ENVIRONMENTAL IMPACT STATEMENT

QUORN PARK SOLAR FARM

Premise

PREPARED FOR:

QUORN PARK SOLAR FARM PTY LTD

OCTOBER 2019

ENGINEERING ENVIRONMENT AGRICULTURE WATER

Certification

For submission of an environmental impact statement (EIS) under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*

EIS PREPARED BY:

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ORANGE NSW 2800

APPLICANT:

Quorn Park Solar Farm Pty Ltd
PO Box 363
LINDFIELD NSW 2070

PROPOSED DEVELOPMENT:

Quorn Park Solar Farm which includes the construction, operation and reconstruction or decommissioning of a solar photovoltaic plant up to 80 MW_{AC}, and associated infrastructure, including battery storage and grid connection.

LAND TO BE DEVELOPED:

Solar Farm - Lot 508 DP 750152
Grid Connection - Lot 1 DP 1090411; Public Road (Back Trundle Road) and Lot 1 DP 717829

CERTIFICATION:

I declare that this statement has been prepared in accordance with Schedule 2 *Environmental Planning and Assessment Regulation 2000*, contains all available information that is relevant to the environmental assessment of the development to which the statement relates, and that the information contained in this statement is neither false nor misleading.

ANDREW BROWNLOW

Date 22 October 2019

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ABBREVIATIONS

Acronyms

AEMO	Australian Energy Market Operator
ABS	Australian Bureau Statistics
AC	Alternating Currents
ACHAR	Aboriginal Cultural Heritage Assessment Report
AER	Australian Energy Regulator
AHIMS	Aboriginal Heritage Information Management System
ANL	Acceptable Noise Levels
ARENA	Australian Renewable Energy Agency
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BAR	Biodiversity Assessment Report
BWAHS	Binjang Wellington Aboriginal Heritage Survey
BOM	Bureau of Meteorology
BSAL	Biophysical Strategic Agricultural Land
CC	Carbon Credit
CEMP	Construction Environmental Management Plan
CO_2e	Carbon Dioxide Equivalent
CRTN	Calculation of Road Traffic Noise
CWLLS	Central West Local Land Services
DA	Development Application
DC	Direct Current
DCP	Development Control Plan
DMP	Decommissioning Management Plan
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMF	Electric and Magnetic Field
EPA	NSW Environment Protection Authority
ESD	Ecologically Sustainable Development
FRNSW	Fire and Rescue New South Wales
GHG	Greenhouse Gas
GSF	Goonumbla Solar Farm
HV	High Voltage
ICNG	Interim Construction Noise Guideline
LEMC	Local Emergency Management Committee
LEP	Local Environmental Plan
LGA	Local Government Area
LGC	Large Generation Certificates
LV	Low Voltage
NEM	National Electricity Market
NERR	National Energy Retail Rules
NHMRC	National Health and Medical Research Council
OEH	NSW Office Environment and Heritage
OEMP	Operations Environmental Management Plan
PCT	Plant Community Type
PSC	Parkes Shire Council

Acronyms	
PSF	Parkes Solar Farm
PV	Photovoltaic
QPSF	Quorn Park Solar Farm
RAP	Registered Aboriginal Parties
REAP	Renewable Energy Action Plan
RED	Renewable Energy Developments Pty Ltd
RET	Renewable Energy Target
RFS	NSW Rural Fire Service
RMP	Recommissioning Management Plan
RMS	NSW Roads and Maritime Service
RNP	Road Noise Policy
SAT	Single-Axis Tracking System
SEAR	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
TSR	Travelling Stock Reserve
Units of measure	
ºC	degrees Celsius
dB(A)	A-weighted decibel
GW	Gigawatt
GWh	Gigawatt Hour
Ha	Hectare
kV	Kilovolt
kV/m	kilo Volts per metre
kW	Kilowatt
kWh	Kilowatt hour
m	Metres
m/s	Metres per second
ML	Megalitre
MW	Megawatt
MWh	Megawatt Hour
MWp	Megawatt Peak
µT	micro Teslas

Executive Summary

The project site relates to the existing farm property, Quorn Park, together with an area for a proposed Electricity Transmission Line (ETL) connecting to existing nearby electrical infrastructure. Quorn Park is a 470 hectare property located approximately 10 km north west of Parkes in the Central West Slopes and Plains of New South Wales. The area assessed in relation to the proposed ETL alignment has an area of approximately 16 hectares, noting that not all of this would be impacted by the proposed ETL.

The proposed Quorn Park Solar Farm (QPSF) is a 80 MW_{AC} electricity generation works that will be comprised of solar photovoltaic modules, steel racking and piled supports, electrical transformers and inverters, electrical cabling, telecommunications equipment, an electrical control room, site substation and perimeter fencing. This application also seeks consent for an energy storage system which would include batteries housed in electrical enclosures. The generated electricity will be exported into the network through connection to an Essential Energy 132 KV line located approximately 700 m to the west of the site.

The development is consistent with the Commonwealth's *Renewable Energy Target*, the NSW's *Renewable Energy Action Plan* and the Central West region's vision for a sustainable future. The *Central West and Orana Regional Plan* identifies renewable energy as an industry linked to the region's future prosperity and Quorn Park is located in an area of the State that has been identified by the NSW Government as favourable as a Solar Energy Zone: benefitting from an outstanding energy resource, reduced environmental and planning constraints, in proximity to existing transmission and distribution infrastructure and load centres, and aligned with the Government's regional growth priorities developed in consultation with regional communities.

Once built the QPSF will generate approximately 200,000 MWh of clean electricity a year, enough to power 23,500 households and displace 164,000 tonnes of greenhouse gas emissions annually. During the nine month construction effort it will have a peak workforce of up to 100 contractors. Post construction it will create 2 – 3 equivalent full time positions.

The site is productive agricultural land supporting dryland farming and grazing. Whilst a solar farm will remove it from primary production, the soil resource and agricultural value of the land will not be degraded. To the contrary, an improvement in soil conditions for plant growth is considered likely with benefits to soil and pasture from the shading of the solar panels. Near-surface soil daytime temperatures will be reduced in summer, which is likely to result in less water loss via evaporation and a reduction in soil carbon loss. Steps have also been taken to avoid, minimise and mitigate biodiversity impacts through identifying a 400 hectare development footprint that would result in a worst case impact of removing 37 isolated paddock trees (12 of which are hollow bearing) and 3.32 hectare of native vegetation (1.93 hectare of which is planted). A total of 88 ecosystem credits and a single species credit is required to offset these residual impacts through the biodiversity offset framework.

A total of 27 Aboriginal sites have been recorded across the development site. These include 23 isolated finds and four artefact scatters of flakes and cores. All of the recorded sites have been assessed as having high cultural value but low scientific significance. Where impacts to these sites are confirmed during detailed design of the farm layout it is proposed to salvage and relocate these sites for protection prior to construction commencing: an approach developed in consultation with representatives of the Aboriginal community. Community consultation has been targeted to potentially impacted neighbours. There are just twelve residences within 2 km of the property boundary, three of whom have limited views of parts of the development site from the curtilage of their homes. Landscape and visual impacts are minor to moderate. Noise modelling under a range of operating scenarios and meteorological conditions concludes that acoustic amenity values for neighbours, during both construction and operations, will be protected and comply with relevant guideline criteria. The QPSF is not an incompatible land use with a potential to create land use conflicts. It is not a threat to continued primary production activities by neighbours. There would be no impact to any groundwater resource nor any adverse change to surface hydrology in terms of modified flow patterns leaving the property.

The QPSF represents an ecologically sustainable development. There is no risk of serious or irreversible environmental damage; biological diversity and ecological integrity is being protected; the health, diversity and productivity of the environment is being maintained and enhanced for future generations; and producing carbon free electricity from solar energy recognises the value of this natural resource.

Introduction

1.1 BACKGROUND

Quorn Park Solar Farm Pty Ltd, a wholly owned subsidiary of Renewable Energy Developments Pty Ltd, is proposing to develop a solar photovoltaic (PV) farm at Parkes. Hereafter this development is referred to as the Quorn Park Solar Farm (QPSF). Quorn Park Solar Farm Pty Ltd is an Australian company which develops utility scale solar plants. The company's leadership has extensive experience in delivering solar and wind energy projects to regional communities in Australia and Europe and has been operating in the industry since 1990.

1.2 DEVELOPMENT OVERVIEW

The QPSF will generate electrical energy by converting solar radiation into electricity through the use of solar PV panels (also known as modules). The farm will operate year-round to generate electricity during daylight hours. The farm will be monitored remotely with no permanent on-site presence. Visitation will be limited to maintenance periods. The farm will consist of solar modules, steel racking and piled supports, electrical transformers and inverters, electrical cabling, telecommunications equipment, an electrical control room, site substation, security lighting, perimeter 2.4 m chainmesh security fencing and site access gates. This application also provides for an energy storage system. The ultimate decision on the equipment type will be dependent upon availability and market conditions at the time of procurement.

The generated electricity will be regulated on site by a 132/33 kV substation and exported through a direct connection to the 132 kV Essential Energy owned transmission line located approximately 700 m west of the QPSF site.

The main components of the development are identified in **Table 1.1** below.

For the avoidance of doubt, no land subdivision is proposed.

Table 1.1 – Main Components of Proposed Development

Either single axis tracking or fixed tilt solar arrays with an estimated 250,000 panels mounted approximately 1.4 m off the ground on galvanised frames and posts with the top edge of the panel up to 4 m above ground level at full tilt;
19 inverter stations interspersed throughout the arrays each of a 40 foot shipping container size with a height of approximately 2.5 m.
A substation compound (approximately 40 m x 40 m) containing 132kV transformer, electrical switch gear and protection equipment, as well as supporting structures for cabling up to 14 m in height.
An energy storage system consisting of either banks of Lithium-ion batteries with associated ancillary inverter, transformer and air conditioning equipment or containerised battery modules; occupying a footprint of approximately 120 m x 50 m.
A control room building (5 m wide x 3.5 m deep x 2.7 m high).
Chain wire site perimeter fencing (2.4 metre-high).
Gravel internal maintenance access tracks and vehicle turnaround areas.
A new double circuit 132 kV transmission line (either overhead and mounted on mono poles approximately 28 m high or underground) to connect with Essential Energy's 132 kV transmission line located approximately 700 m west of the site.
(Possibly) off-site screen plantings for three neighbours who have expressed an interest in this option.

The development would take approximately 9 months to build, operate for 30 years and take one year to either recommission or decommission and rehabilitate the site.

1.3 DEVELOPMENT SETTING

The development site is located off Back Trundle Road approximately 10 km north-west of Parkes in the Central West Slopes and Plains of New South Wales (refer **Figure 1**).

