direct impact of the project to some sites is considered unavoidable. The draft ACHA recommends that;

- prior to construction all sites that are to be avoided by project works should be fenced so that they are not harmed by construction works or any associated traffic or lay down areas etc.;
- that surface collection/salvage be undertaken at those sites that cannot be avoided by the project by Aboriginal stakeholder groups and an appropriately qualified archaeologist;
- that any artefacts removed from site as part of the salvage works are safely stored until they can be reburied/returned to country in a place agreed upon by RAPs; and
- that ongoing consultation occurs with RAPs throughout the project.

Thanks again for your comment, I really appreciate your input. Feel free to call or email me anytime if you have any further comments or would like to discuss anything in the draft ACHA or to do with the project.

Have a great weekend!

Regards,
Kat

Katherine Deverson
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E katherine.deverson@erm.com | **W** www.erm.com



From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Friday, June 21, 2019 1:49 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: Re: 0464261 - Bonshaw ACHA Draft report for you review

Hi Katherine.

Yes comment on site I recommend that an AHIP BE ON the sites that they will construct the solar panels. Remove to a safe spot, or find another area for farms the area is a high occupancy area that was used by my Ancestors.

Kind regards
Vicky Duncan

----- Reply message -----

From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review
Date: Fri., Jun. 21, 2019 12:39 PM

Hi Vicky,

I am just checking in again to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

If you have had a chance to review it, and are able to email back an endorsement of the report and/or any comments you may have, that would be great!

Kind regards,
Kat

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From: Katherine Deverson
Sent: Wednesday, June 12, 2019 1:15 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Vicky,

I am just checking in to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

If you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,
Kat

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From: Katherine Deverson
Sent: Thursday, May 9, 2019 3:17 PM
To: acsworknsw@gmail.com
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: 0464261 - Bonshaw ACHA Draft report for you review

Hi Vicky,

Please find attached the Draft Bonshaw Solar Farm ACHA report which was completed following the surveys we carried out in September 2018.

Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,
Kat

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Elise Caldwell

From: Katherine Deverson
Sent: Wednesday, 12 June 2019 4:41 PM
To: Samantha Duncan
Subject: RE: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Samantha

Thanks so much for getting back to me. I really appreciate your input on this project.

Kind regards,
Kat

Katherine Deverson
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E katherine.deverson@erm.com | **W** www.erm.com



From: Samantha Duncan <duncans528@gmail.com>
Sent: Wednesday, June 12, 2019 3:00 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: Re: FW: 0464261 - Bonshaw ACHA Draft report for you review

Hi Katherine. I apologise for the delay.
I have read the report and 100% endorse the draft.
Kind regards,

Samantha Duncan.

On 12 Jun 2019 1:17 PM, "Katherine Deverson" <Katherine.Deverson@erm.com> wrote:

Hi Sam,

I am just checking in to see if you had any comments on the Bonshaw Solar Farm draft ACHA that I sent through last month?

It you have been able to review it, it would be great if you could email back with your endorsement of the report and/or any comments you may have.

Kind regards,

Kat

Katherine Deverson

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[15 Tench Street | Kingston | ACT 2604 | Australia](#)

T 02 8584 8813 or 02 6126 5311 | M 0466 224 250

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From: Katherine Deverson

Sent: Thursday, May 9, 2019 3:19 PM

To: Samantha Duncan <duncans528@gmail.com>

Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>

Subject: 0464261 - Bonshaw ACHA Draft report for you review

Hi Sam,

Please find attached the Draft Bonshaw Solar Farm ACHA report which was completed following the surveys we carried out in September 2018.

Please review this report and provide any comments by Friday 7 June 2019.

Feel free to contact me anytime if you would like to discuss anything.

Regards,

Kat

Katherine Deverson

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Environmental Resources Management Australia Pty Ltd

[15 Tench Street | Kingston | ACT 2604 | Australia](#)

T 02 8584 8813 or 02 6126 5311 | M 0466 224 250

E katherine.deverson@erm.com | W www.erm.com



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Elise Caldwell

From: Katherine Deverson
Sent: Thursday, 11 July 2019 3:56 PM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: RE: Bonshaw Solar Farm

Hi Helen,
Thank you for your feedback.

I very much appreciate it.

Kind regards,
Katherine

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd
15 Tench Street | Kingston | ACT 2604 | Australia
T 02 8584 8813 or 02 6126 5311 | M 0466 224 250
E katherine.deverson@erm.com | W www.erm.com



From: Helen Duroux <moombahlenelalc1@bigpond.com>
Sent: Thursday, July 11, 2019 3:37 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Subject: RE: Bonshaw Solar Farm

Hi Katherine,

We don't agree to having the trees removed and would advise against removing them at all costs,

Regards

Helen D

From: Katherine Deverson [<mailto:Katherine.Deverson@erm.com>]
Sent: Wednesday, 10 July 2019 10:39 AM
To: Helen Duroux
Cc: Amanda Antcliff
Subject: Bonshaw Solar Farm

Hi Helen,
Thank you for your review of the draft ACHA for the Bonshaw Solar Farm.

As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.

In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees.




The draft ACHA recommends the following for each of these sites:

Avoidance.

Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

<p>BSF18</p>	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	
<p>BSF19</p>	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	
<p>BSF29</p>	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

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This email has been checked for viruses by Avast antivirus software.

www.avast.com

From: [Katherine Deverson](#)
To: acsworknsw@gmail.com
Cc: [Amanda Antcliff](#)
Subject: RE: Bonshaw Solar Farm
Date: Monday, 15 July 2019 5:48:00 AM
Attachments: [image001.png](#)

Hi Vicky,

Thank you for your response and comment. It is greatly appreciated.

Kind regards,

Kat

Katherine Deverson

Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Tench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com



From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Saturday, July 13, 2019 3:34 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: Re: Bonshaw Solar Farm

Hi Kat

Aboriginal cultural site services recommend that live scarred trees stay and notify Kwiemba Elders Group, Edgerton Kwiemba environment cultural heritage aboriginal corporation also local land Council on dead scare tree to salvage.

Kind regards

Vicky Duncan

----- Reply message -----

From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm
Date: Fri., Jul. 12, 2019 4:52 PM

Hi Vicky,

We have recently incorporated your comments into the ACHA and prepared a final version, in doing so we have corrected the overall significance of the scarred tree sites from low to moderate significance which takes into consideration their aesthetic and social/cultural significance.

I have attached the latest version of the ACHA with these changes included. No recommendations have changed since the draft ACHA.

Please let me know if you have any further comments or questions.

Have a great weekend,
Kat

Katherine Deverson

Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Trench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com



From: Katherine Deverson

Sent: Wednesday, July 10, 2019 1:12 PM

To: acsworknsw@gmail.com

Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>

Subject: RE: Bonshaw Solar Farm

Hi Vicky,
The Draft ACHA is now attached.

Cheers,
Kat

Katherine Deverson

Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Trench Street | Kingston | ACT 2604 | Australia

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E katherine.deverson@erm.com | **W** www.erm.com



From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Wednesday, July 10, 2019 1:07 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: Re: Bonshaw Solar Farm

Hi Kath
Can u send report to me please.

----- Reply message -----

From: "Katherine Deverson" <Katherine.Deverson@erm.com>
To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>
Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm
Date: Wed., Jul. 10, 2019 12:12 PM

Hi Vicky,
No, I didn't get them. When did you send them through?

Cheers,
Kat

Katherine Deverson
Heritage Consultant

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E katherine.deverson@erm.com | **W** www.erm.com



From: acsworknsw@gmail.com <acsworknsw@gmail.com>
Sent: Wednesday, July 10, 2019 12:11 PM
To: Katherine Deverson <Katherine.Deverson@erm.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>

Subject: Re: Bonshaw Solar Farm

Hi Kath.

Did you get all picks that I took of project area.

----- Reply message -----

From: "Katherine Deverson" <Katherine.Deverson@erm.com>

To: "acsworknsw@gmail.com" <acsworknsw@gmail.com>

Cc: "Amanda Antcliff" <Amanda.Antcliff@erm.com>

Subject: Bonshaw Solar Farm

Date: Wed., Jul. 10, 2019 10:37 AM

Hi Vicky,

Thank you for your review and comment on the draft ACHA for the Bonshaw Solar Farm.

As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.

In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees.


The draft ACHA recommends the following for each of these sites:



Avoidance.

Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

BSF18	Scarred Tree	Photo3
	<p>During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none</p>	

	were identified.	
BSF19	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	<p>Photo1</p> 
BSF29	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	<p>Photo1</p> 

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

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From: [Katherine Deverson](#)
To: [Samantha Duncan](#)
Subject: RE: Bonshaw Solar Farm
Date: Thursday, 25 July 2019 7:40:00 PM
Attachments: [image001.png](#)
[image005.jpg](#)
[image006.jpg](#)
[image007.jpg](#)

Hi Sam,

Thanks so much for sending through your comments, it is greatly appreciated.

Have a great weekend.

Regards,
Kat

Katherine Deverson

Senior Heritage Consultant

Environmental Resources Management Australia Pty Ltd

15 Tench Street | Kingston | ACT 2604 | Australia

T 02 8584 8813 or 02 6126 5311 | **M** 0466 224 250

E katherine.deverson@erm.com | **W** www.erm.com



From: Samantha Duncan <duncans528@gmail.com>

Sent: Thursday, July 25, 2019 7:19 PM

To: Katherine Deverson <Katherine.Deverson@erm.com>

Subject: RE: Bonshaw Solar Farm

Hi Kat, sorry for the late reply.

I have read through the attachment and agree with the other parties in relation to the scarred trees. If removal can be avoided that would be great due to cultural and spiritual reasons. However, if it is absolutely necessary that the trees be removed then it is vital that T.O's (Traditional Owners) of the boundary areas be present and involved in relocation and the removal process.

Hopefully removal can be avoided as it would be extremely disheartening as an indigenous person with cultural connections to the area and objects within it. After all, our history and our future is all depending on the little historical ARTE facts that remain in every tribal area.

Once again I sincerely apologise for the delay.

Kind regards,

Samantha Duncan..

On 25 Jul 2019 7:08 AM, "Katherine Deverson" <Katherine.Deverson@erm.com> wrote:

Hi Sam,

Just checking in to see if you wanted to make a comment about the scarred tree query in the email below. I have received a response from Vicky but wasn't sure if you also wanted to submit any comments?

I have attached the most recent version of the report to this email, although it is the same copy that I sent through to you on 12 July.

I hope you are well.

Kind regards,
Kat

Katherine Deverson
Senior Heritage Consultant

Environmental Resources Management Australia Pty Ltd
[15 Tench Street, Kingston, ACT 2604, Australia](#)
T 02 8584 8813 or 02 6126 5311 | M 0466 224 250
E katherine.deverson@erm.com | W www.erm.com



From: Katherine Deverson
Sent: Wednesday, July 10, 2019 10:39 AM
To: Samantha Duncan <duncans528@gmail.com>
Cc: Amanda Antcliff <Amanda.Antcliff@erm.com>
Subject: Bonshaw Solar Farm

Hi Sam,

Thank you for your review and comment on the draft ACHA for the Bonshaw Solar Farm.

As you know from our fieldwork and the draft ACHA, numerous sites (including scarred trees and artefact scatters) were located and recorded during our fieldwork.

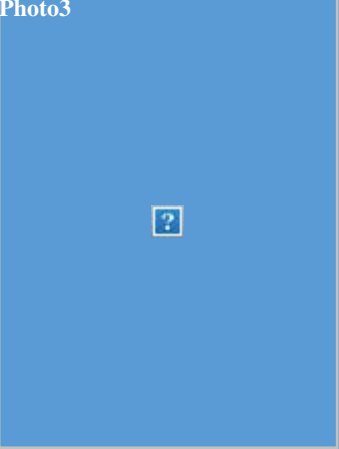
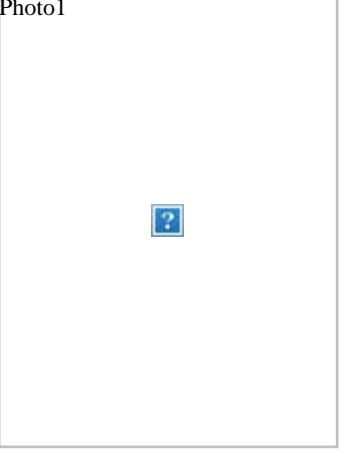

In considering ecological and heritage constraints within the Project Area the proponent has adjusted the Project's footprint, effectively moving it away from several larger sites located along the creek line to avoid impacting the archaeological record in these areas. However, the Project's proposed footprint currently impacts three scarred trees. The draft ACHA recommends the following for each of these sites:

Avoidance.

Prior to construction commencing, exclusion fencing and exclusion signage should be erected around the scarred tree by Aboriginal stakeholder groups and an appropriately qualified archaeologist. At the completion of construction exclusion zone fencing will be removed.

The Proponent would like your comment on the possibility of removing these three scarred trees.

The scarred trees as recorded in the draft ACHA are:

BSF18	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree. The oval shaped scar was approximately 1.7 m in length, 40 cm wide, and had significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	<p>Photo3</p> 
BSF19	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, live, scarred tree with a 1.5 m (length) narrow scar that was approximately 40 cm from the ground and showed significant overgrowth.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and surrounding area was checked for stone artefacts, though none were identified.</p>	<p>Photo1</p> 
BSF29	<p>Scarred Tree</p> <p>During the survey RAPs identified a standing, but dead, scarred tree. The long oval shaped scar was approximately 2 m in length and 40 cm wide.</p> <p>The tree is located on a plain set in a wider landscape context of rolling hills. The exposure and</p>	<p>Photo1</p> 

	surrounding area was checked for stone artefacts, though none were identified.	
--	--	--

If you could kindly review the above information and provide your comments, it would be greatly appreciated.

Kind regards,
Kat

Katherine Deverson
Heritage Consultant

Environmental Resources Management Australia Pty Ltd

[15 Tench Street](#)[Kingston](#)[ACT 2604](#)[Australia](#)

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APPENDIX B SURVEY METHODOLOGY SENT TO RAPS AUGUST 2018

November 2018

9 August, 2018

Helen Duroux
Moombahlene LALC
PO Box 70
Tenterfield NSW 2372

moombahlenelalc1@bigpond.com

Our Reference: 0464261_SURVEY METHODOLOGY_LALC.DOCX

Dear Helen Duroux,



RE: SOLAR FARM, BONSHAW NSW

Thank you for registering an interest in being consulted for this project.

In accordance with the NSW Office of Environment and Heritage's (OEH) *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (the Guidelines), and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW 2010* (Code of Practice), Environmental Resources Management Australia (ERM) is undertaking an Aboriginal cultural heritage assessment (ACHA) associated with the construction and operation of 500 MW capacity solar farm connecting to the existing Dumaresq Substation (*Figure 1*).

This letter provides the relevant information about the proposed project, the current known heritage values of the study area and the proposed archaeological survey methodology.

In accordance with *Section 4.1.6* of the Guidelines, we would also like to provide Moombahlene LALC with a list of the registered groups for this Project:

- Aboriginal Cultural Sites Services;
- Edgerton Kwiambal; and
- Moombahlene LALC.

Annex A also includes a copy of the Newspaper advertisement that was placed in the Inverell Times on 6 July 2018 and the Tenterfield Star on 11 July 2018.

1. PROPOSED DEVELOPMENT

The proponent for the proposed works is GAIA Australia Pty Ltd (GAIA).

The proposed Project Area (PA) is approximately 1097 hectares (ha) with a development footprint of approximately 650 ha. The land is privately owned rural land, currently used for grazing.

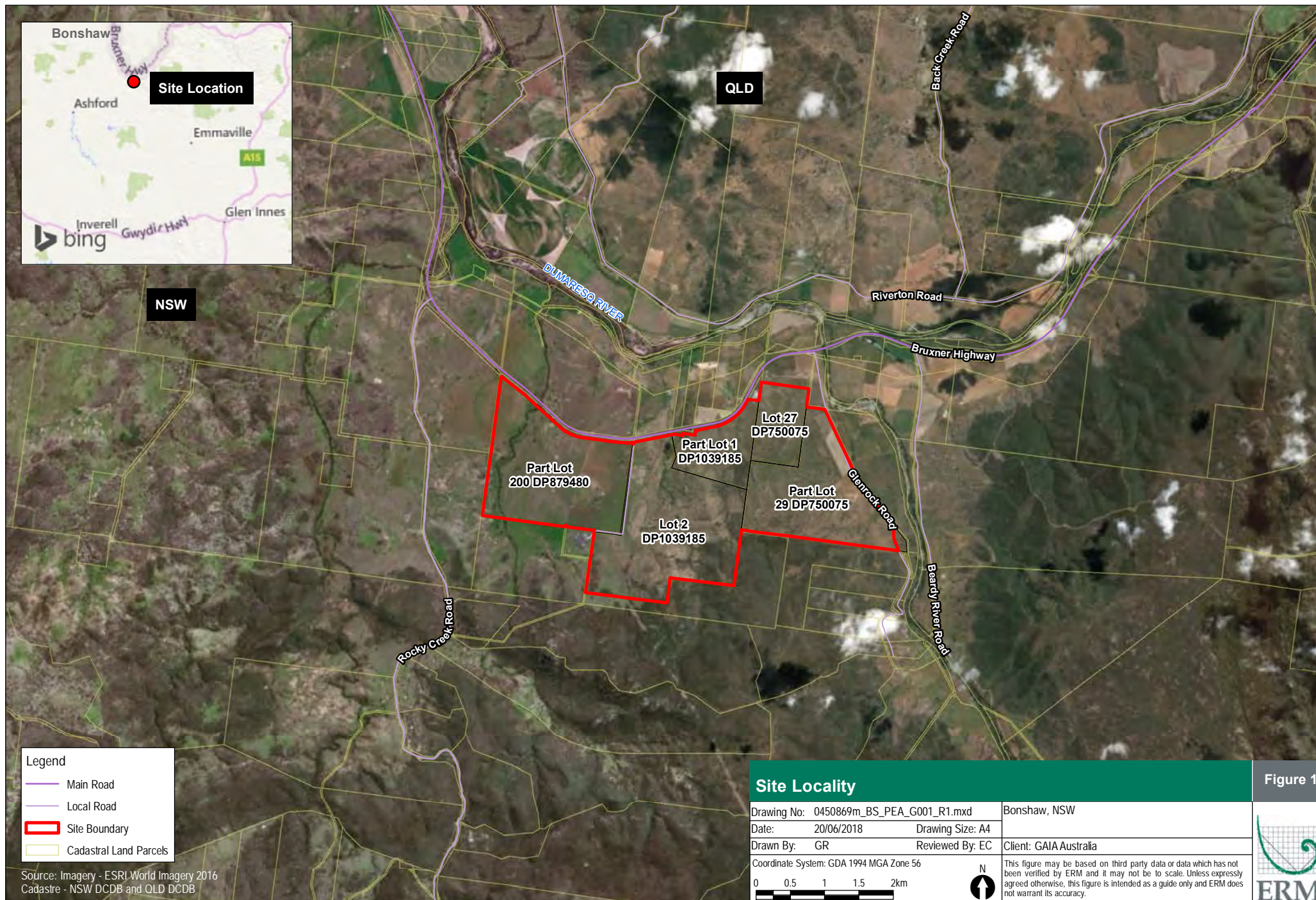


Figure 1

With specific reference to Aboriginal cultural heritage and the assessment of potential impacts to the heritage values of the PA, the project will involve the construction, operation and maintenance of a solar PV generation facility and associated infrastructure with a capacity of up to 500 MW, supplying electricity to the national electricity grid.

The Project would include:

- a network of PV modules in a fixed or tracking arrangement;
- a site office (two proposed options);
- three potential access tracts from Bruxner Highway and one from Glenrock Road;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- parking and internal access tracks;
- perimeter security fencing;
- battery storage; and
- two grid connection options to the 330 kV TransGrid Dumaresq Substation, on the boundary of the PA.