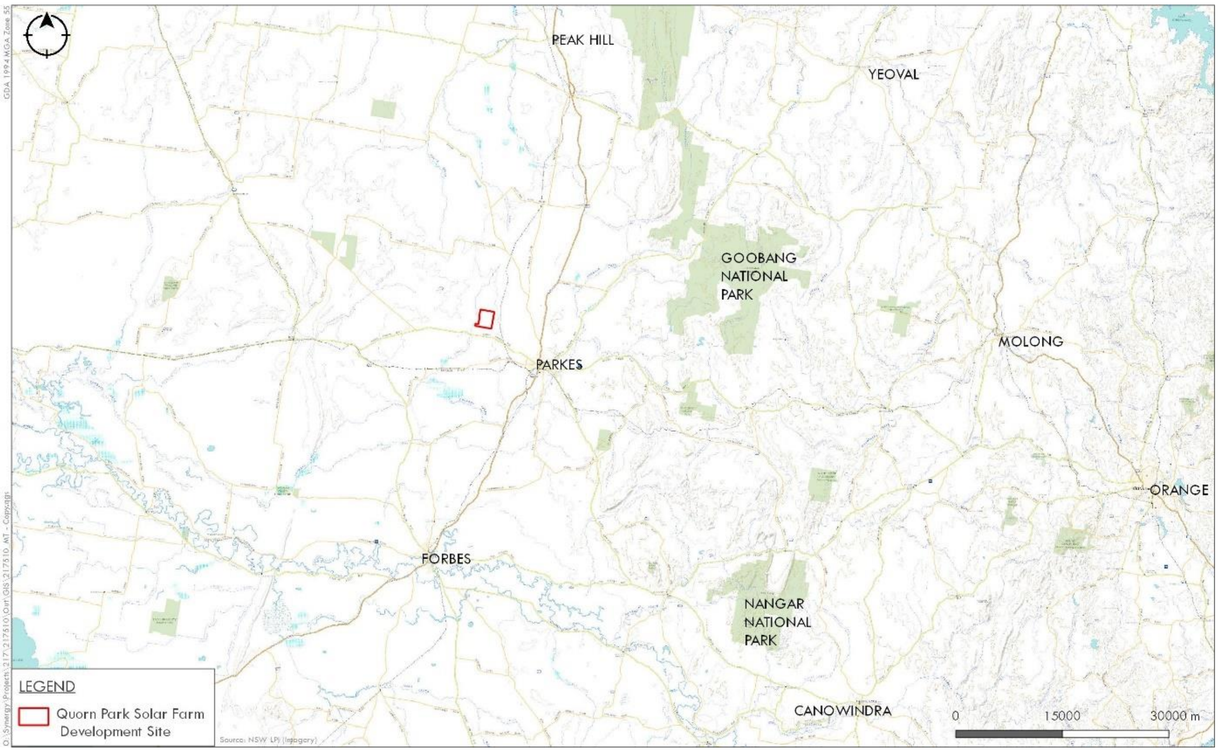

Figure 1: Regional Context

TransGrid's Parkes Zone Substation is located to the south of the site, as is the constructed 65 MW Parkes Solar Farm and the approved (but not built) 70 MW Goonumbla Solar Farm. The Parkes National Logistics Hub (HUB) is located to the south-east. The HUB is a multi-modal transport facility strategically located at the cross roads of the Newell Highway connecting Brisbane and Melbourne, and the transcontinental railway linking the eastern seaboard to Perth (refer **Figure 2**).

Land to the south-east of the proposed solar farm is the subject of the Parkes Special Activation Precinct (SAP) (refer **Figure 3**). The SAP provides an area of approximately 4,800 hectares of land west of Parkes. The SAP seeks to '..*not only become Australia's largest inland freight and logistics hub, but to be a leader in sustainable regional enterprise areas*.'

1.4 STATEMENT PURPOSE

The construction and operation of the QPSF requires development approval under NSW planning legislation. This Environmental Impact Statement (EIS) has been prepared to support a Development Application (DA) lodged with the NSW Department of Planning and Environment (DPE).

1.5 STATEMENT REQUIREMENTS

This EIS identifies and assesses the environmental impacts associated with the construction, operation and recommissioning/decommissioning of the QPSF. It has been prepared in accordance with the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000.*

1.6 STATEMENT STRUCTURE AND SCOPE

The structure and content of this EIS addresses the Environmental Assessment Requirements (SEARs) issued by the Department of Planning and Environment (DPE) on 8 March 2018. A copy of the SEARs is provided in **Appendix A.**

Appendix B provides a checklist identifying where SEAR's requirements have been addressed in this EIS.

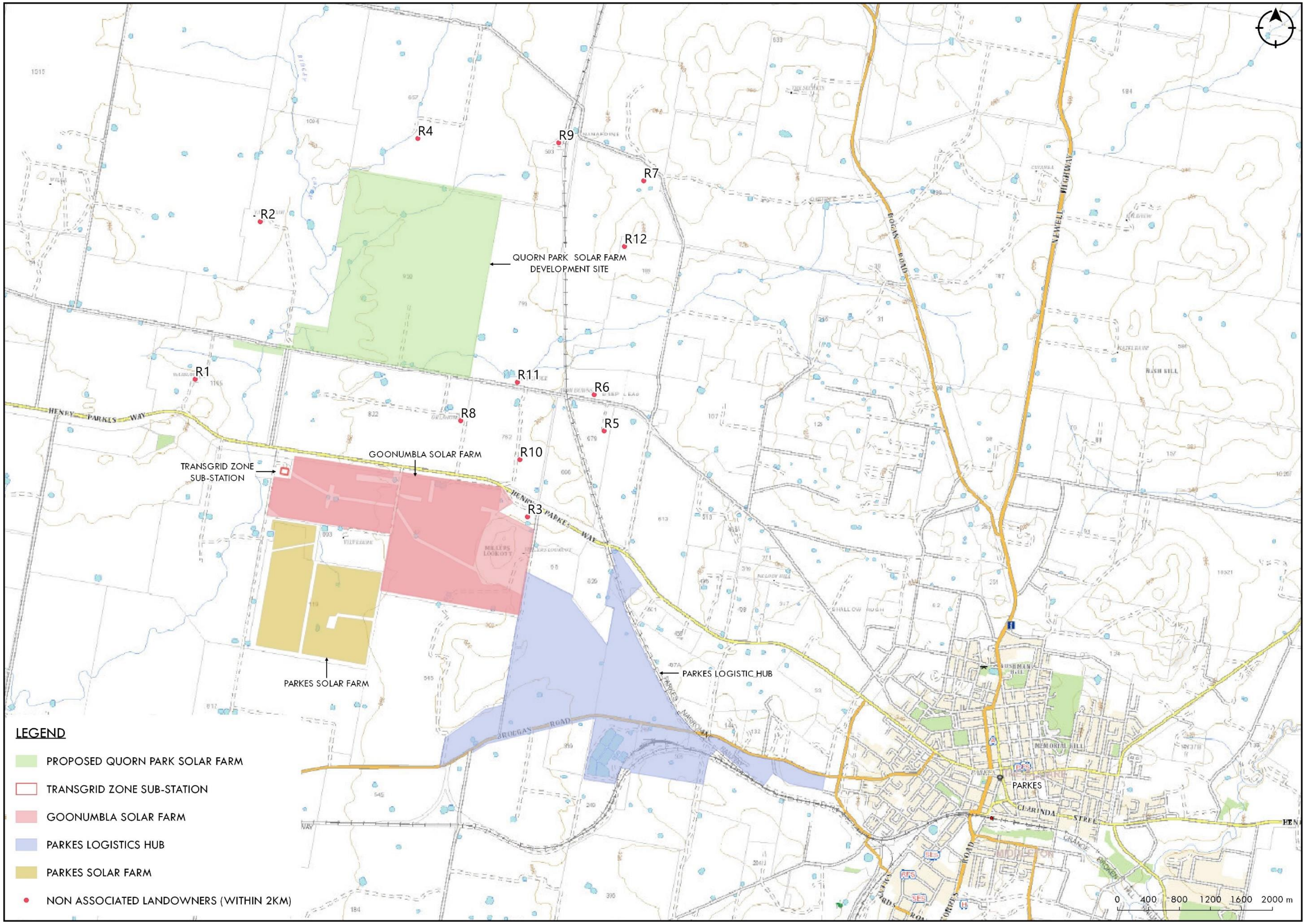

Figure 2: Development Locality

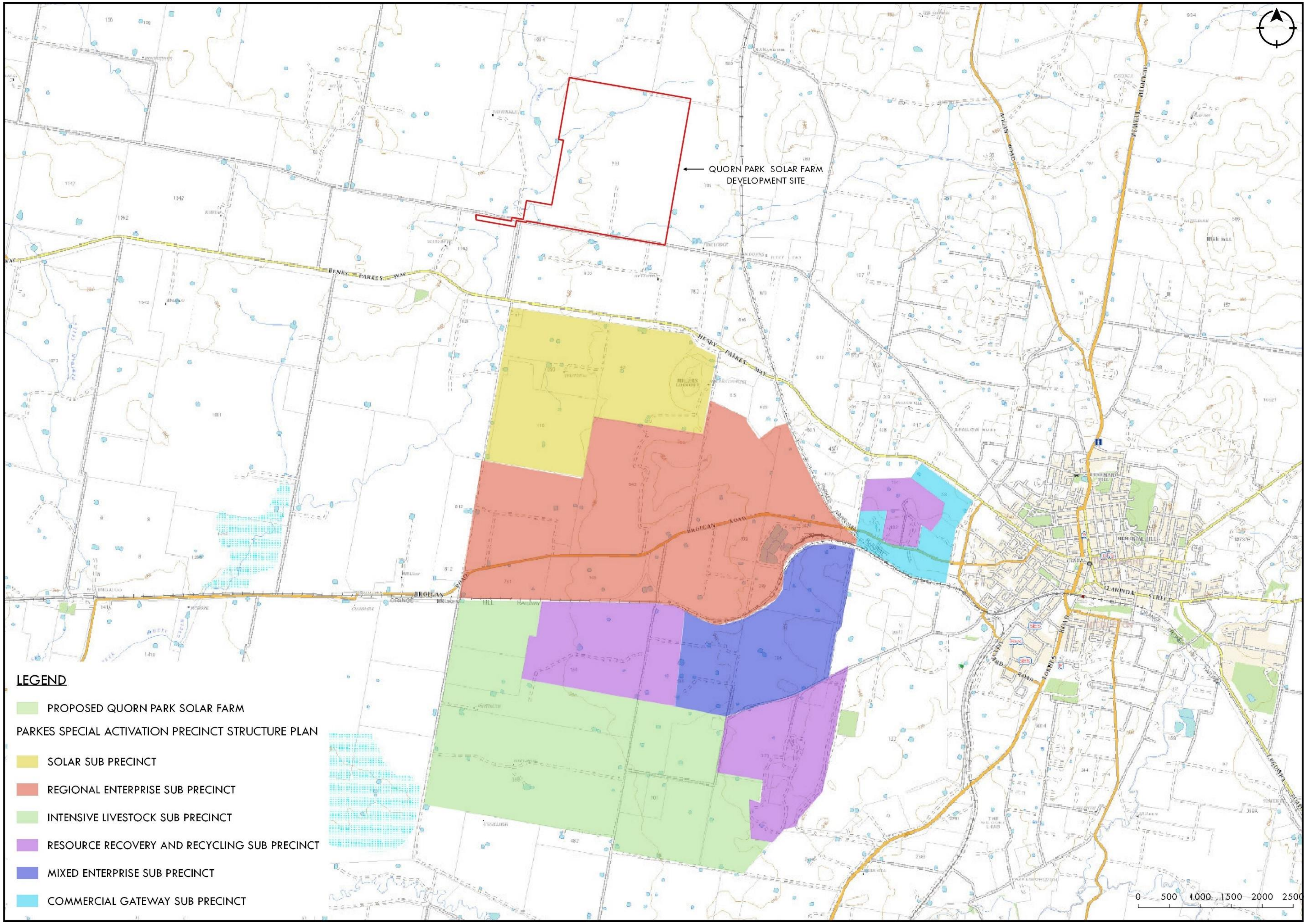

Figure 3: Parkes Special Activation Precinct Draft Structure Plan

The Development

2.1 DEVELOPMENT OBJECTIVE

The objective of the QPSF is to use solar PV modules to convert sunlight into carbon free electricity which will be sold in the National Electricity Market (NEM), create Large Generation Certificates (LGC's) which will be sold to liable entities under the *Renewable Energy Act 2000* and produce electricity that will contribute to the Federal Government's Renewable Energy Target (RET) of 33,000 gigawatt hours (GWh) by 2020.

2.1.1 FARM CAPACITY

The QPSF will have a capacity of 80 MW_{AC} and generate an estimated 200,000 megawatt hours (MWh) of electricity annually.

Census data on the number of households by Local Government Area (LGA) from 2016 reported a total of 6,737 occupied dwellings in the Parkes LGA, with an average household size of 2.4 persons. The Australian Energy Regulator (AER) provides electricity benchmarks and since December 2011, as part of the National Energy Retail Rules (NERR), energy retailers have been required to publish consumption benchmarks on a residential customer's bill.

In October 2017 the AER reported that average annual household electricity usage in Australia, in the climatic zone within which Parkes is located, for a three person household, is 8,497 kilowatt hours (kWh) (ACIL, 2017, updated June 2018). Based on the above, the energy generated from the QPSF will be sufficient to service approximately 23,500 homes annually during the life of the farm.

While the SEARs identified a farm capacity of up to 160 MW_{AC} following more detailed network analysis and discussions with the network operators it was determined that 80 MW_{AC} is an optimum size considering available network capacity and avoiding major network upgrades.

2.1.2 FARM DESIGN AND LAYOUT

2.1.2.1 Design Principles

The capacity and development footprint of the QPSF has been refined through consideration of site investigations, including the identification of constraints and opportunities mapped through the environmental impact assessment process as well as discussions with both TransGrid and Essential Energy about electricity transmission network connection capacity.

Following site inspections, the conduct of specialist surveys (including those for Aboriginal heritage and biodiversity values), and the results of noise impact assessment, physical and land use features within and around the development site and its environs were mapped. This mapping includes non-associated landowners within 2 km of the development site (refer **Figure 4**), recorded Aboriginal artefacts, native vegetation, drainage lines and watercourses, power transmission lines and public roads and Crown land (refer **Figure 5**). The host landowner is not resident on the property.

These environmental constraints have been used to delineate a ~400 ha development footprint within the development site based on avoidance and/or minimisation of significant impact (refer **Figure 6**). Specifically, the following considerations have informed the delineation of the development footprint.

- The constructed drainage channel passing through the north western corner of the site will be avoided. There are three reasons for this.
  - Since construction and discontinuing dryland farming in this corridor the vegetation has established as a native plant community type (PCT 437 Yellow-box derived native grassland) with ecological value.

  - Avoidance of this area provides the opportunity to avoid impacts to two Aboriginal artefact scatters.
  - Avoidance of this corridor (as well as the drainage line below the farm dam that is fed by it) will provide continuity of flow paths leaving the site
- A 40 m buffer from top of bank has been provided for the Strahler 1st order drainage line in the south east corner of the site, the Strahler 3rd order drainage line running along the southern boundary of the development site and in the south west corner of the site, and the Strahler 3rd order drainage line located in the north west corner of the site. There are two reasons for this.
  - Avoidance of this area provides the opportunity to avoid impacts to a third Aboriginal artefact scatter.
  - Provision of this buffer will avoid any disturbance to or impacts on drainage flow paths leaving the site.
- The planted vegetation along the southern boundary of the development site, extending west from the Quorn Park property access, provides both visual screening and constitutes a native plant community type (PCT 82 Western Grey Box planted woodland) with ecological value.
- The 132 kV overhead powerline that traverses the development site has a 45 m wide easement.
- The noise impact assessment determined that there are portions of the development site within which inverter stations and the battery storage system should not be located in order to protect acoustic amenity values for neighbours.

Identifying a proposed development footprint within the development site cognizant of these constraints/opportunities reflects a design approach based on minimising and avoiding significant impact. This development footprint will accommodate all infrastructure and facilities associated with the development, including the temporary construction compound and laydown areas.

The final layout of all infrastructure within the development footprint will be determined by the engineering contractor at detailed design stage. In addition to the constraints identified here, the final layout design will be optimised for sub surface ground conditions and equipment specification. This approach will allow for the optimal final design. For simplicity a zone has been identified within the development footprint within which the site substation will be located. The final design will be included in the construction certificate. For the purpose of impact assessment in this document, worst case scenarios are considered in each case for impact on receivers.

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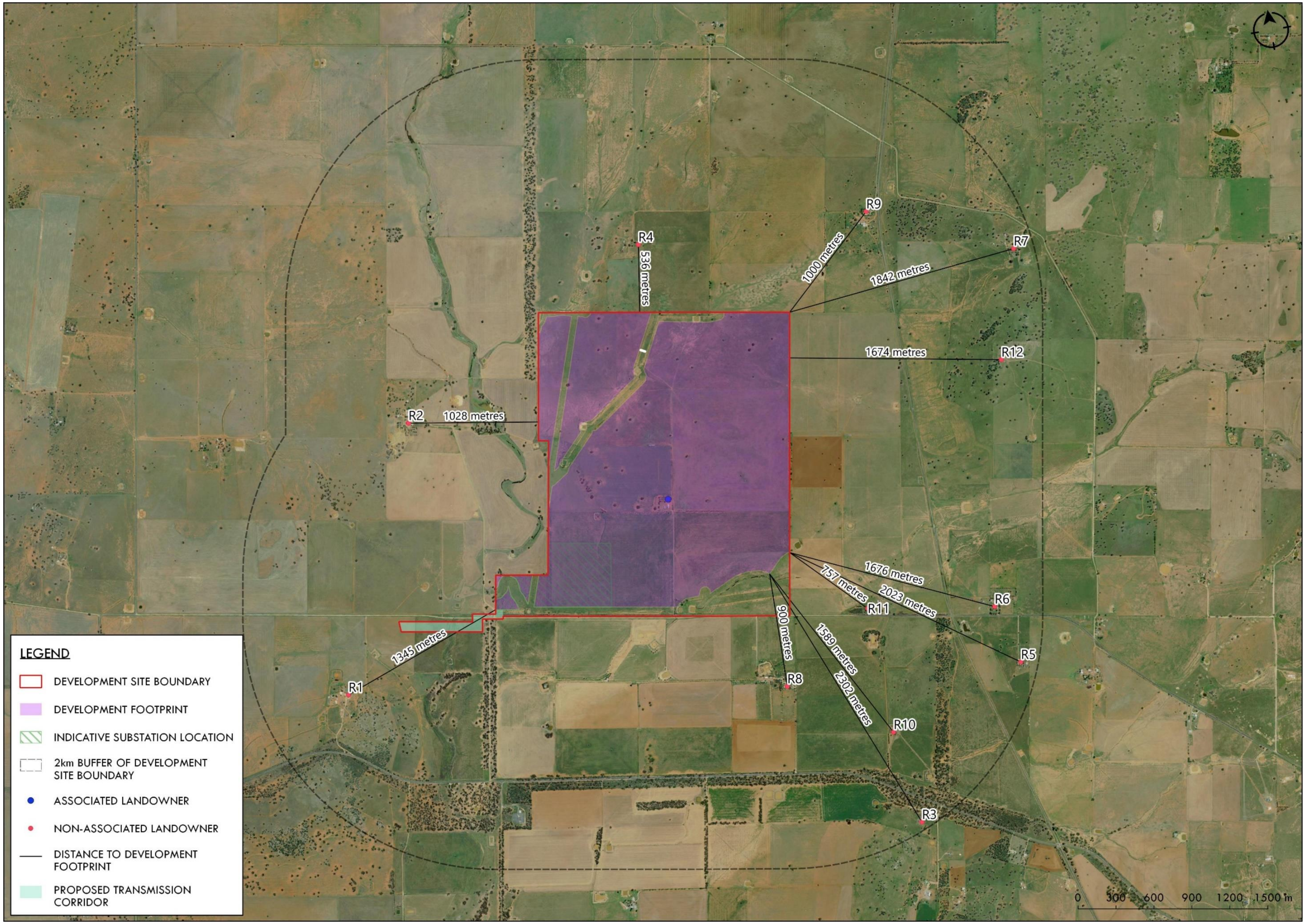