2. HERITAGE BACKGROUND

A preliminary due diligence assessment was undertaken by ERM in June 2018. The assessment included a desktop review of the heritage values which have the potential to impact the PA.

The review was limited to matters identified in the following online resources accessed on Tuesday 6 March 2018:

- Australian Heritage Database register search, including: World Heritage List, National Heritage List, Commonwealth Heritage List, National Trust Register, Register of the National Estate (archive);
- NSW State Heritage Inventory - includes items listed on the State Heritage Register (SHR) and provides a list of places and items of State Significance made under the Heritage Act. Heritage Council approval is required for works proposed to an item on the SHR;
- Inverell LEP 2012 - Schedule 5 and Conservation Areas (Locally listed items);
- Historic Heritage Information Management System (HHIMS) search;

- Aboriginal Heritage Information Management System (AHIMS);
- Schedule 14 of the National Parks and Wildlife Act; and
- Native Title Search.

One active Native Title claim (Comeroi People #NC2011/006) is currently registered within the LGA, and is located on the western side of Rocky Creek Road adjacent to the PA. The PA is not included in this Native Title claim.

An extensive AHIMS register search was conducted for each allotment on 5 March 2018, which identified three previously recorded Aboriginal sites located within the PA. All three of these sites (AHIMS #11-3-0083, #11-3-0084 and #11-3-0093) are reported as artefact scatters, with one potential scar tree also noted at the northern extent of #11-3-0083 (Refer to *Figure 2*). They were recorded as part of the Far North NSW (Dumaresq to Lismore 330kV Transmission Line) Project in 2011 (Ozark, 2011).

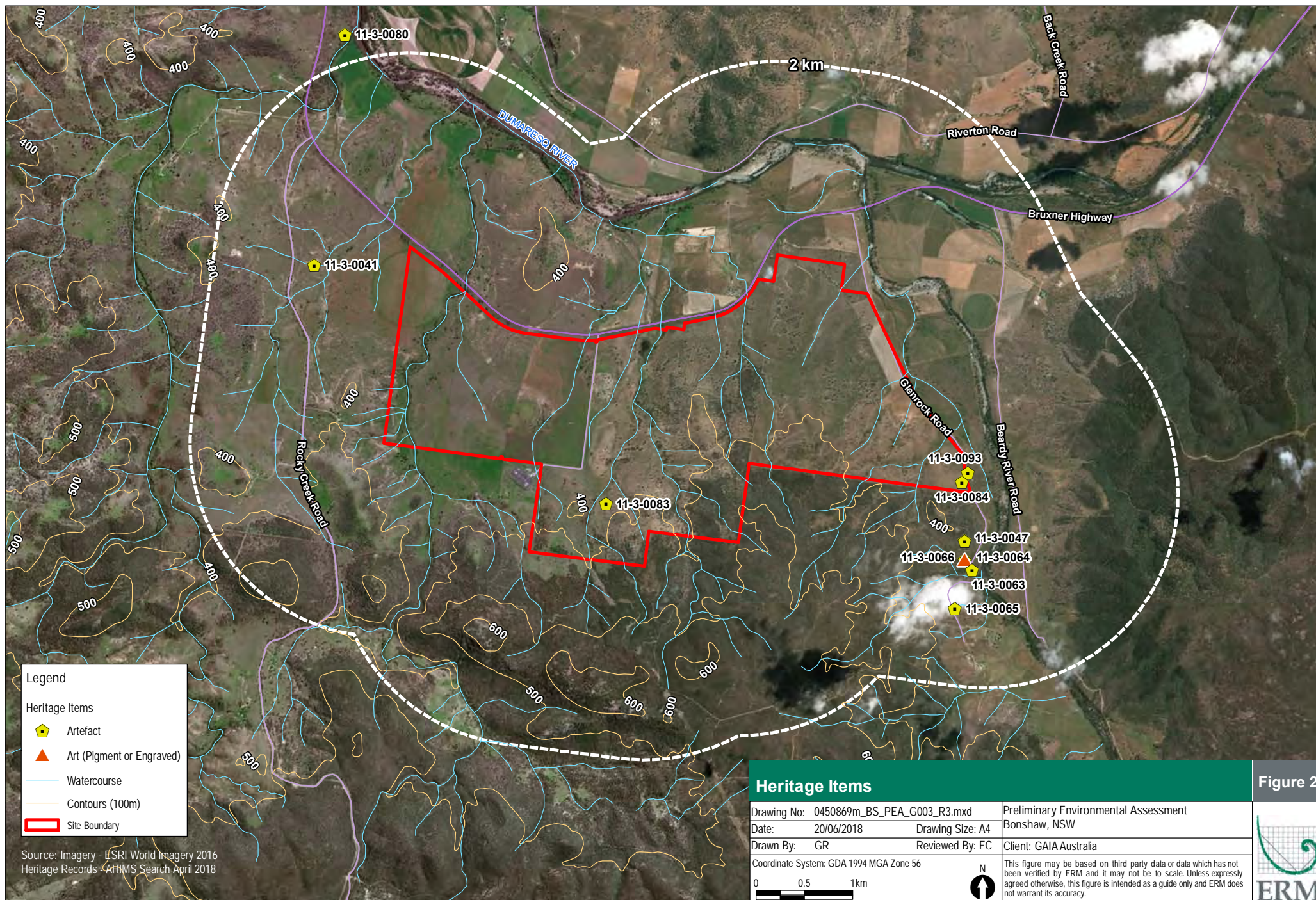


Figure 2

3. FIELDWORK METHODOLOGY

Based on the results of the due diligence assessment, the archaeological survey will be undertaken over two days and will aim to identify all Aboriginal sites present within the proposed impact area including the identification of any PADs.

The proposed methodology for the archaeological survey includes:

- the survey will be undertaken on foot where possible with Registered Aboriginal Parties in attendance;
- the survey will consist of all participants traversing the transmission line corridor using walking transects approximately 5 m apart to ensure the entire survey area is covered (subject to surface visibility and accessibility);
- the survey will target each landform in the PA;
- areas of potential such as raised landforms in close proximity to a semi-permanent water source will also be targeted;
- areas of exposure and ground visibility will be targeted;
- any areas of interest to the Registered Aboriginal Parties will be targeted;
- the previously recorded sites will be targeted, re-identified and recorded; and
- any cultural heritage information for the PA held by Aboriginal parties will be recorded during the field survey. Any cultural knowledge provided by Aboriginal Stakeholders will be treated in confidence and the information will be distributed according to their wishes.

ERM propose the dates of **12 and 13 September 2018** to undertake this archaeological survey. One representative from your organisation is invited to attend. Details of the meeting time and location for each day will be provided once we have confirmed attendance.

Each representative is responsible for providing their own Personal Protective Equipment (PPE), including sturdy walking boots, long pants and long sleeve shirts (and wet weather gear, if required). Please ensure that you have sun protection and enough water for the day.

Should you wish to participate, you will need to supply ERM with:

- the name of the individual who will attend as your representative;
- a Certificate of Currency for Public Liability insurance, valid for the period of work; and

- a Certificate of Currency for Workers Compensation insurance, valid for the period of work.

4. FEEDBACK

ERM requests that you respond to this information package and fieldwork methodology prior to **Friday 7 September 2018** with any comments you may have and confirmation of availability for fieldwork.

Please provide feedback to **Katherine Deverson** on the following contact details:

Post: PO Box 4160, Kingston, ACT 2604


Phone: 02 8584 8813 or 02 6126 5311

Email: katherine.deverson@erm.com

If you hold any knowledge of sites within or near the study area or have any specific information concerning the cultural values of the study area, we would be grateful if you could let us know. Our contact details are listed above. Any cultural knowledge provided by Aboriginal Stakeholders will be treated in confidence and the information will be distributed according to their wishes.

Yours faithfully,

for Environmental Resources Management Australia Pty Ltd



Katherine Deverson
ERM Archaeologist



Paul Douglass
ERM Partner

APPENDIX C AHIMS EXTENSIVE SEARCH RESULTS

November 2018

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 0450869

Client Service ID : 331690

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
11-3-0041	S19	AGD	56	335382	6770551	Open site	Valid	Artefact : -	Isolated Find	
	Contact	Recorders	Permits							
11-3-0047	EL35	AGD	56	342100	6767700	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0063	EL34	AGD	56	342150	6767550	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0064	EL33	AGD	56	342100	6767500	Open site	Valid	Art (Pigment or Engraved) : -		
	Contact	Recorders	Permits							
11-3-0065	EL32	AGD	56	342000	6767000	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0066	EL36	AGD	56	342100	6767500	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0080	TSR Dumaresq River OCS	GDA	56	335700	6772930	Open site	Valid	Artefact : 500		
	Contact Searle	Recorders	Permits							
11-3-0083	Tenterfield-Dumaresq OS14	GDA	56	338395	6768085	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0084	Tenterfield-Dumaresq OS15	GDA	56	342072	6768358	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							
11-3-0093	Tenterfield Dumaresq OS 4 & PAD	GDA	56	342136	6768402	Open site	Valid	Artefact : -		
	Contact	Recorders	Permits							

Report generated by AHIMS Web Service on 05/03/2018 for Eliza Collison for the following area at Lat, Long From : -29.2336, 151.2741 - Lat, Long To : -29.1502, 151.4063 with a Buffer of 0 meters. Additional Info : Site Feasibility Report. Number of Aboriginal sites and Aboriginal objects found is 10

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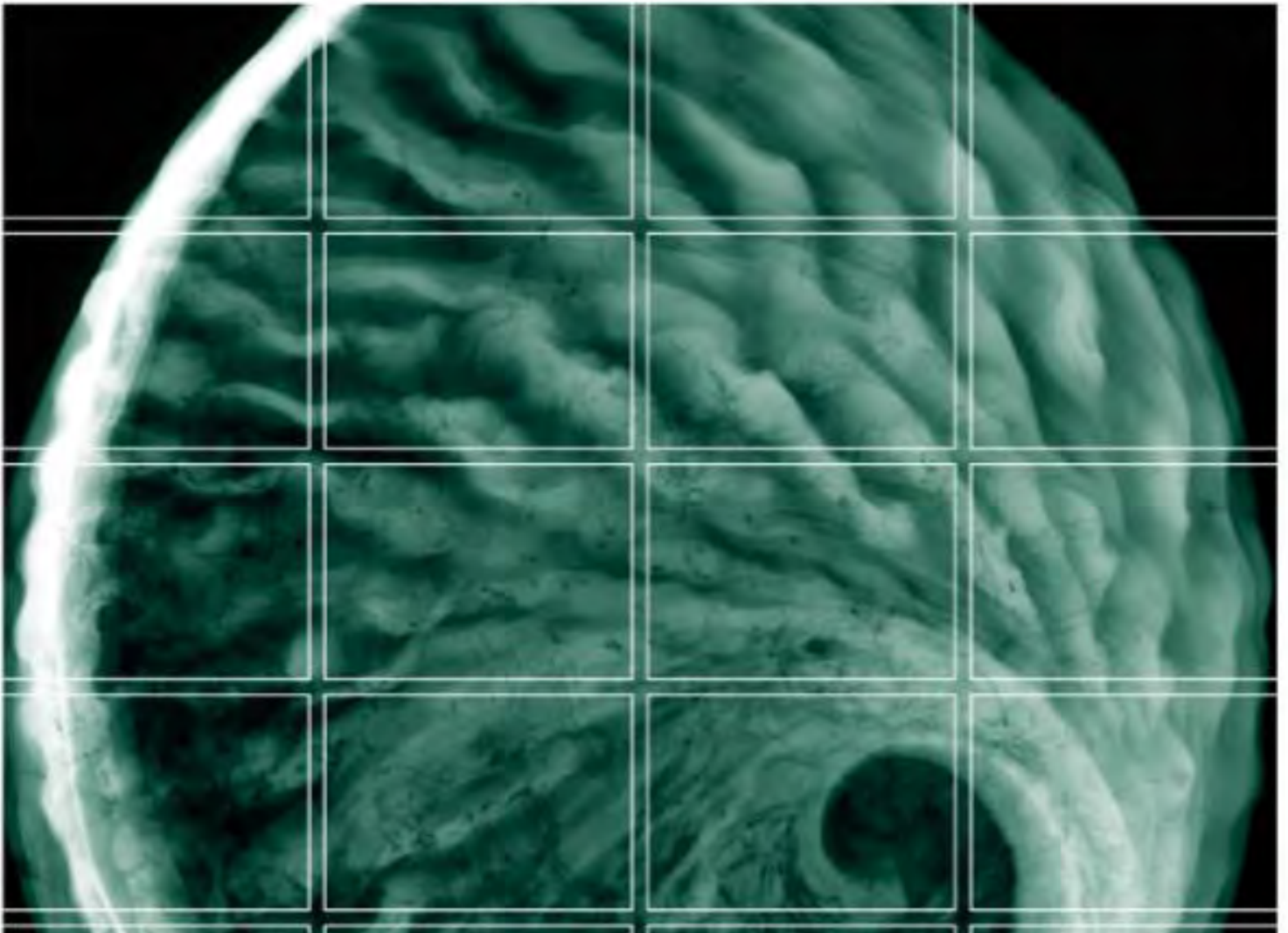
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APPENDIX E

UPDATED BUSHFIRE IMPACT ASSESSMENT



GAIA Australia Pty Ltd

Bonshaw Solar Farm

Bushfire Hazard Assessment

14 January 2020

Project No.: 0470861

Document details	
Document title	Bonshaw Solar Farm
Document subtitle	Bushfire Hazard Assessment
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Author	Joanne Woodhouse
Client Name	GAIA Australia Pty Ltd

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				Name	Date	
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Signature Page

14 January 2020

Bonshaw Solar Farm

Bushfire Hazard Assessment



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Acronyms and Abbreviations

Name	Description
Assets	Anything valued by people which includes houses, utilities, agricultural land, and in many cases, the environment.
Bushfire	Unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective.
Bushfire Hazard	The potential severity of a bushfire, which is determined by fuel load, fuel arrangement and topography.
Contained	The status of a bushfire suppression action signifying that a control line has been completed around the fire, and any associated spot fires, which can reasonably be expected to stop the fire's spread.
Fire Management	All activities associated with the management of fire prone land, including the use of fire to meet land management goals and objectives.
Fuel Hazard	Fine fuels in bushland that burn in the continuous flaming zone at the fire's edge. These fuels contribute the most to the fire's rate of spread, flame height and intensity. Typically, they are dead plant material, such as leaves, grass, bark and twigs thinner than 6 mm thick, and live plant material thinner than 3 mm thick.
Intensity	The rate of energy release per unit length of fire front usually expressed in kilowatts per metre (Kw/m).
APZ	Asset Protection Zone
ERP	Emergency Response Plan
GFDI	Grassland Fire Danger Index
Likelihood	The chance of a bushfire igniting and spreading.
BFMC	Bushfire Management Committee
AFAC	Australasian Fire and Emergency Service Authorities Council Limited
GAIA	GAIA Australia
ISC	Inverell Shire Council
FRNSW	Fire and Rescue NSW
RFS	NSW Rural Fire Service
PBP	Planning for Bushfire Protection (PBP) Guidelines
LEMC	Local Emergency Management Committee
BoM	Bureau of Meteorology
PCT	Plant Community Type
FDR	Fire Danger Ratings. FDR give you an indication of the consequences of a fire, if one was to start. The higher the fire danger, the more dangerous the conditions.

** Most terms are taken from the Bushfire Glossary prepared by the Australasian Fire and Emergency Service Authorities Council Limited (AFAC) and the BFMC (2011) Northern Tablelands Bush Fire Risk Management Plan.*

1. INTRODUCTION

GAIA Australia (GAIA) is seeking to develop a large scale solar photovoltaic (PV) generation facility and associated infrastructure with the capacity of 200 megawatts (MW) situated near Bonshaw in the Inverell Shire Council (ISC) of New South Wales (NSW) (the Project). The location of the Project Area is shown in Figure 1-1 and the proposed solar farm development footprint and conceptual layout is shown in Figure 1-2.

The need for a Bushfire Hazard Assessment was identified within the Secretary's Environmental Assessment Requirements (SEARs) for the further assessment and subsequent approval of the Project and the *Rural Fires Act 1997* imposes obligations on land managers to take all reasonable measures to prevent the occurrence and spread of wildfire to adjoining lands from lands under their care and management. This report contains management and mitigation measures designed to address these obligations.

Additional comments were received from the NSW Rural Fire Service during the public exhibition of the Environment Impact Statement (EIS) and have been addressed within this updated Bushfire Hazard Assessment. Refer to Section 2.3.

1.1 Description of the Project

A description of the works associated with the construction and operational phases of the Project, of relevance to this Bushfire Hazard Assessment are provided below. A detailed description of the Project components is provided in the Environmental Impact Statement (EIS) (ERM, 2019). The Project will consist of:

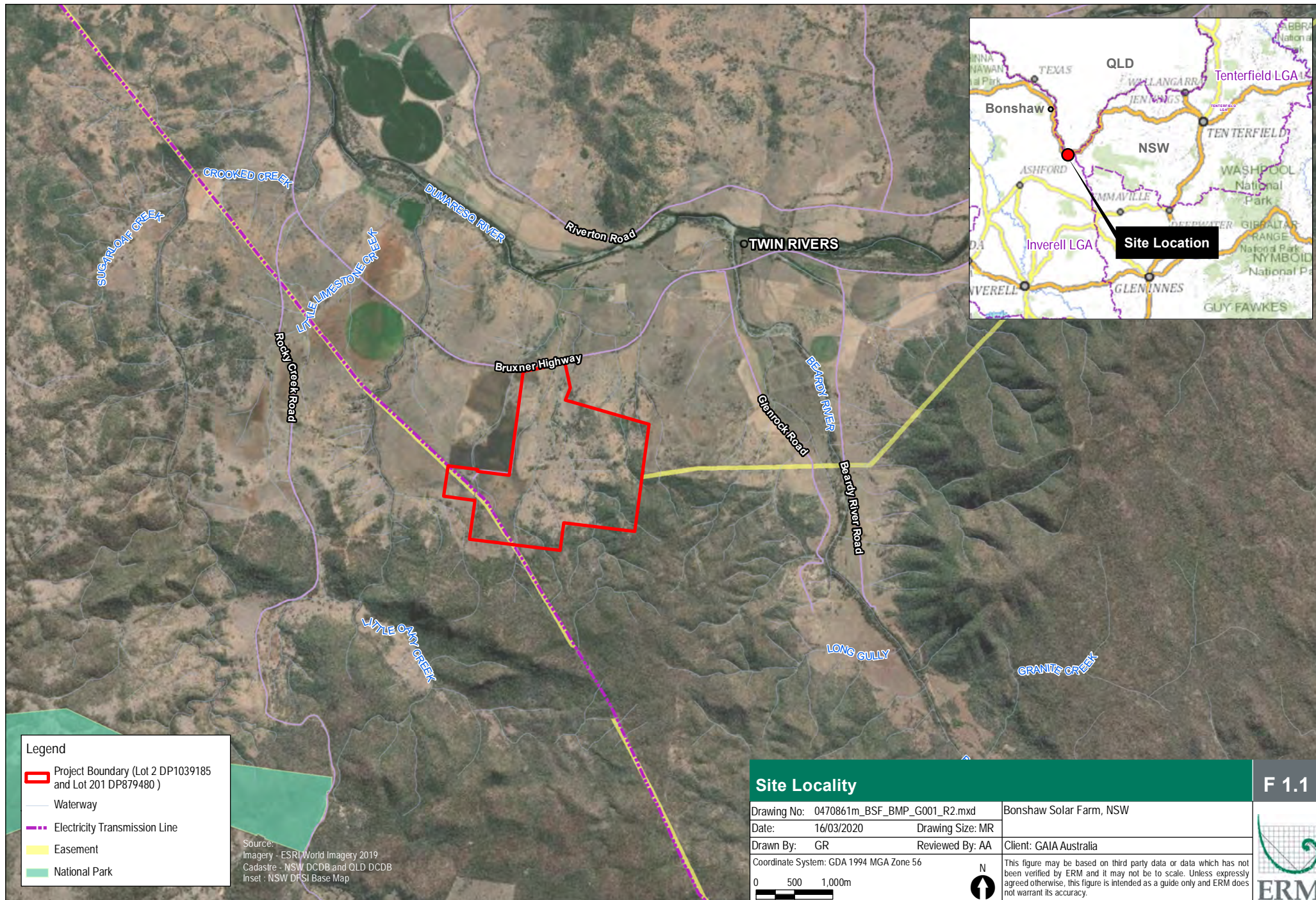
- a network of PV modules in a fixed tilt or single axis tracking arrangement;
- associated battery energy storage system (BESS) / battery storage;
- a switch yard to be connected to the 330 kV TransGrid Dumaresq Substation, on the boundary of the Project Area;
- underground or overhead cabling for connection between arrays and inverters and transformers;
- operations and maintenance (O&M) infrastructure, including O&M buildings incorporating a control room, meeting facilities, a temperature controlled spare parts storage facility, supervisory control and data acquisition (SCADA) facilities, a workshop and associated infrastructure (eg kitchen, toilets and other facilities), and car parking facilities;
- one main entry/exit point to the Bruxner Highway to the north and an additional two access points on the western and southern boundaries of the site.
- a new internal road network up to a combined total length of 13.75km connecting the arrays and other proposed infrastructure to the public road network; and
- Temporary facilities during construction

The final layout of the Project will be dependent on detailed design, availability and commercial considerations at the time of construction.

1.2 Aims and Objectives

Bushfire presents a threat to human life and assets and can adversely impact ecological values. Bushfire risk can be considered in terms of environmental factors that increase the risk of fire (fuel quantity and type, topography and weather patterns), as well as specific activities (such as hot works) or infrastructure components that exacerbate combustion or ignition risks (such as transmission lines and other electrical components). This updated Bushfire Hazard Assessment aims to address the requirements identified by the NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW) in the Secretary's Environmental Assessment Requirements (SEARs) (refer Table 2.2) and to demonstrate that the proposed solar farm can be designed, constructed and operated to minimise ignition risks and provide for asset protection consistent with relevant Rural Fire Service (RFS) design guidelines (Planning for Bushfire Protection (PBP) 2006 and Standards for Asset Protection).

The objectives of this assessment are to reduce the likelihood of a bushfire impacting the site or spreading from the site to surrounding properties.



Legend

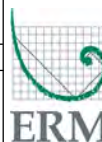
- Project Boundary (Lot 2 DP1039185 and Lot 201 DP879480)
- Waterway
- Electricity Transmission Line
- Easement
- National Park

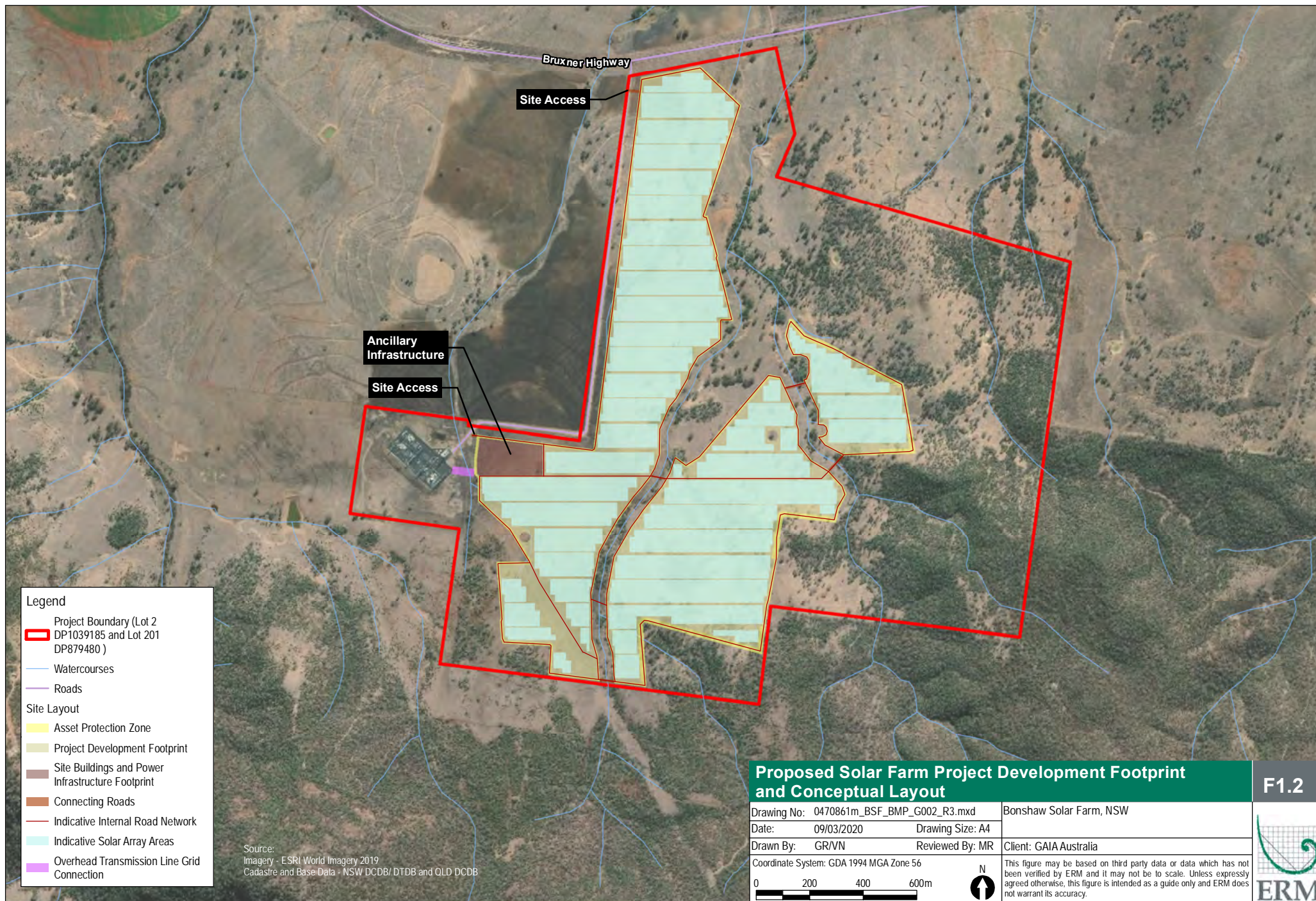
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Imagery - ESRI World Imagery 2019
Cadastre - NSW DCDB and QLD DCDB
Inset : NSW DFSI Base Map

Site Locality

Drawing No: 0470861m_BSF_BMP_G001_R2.mxd	Bonshaw Solar Farm, NSW
Date: 16/03/2020	Drawing Size: MR
Drawn By: GR	Reviewed By: AA
Client: GAIA Australia	
Coordinate System: GDA 1994 MGA Zone 56	
0 500 1,000m	
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2. PLANNING FRAMEWORK

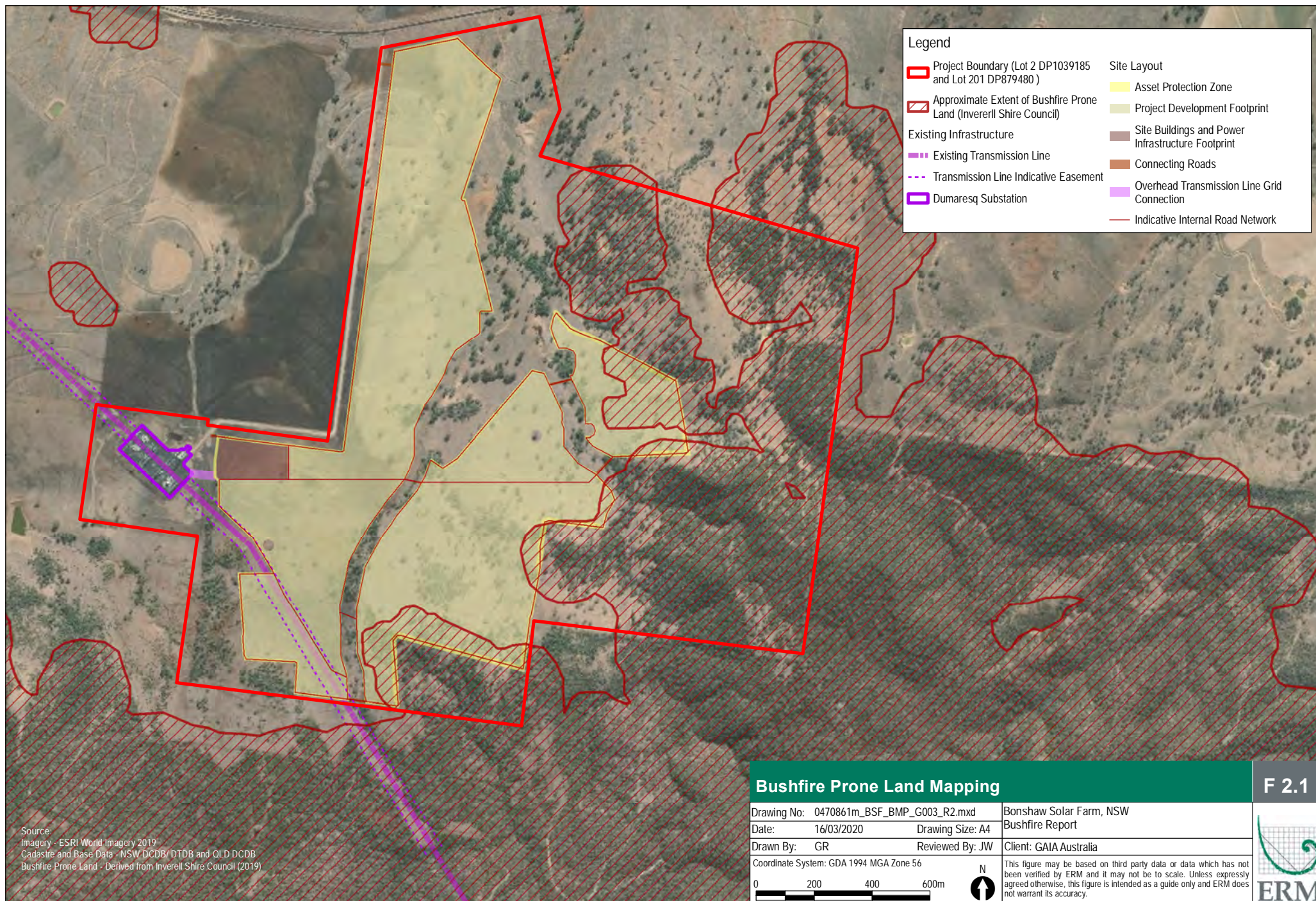
Table 2.1 outlines the relevant legislation and planning controls and how they have been considered within this updated Bushfire Hazard Assessment.

Table 2.1 Key Legislation and Guidelines Addressed within the Assessment

Key Legislation/Guidelines	Description
<i>NSW Rural Fires Act 1997</i>	<p>The main objectives of the <i>Rural Fires Act 1997</i> (RF Act) are to:</p> <ul style="list-style-type: none"> ■ prevent, mitigate and suppress bush and other fires in NSW; ■ co-ordinate bushfire fighting and bushfire prevention throughout the State; ■ protect people from injury or death and property from damage as a result of bushfires; and ■ protect the environment. <p>The proposed development does not require subdivision of land and is not defined as a special fire protection purpose (SFPP) development under Section 100B of the RF Act. Accordingly, the proposal does not require a bushfire safety authority.</p> <p>It is also noted that under Section 63 of the RF Act, owners and occupiers of land have a duty to take practicable steps to prevent the occurrence of bushfires on, and to minimise the danger of the spread of bushfires on or from, that land. This assessment considers the risk of spread of bushfires from the Project to the surrounds and provides measures to minimise the risk of bushfires.</p>
<i>Planning for Bushfire Protection 2006</i>	<p><i>Planning for Bushfire Protection 2006 (NSW RFS)</i> (PBP 2006) is a planning document to link responsible planning and development control with the protection of life, property and the environment.</p> <p>PBP applies to all development applications on land that is classified as bushfire prone land on a council's Bushfire Prone Land Mapping. The Inverell Shire Council Bushfire Prone Land mapping shows the eastern and southern portion of Lot 2 contains bushfire prone land (refer to Figure 1-2). Therefore, consideration has been given to the following overall aims and objectives of PBP 2006:</p> <ul style="list-style-type: none"> ■ afford buildings and their occupants protection from exposure to a bushfire; ■ provide for a defensible space to be located around buildings; ■ provide appropriate separation between a hazard and buildings which, in combination with other measures, minimises material ignition; ■ ensure that appropriate operational access and egress for emergency service personnel and residents is available; ■ provide for ongoing management and maintenance of bushfire protection measures; and ■ ensure that utility services are adequate to meet the needs of firefighters.

Key Legislation/Guidelines	Description
	<p>PBP 2006 provides an assessment framework for the identification of potential impacts of bushfire upon the proposed new assets and establishes six key bushfire protection measures that are to be addressed and collectively form an effective mitigation strategy in order to reduce the bushfire impacts. These six key bushfire protection measures are:</p> <ol style="list-style-type: none"> 1. The provision of clear separation of buildings and bush fire hazards, in the form of fuel reduced APZ (and their subsets, inner and outer protection areas and defensible space); 2. Construction standards and design; 3. Appropriate access standards for residents, fire fighters, emergency service workers and those involved in evacuation; 4. Adequate water supply and pressure; 5. Emergency management arrangements for fire protection and/or evacuation; and 6. Suitable landscaping, to limit fire spreading to a building.
<i>Planning for Bushfire Protection 2019</i>	<p><i>Planning for Bushfire Protection 2019</i> (NSW RFS) (PBP 2019) is a planning document to link responsible planning and development control with the protection of life, property and the environment. It is anticipated that PBP 2019 will be legislatively adopted on 1 March 2020.. Until then, PBP 2019 is in a 'pre-release' stage, also known as the transitional period. PBP 2019 is the culmination of significant investment in scientific research and policy development to provide appropriate bush fire protection whilst still having due consideration for development potential and economic sustainability. We have referred to this guideline here to ensure consistency with AS 3959-2018, specifically Section 2 which has been simplified to address interpretational issues related to slope, grasslands and low threat vegetation.</p>
<i>Australian Standard 3959 - 2018 Construction of Buildings in Bushfire-prone Areas (AS 3959-2018)</i>	<p>For the purposes of this assessment the Project is considered 'other development', as it is not residential subdivision, residential infill, or Special Fire Protection Purpose (SFPP) and the National Construction Code 2019 does not provide for any bushfire specific performance requirements.</p> <p>In a designated bushfire prone area, a Class 2 building, a Class 3 building, a Class 4 part of a building or a Class 9 building that is a special fire protection purpose or a Class 10a building or deck associated with such a building or part, must comply with AS 3959-2018 as a set of 'deemed to satisfy' provisions. These deemed-to-satisfy provisions are not applicable to this Project.</p> <p>General fire safety provisions and the methodology for determining the bushfire attack level (Section 2 AS 3959-2018) are taken as acceptable solutions. The aims and objectives of PBP 2019 apply in relation to other matters such as access, water and services, emergency planning and landscaping/vegetation management. The proposed mitigation measures as appropriate for the solar farm proposal are discussed in <i>Section 4</i>.</p>

Key Legislation/Guidelines	Description
	<p><i>Also note that the new National Construction Code 2019 was adopted on 1 May 2019. A new non-mandatory Fire Safety Verification Method (VM) has been introduced with a delayed adoption date from 1 May 2020. The new VM, which is a voluntary tool under a Performance Solution pathway, provides for a documented process in the design of fire safety Performance Solutions, and is based on the International Fire Engineering Guidelines (IFEG). The applicability of this VM has not been addressed in this assessment and does not apply to this solar farm proposal.</i></p>
<i>Biodiversity Conservation Act 2016</i>	<p>Projects determined by a statutory authority of the NSW State Government are required to be assessed in accordance with the NSW <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act) and the <i>Biodiversity Conservation Act 2016</i> (BC Act).</p> <p>The BC Act requires the consideration of threatened species and their habitats in the developmental planning process and a responsibility of the proponent to determine potential impacts on listed species and Endangered Ecological Communities (EECs). Schedule 3 of the BC Act lists Key Threatening Processes for species, populations and ecological communities within NSW. 'Clearing of native vegetation', 'high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'removal of dead wood and dead trees', are listed by the TSC Act as Key Threatening Processes and need to be carefully considered and managed when implementing fire management activities. The Project site contains threatened species that may be impacted by the proposal (refer to <i>Section 3.1</i>).</p> <p><i>Refer to Bonshaw Solar Farm Biodiversity Development Assessment Report (ERM 2020a) for more detail on the habitat requirements and confirmed records of these species.</i></p>
<i>Commonwealth Environment Protection and Biodiversity Act 1999</i>	<p>The <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) is the primary piece of Federal legislation relating to the environment. Under the EPBC Act any action that has, or is likely to have, a significant impact on a matter of National Environmental Significance (NES) requires approval from the Commonwealth Minister for the Environment. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration to any of these.</p> <p>Consideration of the impact of the proposed activity on matters of NES has been provided in <i>Bonshaw Solar Farm Biodiversity Development Assessment Report (ERM 2020a)</i> and summarised in <i>Section 3.1</i>.</p>
<i>Environment Planning and Assessment Act 1979</i>	<p>The Project was declared a State Significant Development (SSD) in accordance with clause 20 of Schedule 1 the <i>State Environmental Planning Policy</i> (State and Regional Development) 2011 and will be assessed under Part IV of the <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act).</p> <p>Section 4.41 of the EP&A Act excludes projects approved under Part 4 of the EP&A Act from requiring "a bush fire safety authority under section 100B of the <i>Rural Fires Act 1997</i>".</p>



2.2 Secretary's Environmental Assessment Requirements

The NSW Department of Planning and Environment (DP&E) issued SEARs for the Project (SSD 13_6039) on 16 August 2018.

The SEARs identify a number of key assessment requirements with respect to hazard and risk. These requirements and comments and where they are addressed within this assessment are identified in Table 2.2.

Table 2.2 Secretary's Environmental Assessment Requirements

Secretary's Environmental Assessment Requirements (SEARs)		Addressed
Key Assessment Requirements	Hazard/Risks– an assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure.	This updated Bushfire Hazard Assessment has been prepared to meet this requirement.

2.3 Agency Assessment Requirements

In addition to the SEARs, the NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW) provided detailed assessment requirements for consideration. This updated Bushfire Hazard Assessment has been prepared to meet these requirements as outlined in Table 2.3.

Table 2.3 Agency Assessment Requirements

Secretary's Environmental Assessment Requirements (SEARs)		Addressed
Fire and Rescue NSW	<p>It is Fire and Rescue NSW (FRNSW) experience that small and large scale photovoltaic installations present unique electrical hazard risks to our personnel when fulfilling their emergency first responder role.</p> <p>Due to the electrical hazards associated with large scale photovoltaic installations and the potential risk to the health and safety of firefighters, both FRNSW and the NSW Rural Fire Service must be able to implement effective and appropriate risk control measures when managing an emergency at the proposed site.</p> <p>Should a fire or hazardous material incident occur, it is important that first responders have ready access to information which enable effective hazard control measures to be quickly implemented.</p>	Considered in Section 3.8 and Section 4.3.3.
	<p>Recommendations:</p> <ul style="list-style-type: none">■ That a comprehensive Emergency Response Plan (ERP) be developed.■ That the ERP addresses foreseeable on-site and off-site fire events and other emergency incidents (eg fires involving solar panel arrays, bushfires in the immediate vicinity or potential hazmat incidents).	Management and mitigation measures outlined in Section 4 include preparation of an Emergency Response Plan (ERP) in consultation with both NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW).