Figure 4: **Non Associated Landowners**

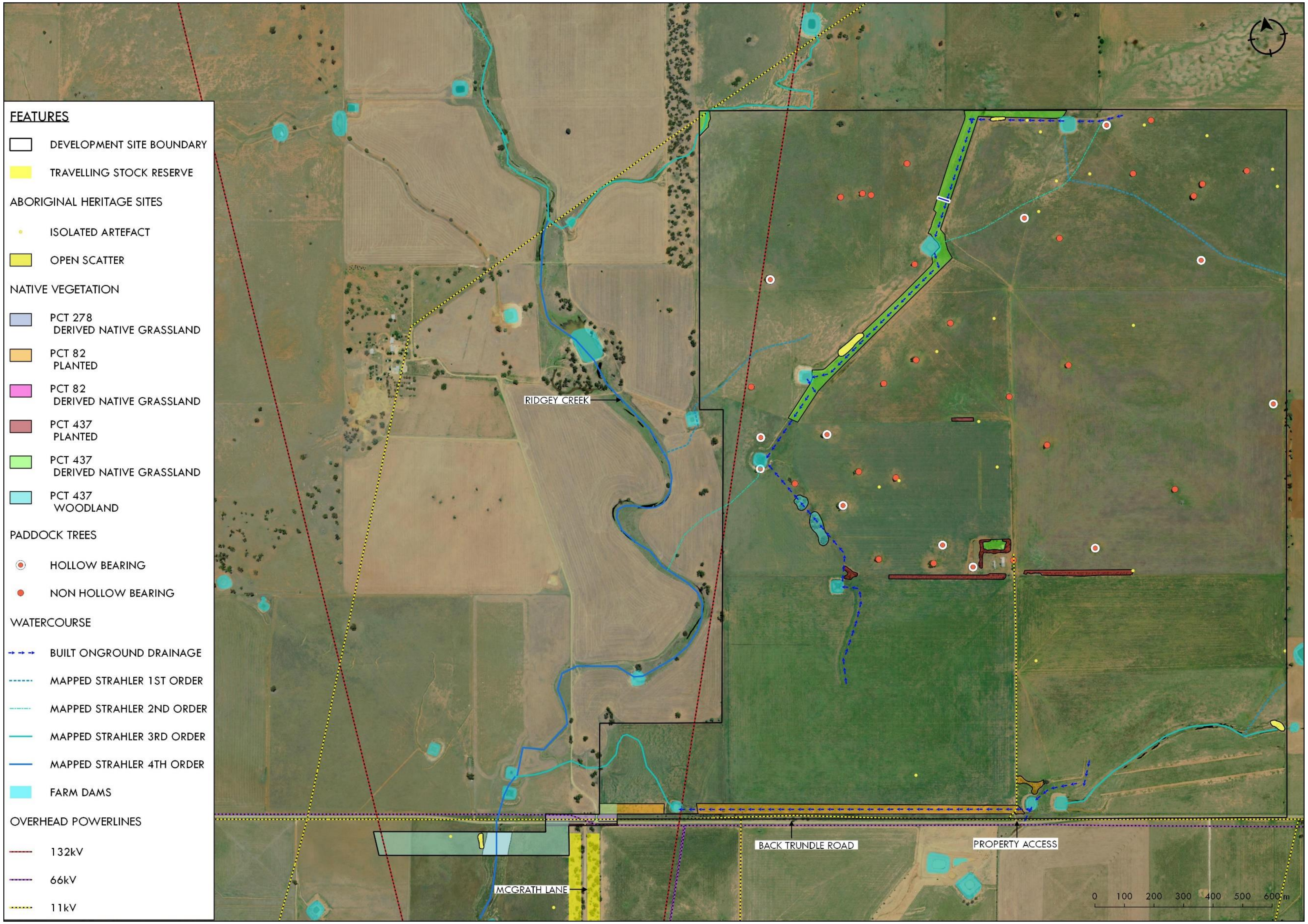

Figure 5: **Development Site Features**

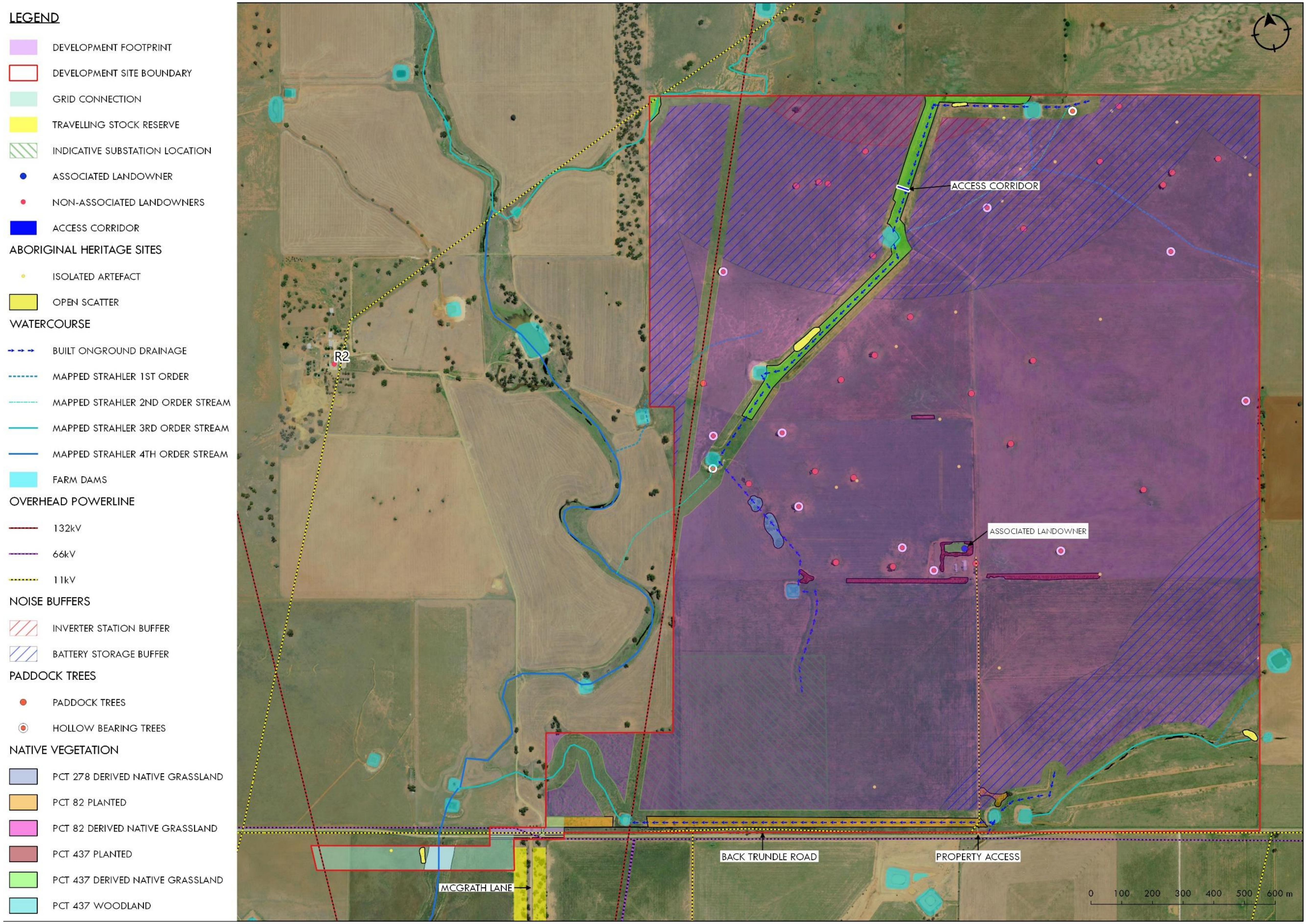

Figure 6: **Development footprint**

2.1.2.2 Electrical Generation Equipment

The solar PV module technology will be either crystalline silicone or thin film. The modules will be connected together via a DC collection system consisting of cables mounted on the module support structure. The racking system will either be fixed-tilt or a SAT or a combination of both.

Fixed tilt systems (refer **Figure 8**) hold the modules in a fixed orientation in relation to the sun and have no moving parts. A SAT system (refer **Figure 7**) tracks the daily movement of the sun and motorised linkages rotate the modules from the east in the morning to the west in the afternoon, constantly aligning towards the sun to maximise energy output performance.

Figure 7: Single Axis Tracking

Figure 8: Fixed Tilt

The modules will be laid out in rows or strings, with variable spacing depending on the technology used. The flatness of the QPSF site will lead to optimal spacing without output being affected by shading of adjacent strings. The choice of fixed tilt or SAT will determine the orientation of the strings, whether east-west (fixed) or north-south (SAT). The racking system will be supported by steel piles. These are hollow sections or I-sections which are typically driven into the ground.

The tracker technology has yet to be selected but is expected to be either single portrait or double portrait configuration. Assuming minimum 500 mm leading edge above ground level at full tilt, the height of the panels above ground level would be approximately 2.5 m and 4 m respectively. The tracker and panel configuration in turn determines spacings between the rows – with typical spacings of between 7-12 m.

Inverters will convert the DC current to AC current and medium voltage transformers will increase the voltage to the collection system rating. Inverter and transformer assemblies are mounted on a steel platform (skid) or slab at ground level and are generally covered with an all-weather kiosk (refer **Figure** 9).

Contingent on procurement, the QPSF will have 19 x 5 MW inverters located either side of a transformer. These inverters will be positioned within the array of modules with each power block of the solar farm corresponding to the capacity of the inverter assembly.

The AC collection system will consist of cabling at 22 kilovolt (kV) or 33 kV which connects to each inverter assembly and delivers the electricity to the site substation. Cables are laid underground and backfilled. Trench details are determined by local regulations and voltage specifications, but typically are approximately 1 m deep.

Figure 9: Typical Inverter Assemblies

2.1.2.3 Battery Storage

The development application for the QPSF seeks consent for an energy storage system (ESS) with a nominal 20 MW power rating and 20 MWhr energy capacity. No final determination has been made on the system that could be used. The ESS would consist of either banks of Lithium-ion batteries with associated ancillary inverter, transformer and air conditioning equipment (refer **Figure 10**) or containerised battery modules (refer **Figure 11**).

Either system would be set on concrete footings and be located at a single location within the farm; occupying a footprint of approximately 0.6 ha depending on the system selected.

Battery storage is likely to be added to the solar farm within the first five years of operations. Batteries are expected to become economically feasible over this timeframe due to lower costs, changing market rules and technology improvement. In the long term, storage is likely to be a requirement of the new generation system.

Figure 10: Tesla 40 MW Powerpack System

Figure 11: Containerised Battery Storage System

Battery storage adds benefits to solar generation because it allows for the despatch of energy according to market demand and can help overcome potential issues associated with intermittency of output.

2.1.2.4 Solar Farm Substation

The solar farm will include a 132/33 kV substation containing a transformer to increase voltage from 33kV to 132kV, medium voltage electrical switch gear and protection equipment contained within cabinets, as well as a landing structure for the 132kV overhead cables from the grid connection. The landing structure will be the termination point for overhead cables from the grid connection and is likely to be approximately 14m high subject to final engineering design. The equipment and structures will be installed on concrete foundations within a secure fenced compound with the substation yard kept free of vegetation. Security lighting is likely to be included on the structures. **Figure 12** provides an indicative view of the substation.

Figure 12: Indicative Substation

2.1.2.5 Grid Connection

Three grid connection options have been investigated and assessed by RED in consultation with TransGrid, Essential Energy and landowners. Each were evaluated against commercial, network capacity, environmental and land access considerations.

The proposed option involves a direct connection from the QPSF substation to the 132 kV Essential Energy owned overhead power lines approximately 700 m to the south west of the development site. While the exact works required to facilitate this connection will be finalised through detailed design and further consultations with Essential Energy and TransGrid, they will involve a new double circuit 132 kV transmission line (either overhead or underground) from Essential Energy's 132 kV transmission line to connect with the QPSF site substation. One circuit will be strung on each side of the new poles, if overhead. By this arrangement, the Essential Energy line will effectively be extended via a single circuit into the QPSF substation, connecting with the QPSF switch gear and back to its current alignment via the second circuit. Protection equipment and communications in TransGrid's Parkes Zone Substation may need to be upgraded.

2.1.2.6 Ancillary Infrastructure

A control room with a parking area will be located conveniently on the site. Staff will occupy the control room during commissioning in order to advance the farm to its operational readiness. Once the farm is operational, staff will occasionally occupy the control room as needed to monitor the performance of the farm and to diagnose any faults. From the control room there will be communications connections to the electricity market operator, TransGrid, and the operation's team.

2.1.3 FARM CONSTRUCTION

2.1.3.1 Development Program

Construction will include all pre-operation activities associated with the project other than survey, acquisitions, fencing, investigative drilling or excavation, or other preparatory activities that have minimal environmental impact such as site mobilisation, minor adjustments to services/utilities, establishing temporary construction sites or minor clearing.

Construction is estimated to take up to nine months (36 weeks) with the earliest date for commencement of construction the first quarter 2020.

2.1.3.2 Site Preparation

The site will require minimal preparation in advance of installing the PV modules as it is flat and largely devoid of vegetation. A site entrance will be opened on Back Trundle Road and site gates secured in position. Fencing will be upgraded or installed around the site perimeter. The site will be cleared of internal fences and timber and groundcover slashed as required. The Essential Energy 11 kV distribution line in the south of the site will be relocated/disconnected.

Site facilities and construction laydown areas will be established within the development footprint and construction vehicles and equipment will be mobilised to the site. The site access tracks will be staked and established through grading and compacting. Some tracks may require road base to create an all-weather surface, however extensive track construction is not planned. Tracks will be treated to create a durable, dust-minimising surface.

Contingent on the equipment to be installed and the construction methodology to be adopted by the EPC Contractor awarded the contract to build the QPSF, opportunistic soil conditioning and groundcover establishment works will also be undertaken at his stage. Specifically, recommendations of the soil survey undertaken (refer **Section 8**) as part of site investigations include:

- Application of lime to overcome acidity constraints, with the upper 15 cm of soil currently strongly acidic and limiting to plant growth. The application of lime will provide an enhanced capacity to establish and maintain groundcover. If possible, it is recommended to use non-inversion cultivation at a depth of 15 cm to thoroughly mix the lime with acidic topsoil, with additional 0-15 cm soil testing recommended to provide to inform lime application rates. It was concluded that there was no obvious need for deep ripping to improve plant root growth across the site.

- Establishment of a perennial pasture groundcover that includes a balanced mix of grasses, legumes and herbs.

In implementing the above recommendations, the EPC Contractor will need to time these works such that the benefits of doing them are not compromised as a result of subsequent impacts during construction. In particular, a balance will be required as to when to sow pasture that reflects requirements and limitations of:

- the prevailing seasonal conditions;
- sowing too early, with subsequent compaction impacts associated with certain construction tasks restricting successful pasture establishment; and
- sowing too late, with built solar farm infrastructure then limiting the ability to establish coverage around and under infrastructure.

2.1.3.3 Substation Construction & Grid Connection

The site substation will also be commenced at this phase. Civil works will be required to prepare the base including shallow excavations for slab foundations and provision for cable trenches. Concrete slab foundations will be poured and road base will be laid down to create an all-weather compound. Cables will be laid in trenches and installed through foundation cavities. The transformer, switch gear and protection equipment will be installed on the slab foundations. Cabling will be terminated onto the inverters. HV cables will be suspended or laid in a trench to connect the QPSF to Essentially Energy’s 132 kV feeder line.

2.1.3.4 Solar PV Modules

Following site preparation, the supporting structures and the solar modules will be installed. The site will be surveyed and locations of all the equipment will be pegged. Top soil will be left intact wherever possible.

The circular hollow sections or flanged sectioned steel piles which support the racking system will be driven into the ground pneumatically or alternatively holes will be bored and the piles will be grouted in position.

Piles may be cut off to height and the steel racking assembly will be attached according to the manufacturer’s proprietary system. The solar PV modules are then installed on the racking and secured in position to withstand wind loading. Once the modules have been installed the DC collection cables are laid on the structure and terminated to the modules. If a tracking system is being used, the rotating mechanism and server motors will be installed on the support structure.