Secretary's Environmental Assessment Requirements (SEARs)	Addressed
<ul style="list-style-type: none"> ■ That the ERP details appropriate risk control measures that would need to be implemented to safely mitigate potential risks to the health and safety of the firefighters and first responders. ■ That two copies of the ERP be stored in an Emergency Information Cabinet located at the main entrance points ■ Once constructed and prior to operation, that the operator of the facility contacts the relevant Local Emergency Management Committee (LEMC). 	
<p>NSW Rural Fire Service</p> <p>The NSW Rural Fire Service (RFS) identify that the land is partially mapped as bushfire prone land by Inverell Shire Council.</p> <p>The NSW RFS is the primary response agency for fighting fires within the site and surrounding locality.</p>	<p>Noted. The Inverell Shire Council Bushfire Prone Land mapping shows the eastern and southern portion of Lot 2 contains bushfire prone land (refer to Figure 2-1).</p>
<p>The NSW RFS recommends that the project address following, having regard to the requirements of Planning for Bushfire Protection 2006:</p> <ul style="list-style-type: none"> ■ Potential bushfire threats to the facility; ■ Potential hazards to fire fighters; ■ Management of bushfire (including grassfire) impacting on and structural fire emanating from the proposed solar farm and its associated infrastructure; ■ Fire fighting water supplies; ■ Vehicle access and defensible space around the solar array; ■ Land and vegetation management opportunities; and ■ Proposed emergency management procedures. 	<ul style="list-style-type: none"> ■ Potential bushfire threats to the facility are discussed in Section 3.6; ■ Potential hazards to fire fighters are discussed in Section 3.8; ■ Management of bushfire (including grassfire) are discussed in Section 4; ■ Fire fighting water supplies are discussed in Section 4.3.5; ■ Vehicle access and defensible space around the solar array are discussed in Section 4.1; and ■ Preparation of an Emergency Response Plan (ERP) is outlined in Section 4.3.3 and Section 0, and will include emergency management procedures.
<p>As part of any consent issued for the project, the NSW RFS will require the proponent to develop a Fire Management Plan in consultation with the local NSW RFS District Fire Control Centre.</p>	<p>Management and mitigation measures outlined in Section 4.3.3 and Section 4.4 include preparation of an Emergency Response Plan (ERP) in consultation with both NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW).</p>

Additional comments were received from the NSW Rural Fire Service during the public exhibition of the Environment Impact Statement (EIS) and have been addressed within this updated Bushfire Hazard Assessment. In summary, the RFS reaffirm comments and recommendations previously submitted in preparation of the SEARs (Table 2.3 above) and confirm that they are the primary response agency for all structural fire on the property. Refer to Table 2.4 Summary of Rural Fire Service Response to EIS.

Table 2.4 Summary of Rural Fire Service Response to EIS

Agency Response to the EIS Public Exhibition		Addressed within updated Bushfire Hazard Assessment
NSW RFS	<p>The NSW RFS recommend a more detailed assessment of the development site perimeter to be undertaken to determine appropriate APZ.</p> <p>While a 10m APZ is supported for grassland vegetation, a larger APZ may be required where the development is adjacent to woodland and/or forest vegetation. It is further recommended that minimum APZ's are based on Table A2.5 of Planning for Bush Fire Protection 2006.</p>	<p>Section 4.1 has been updated and a minimum 20m wide APZ is recommended along those sections of the south eastern perimeter that abut forest vegetation (refer to Figure 1-2).</p> <p>This is consistent with Table A2.5 of Planning for Bush Fire Protection 2006 and is based on forest vegetation located upslope of the development footprint</p>
	<p>The following conditions should be included in any approvals granted for the project;</p> <ul style="list-style-type: none"> ■ A Fire Management Plan (FMP) be prepared in consultation with the NSW RFS Northern Tablelands Fire Control Centre. ■ The entire solar arrays development and associated infrastructure footprint is managed as an APZ as outlined within Section 4.1.3 and Appendix 5 of the Planning for Bush Fire Protection Guidelines and the NSW RFS Standards for Asset Protection Zones. ■ A 50,000 litre water supply (tank) fitted with a 65mm storz fitting shall be located adjoining the internal property access road within the required APZ. ■ To allow for emergency service personnel to undertake property protection activities, a defensible space (APZ) that permits unobstructed vehicle access is to be provided around the perimeter of each of the solar array areas and associated infrastructure. 	<p>Management and mitigation measures outlined in Section 4 have been updated to include these recommendations.</p>

3. BUSHFIRE HAZARD ASSESSMENT

The following steps were undertaken in the assessment process:

- determine whether the development area has been mapped as bushfire prone land and requires compliance with PBP 2006 (Figure 2-1);
- identify the assets within and surrounding the Project site requiring protection (Section 3.1);
- identify the bushfire risk factors such as bushfire history and known bushfire behaviour in the Project site and within the surrounding lands (Sections 3.2 to Section 3.7);
- map the bushfire hazard at a site specific scale following the relevant guidelines and compare with bushfire prone area mapping (Figure 2-1); and
- produce risk mitigation and management treatments and satisfy PBP 2006 requirements (Section 4).

3.1 IDENTIFICATION OF ASSETS

The Project is set amongst a historically cleared landscape where rolling hills dominate and the majority of native vegetation has been partially or fully cleared for grazing and cropping. However, patches of woodland and open forest remain along riparian corridors and within the undeveloped eastern portion of the property (outside of the Project site).

Assets within and surrounding the Project site are shown in Figure 3-1 and described in Table 3.1.

Table 3.1 Identification of Assets

Asset	Description
Assets Within The Project site	
Project Infrastructure (Figure 1-2)	<p><u>Solar Farm Switching Station</u></p> <p>A new dedicated solar farm switching station will be built to connect the Project to the existing Dumaresq Substation. The switching station will be located within a fenced enclosure at the south-western boundary of the site. The switching station will comprise transformers, voltage switching equipment, metering, and protection and communications infrastructure.</p> <p><u>Inverter Building</u></p> <p>Inverters will convert direct current (DC) electricity generated by the Project to alternating current (AC) for reticulation around the site and connection to the electricity grid. Inverters will either be housed in shipping containers or skid mounted in an open-air configuration.</p> <p><u>Control Building, Car Park and Refuse Storage Area</u></p> <p>The control building and car park will be located close to the proposed substation in the south-west of the site.</p> <p><u>Photovoltaic (PV) Array</u></p> <p>The PV array will be the largest component of the Project. The array will comprise solar panels mounted on a supporting frame behind a non-reflective tempered glass layer. The height of the PV panels above natural ground is approximately 1.4 to 4.2 m based on tracker option to be used. The tracking system orients each panel towards the sun from the east in the morning through to the west in the afternoon. Following sunset, the Panels will “backtrack” to face east.</p>

Asset	Description
	Individual PV panels are constructed using a “high-transmission, low-iron” glass which has lower reflectance than that of normal glass. A coating applied to the panel surface applies a stippled finish to further diffuse the reflected light and therefore energy.
Site Access	<p>The Project site is located adjacent to the Bruxner Highway, which provides direct access to the proposed solar farm. The current project design provides one main entry/exit point to the Bruxner Highway to the north and an additional two access points on the western and southern boundaries of the site.</p> <p>The construction and maintenance of the Project will also require the construction of approximately 13.75km of private access roads within the Project site. The roads will provide ongoing access to the solar arrays and other project infrastructure. The internal access tracks will be up to 4.0 m in width with local widening in some areas to allow for turning radius of larger vehicles. The perimeter roads will be 6m wide and will form part of the required APZ</p> <p>The proposed road network is shown in Figure 1-2.</p> <p><i>The majority of the proposed internal access roads are in areas identified as low bushfire hazard. There are some small sections of access roads in the southern and south-eastern portion of the Project site identified as high and medium bushfire hazard.</i></p>
Heritage	<p>35 Aboriginal heritage sites (and three associated Potential Archaeological Deposits) have been recorded within the PA (ERM 2019b). 29 of these sites were stone artefacts including isolated finds and stone artefact scatters. Seven scarred trees were also identified. Careful detailed design of the Project footprint has successfully avoided several of these sites and they will be retained and protected from any direct and/or indirect impacts.</p> <p>A full description of heritage values is provided in the Bonshaw Solar Farm Heritage Assessment (ERM 2020b).</p>
Biodiversity	<p>Although the Project is set amongst a landscape where the majority of native vegetation has been partially or fully cleared for grazing, there are large patches of remnant vegetation and numerous other habitat values within and surrounding the Project site. Ground cover has been largely reduced due to heavy grazing practices and has been identified as a mixed of native and exotic grassland. Grazing (sheep) will continue across the Project site during operation of the solar farm.</p> <p>A full description of biodiversity values is provided in the Bonshaw Solar Farm Biodiversity Development Assessment Report (ERM 2020a). In summary, and with respect to assets requiring protection from bushfires, seven threatened fauna have been confirmed to occur within the Project site (refer to Table 4.2) and occur within the surrounding habitats.</p>
Assets Surrounding The Project Site	
Substation	The 330 kV TransGrid Dumaresq Substation is located to the south-west of the proposed site with a 264 kV power lines running roughly in a south-easterly direction in the southern portion of the site.

Asset	Description
Residential Properties and Farms	<p>The predominant land use in the proximity of the Project is rural landscape used for grazing and some cropping with natural waterways and vegetated ridgelines. The area to the north of the site between the Bruxner Highway and the Dumaresq River (which form the border between New South Wales and Queensland), is relatively flat land used for cropping and grazing, with some irrigation. Isolated farmsteads with associated out buildings and cattle yards are located in the area.</p> <p>There are 10 residential dwellings located within a 2km buffer of the proposed solar farm and are not directly involved with the Project. There are also farm sheds, shearing sheds, machinery sheds and a range of other structures associated with farming, scattered in the lands surrounding the Project site.</p>
Nearest Towns and Localities	<p>Small townships/localities are located in the broader region, which include Bonshaw (16 km north west), Ashford (23 km to the south west) and Dumaresq Valley (13 km to the east). In the 2016 census, Bonshaw had a population of 133 people, Ashford had a reported population of 652 people and Dumaresq Valley had a population of 49 people.</p>
Public Roads	<p>Access routes have been designed to achieve practical transport paths that minimise disruption to local traffic and environmental impacts.</p>

Table 3.2 Threatened Species Recorded within the Project Area

Species	Conservation Status	Location within the Project site ¹	Vulnerability to bushfire ²
<i>Setirostris eleryi</i> (Bristle-faced Free-tailed Bat)	EPBC Act: Not Listed BC Act: Endangered	Calls within the Project site were attributed to the Bristle-faced Free-tailed Bat with 'Definite' confidence. Knowledge of the ecology of this species is limited, however they are likely to utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and direct mortality of individuals and modification of habitat from fires is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Miniopterus schreibersii oceanensis</i> (Eastern Bentwing-bat)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Eastern Bentwing-bat with 'Definite' confidence. Although the calls were not definitive, the Eastern Bentwing-bat may utilise a variety of habitats across the Project site, including woodland habitats and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of foraging habitats and hazard reduction and wildfire fires during the breeding season is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Chalinolobus picatus</i> (Little Pied Bat)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Little Pied Bat with 'Definite' confidence. This species may utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and inappropriate fire regimes is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Nyctophilus corbeni</i> (Corben's Long-eared Bat)	EPBC Act: Vulnerable BC Act: Vulnerable	Calls within the Project site were attributed to the Corben's Long-eared Bat with 'Definite' confidence. This species may utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and inappropriate fire regimes is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Vespadelus troughtoni</i> (Eastern Cave Bat)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Eastern Cave Bat with 'Possible' confidence. This species may utilise a variety of habitats across the Project site, including woodland habitats and adjacent cleared areas.	Loss of suitable feeding habitat near roosting and maternity sites as a result of modifications from timber harvesting and inappropriate fire regimes usually associated with grazing is listed as a threat to this species. No roosting habitat has been recorded within the Project site.

Species	Conservation Status	Location within the Project site ¹	Vulnerability to bushfire ²
<i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tailed Bat)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Yellow-bellied Sheath-tailed Bat with 'Possible' confidence. This species may utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and inappropriate fire regimes is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Falsistrellus tasmaniensis</i> (Eastern Falsistrelle)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Eastern Falsistrelle with 'Possible' confidence and it is likely that these calls represent variants of <i>Scotorepens greyii</i> (Little Broad-nosed Bat). This species, if present, may utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and loss of roosting habitat is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
<i>Chalinolobus nigrogriseus</i> (Hoary Wattled Bat)	EPBC Act: Not Listed BC Act: Vulnerable	Calls within the Project site were attributed to the Hoary Wattled Bat with 'Possible' confidence and it is likely that these calls represent variants of <i>Scotorepens greyii</i> (Little Broad-nosed Bat). This species, if present, may utilise a variety of habitats across the Project site, including woodland habitats, tree hollows and adjacent cleared areas.	Frequent, high intensity fires may cause the degradation of roosting and foraging habitats and inappropriate fire regimes is listed as a threat to this species. It is noted that mobile species such as bats are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.
Grey-crowned Babbler	EPBC Act: Not Listed BC Act: Vulnerable	A breeding population of this species has been recorded across the Project site and has been observed nesting and foraging within the woodland habitats.	Inappropriate fire regimes is listed as a threatening process for this species. Excessive fires lead to loss of tree and shrub regeneration and absence of fire may lead to the grass sward being too dense and therefore unsuitable for foraging by babblers.

1. Refer to *Bonshaw Solar Farm Biodiversity Development Assessment Report* (ERM 2020a) for more detail on the habitat requirements and confirmed records of these species.

2. NSW OEH (2019) *Threatened Species Profiles*. <https://www.environment.nsw.gov.au/threatenedSpeciesApp/>

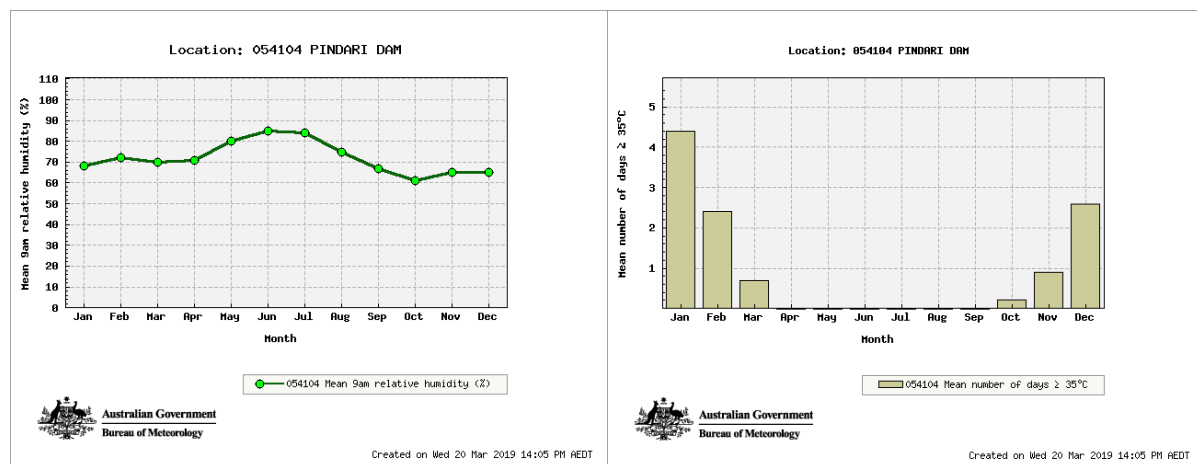
3.2 Regional fire weather

As reported by BFMC (2011), the typical/average climate in the Northern Tablelands is consistent with a Temperate Zone (warm summer, cool winter). Autumn and spring are the most comfortable seasons in most parts. The weather is more changeable than in the tropics, with cool cloudy days alternating with warmth and sunshine. Rain falls occasionally but doesn't usually last very long and the bushfire season generally runs from August to March annually.

Prevailing weather conditions associated with the bushfire season in the Northern Tablelands BFMC area are north-westerly winds accompanied by high daytime temperatures and low relative humidity. Dry lightning storms occur frequently during the bushfire season (BFMC 2011).

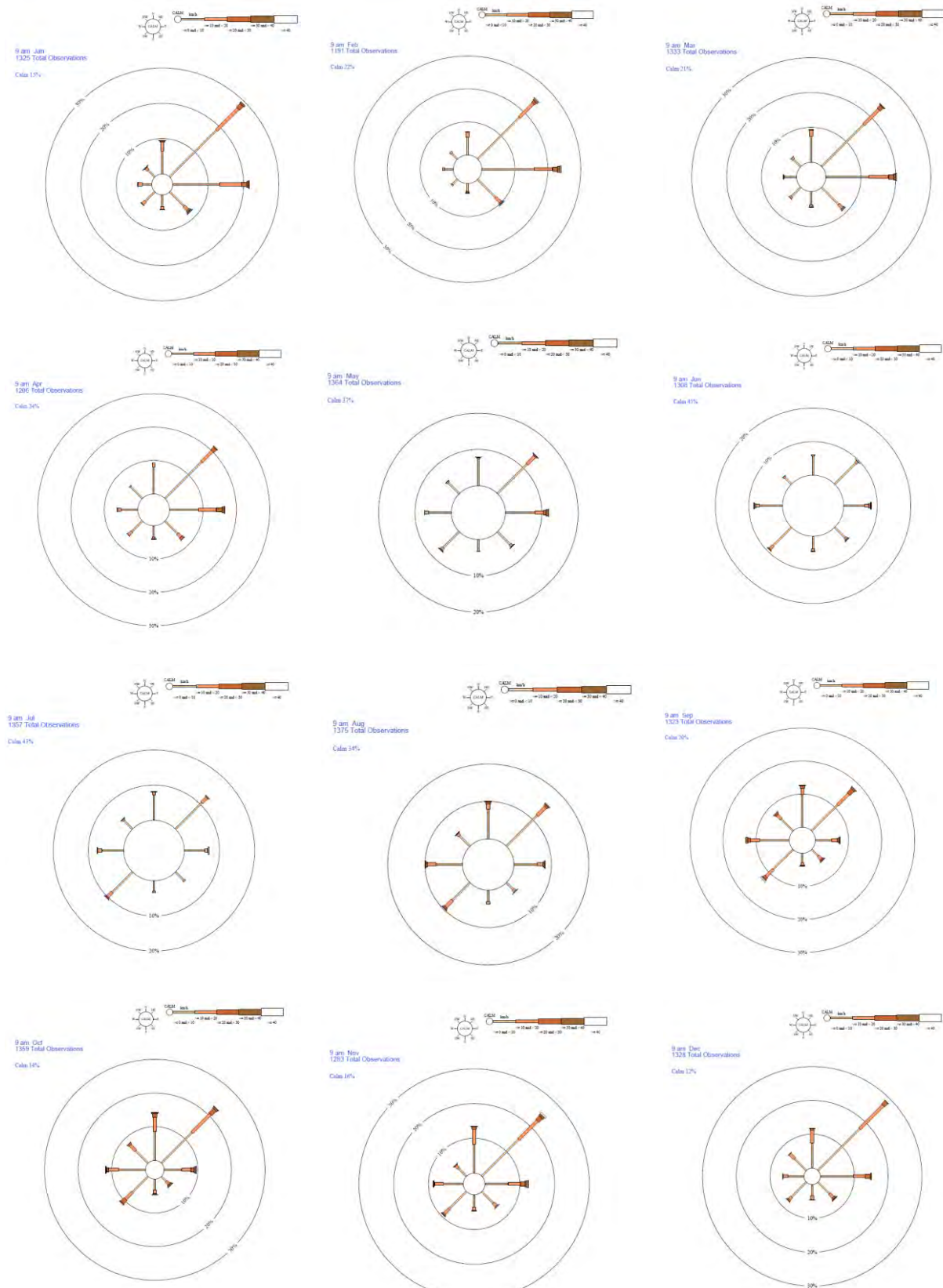
Data from the Bureau of Meteorology weather station at Pindari Dam, which is 4 km from the solar farm site, confirms that both low humidity and high temperature occur within the bushfire season and would contribute to the fire hazard within this region (refer to Figure 3-2)

Figure 3-2 Low humidity and high temperature within the bushfire season (BOM 2019)



Data from the Bureau of Meteorology weather station at Pindari Dam indicates that north westerly winds are uncommon within the region, with strong north easterly winds being more common during the bushfire season (refer to Figure 3-3).

Figure 3-3 Monthly Wind direction versus Wind speed (km/h), Pindari Dam 1971-2018 (BOM 2019)



3.3 Vegetation

The vegetation of the Project site is typical of an agricultural landscape of the Northern Tablelands region of NSW. Generally, the vegetation is a combination of grasslands (both native and non-native pastures) with scattered patches (or 'islands') of woodland (refer to Figure 3-4). The Project site is comprised of 35% native vegetation types and 65% non-native or highly disturbed vegetation types and other land covers (dams and watercourses).

Descriptions of the vegetation types including species composition and structural diversity is provided in the Bonshaw Solar Farm Biodiversity Development Assessment Report (ERM 2020a).

The vegetation has been simplified in line with the vegetation formations as per Keith (2004). The vegetation types have been classified into fuel groups using the following parameters:

- frequency that the vegetation provides 'available fire fuel';
- structure of the vegetation and the ability of ground level fuels to carry fire into higher vegetation levels eg. from understorey into crown fire;
- arrangement of the fuel within the vegetation type, eg fine fuels that are elevated, such as in heath, contribute more to fire intensity than a similar quantity of leaf litter fuel; and
- amount of fuel that accumulates after a long period without fire.

Table 3.3 Description and Characteristics of Fuel Groups

Bushfire Fuel Group	Characteristics	Plant Community Type within the Project Area	Keith Formation (2004)
High	Continuous fuels, higher quantity, available to burn during average seasons (higher fire intensity expected e.g. woodland and forest fuels).	PCT 594_Moderate	Dry Sclerophyll Forests (Shrub/grass sub-formation)
		PCT 596_Moderate	Dry Sclerophyll Forests (Shrub/grass sub-formation)
		PCT 516_Moderate	Grassy Woodlands
Medium	Less continuous fuels, medium level quantity, available to burn during average seasons but may be less often than high (medium or high fire intensity expected).	PCT 594_Low	Grassy Woodlands
		PCT 596_Low	Grassy Woodlands
		PCT 516_Low	Grassy Woodlands
		PCT 596_Very Low	Native Grassland
		PCT 516_Very Low	Native Grassland
		PCT 516_Derived	Native Grassland
		PCT 596_Derived	Native Grassland
Low	Possibly discontinuous fuels, low-medium fuel quantity, moister fuels unlikely to contribute to high intensity fires in average season, fuel structure facilitates easier control, (fire intensities expected range from low-high and generally regarded as easier to control e.g. moist and wet forests).	PCT 516_Disturbed Grassland	Disturbed Grassland
		PCT 594_Disturbed Grassland	Disturbed Grassland
		PCT 596_Disturbed Grassland	Disturbed Grassland
Minimal	Unlikely to burn or always burn within controllable limits.	Farm Dams	N/A

The risk of a grassfire should not be underestimated within the Project site. The areas of moderate quality native grassland have been given a Medium classification compared to the areas of heavily grazed low quality grasslands (Low). The difference in spread rate between a fire in the heavily grazed pasture and areas of native grassland is only about 20%, although the native grasslands will generally have taller flames that may burn across tracks or firebreaks (Bradstock et al 2012) attributing it to the higher classification in Table 3.3 above.

3.4 Slope

Steeper slopes can also significantly increase the rate of spread of fires, and the relationship of the steepness of slope, and whether a fire moves upslope or downslope, is vital to understanding bushfire behaviour potential. Slope and wind are often the major factors determining the direction of fire spread.

The Project site is dominated by a gently undulating landscape to the north, forming steep slopes to the south and east dissected by second and third order streams. Based on a review of topographic maps and aerial imagery, landforms present within the Project site include drainage depressions, gentle to steeply inclining slopes, and upper flat ridges. The elevation at the Bruxner Highway (north boundary) is approximately 335 m and rises up to approximately 420 m in the south-western portion of the site. The ridgelines to the south of the project rise up to approximately 660 m forming the dominant landscape feature. The slope map is included as Figure 3-5.

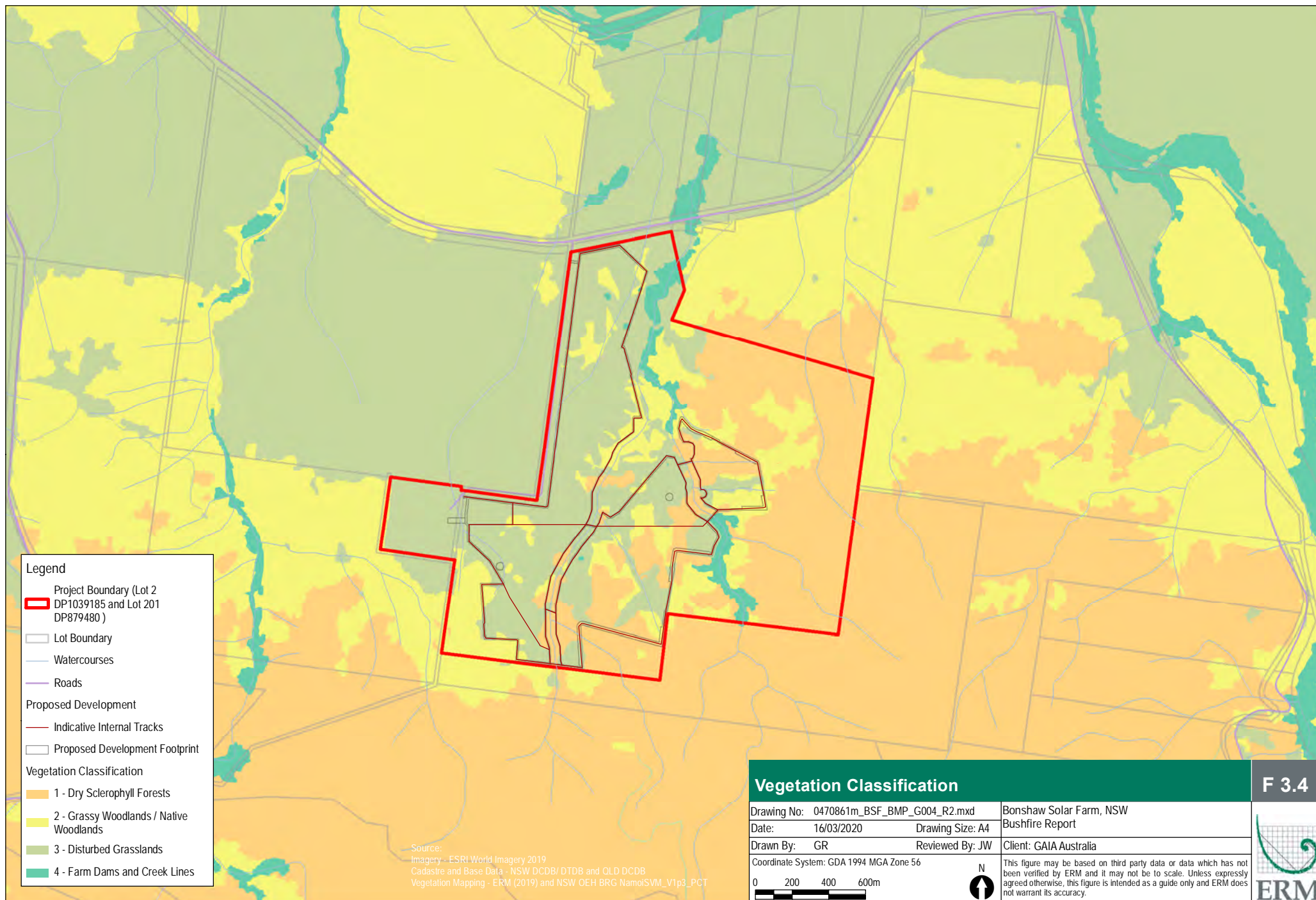
3.5 Fire behaviour potential

Bushfire hazard classes were identified across the landscape by applying relative weightings to the varying fuel groups (refer Table 3.3) and combining them with available slope classes (ie 0-5°, 5-10°, 10-15°, >15°) within a Geographic Information System (GIS) model. The vegetation fuel load and slope data sets were loaded into a Weighted Overlay Model, to combine the data and highlight areas of overall higher hazard considering both fuel load and slope. Slope was calculated in degrees and bushfire hazard rating based on steepness and movement speeds of potential bushfire up or down these slopes. The model assumed in this case that both slope (upslope and downslope) and fuel load were equally important or weighted the same in the analysis process.

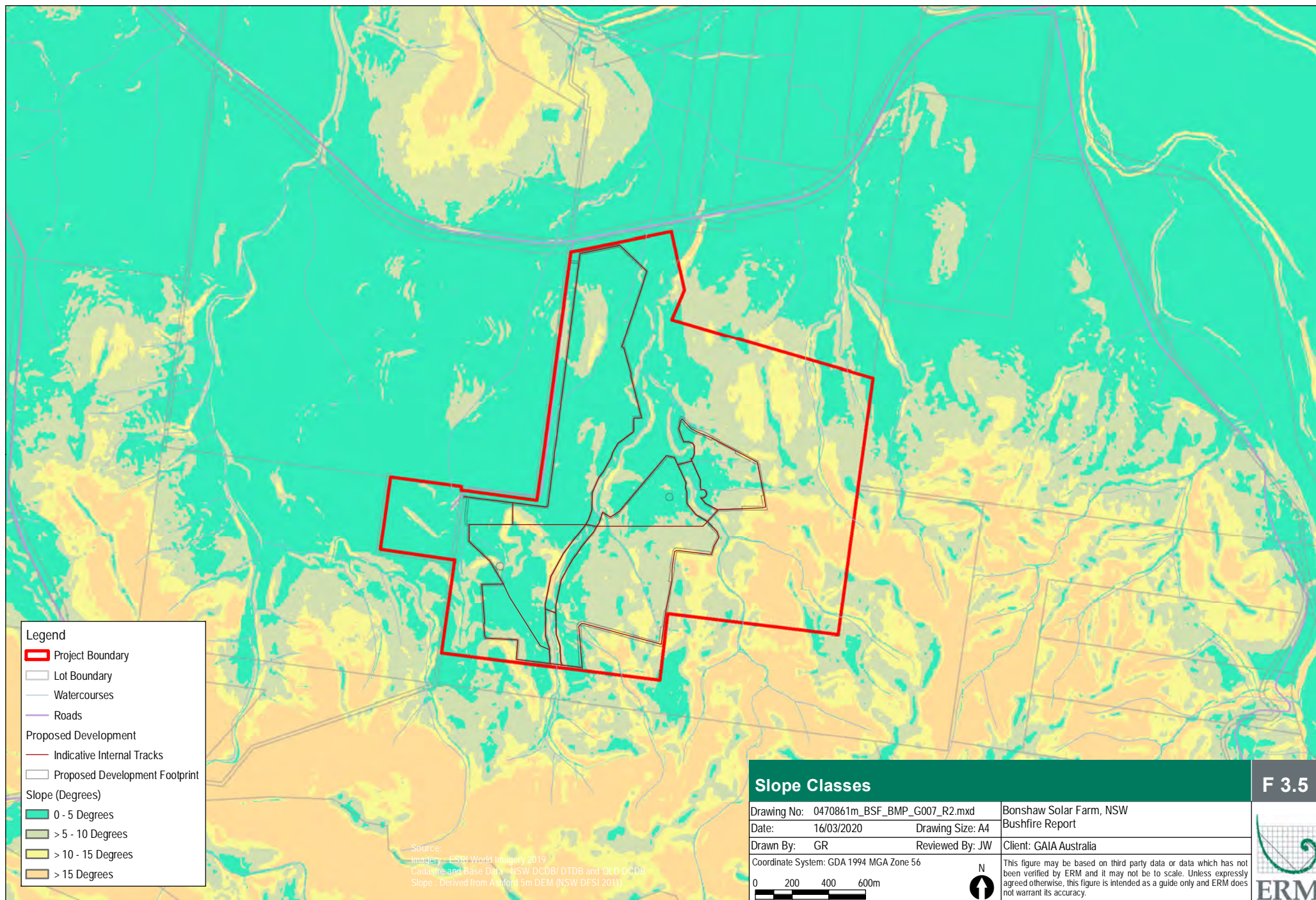
The result is a Risk Assessment Overlay that identifies overall bushfire hazard classes for the entire Project site (refer to Figure 3-6). This analysis does not indicate how often an area will receive potentially damaging fires or the actual intensity of a fire, it does however, provide a useful comparative ranking, identifying sites of higher and lower potential fire behaviour compared to others in an area. The direction of the slope (upslope or downslope) has been considered in more detail in the determination of Asset Protection Zones (APZ) for those areas in the south eastern portion of the site mapped as being bushfire prone land and high bushfire hazard.

Based on the information provided in the fire weather and fire hazard analysis above, the greatest hazard is a combination of undesirable fire weather (ie hot and dry winds and low humidity during summer) and the potential for a fire to spread towards farm assets in the surrounding area. Strong north easterly winds are common during the bushfire season in this region (based on BOM data from the nearby Pindari Dam) and would quickly carry a bushfire or grassfire from surrounding properties towards the solar farm assets. A fire under the influence of wind may travel very fast, reaching assets before fire fighters can attend the scene.

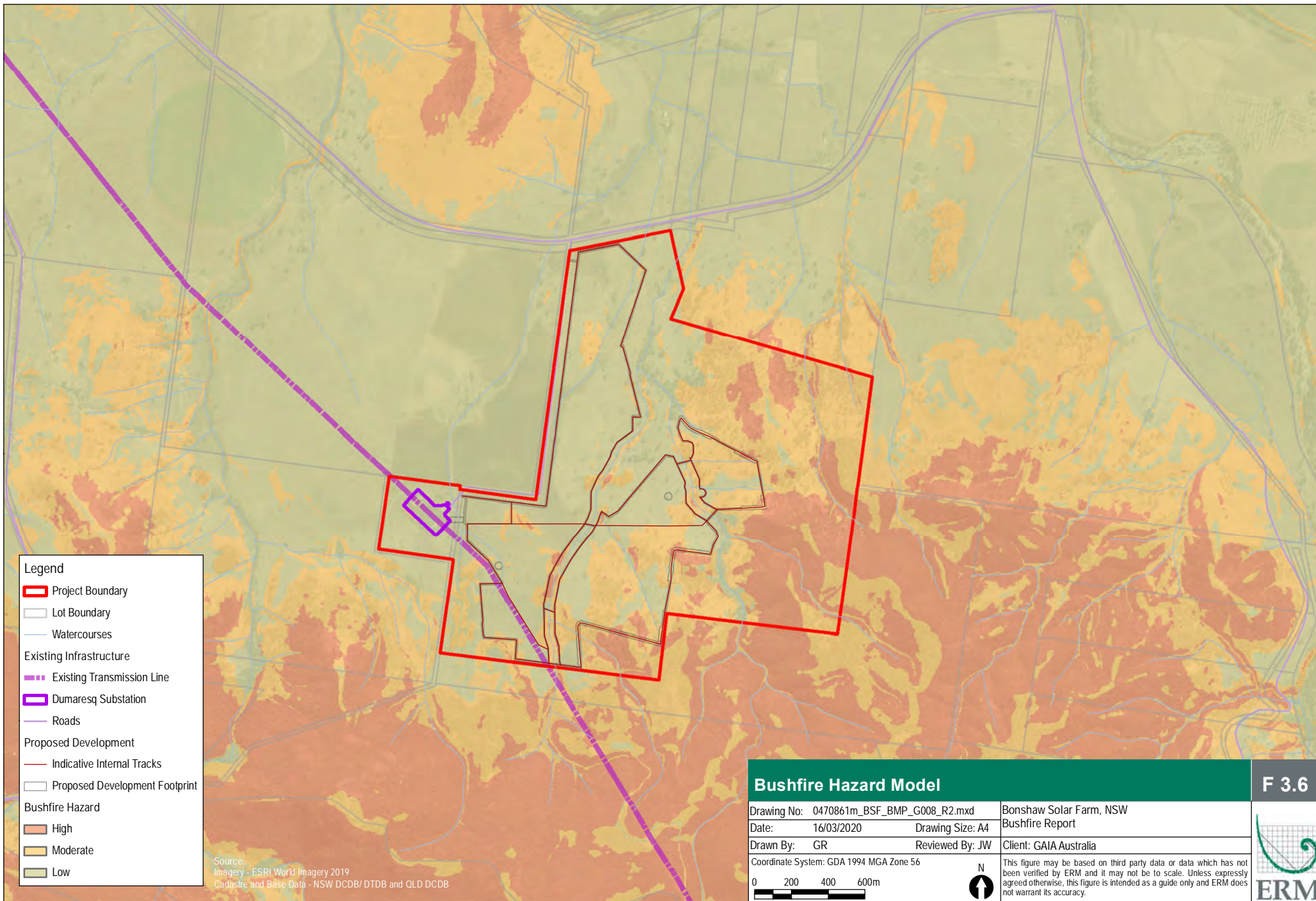
Grassfires should not be underestimated and can start and spread quickly. They can travel up to 25 km per hour and pulse even faster over short distances. As described by Bradstock et al (2012), grass is a fine, high surface area to volume ratio fuel with high thermal conductivity, low density and vertical orientation, which rapidly ignites (and rapidly burns out). Grassfires are also generally more open to wind than forest fuels (Cheney and Sullivan 2008) making them unpredictable. Grassfires tend to be less intense and produce fewer embers than bushfires, but still generate enormous amounts of radiant heat. Grassfires can also start earlier in the day than bushfires, because grass dries out more quickly when temperatures are high and humidity is low.



F 3.4



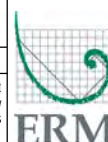
F 3.5



Bushfire Hazard Model

F 3.6

Drawing No: 0470861m_BSF_BMP_G008_R2.mxd	Bonshaw Solar Farm, NSW
Date: 16/03/2020	Bushfire Report
Drawn By: GR	Reviewed By: JW
Client: GAIA Australia	
Coordinate System: GDA 1994 MGA Zone 56	
0 200 400 600m	
N	
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.	



The difference in spread rate between a fire in the heavily grazed pasture and areas of native grassland is only about 20%, although the native grasslands will generally have taller flames that may burn across tracks or firebreaks (Bradstock et al 2012). Under the most extreme weather, a fire could spread between and under solar panels even in the heavily grazed grass and embers may breach any fire break. Therefore, the asset protection zones recommended may only be reliable up to Very High fire danger.

3.6 Fire ignitions

The Northern Tablelands BFMC area has on average 170 bushfires per year, of which five on average can be considered to be major fires. The main sources of ignition in the Northern Tablelands BFMC area are escaped private burns and occasional lightning strike fires (BFMC 2011).

There are no publically available ignition occurrence records for the site or nearby that provide statistical validity or a guide to likelihood of nearby ignition.

3.6.1 Construction (and decommissioning)

Earth moving equipment, power tools (e.g. welders, grinders), mowers and slashers are well known for starting bushfires under conditions of high temperature, low humidity and high wind. Activities associated with solar farm construction that may cause or increase the risk of bushfire include:

- Site maintenance activities such as mowing, slashing and using other petrol-powered tools.
- Hot works, including welding and soldering activities.
- Operating a petrol, LPG or diesel vehicle in grassland areas.
- Operating plant fitted with power hydraulics in grassland areas.
- Smoking and disposal of cigarettes on site.

Construction and ongoing maintenance of the solar farm will be a potential source of ignitions, with a greater risk within the declared fire danger period (typically from August to March). Site access would be formalised at the beginning of the construction stage, which would increase the ability to access and suppress any fire onsite or on adjoining sites.

The bushfire hazard associated with the construction activities listed above is considered manageable and would be minimised through the implementation of fire and bushfire mitigation measures outlined in Section 4, including the preparation of an emergency response plan.