2.1.3.5 Inverter Assemblies and Electrical Collection System

Once the PV modules have been installed cable trenches will be excavated and AC and DC cables will be laid. Trenches will be backfilled with excavated material and cables will be terminated to the modules. Foundations for the inverter assemblies will be constructed as either concrete slabs on the ground or piles. The inverter and transformer assemblies will be placed on the foundations and the cables will be terminated to them. Testing and quality assurance will be carried out as connections are made.

Once all the inverter assemblies and electrical collection system have been installed, commissioning of equipment can commence. Commissioning will include terminations, testing, calibration and troubleshooting. The inverters, transformers, collection system, solar PV array, substation and storage system will be tested prior to commencement of commercial operations to ensure any system issues are rectified. Commissioning will involve site crews as well as Essential Energy and TransGrid personnel. Upon completion of successful testing, the solar farm can be connected to the network and it will be ready to export electricity.

2.1.3.6 Battery Storage System

The battery storage civil works would involve similar earthmoving and lifting equipment as for the construction of the substation. These works would include preparing the site, removing and stockpiling top soil. Cable trenches would be dug to accommodate electrical cables and earthing mat. A sand bedding layer will be placed in the trenches and around the cables before backfilling. The concrete foundations would be formed and poured for the storage cells or containers. The perimeter fence would be erected around the storage compound if not included in the substation compound. Cables would be laid to connect the substation control room, the battery cells, the battery inverters and other ancillary equipment. Cables would also be laid or suspended to connect the battery inverters to the site substation. The battery cells or containers, transformers, air conditioning units, inverters and switch gear would be craned into position and secured on foundations. Cables would be terminated. A hardcore base may be laid around the foundations. Top soil would be distributed around the compound and reseeded. The units would then be energised and commissioned.

2.1.3.7 Site Restoration

During construction there will be additional infrastructure established including site offices and amenities, vehicle parking and turning areas, equipment laydown and storage areas, safety fencing, and temporary power. This infrastructure will be removed at completion of commissioning and disturbed ground made good through ripping and establishing a groundcover.

2.1.3.8 Materials and Resources

The following provides approximate quantities for materials and resources during the construction program.

Labour

Over the nine month construction effort the demand for labour will vary depending on the site activities being undertaken. Installation and commissioning of modules is labour intensive. Employment is expected to peak at approximately 100 on-site workers involved directly in project construction. This peak period is expected to extend over a six month (24 weeks) period. Outside this peak the workforce would drop to 50. These jobs will include construction managers, electricians, fitters, plant operators, mechanics and other skilled labour.

Water

Water demand during construction would be limited to that required for dust mitigation and/or moisture conditioning of material, as well as a potable supply for construction staff. The former will be sourced from a legal supply source, including farm dams on-site (if available) and/or commercial water suppliers.

There is no intent or need for any volumetric water licencing requirement. No water entitlement is needed or required to be purchased.

Consultation with PSC has confirmed an ability and willingness for PSC to provide a supply of non-potable water for dust suppression during construction. Estimating accurately the volume of water that will be needed during construction is not possible. The extent, frequency or duration in which climatic conditions determine the need for strategic watering is speculative. It is also noted that there are a suite of mitigation measures that can and would be employed to manage dust that do not involve watering. These include scheduling of particular works outside the summer period, limiting construction activity to localised areas across the site, and restricting vehicle movements and speeds during dry and windy conditions.

PSC has a supply of non-potable water available at the ‘brick pit’ (a large flooded abandoned brick pit with reliable recharge rates). In extended dry weather the water level can drop but available volume stays good. Consultation has confirmed that PSC is amenable to allowing access to this water for construction of the QPSF.

The quantity of water required for dust mitigation during construction can only be roughly estimated. Ultimately, it will be determined by the detailed design, the EPC contractor's approach to the construction program and the climatic conditions experienced at the time the works are undertaken. Assuming a maximum daily use, in excessively dry and windy conditions, would be 50 kL, and that these conditions are experienced 50% of the time during the five month construction peak, this equates to 3 ML. This requires approximately 112 x 27 kL bulk tankers. By reference to the traffic assessment and the 36 week construction program, of which 20 is peak construction, this equates to just over 5.5 trucks per week. This is approximately one per day and will be accommodated within the current maximum traffic movements of 60 light vehicles and 125 heavy vehicles. The source of the water is Parkes Shire Council.

Potable supply will be provided through bottled water.

Dry port-a-loos would be provided for amenities throughout construction minimising water demand and negating the need for on-site domestic sewage treatment.

Sand and Gravel

The construction of all-weather access tracks and compacted hardstand for the inverter assemblies and substation will require gravel, whilst sand will be required for the bedding of cabling in the trenches before backfilling. These materials will be sourced from local suppliers.

2.1.3.9 Hours of work

Site construction activities would be restricted to the Environment Protection Authority's (EPA) recommended standard hours for construction; being Monday to Friday 7.00 am – 6.00 pm; Saturday 8.00 am to 1.00 pm; and with no work on Sunday's or Public Holidays.

The construction noise impact assessment undertaken as part of this EIS (refer **Section 12**) concluded that there is the capacity to undertake construction activities outside standard construction hours in compliance with guideline limits and without compromising acoustic amenity values for all neighbours.

It is also noted that for construction outside standard hours the assessment criteria was determined based on the minimum allowable Rating Background Level (RBL) as provided in the *Noise Policy for Industry* (NPfI). That is, for the purposes of the assessment it was assumed that the RBL is 30 dB(A) for night periods thereby resulting in a noise affected limit of 35 dB(A) for construction outside standard hours. Notwithstanding, DPE has advised works outside of standard construction hours will not be approved as part of the DA however, the applicant will have the flexibility to extend hours following approval (if approved).

2.1.4 FARM OPERATION

2.1.4.1 Hours of Operation

Unless required for reasons of safety, all operational maintenance activities undertaken at the QPSF would be restricted to daytime hours as defined by the EPA's *Noise Policy for Industry*: these being the period from 7 am to 6 pm (Monday to Saturday) and 8.00 am to 6.00 pm (Sundays and Public Holidays).

2.1.4.2 Maintenance Activities

Following commissioning the QPSF will begin operating with the production of electricity for contribution to the electricity grid. The solar modules will operate during daylight hours, seven days per week, 365 days per year.

The farm will operate independently, and no permanent employees will be stationed on-site. The farm will be monitored remotely from an off-site location and apart from a routine maintenance program, operators will only visit the farm when responding to any performance issues (ie. where actual output measured by the monitoring system deviates from generation forecasts and other key performance metrics).

Activities at the farm that will be part of a routine maintenance program will generally be limited to:

- Equipment, cabling, substation and communications system inspection and maintenance.
- Fence, access road and control room management.
- Vegetation (fuel load), weed and pest management.
- Possible solar PV module washing on an as-needed basis (see below).
- Security monitoring.
- Communicating with customers, transmission and distribution network operators, Australian Energy Market Operator (AEMO), Parkes Shire Council, neighbours and other stakeholders.

The farm will generate 2-3 full time equivalent positions over the life of the development.

2.1.4.3 Solar PV Module Washing

The solar PV modules may be periodically washed to remove excess dirt, dust or other matter (i.e. bird droppings) which can prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output.

The frequency of any washing will depend on monitoring the actual performance of the farm. RED note that experience indicates washing may be limited to occasional events such as following severe dust storms and in many applications cleaning is not required at all due to the anti-static properties of the modules and normal precipitation.

If required washing will be carried out manually or mechanically. Clean water would be transported to site by a water trucks that would then be driven down the rows between the strings of modules and personnel or mechanical devices would use spray equipment to clean the surface of modules. Washing panels would not require any detergent or cleaning agent and, based on experience overseas the 80 MW_{AC} QPSF, with ~250,000 PV panels would require ~116 kL to wash.

Potable quality water would be purchased from PSC for this purpose.

2.1.4.4 Fuel Management

Fuel management will be a key ongoing activity targeting bushfire risk presentation (refer **Section 14**). Groundcover across the property will be proactively managed to avoid excessive fuel loads (which would also compromise the solar farm's performance) and prevent the proliferation of any noxious weeds.

2.1.5 FARM UPGRADING/RECOMMISSIONING

2.1.5.1 Recommissioning

The design life of the PV modules will be at least 30 years. At the end of their useful life modules and electrical equipment will be either replaced and the farm re-commissioned, or the farm will be decommissioned and the site returned to agricultural land use.

This will be a commercial decision based on the relative economics of solar PV generation compared to alternatives at the time. In all likelihood the economics will be favourable because the farm infrastructure, including network connection, underground cabling, foundations, control room and access tracks will continue to be serviceable and the cost of replacing modules and inverter assemblies favourable compared to competing generating technologies. Further, the technology available in 30 years' time is likely to have much higher efficiency factors than today's modules.

Recommissioning would involve removal of any obsolete equipment such as modules and inverters and disposing of these off-site according to good practice, including recycling wherever possible. The technology available at that time would be installed using the existing structures and infrastructure to the extent possible and the farm would be recommissioned.

2.1.5.2 Upgrades

Over time the owner of QPSF may upgrade the solar panels and ancillary infrastructure on site. In so doing, infrastructure would be contained within the approved development footprint and prior to undertaking any such upgrades the owner of QPSF would provide revised layout plans to the Department of Planning and Environment (DPE).

As advised by DPE, upgrading of panels would only require a modification application if it would change the development envelope of the project.

2.1.6 FARM DECOMMISSIONING

If the decision at the end of the design life is to decommission the farm the procedure would be to initially disconnect the solar farm from the network. The interconnecting cable and substation equipment would be removed and disposed of off-site, reusing and recycling materials wherever possible. Foundations would be broken up and removed off site. The substation compound fencing would be removed and area would be graded and seeded.

Modules and the racking system would be removed and it could be expected that a significant amount of the support structure could be reused or recycled off-site. Piles will be lifted out of the ground and recycled wherever possible. In general, cables are likely to be worth removing and recycling. However underground cables which are deeper than 800 mm below ground level may be left buried to avoid excessive ground disturbance. The site control room and facilities would be lifted off their foundations and transported off site on flatbed trucks. Finally, the surface of the site would be ripped and returned to agricultural use.

Detail on the baseline agronomic characteristics of the site and requisite performance indicators for establishing that the site has been rehabilitate fit-for-purpose is provided in **Section 9.5.**

Statutory Planning

3.1 DEVELOPMENT SITE

The development, inclusive of the grid connection would entail works and infrastructure located on lands as identified in **Table 3.1**.

Table 3.1 – Development Lots

Element	Lot/DP	Owner
Solar Farm	Lot 508 DP 750152	Rolinda Holdings Pty Ltd
Grid Connection	Lot 1 DP 1090411 Public Road (Back Trundle Road) Lot 1 DP 717829	SL McGrath Parkes Shire Council TransGrid

3.2 PERMISSIBILITY

The development site is located on land zoned RU1 – Primary Production under the *Parkes Local Environmental Plan 2012* (LEP). As a solar farm is not expressly listed as permitted with consent or without consent, it would be considered a prohibited land use under a strict reading of the LEP.

However, based on a broader reading of the LEP, and consideration of the objectives of the RU1 zone and other PSC documents, the DPE has previously satisfied itself that there is no clear intention to prevent the development of a solar farm on land zoned for Primary Production in the Parkes LGA. The basis for this position includes the following considerations.

Firstly, the Parkes LEP expressly references *State Environmental Planning Policy (Infrastructure) 2007* and acknowledges that electricity generating works and solar energy systems are regulated by the Infrastructure SEPP rather than the LEP. A solar farm is permitted with consent under the Infrastructure SEPP.