Any bushfire risk associated with decommissioning of the project would be similar the construction phase and would be subject to the same management and mitigation measures.

3.6.2 Operation

Repairs and maintenance activities during operation could also increase bushfire risk.

GAIA have confirmed the following information regarding the fire risk for the PV panels:

- *All electrical components are required to be manufactured in material that does not allow self-combustion and ignition and should self-extinguish. In addition, the electrical equipment is fitted with over current protection devices and isolation switches along with earth leakage protection devices as standard components.*
- *The PV panels will be made of tempered glass with aluminium frames. GAIA have also advised that the solar panels to be used meet the IEC 61730 and UL1703 (Type 1) fire resistance test standards under fire conditions.*
- *It is intended that the vegetation fuel under and between the PV panels will be maintained in a low fuel state by sheep grazing and other land management activities such as mowing and application of pesticides. It is recognised that a fire could still spread in this fuel under severe fire weather conditions.*

- *The likelihood of a fire spreading within the area of the proposed PV panels, by propagating from panel to panel in a solar farm installation, is difficult to assess as no fire history within a solar farm was found from within Australia. GAIA have confirmed that solar panels are non-reflective and present no risk of ignitions from concentrated solar energy. All electrical LV and MV components are in enclosures that will contain any arcing should a fault occur.*
- *The risk of a fire spreading widely from panel to panel is likely to be very low because of the panel construction materials (i.e. fire resistance rating) and the time of flame exposure to initiate these materials.*

The level of risk from faults cannot be assessed at this stage because there is no case history available and it is not possible to compare the ignition risk from existing farm operations (e.g. grazing) relative to solar farm operation.

An Asset Protection Zone of 10 m will be maintained around all buildings at the site including the solar farm substation, inverters, control building and external perimeter of the PV arrays throughout the operational phase of the project. It is anticipated that TransGrid would continue maintain their adjacent substation infrastructure to minimise bushfire ignition risks.

The perimeter road will be 6m wide (located within the perimeter APZ), with internal access tracks a minimum of 4 m wide around the perimeter of each of the solar array areas and associated infrastructure, allowing adequate access for emergency vehicles including fire trucks.

3.7 Fire history

No fire history is available from the Project Area itself although large scale fires are known to occur within the Northern Tableland Region. A review of the RFS Fire History Mapping available via SEED maps shows three major fires within the past 10 years (refer to Figure 3-7):

- Black Creek and Granite Creek fires burnt 23391 ha in 2009/2010;
- South Valley Road fire burnt 1328 ha in 2009/2010; and
- Emmaville Road fire burnt 4555 ha in 2012/2013.

More recently, the 2019-2020 bushfire season has seen multiple large scales across the region including the nearby Gulf Road.

3.8 Fire-fighter and public safety

The usage of the general area surrounding the site is mostly limited to landowners.

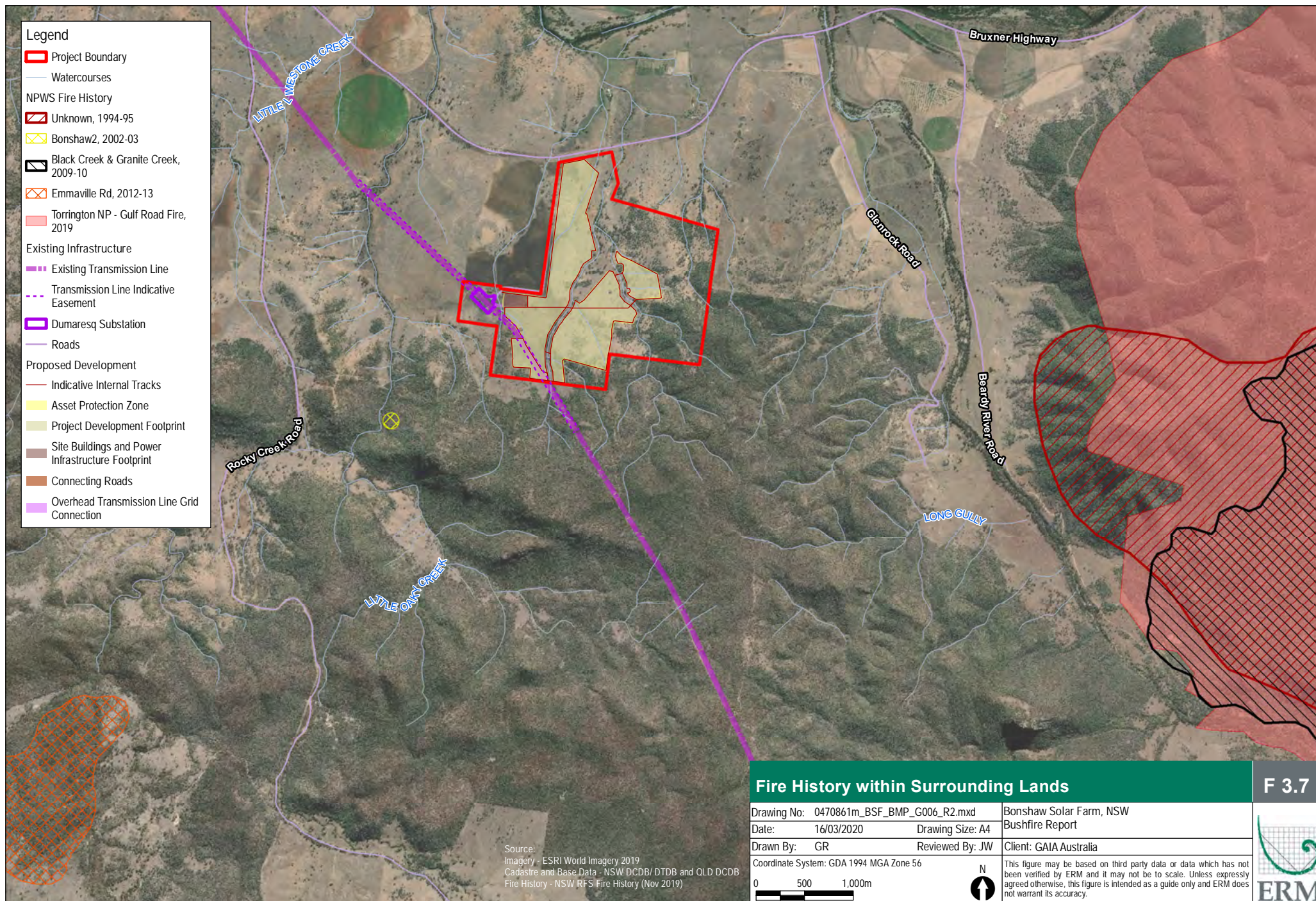
The fire-fighters likely to respond to a bushfire in this area would be volunteers from the NSW Rural Fire Service and or individual property owners. Brigades from NSW Fire and Rescue could also respond.

The risks to fire-fighter safety associated with a fire burning the solar panels and associated equipment include:

- electrocution – solar panels would be energised under any natural or artificial light conditions. Isolation and shut down procedures in the case of a fire or other emergency are a key safety risk and must be included in the Emergency Response Plan;
- safe use of water spray or foam application is likely only possible from the perimeter of the solar arrays and would not reach the 250 plus m required to reach the centre of the arrays; and
- inhalation of fumes and smoke from any plastic components such as cables (although the main structure of the panels will be tempered glass and aluminium).

The materials for individual components within the solar farm infrastructure have not yet been finalised, therefore, the flammability and toxicity of burning components have not been determined in detail although this information will form part of the Emergency Response Plan that will be development prior to construction.

Any volunteer fire-fighters from the NSW Rural Fire Service, NSW Fire and Rescue or property owners from neighbouring farms attending bushfires in this area may not be trained in structural and electrical fire-fighting. The Emergency Response Plan will detail appropriate risk control measures that would need to be implemented to safely mitigate potential risks to the health and safety of the firefighters and first responders. At least two copies of the ERP will be stored in an Emergency Information Cabinet located at the main entrance point and must be accessible to all first responders. Two copies of the ERP will also be stored within the operations facilities.



4. MITIGATION STRATEGIES

Consideration is given to whether the proposed Solar Farm will result in people congregating in large numbers. The operation of the proposed Solar Farm is considered to be a low intensity use in terms of the number of people on site at any one time, with only 10 full time staff on site during the operational phase. However, there could be up to 190 people on site during construction phase over a period of up to 52 weeks. Although the construction period does not pertain to the expected end use of the Project site, the number of people who could be on Site at one time does warrant consideration in terms of providing adequate defensible space and access as the first stage of construction.

Mitigation strategies are guided by the following factors that contribute to bushfire risk:

- Fuels, weather, topography and predicted fire behaviour;
- Suppression resources (air and ground), access (roads, tracks) and water supply; and
- Values and assets

Mitigation must be a combination of complementary strategies, all of which are required to provide the best possible protection outcome for the solar farm and the community.

4.1 Asset Protection Zone

An Asset Protection Zone (APZ) is typically designed to separate a vulnerable asset from the bushfire hazard (vegetation/fuel). APZs do not eliminate the fire risk, but may lower it to an extent where fire control is more feasible or damage to the asset is reduced or eliminated.

Understanding the value and limitations of APZ is important, and as is the understanding that bushfires attack built assets by either flame contact, radiant heat or burning debris. An APZ can be used to lower or eliminate the bushfire attack from flame contact and radiant heat around the perimeter of the solar farm and all built assets, but under strong winds or during a major fire event burning debris can result in a fire breaching an APZ to ignite grassy fuel within the solar farm itself. A fire emanating from the PV panels may also jump the APZ by burning debris under similar conditions.

Despite the limitations of any APZ it is recommended that:

- a minimum 10m wide APZ be established around the perimeter (excluding the south eastern corner) of the solar farm and around the solar farm substation, inverter building and control building.
- a 6m wide APZ is provided to the riparian corridors which run through the centre of the project footprint.
- a minimum 20m wide APZ is provided along the southern eastern perimeter of the development.

Based on the mapped high bushfire hazard within the south eastern portion of the site (refer to Figure 3-6) and based on recommendations made by the NSW RFS (refer to Table 2.4) it is recommended that a minimum 20m wide APZ is provided along those sections of the south eastern perimeter that abut forest vegetation (refer to Figure 1-2). This is consistent with Table A2.5 of Planning for Bush Fire Protection 2006 and is based on forest vegetation located upslope of the development footprint.

Table A2.5 Minimum Specifications for Asset Protection Zones (m) for Residential and Rural Residential Subdivision Purposes (for Class 1 and 2 buildings) in FDI 80 Fire Areas ($\leq 29\text{kW/m}^2$)					
Vegetation Formation	Effective Slopes				
	Upslope/Flat	$>0^\circ\text{-}5^\circ$	$>5^\circ\text{-}10^\circ$	$>10^\circ\text{-}15^\circ$	$>15^\circ\text{-}18^\circ$
Rainforests	10	10	15	15	20
Forests	20	20	30	40	45
Woodland	10	15	15	20	25
Plantations (Pine)	15	20	25	35	40
Tall Heath (Scrub)	15	15	20	20	20
Short Heath (Open Scrub)	10	10	10	15	15
Freshwater Wetlands	10	10	10	15	15
Forested Wetlands	15	20	20	30	35
Semi-Arid (Woodland)	10	10	10	10	15
Arid Shrubland	10	10	10	15	15

* Extract from Planning for Bushfire Protection 2006 (NSW RFS) (PBP 2006)

The recommended APZ is also consistent with the requirements of the Victorian CFA renewable energy guidelines (CFA 2018) which require that all containers/infrastructure for battery installations must be clear of vegetation for 10m on all sides and that a fire break area of 10m width is to be maintained around the perimeter of the facilities, electricity compounds and substations.

The specifications recommended for the APZ are as follows:

- mineral earth fire break i.e. dirt or gravel.
- no trees and shrubs planted within the APZ.
- 6m wide perimeter access track, 50,000 litre water tank and external fence can be located within the APZ.

The planting of any trees and shrubs for visual screening on the external side of the APZ will increase the risk of burning embers from an external fire entering the solar farm. The following measures will mitigate the risk of planted or remnant trees carrying embers into the solar farm:

- use species suitable for the environment that have low fire spotting characteristics (e.g. smooth bark); and
- where possible, increase the distance between the trees and the APZ.

4.2 Solar farm construction

Should construction of the solar farm take place between 1 December and 31 March (increased fire weather), the following measures are recommended to control the risk of grass fire ignitions:

- Ensure that appropriate permits have been issued for work during the Fire Danger Period, and that any conditions on permits are adhered to;
- Adhere to restrictions on Total Fire Ban or days of high fire danger;
- Carry fire extinguishers or firefighting equipment in vehicles;
- Carry emergency communications equipment;
- Ensure vehicles keep to tracks whenever possible;
- Restrict smoking to prescribed areas, and provide suitable ash and butt disposal facilities;
- the APZ and perimeter road must be constructed as the first stage of development;
- all plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g. soil and vegetation);
- suitable fire fighting equipment (specific requirements to be confirmed in consultation with RFS) is present on site with at least two personnel trained in bushfire fighting;
- on days when Very High fire danger or worse is forecast, the “fires near me” app is to be checked hourly for the occurrence of any fires likely to threaten the site; and
- all operations involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) cease while the Grassfire Danger Index (GFDI) is or forecast to be 35 or greater (Rural Fire Service 2018).

4.3 Solar farm ongoing operations

4.3.1 Fuel management within solar farm

It is assumed that a grass fire may start and spread within the footprint of the solar farm. Ignitions could include lightning fires, human error or electrical faults. For this reason, it is recommended that vegetation fuels internal to the APZ and throughout the solar farm are maintained in a minimal condition by grazing, slashing or mowing. This will minimise the radiant heat exposure to solar farm components and reduce the risk of a fire spreading beyond the solar farm.

In 2018, Parkes Solar Farm in NSW undertook a three week trial using sheep to manage grass fire hazards on solar farms. The sheep were monitored closely throughout the trial period, and toward the end of the trial all of the sheep were observed to be relaxed, eating and moving freely around the 15 hectares block. By the end of the trial, all of the grass had been eaten to a reasonable length (not less than 50mm) and the hazard reduction was determined a complete success (<https://crystalbrookenergypark.com.au/wp-content/uploads/2019/01/Attachment-F-Sheep-Trial-Parkes-1.pdf>). Continued grazing is recommended within the Bonshaw Project site to ensure that grass is maintained below 100mm high.

4.3.2 Days of Very High or worse fire danger

Fire Danger Ratings give you an indication of the consequences of a fire, if one was to start. The higher the fire danger, the more dangerous the conditions. These forecasts are updated daily during the fire danger season and are available on the RFS website (<http://www.rfs.nsw.gov.au/fire-information/fdr-and-tobans>) and the BOM website (<http://www.bom.gov.au/nsw/forecasts/fire-danger-ratings.shtml>).

To reduce the risk of fires damaging or destroying life, property and the environment the NSW RFS Commissioner may also declare a Total Fire Ban (TOBAN). In a Total Fire Ban no fire may be lit in the open and all fire permits are suspended. No general purpose welding, grinding, soldering or gas cutting can be done in the open.

To minimise the risk of grass fire ignitions, all operations on the site involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) should cease while the Fire Danger rating is Very High or when the GFDI is or forecast to be 35 or greater. This will require establishing an operational procedure for onsite recording of temperature, relative humidity and wind speed, as well as associated training.

For example, if the temperature is 35°C, the relative humidity is 14% (round down to 10%) then high risk activities must stop when the average wind speed is greater than 26km/hr.

Current Relative Humidity											
Current Temperature		5%	10%	15%	20%	25%	30%	40%	50%	60%	65%
	15°C	31	35	38	40	43	45	49	53	56	58
	20°C	29	33	36	38	40	43	46	50	53	55
	25°C	27	30	33	36	38	40	44	47	50	52
	30°C	25	28	31	33	35	37	41	44	47	49
	35°C	23	26	28	31	33	35	38	41	44	46
	40°C	21	24	26	28	30	32	35	39	41	43
	45°C	19	22	24	26	28	30	33	36	39	40
Average wind speed (kph) that equates to 35 GFDI											
Is the wind speed you recorded equal to or greater than the wind speed shown above? If yes, it is recommended you do not harvest. Check weather conditions later.											

4.3.3 Fire-fighter safety

The safety hazards for fire-fighters from PV panels (Section 3.8) and local fire-fighting capability are such that fire suppression within the footprint of the solar farm cannot be expected or relied upon. The only exception to this would be aerial water bombing that is compliant with air operations safety procedures; however, these resources may not be available at short notice for a fire that could spread quickly under strong winds. Fire suppression is most likely only to be feasible from the APZ and perimeter road system or beyond.

Given the possible toxicity of smoke from burning solar farm components, fire-fighters, farm workers and neighbours should avoid working down wind of any fire burning within the solar farm.

Given these safety concerns for fire-fighters, it is not recommended that fire-fighting equipment for fire-fighters be located permanently on site unless directed to by NSW RFS because such equipment may not be utilised safely or effectively.

An Emergency Response Plan (ERP) should be prepared for the solar farm that provides the following:

- a safe method of shutting down and isolating the PV system;
- control and coordination arrangements for emergency response (eg evacuation procedures, emergency assembly areas and procedures for response to hazards);
- agreed roles and responsibilities of on-site personnel (eg equipment isolation, liaison, evacuation management);
- up-to-date contact details of site personnel and any relevant off-site personnel who could provide technical support during an emergency;

- a manifest (and safety data sheets) for any battery, diesel or other dangerous goods storage/handling, including the class identification, quantity, type (bulk or packaged) and location. Appropriate material (including absorbent, neutralisers, equipment and personal protective equipment) for the clean-up of spills is to be provided and available on-site;
- clearly states work health safety risks and procedures to be followed by fire-fighters, including personal protective clothing;
- minimum level of respiratory protection;
- minimum evacuation zone distances;
- activation of water spray/foam systems and any other response/protection measures; and
- any other risk control measures required to be followed by fire-fighters.

The ERP must be prepared with consideration of Australian Standard/ISO 31000 Risk management principles and guidelines and Australian Standard 3745: Planning for emergencies in facilities.

Two copies of the ERP should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at each vehicle entrance point to the solar farm, external to any security fence or locked gate, and a copy provided to local emergency responders. Two copies of the ERP will also be stored within the operations facilities.

The Emergency Information Cabinets must be clearly visible, installed at a height of 1.2m - 1.5m and accessible by all emergency services.

A schedule for ongoing site familiarisation to account for changing personnel, site infrastructure and hazards should be developed in conjunction with the local RFS.

4.3.4 Shielding of solar farm components

Solar panels and other components (e.g. cables) will be exposed to flame contact in the event of a bushfire spreading within the solar farm footprint. Therefore, it is recommended that components that are vulnerable to damage from temperatures associated with flame contact are shielded as far as possible. Design should consider the following features:

- burial of cables underground;
- shielding of above ground cables (e.g. metal conduit).

4.3.5 Water storage

Whilst the likelihood of a damaging fire impacting the solar farm is considered low, the consequence could be significant e.g. large number of panels and/or related electrical systems damaged.

The risk of a fire starting from the solar farm and spreading to surrounding areas is also considered low. Water supply should be designed to provide filling points for fire tanker units near the solar farm entrance only as internal access may not be possible. A storage of 50,000 litres is recommended, based on refilling six tanker units (4,000 litres) twice each. Based on the recommendations of the NSW RFS, this 50,000 litre water supply (tank) must be fitted with a 65mm storz fitting should be located adjoining the internal property access road within the required APZ.

4.4 Summary of recommended mitigation strategies

Table 4.1 summarises the bushfire mitigation strategies and recommendations made in this document.

Table 4.1 Summary of recommended mitigation strategies

Mitigation Strategy	Action	Timing
Asset Protection Zone (APZ)	<ul style="list-style-type: none"> A minimum 10m wide APZ will be established around the perimeter (excluding the south eastern corner) of the solar farm and around the solar farm substation, inverter building and control building; A 6m wide APZ is to be provided to the riparian corridors which run through the centre of the project footprint; and consistent with Table A2.5 of Planning for Bush Fire Protection 2006 a minimum 20m wide APZ is provided along those sections of the south eastern perimeter that abut forest vegetation (refer to Figure 1-2). <p>The specifications recommended for the APZ are:</p> <ul style="list-style-type: none"> mineral earth fire break i.e. dirt or gravel. no trees and shrubs planted within the APZ. 6m wide perimeter access track can be located within this 10m wide APZ. 	The APZ and perimeter road must be constructed as the first stage of development.
Solar farm construction	<p>Should construction of the solar farm take place between 1 December and 31 March (increased fire weather), the following measures are recommended to control the risk of grass fire ignitions:</p> <ul style="list-style-type: none"> Ensure that appropriate permits have been issued for work during the Fire Danger Period, and that any conditions on permits are adhered to; Adhere to restrictions on Total Fire Ban or days of high fire danger; Carry fire extinguishers or firefighting equipment in vehicles; Carry emergency communications equipment; Ensure vehicles keep to tracks whenever possible; Restrict smoking to prescribed areas, and provide suitable ash and butt disposal facilities; the APZ and perimeter road must be constructed as the first stage of development; all plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g. soil and vegetation); suitable fire fighting equipment (specific requirements to be confirmed in consultation with RFS) is present on site with at least two personnel trained in bushfire fighting; 	During Construction

Mitigation Strategy	Action	Timing
	<ul style="list-style-type: none"> on days when Very High fire danger or worse is forecast, the “fires near me” app is to be checked hourly for the occurrence of any fires likely to threaten the site; and all operations involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) cease while the Grassfire Danger Index (GFDI) is or forecast to be 35 or greater (Rural Fire Service 2018). 	
Access roads and road network	<p>The perimeter road and site access points must be constructed as the first stage of development.</p> <p>One main entry/exit point to the Bruxner Highway to the north and an additional two access points on the western and southern boundaries of the site must be maintained for the life of the project.</p> <p>To allow for emergency service personnel to undertake property protection activities, a defendable space (APZ) that permits unobstructed vehicle access is to be provided around the perimeter of each of the solar array areas and associated infrastructure.</p>	During construction and operation
Solar farm ongoing operations	<p>The entire solar arrays development and associated infrastructure footprint must be managed as an APZ as outlined within Section 4.1.3 and Appendix 5 of the Planning for Bush Fire Projection Guidelines and the NSW RFS Standards for Asset Protection Zones.</p> <p>Maintain minimal fuel load by grazing, slashing or mowing.</p> <p>Continued grazing is recommended within the Bonshaw Project site to ensure that grass is maintained below 100mm high.</p> <p>No vegetation within the Substation or within the recommended APZ.</p> <p>Suspend site maintenance operations when GFDI ≥ 35.</p>	During construction and operation
Solar farm ongoing operations	<p>A Fire Management Plan (FMP) prepared in consultation with the NSW RFS Northern Tablelands Fire Control Centre. The FMP must include:</p> <ul style="list-style-type: none"> 24 hour emergency contact details including alternative telephone contact; site infrastructure plan; fire fighting water supply plan; site access and internal road plan; construction and maintenance of Asset protection Zones (APZ); location of hazards (physical, chemical and electrical) that will impact on fire fighting operations and procedures to manage identified hazards during fire fighting operations; fire mitigation strategies as outlined within Section 4 of this updated Bushfire Hazard Assessment; and any additional matters as required by the NSW RFS District Office. 	During construction and operation

Mitigation Strategy	Action	Timing
Fire-fighter safety	<p>Emergency Response Plan prepared and stored at 'Emergency Information Cabinet' at main entrance to solar farm and provided to local emergency responders. The ERP must include:</p> <ul style="list-style-type: none"> ■ a safe method of shutting down and isolating the PV system; ■ control and coordination arrangements for emergency response (eg evacuation procedures, emergency assembly areas and procedures for response to hazards); ■ agreed roles and responsibilities of on-site personnel (eg equipment isolation, liaison, evacuation management); ■ up-to-date contact details of site personnel and any relevant off-site personnel who could provide technical support during an emergency; ■ a manifest (and safety data sheets) for any battery, diesel or other dangerous goods storage/handling, including the class identification, quantity, type (bulk or packaged) and location. Appropriate material (including absorbent, neutralisers, equipment and personal protective equipment) for the clean-up of spills is to be provided and available on-site; ■ clearly states work health safety risks and procedures to be followed by fire-fighters, including personal protective clothing; ■ minimum level of respiratory protection; ■ minimum evacuation zone distances; ■ activation of water spray/foam systems and any other response/protection measures; and ■ any other risk control measures required to be followed by fire-fighters. <p>A schedule for ongoing site familiarisation to account for changing personnel, site infrastructure and hazards should be developed in conjunction with the local RFS.</p>	ERP to be developed and approved by both NSWRFs and NSWFS prior to construction.
Shielding of solar farm components	<p>Shield all heat sensitive components from potential flame contact. Design should consider the following features:</p> <ul style="list-style-type: none"> ■ burial of cables underground; ■ shielding of above ground cables (e.g. metal conduit). 	Considered during project design. Maintained for life of the Project
Water storage	<p>Water supply should be designed to provide filling points for fire tanker units near the solar farm entrance only as internal access may not be possible. A storage of 50,000 litres is recommended, based on refilling six tanker units (4,000 litres) twice each. This 50,000 litre water supply (tank) must be fitted with a 65mm storz fitting and should be located adjoining the internal property access road within the required APZ.</p>	Considered during project design. Maintained (and at full capacity i.e. 50,000 litres of water available) for life of the Project.

5. REFERENCES

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APPENDIX F AMENDMENT REPORT

Javier Canon
Senior Policy Officer
Department of Planning, Industry & Environment
4 Parramatta Square, 12 Darcy Street
PARRAMATTA NSW 2150

27 March 2020

Reference: 0470861



Dear Javier Canon

Subject: Bonshaw Solar Farm (SSD 9438) Amendment Report

1. INTRODUCTION

GAIA Australia Pty Ltd (GAIA) are seeking approval to develop a large scale photovoltaic (PV) generation facility with a capacity of 200 megawatts (MW) and associated infrastructure, including a Lithium-ion Energy Storage System (ESS/Li-ion). The proposed development of the Bonshaw Solar Farm (the 'Project') is located at Bonshaw, within the Inverell Local Government Area in New South Wales (NSW) (refer to *Figure 1.1*). The Project is located approximately 66 km north of Inverell, with site access fronting Bruxner Highway.

The Project site has been amended through the Response to Submissions process, notably reducing the development footprint from approximately 167 hectares (ha) to approximately 149 ha (the 'Development Footprint'). The Project, as originally described in the Environmental Impact Statement (EIS), comprised exclusively of Lot 2 of Deposited Plan (DP) 1039185. However, the purpose of this Amendment Report (AR) is to address the TransGrid submission, through the addition of the Dumaresq Substation, comprising Lot 201 DP879480, to the 'Project Site'. This will facilitate the connection to the grid of the solar farm to the substation via an overhead transmission line. The AR also provides an environmental assessment of the potential impacts associated with the grid connection component (refer to *Section 5*).

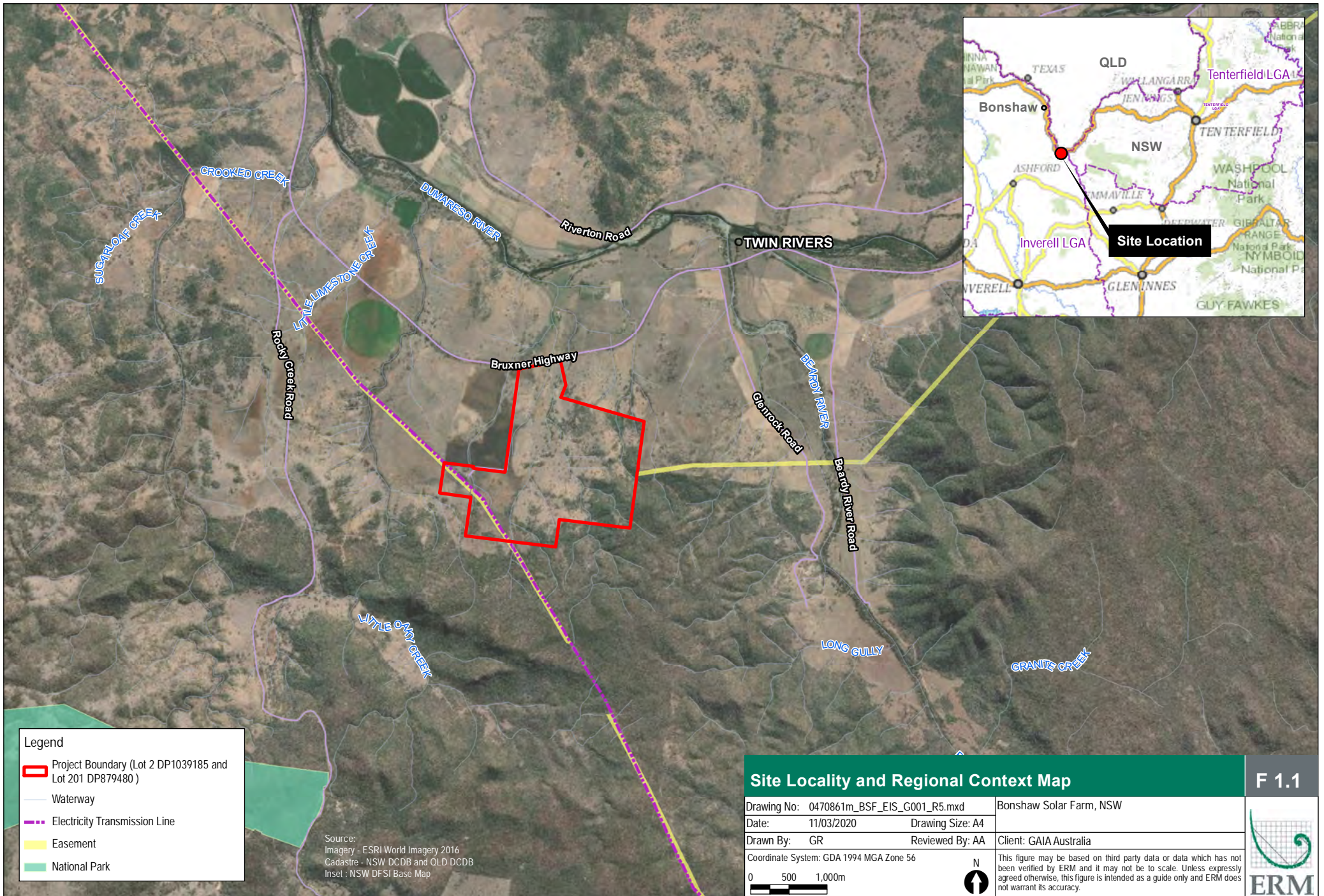
The Project follows the approvals process under Part 4 of the *Environmental Planning and Assessment Act 1979* as it meets the criteria of a State Significant Development (SSD) under clause 20, Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

1.1 Project Progress

The EIS for the Project originally stated in *Section 2.1* that the proposed grid connection would be by an overhead transmission line from the solar farm's ancillary infrastructure to the Dumaresq Substation. The EIS stated that the grid connection would be obtained separately, in accordance with Part 5 – Infrastructure and Environmental Impact Assessment of the EP&A Act 1979.

Following exhibition of the EIS, TransGrid made comment of the proposed method for obtaining approval separately, noting that all works associated with the Project are to be included in the development approval for the Bonshaw Solar Farm.

Consequently, the AR seeks to provide details of the overhead connection to assist with the Department's assessment and determination of the Project.



2. DESCRIPTION OF AMMENDMENTS

This amendment report provides the inclusion of the Dumaresq Substation for the Project, specifically addressing the environmental impacts associated with the overhead connection from the Bonshaw Solar Farm to the existing Dumaresq Substation. The overhead connection will include a 30 m easement that will require ongoing maintenance as a transmission easement.

The overhead connection will connect from a pylon in the 'Ancillary Infrastructure' area, extending approximately 150 m directly into the Dumaresq Substation. There will be no ground disturbance within the transmission corridor.

The location of the overhead connection and the easement area is shown in *Figure 2-1* below.

2.1 Project Updates

In responding to the submissions raised, the Project has been updated to include the following changes (refer to *Table 2-1*):

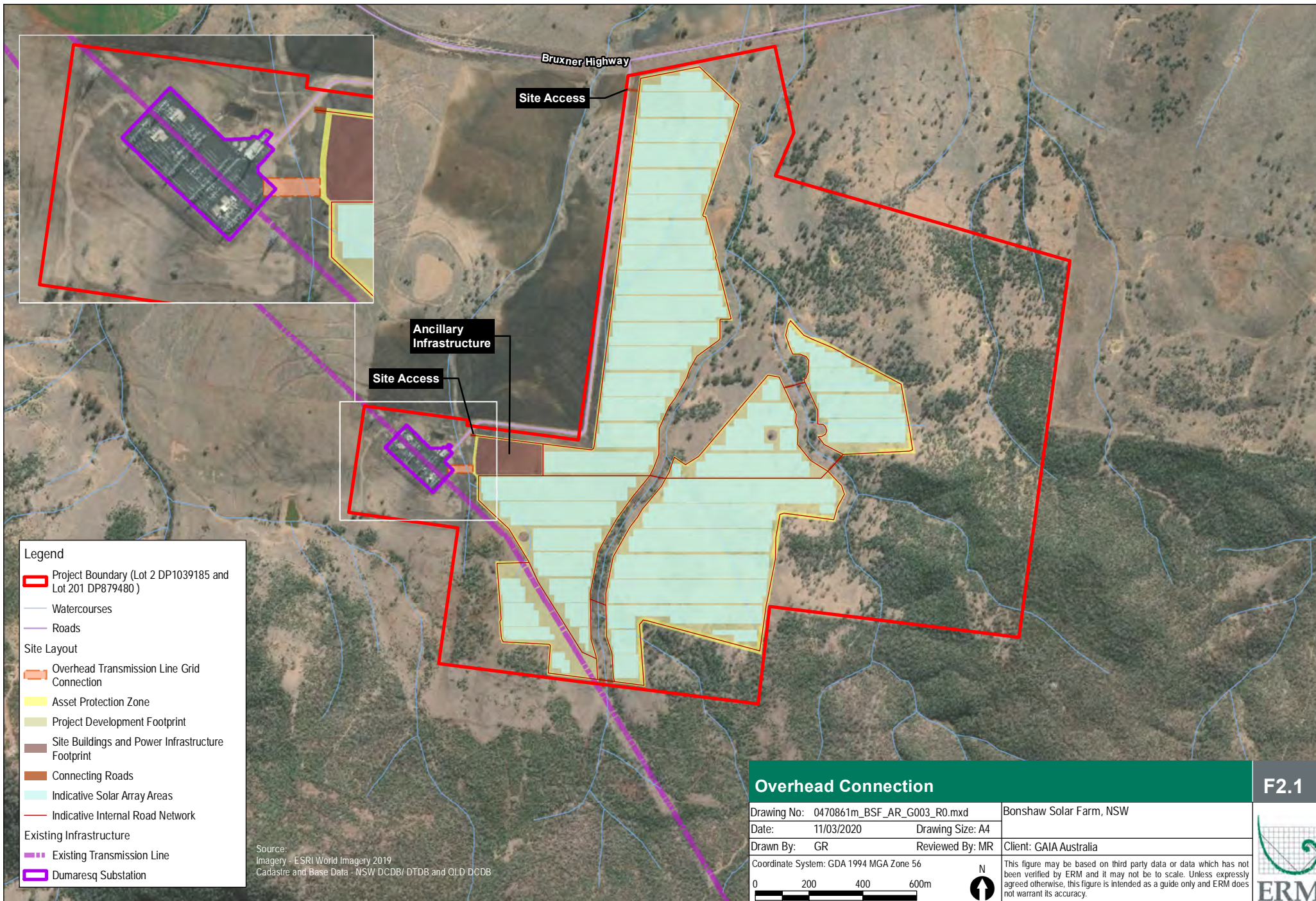
Table 2-1 Summary of Project Updates

Aspect	Project Response
Grid Connection	<p>Grid connection will be obtained through a proposed overhead transmission connection. The overhead connection will connect from a pylon in the 'Ancillary Infrastructure' area, extending approximately 150 m directly into the Dumaresq Substation (refer to <i>Figure 2-1</i>). The overhead connection is considered as an amendment to the original project description in the EIS.</p> <p>This response has triggered the need to develop this Amendment Report that details the description of the proposed project amendment, including an assessment of the relevant environmental impacts.</p> <p>Furthermore, the addition of the Dumaresq Substation requires landowner consent for the inclusion of Lot 201 DP 879480 and the Crown Land corridor. Evidence of landowner consent is provided in <i>Attachment A</i> below.</p>
Water Supply	<p>Water supply for the project will be provided through a licenced water supplier. GAIA have identified three (3) potential suppliers for the project – Trident Water or Wade's Water in Warwick or Vital Water Service in Casino. These will be further reviewed once the project commits to a construction timeframe (post-approval).</p>
Infrastructure	<p>The project is likely to fixed tilt (25°) PV panels. However, flexibility in technology is required to ensure the project remains viable, this includes the potential use of bi-facial panels. Piers for solar panel mounting will be ground screwed, allowing the piers to be removed and the ground restored to its original state.</p> <p>Should the use of alternative technologies result in additional infrastructure or ground treatments (i.e. white sand to increase reflectivity), this will require a modification to the Development Consent and assessment of potential additional impacts.</p>