Secondly, a solar farm is not inconsistent with the objectives of the RU1 zoning, particularly in relation to:

- *encouraging diversity in primary production industries;*
- *permitting a range of activities that support the agricultural industries; and*
- *minimising fragmentation and alienation of resource lands.*

A solar farm encourages a new element of agricultural enterprise and diversity through the generation of solar energy, while maintaining the opportunity for an element of traditional agricultural land use through strategic grazing of the site to manage fuel loads. The QPSF would not fragment or alienate any resource lands during its operation as it will have no off-site impact that would compromise the use of neighboring lands for primary production purposes. Further, post-operation the site can be returned to agricultural land use in the future if the solar farm is decommissioned.

Thirdly, a solar farm contributes to some of PSC's broader goals around land use for the region. Specifically, the QPSF development would meet a key objective of the *Parkes Shire Land Use Strategy* (2012) for the RU1 Primary Production zone:

> *To provide for other types of development that are appropriate within a rural zone and that do not compromise the future productivity of the land, including …. Employment generating development that is well located within a rural area, for example solar power electricity farms.*

It is also noted that the proposed QPSF is consistent with the vision articulated in the *Central West and Orana Regional Plan 2036* (June 2017). This *Plan* identifies four key goals with 29 supporting directions to realize the vision for the region. Direction 9 in the first goal to become the most diverse regional economy in NSW is to increase renewable energy generation.

3.3 STATE SIGNIFICANT DEVELOPMENT

The QPSF is an electricity generating activity with a capital investment value of approximately $88.7 million. Accordingly, the development is classified as a State Significant Development (SSD) and pursuant to *State Environmental Planning Policy (State and Regional Development) 2011* the Minister for Planning is the consent authority.

3.4 STATE LEGISLATION

3.4.1 BIODIVERSITY CONSERVATION ACT 2016

In August 2017 the *Biodiversity Conservation Act 2016* (BC Act) commenced operation and changed the way impacts to biodiversity are assessed and offset in NSW, with offsetting required for any projects exceeding certain clearing thresholds outlined in the *Biodiversity Conservation Regulation 2017* (BC Regulation). The Secretary's Environmental Assessment Requirements (SEARs) state that the EIS require a biodiversity assessment under the BC Act, including preparation of a Biodiversity Development Assessment Report (BDAR) under the Biodiversity Assessment Method (BAM) unless it can be demonstrated that the QPSF will not have any significant impact on biodiversity values. As the project will impact on biodiversity values the BAM has been used to assess and offset impacts to biodiversity in accordance with the BC Act.

3.4.2 FISHERIES MANAGEMENT ACT 1994

The *Fisheries Management Act 1994* (FM Act) provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the Assessment of Significance process under Section 220ZZ of the FM Act.

Two key objectives of the FM Act are to conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications, the Department of Primary Industries (DPI) will assess the likelihood of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS). While a number of mapped watercourse identified as key fish habitat occur within the development site, none of these support key fish habitat or habitat for threatened species.

3.4.3 NATIONAL PARKS AND WILDLIFE ACT 1974

An Aboriginal Heritage Impact Permit (AHIP) under s.90 of the *National Parks and Wildlife Act 1974* is not required for SSD pursuant to s.4.41(1)(d) of the *Environmental Planning and Assessment Act 1979*. An assessment of impacts on Aboriginal heritage is provided in **Appendix D**.

3.4.4 WATER MANAGEMENT ACT 2000

A water use approval under s.89, a water management work approval under s. 90 or an activity approval under s.91 of the *Water Management Act 2000* is not required for SSD pursuant to s.4.41(1)(g) of the *Environmental Planning and Assessment Act 1979*. The development does not entail any aquifer interference activity.

3.4.5 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

The development is not a scheduled premise that requires licensing under s.48 of the *Protection of the Environment Operations Act 1997*.

3.4.6 ROADS ACT 1993

Improvements to the Henry Parkes Way and McGraths Lane intersection and the Quorn Park property access off Back Trundle Road will require a consent under s.138 of the *Roads Act 1993*. The relevant roads authority is Parkes Shire Council, noting that the concurrence of Roads and Maritime Services is required in relation to any works occurring on a classified road (Henry Parkes Way).

3.4.7 CROWN LANDS ACT 1989

The development does not require works on Crown Land.

3.4.8 ABORIGINAL LAND RIGHTS ACT 1983

Land subject to an Aboriginal Land Claim (ALC 14792) is located on Lot 7300 DP 1135641. The development does not entail works in this land. McGraths Lane bisects this lot and is a 20 m wide Parkes Shire Council public road, in use, and excluded from Lot 7300.

3.4.9 BIOSECURITY ACT 2015

The *Biosecurity Act* has superseded the *Noxious Weeds Act 1993*, which is now been repealed. The primary object of the *Biosecurity Act* is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. The *Biosecurity Act* stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and
- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

3.5 STATE PLANNING POLICIES

3.5.1 SEPP 55 - REMEDIATION OF LAND

A review of the EPA Contaminated Land Record under s.58 of the *Contaminated Land Management Act 1997* and the List of NSW contaminated sites notified to EPA under s.60 of the Act does not identify any registered contaminated sites at or near the development site. Nor is the development site located on land upon which development referred to in Table 1 of the *Managing Land Contamination Planning Guidelines SEPP 55 – Remediation of Land*, is being or is known to have been carried out. Pursuant to Clause 7 of *State Environmental Planning Policy No 55 – Remediation of Land* there is no apparent reason to consider that land on the development site would be contaminated.

3.5.2 SEPP - RURAL LANDS 2008

Pursuant to this Policy the QPSF does not:

- compromise the orderly and economic use and development of rural lands for rural and related purposes,
- compromise the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State,
- increase land use conflicts, or
- impact on listed State significant agricultural land.

3.5.3 SEPP 44 - KOALA HABITAT PROTECTION

The aim of the *State Environmental Planning Policy 44 – Koala Habitat Protection* to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 1 of SEPP 44. The development site is located in the Parkes LGA, which is listed in Schedule 1, therefore Koala habitat has been considered within this assessment.

Two Koala feed tree species, as defined within Schedule 1 of the SEPP, were identified within the development site; Poplar Box and White Box. These trees species comprise considerably less than 15% of the tree species within the development site and are restricted to planted wind rows. The planted trees are small in size and within discrete isolated patches of vegetation with no landscape connectivity to any areas of known Koala habitat. Scat surveys (SAT tests) in more optimal areas of habitat outside of the development site did not reveal any evidence of Koala and the species is not anticipated to occur within the vicinity. The vegetation within the development site is not considered potential Koala habitat as defined under SEPP 44.

3.5.4 SEPP 33 – HAZARDOUS AND OFFENSIVE DEVELOPMENT

The proposed QPSF does not pose a significant risk in relation to the locality to human health, life or property, or to the biophysical environment. It is not a potentially hazardous industry (refer **Section .14**). The QPSF would not emit a polluting discharge which would have a significant adverse impact in the locality or on the existing or likely future development on other land. The proposed QPSF is neither a hazardous nor offensive industry.

3.6 COMMONWEALTH LEGISLATION

3.6.1 ENVIRONMENT PROTECTION BIODIVERSITY CONSERVATION ACT 1999

The development does not involve any actions that would have a significant impact on any matters of National Environmental Significance (NES). The development will have no impact on any World Heritage properties, National heritage places, Ramsar wetlands, threatened species and ecological communities, migratory species, a Commonwealth marine area or the Great Barrier Reef Marine Park. The development is not a nuclear action, coal seam gas development or large coal mine. Referral under the Commonwealth's *Environment Protection Biodiversity Conservation Act 1999* is not required.

3.6.2 RENEWABLE ENERGY ACT 2000

The *Renewable Energy Act 2000* establishes solar as an eligible energy source under the Commonwealth's RET. Creating LGC's from the QPSF, which can then be sold to liable entities, is subject to the approval of the Clean Energy Regulator pursuant to the *Renewable Energy Act 2000.*

Consultation

4.1 INTRODUCTION

The approach to the consultation undertaken as part of this EIS has been to target stakeholders that have a potential to be impacted by the development. This has included all neighbours within 2 km of the development site boundary and representatives of the Aboriginal community.

4.2 NEIGHBOURS

4.2.1 CONSULTATION LETTER

In January 2018 Renewable Energy Developments (RED) wrote to all non associated landowners within 2 km of the development site. The letter outlined the scale and location of the proposed solar farm, why it had been identified as suitable for a solar farm and the anticipated timeline for approvals. The letter emphasised that community engagement was important to RED and that as the proponent, RED wanted to make sure neighbours were provided with accurate and up to date information about the project and the approval processes involved. RED confirmed it would welcome feedback, value local knowledge and extended an offer to meet, if the landowner would like, to discuss any aspect of the development. Contact details were provided and the invitation included the offer to meet at a time and location that was convenient to the landowner.

A second letter was sent to these landowners in September 2018. This letter provided an update on the progress of the project, indicating that site investigations and the various environmental surveys were progressing well with no significant constraints as yet identified. The letter confirmed that the impact assessment process was on schedule and again extended an invitation to meet to discuss the development.

No landowner provided a written response or contacted RED in response to this approach.

4.2.2 DISCUSSIONS & MEETINGS

Complementing the above RED contacted and met with interested landowners to discuss the development. These discussions occurred over the phone as well as meeting most neighbours at their properties. Of the 12 neighbours within 2 km of the development site RED has had discussions with all 11 who have residences north of Henry Parkes Way. The twelfth (R3), located south of Henry Parkes Way, cannot see the site.

Five (5) of the neighbours indicated to RED that they had no issues or concerns with the proposed solar farm. For the others a number of issues were raised and discussed. These issues included:

- loss of agricultural land;
- visual impact;
- construction traffic;
- contaminants in the waterways from runoff;
- fires causing airborne contaminants;
- local heating of the environment and impact on cattle;
- end of life disposal of panels; and
- impacts on property value.

In response to the above RED has made the following commitments as part of the proposed development, and note the following.

- Construction traffic will access/egress the site west of the Quorn Park property access of Back Trundle Road, via McGraths Lane and Henry Parkes Way. In so doing, this does not put construction traffic onto Back Trundle Road east of the property access - where the landowner who raised construction traffic as an issue resides.
- Post construction of the solar farm and with the opportunity to see what the solar farm looks like from their properties, RED will negotiate in good faith to establish landscape screen plantings on the properties of the two landowners who expressed an interest in this opportunity.

4.3 MINERALS LICENCE HOLDERS

Two exploration leases (EL) cover the development site – refer **Figure 13** (**page 2**).

As outlined in **Section 9.2,** consultation with potentially affected minerals exploration licence holders was completed. No written response was received from other licence holder.

4.4 ABORIGINAL COMMUNITY

The four step process of consultation with Aboriginal stakeholders was undertaken in accordance the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCRP 2010)* as part of the Aboriginal Cultural Heritage Assessment (ACHA): a full copy of which is provided in **Appendix D**.

Consultation Step 1 – Notification

Notification letters were sent to the relevant bodies/agencies requesting details of any parties with a known interest, or who hold knowledge related to the development area. Notification was undertaken via the placement of a newspaper notice in the Parkes Advocate. Following receipt of a list of potential Aboriginal stakeholders from the OEH, notification letters were also sent to these organisations and individuals. Notification resulted in three groups or individuals registered to be consulted as RAPs (Peak Hill Local Aboriginal Land Council, Rob Clegg and the Binjang Wellington Wiradjuri Aboriginal Corporation).

Consultation Step 2 Information to Respondents

An information document was forwarded to these respondents. The document provided details of the project and the proposed heritage assessment methodology and invited comments from the interested parties. The document also sought any information regarding known Aboriginal cultural significance values associated with the development area. No comments were provided by the RAPs on the proposed survey methodology nor were any cultural values regarding the development site and its surrounds provided.

Consultation Step 3 Information Gathering

An archaeological survey was then undertaken involving the RAP representatives.

Consultation Step 4 Review

The draft report Aboriginal Cultural Heritage Assessment Report (ACHAR) was then provided to the RAPs for comment before finalising.

4.5 ABORIGINAL LAND COUNCIL

Searches of the Register of Aboriginal Land Claims database (the Register) indicates that land in proximity to the development are affected by Aboriginal Land Claims pursuant to the *Aboriginal Land Rights Act 1983*.

Table 4.1 – Aboriginal Land Claims

ALC	Lot/Deposited Plan	Comment
14019 19643	Lot 7002 DP 94814	Located on the southern side of Henry Parkes Way, to the west of the TransGrid zone substation. The land is a reserve (Travelling Stock Reserve) within the meaning of Part 5 of the *Crown Lands Act 1989*. It is noted that this parcel already contains two easements for transmission lines. One for TransGrid (Government Gazettal March 2015) and the second, issued in October 2017, for Parks Solar Farm Pty Ltd.
14792	Lot 7300 DP 1135641	Located on either side of McGraths Lane.

The proposed development does not entail impacts on these lands.

4.6 PARKES SHIRE COUNCIL

RED met with Parkes Shire Council to brief them on the proposed project after receipt of the SEAR. It was noted that the project is a state significant development and therefore PSC is not the consent authority. The environmental assessment activities were explained, as was the approach being taken to community consultation through neighbour engagement. Access for construction vehicles was discussed in the context of development of the transport Hub. Investment in the region, employment opportunities and the benefits of local generation were also discussed. Council was supportive of the project because of these benefits to the region.

4.7 NETWORK OWNERS

RED has continued to consult with TransGrid and Essential Energy about the network connection options.

Trans Grid's 132 kV Parkes substation is located on a strong part of the HV transmission network and has significant capacity to accommodate new generation. TransGrid recently published information on the capacity to connect at various substations on their network. They identified Parkes as one of eight opportunities. At 132 kV, TransGrid forecasts 260 MW-390 MW capacity to connect. At 66 kV, TransGrid forecasts 140 MW capacity to connect.

The QPSF has been sized to take advantage of available capacity at 132 kV. Network analysis takes into account the Parkes Solar Farm and Goonumbla Solar Farm also in the region. Network studies are currently underway to design the connection and to identify the technical requirements for the operation of the farm. These studies may have some impact on the final capacity of the QPSF. However RED expects these studies will conclude that 80 MW_{AC} is capable of being connected

A number of grid connection options have been investigated and assessed by RED in consultation with TransGrid, Essential Energy and landowners. Each were evaluated against commercial, network capacity, environmental and land access considerations.

The proposed option involves a direct connection from the QPSF substation to the 132 kV Essential Energy owned overhead power line approximately 700 m to the south west of the development site. While the exact works required to facilitate this connection will be finalised through detailed design and further consultations with Essential Energy and TransGrid, they will involve a new double circuit 132 kV transmission line (either overhead or underground) from the QPSF site substation to connect with Essential Energy's 132 kV transmission line. Protection equipment and communications in TransGrid's Parkes Zone Substation may need to be upgraded.

Environmental Issues

5.1 PRELIMINARY RISK ASSESSMENT

The process of identifying key environmental issues associated with the construction and operation of the QPSF has evolved over a period of 12 months. The objective has been to accurately identify and map features of the development site and its surrounds that could represent a design constraint and to inform the impact assessment methodologies.

The process commenced with a preliminary desktop risk assessment that identified the likely planning and environmental issues associated with the development. A number of site inspections were then completed to ground truth the bio-physical data sourced from the desktop assessment and inspect the features in and around the development site.

In February 2018 a formal request for SEAR was prepared and lodged with the DPE.

5.2 SECRETARY'S REQUIREMENTS

The SEAR were subsequently issued on the March 2018 and identified the following as the key specific issues that must be addressed in the EIS.

- Biodiversity
- Aboriginal heritage
- Land Use
- Visual
- Noise
- Transport
- Water
- Hazards and Risks
- Socio-Economic

A copy of the SEAR is provided in **Appendix A**.

Biodiversity

6.1 INTRODUCTION

A Biodiversity Development Assessment Report (BDAR) was undertaken as part of this EIS: a full copy of which is provided in **Appendix C1**. Provided below is a summary of the assessment findings.

The 'development site' as referred to within the BDAR and in this section is the potential disturbance footprint of the solar array areas and associated infrastructure. It is the development footprint and represents a worst-case scenario; noting, that the actual impact footprint is likely to be somewhat smaller than assessed. The development footprint will allow flexibility for the final design of the solar arrays. It is not yet known if the grid connection will involve a narrow trench in the case of underground cables, or pole and wire placement, with impact footprint largely restricted to 200 m spaced poles. To ensure that a sufficient impact area has assessed a clearance of a 5 m wide corridor was assumed for the transmission line; again, representing a worst case scenario.

The 'study area' as referred to within the BDAR and in this section includes the entire area surveyed at commencement of the project; inclusive of the three grid connections originally considered.

For the avoidance of doubt, the property access would require minor upgrades to accommodate the largest design vehicle. The areas impacted would be limited to highly disturbed exotic grassland, dominated by wild oats and vervain. No existing trees would be impacted by these works. EMM confirm that the proposed upgrades to the solar farm entry point will have negligible biodiversity impact given that a small area of exotic grassland will be affected (**Appendix C2**).

6.2 LANDSCAPE FEATURES

6.2.1 BIOREGIONS AND LANDSCAPES

The development site occurs within the NSW South Western Slopes IBRA Bioregion and the Lower Slopes IBRA subregion. A total of two BioNet NSW Landscapes (formerly Mitchell Landscapes) intersect with the development site:

- Goonumbla Hills; and
- Bimbi Plains.

Goonumbla Hills occupies the majority of the site at 69 %. Bimbi Plains also occurs within the south-west of the development site, occupying 31%. For the purposes of the BAM assessment, the Goonumbla Hills BioNet NSW Landscape was selected, given it occupies the largest area of the development site.

6.2.2 WATERWAYS AND WETLANDS

The development site is part of the Lachlan catchment. The Lachlan catchment covers an area of approximately 84,700 km^2. The Lachlan River rises near Gunning and terminates in the great Cumbung Swamp near Oxley, 1450 river kilometres to the west (DPI 2018).

A total of four second order watercourses and one third order watercourse are mapped within the study area. These are no longer discernible at ground level, due to current and historical land use and damming of the watercourses both within and outside of the study area. These mapped watercourses are vegetated by terrestrial species and no longer provide any aquatic habitat. One fourth order watercourse, Ridgey Creek, intersects the grid connection alignment. At the point of the intersection Ridgey Creek has poorly defined channel, largely limited to a sedge and grass dominated swale.

No wetlands occur within or close to the study area, with the closest important wetland listed on the Directory of Important Wetlands in Australia (DIWA) the Lake Cowal/Wilbertroy Wetland, over 80 km to the south-east.

6.2.3 CONNECTIVITY

The study area exists within a cleared landscape dominated by agricultural land and does not include any biodiversity corridors mapped by local council or the NSW Office of Environment and Heritage (OEH).

Two connectivity corridors were identified in the field which are likely to provide some landscape connectivity. The north western corner of the solar farm area is adjacent to a woodland corridor approximately 90 m in width, extending for 2.6 km. Habitat is largely limited the corridor itself, with no further connectivity beyond.

Habitat connectivity features within the study area are largely limited to rows of planted vegetation which are not connected to any other areas of treed habitat. The development will not significantly impact any of the identified corridors. Aside from vegetated corridors, there is a lack of significant geological features, such as ridgelines, valleys and large watercourses that may be used as flight corridors for migratory species across the development site.

6.2.4 GEOLOGICAL FEATURES

The development site does not contain karst, caves, crevices, cliffs or other areas of geological significance. Similarly, there are no soil hazard features that occur within the development site or buffer area.

6.2.5 OUTSTANDING BIODIVERSITY VALUE

There are no areas of outstanding biodiversity value, as declared by the Minister, within the development site or study area.

6.3 NATIVE VEGETATION

6.3.1 DESCRIPTION

The majority of the development site is used for cropping, with clear evidence of sustained management including ploughing and planting of crops. Native vegetation is highly modified by both historical and ongoing management practices including clearance of the original vegetation, cropping, addition of fertilisers, ploughing and weed invasion. No vegetation within the development site is considered intact, given that each vegetation zone has at least one of its strata removed or highly modified.

Native remnant canopy vegetation is limited to paddock trees and small patches of woodland with an entirely cleared midstorey. Several discrete areas of derived grassland remain, where the ground cover is predominantly native; however, midstorey and canopy species have been removed.

Planted native wind breaks are present, with a mixture of canopy and midstorey species that do not reflect any Plant Community Types (PCT). In these areas, the groundcover is a mixture of exotic grasses and forbs. Exotic vegetation within the development site includes cropping and occasional planted exotic trees.

6.3.2 PLANT COMMUNITY TYPES

The ecological surveys identified the presence of three PCTs within the development site. The location of these are shown on **Figure 5**. The PCT, vegetation formation and vegetation class (Keith 2004) are described in **Table 6.1** below.

In addition to the three PCTs identified within the development site, dams and cropping and exotic vegetation were also identified.

Table 6.1 – Plant Community Types

Plant Community Type	Formation	Class	Area (ha)
82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy woodland	Floodplain transition woodland	0.33
278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Grassy woodland	Western slopes grassy woodlands	0.04
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Grassy woodland	Western slopes grassy woodlands	2.96

6.3.3 VEGETATION ZONES

Each of the PCTs identified within the development site was stratified into vegetation zones based on broad condition state and allocated a condition class. This process identified six vegetation zones as identified in **Table 6.2**.

Table 6.2 – Vegetation Zones

Zone	Plant Community Type	Code	Area (ha)
1	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Derived shrubland	0.10
2	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Planted	0.22
3	278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Derived native grassland	0.04
4	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Derived native grassland	0.67
5	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Woodland	0.58
6	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Planted	1.71

In addition to the PCTs identified, areas dominated by exotic vegetation were also present, including cropping, and exotic trees.

6.3.4 PADDOCK TREES

A total of 37 paddock trees were assessed, comprising three different species. Yellow Box was the most frequently recorded (25), followed by Kurrajong (7) and Grey Box (5). Twelve of these are hollow beraring. All paddock trees were assigned to PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion, based on their landscape position and the dominance of Yellow Box. The location of these paddock trees is identified in **Figure 5**.

6.4 THREATENED SPECIES

6.4.1 FAUNA HABITAT ASSESSMENT

Concurrent with the vegetation mapping, a habitat assessment was undertaken seeking to identify the following fauna habitat features within the development site:

- habitat trees including large hollow-bearing trees;
- availability of flowering shrubs and feed tree species;
- waterway condition;
- quantity of ground litter and logs; and
- searches for indirect evidence of fauna.

This habitat assessment identified that the majority of the development site is highly disturbed, only supporting fauna species which are able to persist in highly modified agricultural landscapes.

The grassland and cropped areas have low habitat value, primarily providing foraging habitat for seed eating and insectivorous birds including Red-rumped Parrot (*Psephotus haematonotus*), Australasian Pipit (*Anthus novaeseelandiae*) and the exotic European Starling (*Sturnus vulgaris*). A single native mammal species was observed, the Eastern Grey Kangaroo (*Macropus giganteus*), which is able to persist in open areas and cross fence lines. The European Hare (*Lepus europaeus*) was also moderately abundant.

Habitat resources within remnant woodland areas of the development site (PCT 437_woodland) are largely limited to the trees themselves, given the absence of any midstorey species and lack of functional leaf litter. Some woody debris was present; however, the lack of any other supporting habitat features, such as dense tussock grasses and shrub means that the understorey habitat is considered very poor and unlikely to support many species except those most disturbance tolerant.

Scattered trees within the development site provide similar fauna habitat to the remnant woodland; however, the scattered trees tended to be larger and therefore likely to have a higher nectar yield for nectivorous birds. Bird surveys conducted during Yellow Box flowering recorded few species however, and it is likely that the large gaps between the trees (low density) increase foraging energy expenditure, reducing the viability of the foraging resource.