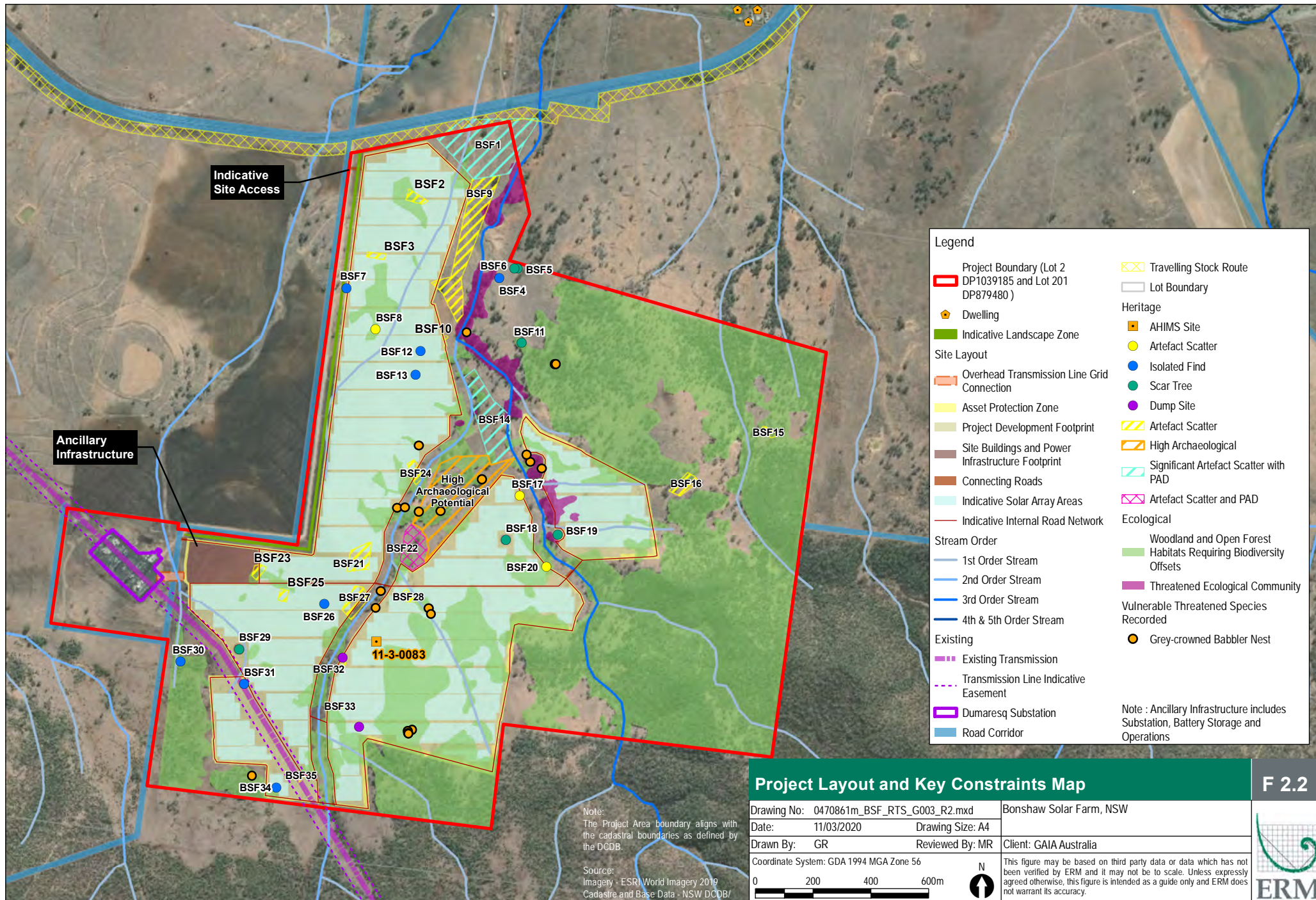
Aspect	Project Response
Biodiversity	<p>The BDAR has been updated to address comments raised by BCD (as detailed in the RTS).</p> <p>The BDAR has included an assessment of the grid connection component, including Dumaresq Substation. This change to the Project Area has resulted in the need to update the calculations recorded in the BDAR and the final BAM calculation.</p>
Cultural Heritage	<p>All amended sections refer to the Cultural Heritage Assessment Report.</p> <ul style="list-style-type: none"> ■ Inclusion of Section 5.3.2.1 of the CHA to describe the AHIMS Site #11-3-0083; ■ Inclusion of Figure 5.2 – Reference Map to location of AHIMS #11-3-0083; ■ Inclusion of discussion of AHIMS #11-3-0083 in the survey results (Section 7.2.3); ■ Inclusion of AHIMS #11-3-0083 in Aboriginal Heritage Statement of Significance; ■ Minor amendment to entry for AHIMS #11-3-0083 in Table 8.1; ■ Addition of AHIMS #11-3-0083 to Impact Assessment (Section 9); ■ Section 9 – clarification of impact metric utilised and reasoning for use; ■ Amendments to Table 9.1 to remove usage of ‘Possible Impact’; ■ Revision of Aboriginal Heritage recommendations and unexpected finds procedure, in line with comments received from DPIE; and ■ Addition of Section 10.2.1.4 ‘Cultural Heritage Management Plan’ to outline requirements for preparation of a CHMP.
Traffic	<p>The Traffic Impact Assessment has been updated to include an assessment of all transport routes and key intersections associated with the project. The site access has been consolidated with the existing access to the Dumaresq Substation access road, with site access to be provided off this road rather than directly onto the Bruxner Highway.</p>
Bushfire	<p>The Bushfire Hazard Assessment has been updated to reflect the revised Asset Protection Zones (APZ) which has also been reflected in the updated Project Layout provided in <i>Figure 2-2</i>.</p>
Hazards	<p>Preparation of a Preliminary Hazard Assessment (PHA) which details the Project’s potential risks and hazards and suitable controls.</p> <p>In response to <i>State Environmental Planning Policy No.33 – Hazardous and Offensive Development</i> (SEPP33).</p> <p>This is primarily related to the lithium-ion batteries being new technology that may not have been taken into account during the initial process determined for SEPP33.</p> <p>The outcome of the PHA concludes that It has been recognised that the Project is to include small quantities of hazardous materials which do not trigger the threshold. With consideration of the insignificant quantity of materials stored on site, along with the significant distance to neighbouring properties, it can be concluded that the risks associated with storage and transportation of hazardous materials are unlikely to be significant or pose a risk to public safety.</p>

Aspect	Project Response
	<p>The PHA has also revised a level 1 hazard analysis on the Project Battery and Energy Storage System (BESS) within the PHA. The following condensed assessment was concluded as a result of the assessment:</p> <ul style="list-style-type: none"> ■ That the BESS is located in the most appropriate location regarding the surrounding bushfire hazards and bushfire prone land. ■ That the Energy Storage System (ESS) supplier will maintain the most up to date global standards that commit to negating the possibility of fire propagation to additional units in the event of a thermal runaway. ■ That the preferred ESS supplier only supplies BESS units that contain a fire extinguishing system. ■ That the ESS and installation comply with the relevant Australian Standards on Energy Storage Systems (outlined in the PHA)
Statement of Commitments	<p>The following Statement of Commitments are provided in addition to the commitments made in the EIS and are a direct response to the submissions:</p> <ul style="list-style-type: none"> ■ Prepare a comprehensive fire safety study (FSS) for the Battery Energy Storage Systems (BESS) component of the development. The FSS should be developed in accordance with the requirements of Hazardous Industry Planning Advisory Paper No.2 (HIPAP No.2), and in consultation with and to the satisfaction of FRNSW; ■ Preparation of a Fire Management Plan (FMP) in consultation with NSW RFS Northern Tablelands Fire Control Centre; ■ Preparation of a Decommissioning and Rehabilitation Plan prior to decommissioning the Project which will detail how the site will be rehabilitated to the pre-development state; and ■ Undertake a pre and post construction road dilapidation report for the local transport route and restore any road damage resulting from construction of the project.

The implications of these updates to the project on the layout is provided in *Figure 2-2* below.



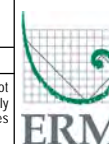
F2.1



Project Layout and Key Constraints Map

F 2.2

Drawing No: 0470861m_BSF_RTS_G003_R2.mxd	Bonshaw Solar Farm, NSW	
Date: 11/03/2020	Drawing Size: A4	
Drawn By: GR	Reviewed By: MR	Client: GAIA Australia
Coordinate System: GDA 1994 MGA Zone 56		
0 200 400 600m 		This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.



3. STRATEGIC AND STATUTORY CONTEXT

3.1 Strategic Context

The Project will support the Commonwealth and NSW Governments in achieving their respective renewable energy and greenhouse gas emission reduction targets. The aim of the Commonwealth Government's Renewable Energy Target (RET) is to create a market for renewable energy to deliver around 23.5% of electricity from renewable sources by 2020, including the target of providing 33 terawatt hours (TWh) through large-scale renewables by 2020. Likewise, the NSW Renewable Energy Action Plan (REAP) supports the RET, by outlining 24 actions under 3 goals that detail the NSW Government's commitment to work closely with NSW communities and the renewable energy industry to increase renewable energy production in NSW to reach 20% of all energy generated by 2020.

According to the Clean Energy Australia Report 2019 (Clean Energy Council, 2019), in 2018 in NSW, the state generated 69,085 gigawatt hours (GWh) of energy, with the total renewable energy generation comprising 10,355 GWh, or 15.0%.

The Bonshaw Solar Farm will deliver 200 MW of renewable energy to the National Electricity Market (NEM), equating to 420 GWh per annum. The Project will assist the Commonwealth and NSW Governments in reaching the respective renewable energy targets.

3.2 Statutory Context

The statutory context has not changed from the original application, as documented in the Environmental Impact Statement.

3.2.1 Local Legislation

The Dumaresq Substation is situated within the Inverell Shire and the *Inverell Local Environmental Plan 2012* (Inverell LEP) applies. Both the Bonshaw Solar Farm and the Dumaresq Substation are zoned RU1 Primary Production under the Inverell LEP (*Figure 3-1*). The objectives of the zone are:

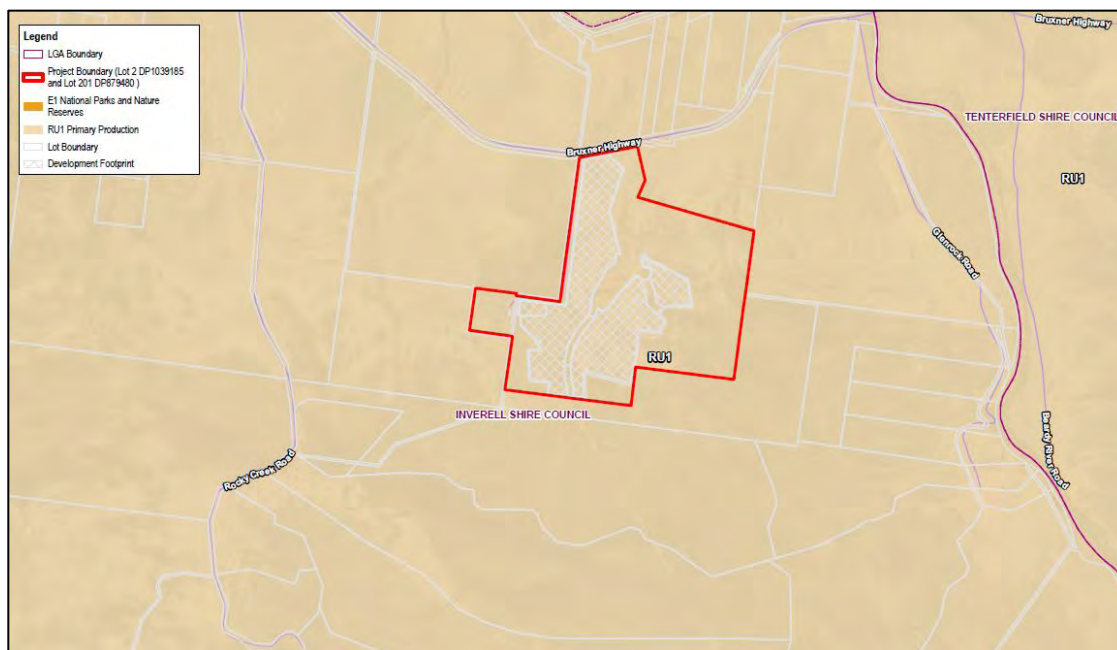
- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.

Development for the purpose of electricity generation is not specified in item 2 or 3 of the Inverell LEP for the specified zone, and is therefore 'Prohibited'. As stated in *Section 4.2.3* of the EIS, permissibility of the solar energy development is provided by way of Clause 34 (7) of the Infrastructure SEPP.

Table 3-1 summarises the planning controls relevant to the Project under the Inverell LEP.

Table 3-1 Inverell LEP 2012 Mapping

Inverell LEP Mapping Attribute	Relevance to Project Site
Land Zoning	Zoned RU1 Primary Production
Minimum Lot Size	200 ha
Heritage	The Project is not mapped as containing a heritage item.
Designated Buffer Area	The Project is not mapped as being a designated buffer area.

Figure 3-1 Inverell Land Zoning

4. ENGAGEMENT

Engagement with the Electricity Transmission Ministerial Holding Corporation, as landowner of the Dumaresq Substation, and Crown Lands, as owner of the local access road to the Project site was undertaken as part of this AR process. A copy of the owners consent from both parties is provided as **Attachment A**.

5. ASSESSMENT OF ENVIRONMENTAL IMPACTS

This section of the AR addresses the environmental impacts specifically associated with the overhead grid connection, including the maintenance of a 30 m easement. It has been assessed that the impacts will be minimal. Key environmental impacts associated with the amendment are provided below (refer to *Table 5-1*).

Table 5-1 Environmental Assessment

Environmental Matter	Overhead Connection Environmental Impacts
Biodiversity	<p>The vegetation within the overhead connection corridor has been mapped as heavily disturbed grassland with vegetation integrity score <17. In accordance with the BAM, an offset is not required for impacts on native vegetation where the vegetation integrity score is below those set out in Paragraph 10.3.1.1. These thresholds are as follows:</p> <ul style="list-style-type: none"> ■ A vegetation zone that has a vegetation integrity score <15 where the PCT is representative of an endangered or critically endangered ecological community, or ■ A vegetation zone that has a vegetation integrity score <17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community, or ■ 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. <p>Regular ground maintenance is required beneath the overhead connection, which will be managed through the Construction and Operational Environmental Management Plans (CEMP/OEMP) for the Project. This ongoing maintenance within an already highly disturbed grassland will not present any additional impact to those already addressed within the EIS and based on the revised BDAR and BAM calculations, does not increase the credit requirements for the proposed solar farm.</p>
Heritage	<p>European Heritage: There are no registered European heritage matters associated with the Dumaresq substation land.</p> <p>Aboriginal Heritage: An aboriginal heritage survey and assessment of the Bonshaw Solar Farm was undertaken and the results recorded in the EIS. The assessment included a search of registered in the vicinity of the Bonshaw Solar Farm (encompassing the Dumaresq Substation). The search results revealed there are no previously recorded aboriginal heritage items identified in the Dumaresq Substation.</p>

Environmental Matter	Overhead Connection Environmental Impacts
	<p>During the field survey 35 previously unidentified Aboriginal heritage sites were recorded on the Bonshaw Solar Farm. The sites were often located along small creek lines. BSF23 represents the closest newly recorded aboriginal site to the location of the proposed overhead connection. Given the proximity from any creek; distance from the cluster of newly recorded sites; and consideration of the previously disturbed Dumaresq Substation, it is considered unlikely that the overhead connection presents a risk to impact upon any Aboriginal heritage items. Furthermore, the nature of the overhead connection will not require any ground disturbance within the transmission easement.</p> <p>Irrespective of the known presence of artefacts, the Unexpected Finds Protocol will be applicable to the entire project site, as amended (refer to <i>Figure 1-1</i>) to ensure any heritage object and/or relic is appropriately assessed and managed.</p>
Transport	<p>Consideration of the height limit for any possible vehicle movements in the vicinity of the overhead connection (whether that be during construction of the Solar Farm or during its operation) will be adequately captured through the CEMP/OEMP. This will likely involve signage of the height limit to notify any vehicle movements underneath.</p>
Visual	<p>Given the proximity of the overhead line to existing transmission lines from the Dumaresq substation, and the significant distance to any nearby receptors, there will be no additional visual impacts associated with the overhead connection.</p>
Noise	<p>Installation of the overhead line will generate noise. However, in the context of the overall development, this will be minimal.</p> <p>The distance between the overhead connection and any nearby receptors is significant to make the noise impacts nil.</p>

6. EVALUATION OF MERITS

This AR has been prepared to address the inclusion of the Dumaresq Substation, comprising Lot 201 DP879480, to the Project site for the overhead grid connection. The AR also provides an environmental assessment of the potential impacts of the proposed amendment.

Grid connection is a key component of the Bonshaw Solar Farm project, a necessity for the success of the Project. As detailed in *Section 5* above, the overhead connection proposed represents the grid connection option that offers the least disturbance and minimal environmental impact.

Further merit for the amendment is found in the overall Project benefits, through the annual generation of 420 GWh of electricity contributing to the NEM. The Project will assist the Commonwealth and NSW Government in reaching the reduction targets of the RET and REAP respectively.

With these considerations in mind, it is inferred that the proposed amendment has sufficient merit for inclusion in the overall Project, for assessment by the Department of Planning, Industry and Environment.

Yours sincerely,



Lachlan Giles
Environmental Planner



Michael Rookwood
Senior Planner

ATTACHMENT A LANDOWNER CONSENT

ERM Australia Pty Ltd
C/- Michael Rookwood
Level 1, 45 Watt Street
NEWCASTLE NSW 2300

19 September 2019

Dear Sir/Madam

Landowner's Consent for Lodgement of Application – SSD-9438 – Bonshaw Solar Farm

Consent is granted by the Minister for Lands to the lodging a development application under the *Environmental Planning and Assessment Act 1979* with Department of Planning, Industry & Environment for the development proposal described above.

This consent is subject to the following:

- (1) This consent is given without prejudice so that consideration of the proposed development may proceed under the *Environmental Planning and Assessment Act 1979* and any other relevant legislation.
- (2) This consent does not imply the concurrence of the Minister for Water, Property & Housing for the proposed development, or the issue of any necessary lease, licence or other required approval under the *Crown Land Management Act 2016*; and does not prevent the Department of Planning, Industry & Environment - Crown Lands (Department of Planning, Industry & Environment - Crown Lands) from making any submission commenting on.
- (3) This consent will expire after a period of 12 months from the date of this letter if not acted on within that time. Extensions of this consent can be sought.
- (4) The Minister reserves the right to issue landowner's consent for the lodgement of applications for any other development proposals on the subject land concurrent with this landowner's consent.
- (5) Irrespective of any development consent or any approval given by other public authorities, any work or occupation of Crown land cannot commence without a current tenure from the Department of Planning, Industry & Environment - Crown Lands authorising such work or occupation.
- (6) The land may be subject to restrictions on use under the *Native Title Act 1993*.
- (7) As the application is being lodged over land managed by the Northern Tablelands Local Land Services (NTLLS), the Applicant will need to seek concurrence from NTLLS to the proposal. For works on Travelling Stock Routes, conditions are generally placed on any proposed works that may interrupt the reserve's purpose.

Regarding the proposed turning circle at the junction of New England Highway and Sunnyside Platform Road, it is the Department's preferred option that the required Crown land be acquired by Tenterfield Shire Council as a public road. Council is the best placed authority for the management of transport activities in this instance. The construction and ongoing operation of such a facility cannot be guaranteed under a Crown land tenure.

Incomplete Aboriginal Land Claim

The Crown reserve 82418 (Lot A DP 389562) affected by your proposed development is subject to an Aboriginal land claim under the *Aboriginal Land Rights Act 1983*, as outlined below.

Claim number	Claimant	Lodgement date
31709	New South Wales Aboriginal Land Council on behalf of Moombahlene Local Aboriginal Land Council	13 October 2010

If the investigation of the above claim determines that the land at the date of claim lodgement was claimable Crown land, the Minister for Lands is required to transfer the land to the claimant Land Council under the *NSW Aboriginal Land Rights Act 1983* regardless of any improvements.

The Department cannot guarantee your occupation of the land should the claim be granted. If the claim was successful, the Land Council would become freehold owners of the land and they may not permit the proposed activity/activities.

Prior to undertaking any development on the land under claim negotiation with the claimant Land Council should be undertaken to ensure that one of the following outcomes have been achieved

1. The claimant Land Council has withdrawn the above land claim; or
2. The claimant Land Council amends their claim to exclude the land affected by this proposal; or
3. The claimant Land Council has provided concurrence to the proposal.

Please note that you are responsible for pursuing any negotiations. The department's Aboriginal Land Claims Investigation Unit may be able to provide some assistance with the best practice for discussions. They can be contacted on (02) 6883 3396 or alc@crowland.nsw.gov.au.

For further information, please contact Jennifer Lee via the details given in the letter head.

Yours faithfully



Jennifer Lee
Department of Planning, Industry & Environment - Crown Lands



The
Treasury

Jim Betts
The Secretary
NSW Department of Planning, Industry & Environment
GPO Box 39
SYDNEY NSW 2001


Dear Mr Betts,

**Owner's consent to lodge Development and Environmental Impact Statement
Application – Lot 201 DP 879480
GAIA Australia Pty Ltd - Bonshaw Solar Farm Project (SSD – 9438)**

The Electricity Transmission Ministerial Holding Corporation is owner of land located at Bonshaw, being Lot 201 in DP 879480 (**the Land**). I understand GAIA Australia Pty Ltd (**Proponent**) has proposed a development known as Bonshaw Solar Farm Project (SSD – 9438) which is proposed to connect into the Dumaesq 330kV Substation and therefore cross and impact the Land.

Please accept this letter as consent (for the purposes of clause 49 of the *Environmental Planning and Assessment Regulation 2000*) of the owner of the Land for the Proponent to lodge a development and environmental impact statement application in relation to the Bonshaw Solar Farm.

Yours sincerely



25/3/2020

Angelo Kriketos
As agent for Michael Pratt, NSW Treasury Secretary
(Treasurer's delegate under delegation dated 24 November 2015)
on behalf of the Electricity Transmission Ministerial Holding Corporation

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