Planted native woodland provides different habitat features compared to remnant woodland. Trees were a mix of species occurring as dense and somewhat stunted low woodland. No hollows were present and nectar production is likely to be low given the small size of the trees. Despite a lack of fallen timber; shelter and structural complexity of the habitat was higher than other habitats due to the presence of some planted midstorey species and reduced spacing between trees. Most of the planted areas were also fenced, leading to a more structurally complex groundcover.

Several small farm dams exist within the development site however the habitat quality is considered low considering the eroded banks and the absence of submerged, emergent and marginal aquatic vegetation.

The majority of the mapped lower order (Strahler first and second order) streams within the development site have been so extensively modified by the construction of dams and retention banks that no channel or surface water is now evident. These watercourses are considered defunct from a fauna habitat perspective. One fourth order watercourse, Ridgey Creek, intersects the grid connection alignment.

At the point of the intersection Ridgey Creek has poorly defined channel, largely limited to a sedge and grass dominated swale. This area is does not have any capability to support fish species given the lack of permanent water, a defined channel or the presence of any pools. There is potential that the habitat may support frogs, including the threatened Sloane's Froglet (*Crinia sloanii*), given that it has the ability to breed in small areas of ephemeral habitat.

6.4.2 SPECIES ASSESSMENT

Targeted surveys were undertaken for the following species.

- *Austrostipa metatoris;*
- *Pine Donkey Orchid;*
- *Silky Swainson-pea;*
- *Koala;*
- *Squirrel Glider;*
- *Superb Parrot (breeding)*
- *Gang-gang Cockatoo (breeding);*
- *Major Mitchell's Cockatoo (breeding); and*

A survey was not undertaken for the Sloane’s Froglet as this species is most detectable during July and August. The species was assumed present in areas of suitable habitat.

No threatened species were recorded within the development site opportunistically or during targeted surveys.

6.5 IMPACTS

This section identifies the potential impacts of the development 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 RED to design a development that further avoids, minimises and mitigates impacts.

6.5.1 POTENTIAL DIRECT, INDIRECT AND PRESCRIBED IMPACTS

The main direct impacts of projects are generally associated with direct impacts arising from the clearing of native vegetation communities and loss of species habitat and associated indirect impacts. Potential direct impacts that could arise from the project, prior to any avoidance, minimisation or mitigation, include:

- clearing of native vegetation and threatened species habitat; and
- disturbance of watercourse beds and banks during trenching or for access requirements.

Unmitigated, the project has the potential to result in minor indirect or minor prescribed impacts. Prescribed impacts that could occur as a result of project include:

- fauna vehicle strike from construction traffic;
- impacts to surface water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses;
- impacts to groundwater water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses; and
- fragmentation of habitats and associated impacts to connectivity and fauna movement.

Unmitigated indirect impacts that could occur as a result of the project include:

- increased noise, vibration and dust levels;
- artificial lighting impacting nocturnal species behaviour; and
- increase in weeds and pathogens.

Increased vehicle movements associated with the project have the potential to result in increased fauna vehicle strikes and associated fauna mortality. The risk of significant impacts is considered very minor given the lack of threatened fauna recorded and the low general fauna abundance. Mitigation measures will reduce this risk.

Construction activities that take place in the vicinity of watercourses have the potential to impact on aquatic ecology by the release of sediment-laden water that could arise on-site following mobilisation of soils/sediments. 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. Most mapped watercourses within the development site no longer have any discernible channel and have no surface water present for the majority of the time, due to extensive damming and diversion with contour banks. Any original riparian vegetation is also non-existent, having been historically cleared.

One ephemeral watercourse within the development site, Ridgey Creek, has the potential to provide habitat for the Sloane's Froglet. Ridgey Creek may require a single trench to bisect it if underground transmission lines are utilised.

The project does not require large inputs or storage of chemicals/liquids which pose a risk to groundwater contamination. Potential impacts are limited to low volume sources such as fuel and oil from construction equipment. Appropriate procedures will be included in the construction environmental management plan (CEMP) to reduce the chance of any spill occurring and minimise potential impacts if they were to occur.

The project is not likely to impact groundwater during construction, operation and decommissioning due to the limited amount of surface disturbance activities required during the installation and decommissioning of project infrastructure.

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 vegetation clearance on fragmentation is anticipated to be negligible, given that no significant fauna movement corridors currently exist within the development site, which is a result of high levels of existing fragmentation and small patch sizes.

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. No threatened species are anticipated to rely on any of the habitats currently present and no sensitive receptors have been identified.

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. Mitigation measures will manage this potential impact.

Infection of native plants by Phytophthora cinnamomi is listed as a key threatening process under the BC Act and EPBC Act. *P.cinnamomi* 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 *P.cinnamomi* can lead to:

- 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. cinnamomi is known to occur within the region, however it is less common than east of the range and it remains unknown if it currently exists within the development site. No tree dieback has been recorded within the development site.

6.5.2 MEASURES TO AVOID, MINIMISE AND MITIGATE IMPACTS

Significant steps have been taken 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; and
- consultation between the design team and project ecologists to consider direct and indirect impacts and work through an iterative design process, with multiple iterations to identify a development footprint to achieve a feasible project with least biodiversity impact.

The original study area included the entire 470 ha Quorn Park property as well three grid connection options for which a biodiversity constraints assessment was completed, including vegetation mapping, habitat mapping and BAM plots. The detailed vegetation plots provided an estimate of the vegetation integrity score, which was used to assess the quality of vegetation present, in addition to the habitat-based assessment for threatened species.

Two of the grid connection options contain PCT 82 in a remnant woodland form which has the highest likelihood of providing habitat for threatened species (through targeted surveys did not detect any). These areas also had the highest vegetation integrity score. These two connection alignments were subsequently dropped and the grid connection alignment proposed substantially reduced the amount of clearance to these TECs.

Additional avoidance through design was also undertaken in the solar farm area. Clearance of PCT 82_planted was largely avoided by retaining the windrow parallel to Back Trundle Road. A swale also exists within the solar farm area containing PCT 437 derived native grassland, which is a *Biodiversity Conservation Act 2016* listed TEC and a candidate for serious and irreversible impacts (SII). This has largely been avoided by the development site.

Avoidance of the highest value vegetation has resulted in the residual impact being reduced significantly, however some residual impact remains. Avoidance of all native vegetation within the central portion of the solar array would result in significant disruption to the layout of modules. To retain trees it would require significant buffers of around 10 times their height in order to avoid shading on the modules. The costs associated with additional structures, cabling, roads etc and suboptimal operating performance due to the buffers would be a significant impact on the financial viability of the project. The buffers would also have to be managed to keep grass down, potentially requiring more fencing.

6.5.3 IMPACTS REQUIRING OFFSETS

Worst case impacts to native vegetation requiring offsets include:

- 0.10 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion derived shrubland;
- 0.22 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion planted;
- 0.04 ha of PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion;
- 0.67 ha of PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland;
- 0.58 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland;
- 1.71 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion planted; and
- direct impacts to up to 37 paddock trees assigned to 437-Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion.

Based on the above, a total of 88 ecosystem credits would be required to offset the residual impacts of the development. One threatened species, Sloane's Froglet was assumed present within PCT 278 derived native grassland. The area impacted is 0.04 ha. The species has a biodiversity risk rating of 1.5 and it generated 1 species credit.

It is noted however that detailed design has yet to be undertaken and could result in less impact (definitely not more) than that assumed for the biodiversity assessment. In this scenario a commensurate reduction in offset credits would result.

Offsets will be provided in accordance with the biodiversity offset framework and the *Biodiversity Conservation Act 2016*.

6.6 CONCLUSION

The development site is situated in a heavily cleared agricultural landscape dominated by cropped areas and exotic pasture and native pasture. Woodland areas within the development site are fragmented and highly disturbed.

Measures to avoid and minimise impacts to vegetation were considered during the initial design stages of the project, resulting in avoidance of significant biodiversity values and minimisation of impacts on other areas of native vegetation. Particular efforts were made to avoid those woodland areas with larger patch size and greater connectivity to other areas of habitat outside of the development site.

Based on both habitat assessments and field surveys, the development site has low importance for threatened flora or fauna species. Targeted surveys did not detect any threatened species. One species, Sloane's Froglet was assumed present as targeted surveys could not be conducted owing to seasonal constraints. This generated a single species credit.

White Box Yellow Box Blakely's Red Gum Woodland was recorded within the development site with the total area impacted, reduced to 1.29 ha through avoidance. The vegetation was highly degraded and of low quality with its loss unlikely to cause serious and irreversible impacts to the TEC given the low magnitude of impact and its poor quality.

Heritage

7.1 ABORIGINAL HERITAGE

7.1.1 ABORIGINAL CULTURAL HERITAGE ASSESSMENT

An Aboriginal Cultural Heritage Assessment (ACHA) was undertaken as part of this EIS: a full copy of which is provided in **Appendix D**. The purpose of the study was to identify and assess heritage constraints and to manage/mitigate potential impacts relevant to the proposed development consistent with the legislative requirements and the SEARs. The study area for the ACHA is approximately 486 ha, taking account of the 470 ha Quorn Park site, together with an area of approximately 16 ha, being the land assessed in relation to the alignment of the proposed ETL, noting that not all of this 16 ha would be impacted by the alignment. The alignment is subject to detailed design by reference to mapped and known constraints. A full assessment over all potentially affected areas ensures a robust assessment.

7.1.2 ASSESSMENT APPROACH

The assessment followed the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010). Field assessment and reporting followed the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011). The Aboriginal cultural values assessment followed the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs; DECCW 2010b).

7.1.3 STAKEHOLDER CONSULTATION

A four step process of consultation with Aboriginal stakeholders was undertaken in accordance the OEH *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs; DECCW 2010b).

Consultation Step 1 – Notification

Notification letters were sent to the relevant bodies/agencies requesting details of any parties with a known interest, or who hold knowledge related to the development area. Notification was undertaken via the placement of a newspaper notice in the Parkes Advocate. Following receipt of a list of potential Aboriginal stakeholders from the OEH, notification letters were also sent to these organisations and individuals. Notification resulted in three groups or individuals registered to be consulted as Registered Aboriginal Parties (RAPs) (Peak Hill Local Aboriginal Land Council, Rob Clegg and the Binjang Wellington Wiradjuri Aboriginal Corporation).

Consultation Step 2 Information to Respondents

An information document was forwarded to these respondents. The document provided details of the project and the proposed heritage assessment methodology and invited comments from the interested parties. The document also sought any information regarding known Aboriginal cultural significance values associated with the development area. No comments were provided by the RAPs on the proposed survey methodology nor were any cultural values regarding the development site and its surrounds provided.

Consultation Step 3 Information Gathering

An archaeological survey was then undertaken involving the RAP representatives.

Consultation Step 4 Review

The draft ACHA was then provided to the RAPs for comment before finalising.

7.1.4 ABORIGINAL HERITAGE SITES

A total of 27 Aboriginal sites were recorded during the field survey. These included 23 isolated finds and four artefact scatters of flakes and cores. The location of these recorded sites is shown on **Figure 5**. All of the recorded sites have been assessed as having low scientific significance. This is because the sites are low density artefact scatters or isolated finds located in landforms which have been highly disturbed and where further subsurface archaeological deposits are unlikely. In some instances, the assessment of low scientific significance is because the recorded sites are well-represented within the region and are unlikely to yield further scientific data.

7.1.5 ASSESSMENT OF SIGNIFICANCE

Scientific, cultural and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

7.1.5.1 Social or Cultural Value

The assessment of cultural or social value concerns the importance of a site or features to the relevant cultural group – in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

No feedback was received relating to the social or cultural value of the recorded sites from the RAPs. As such, for the purposes of assessing the potential impact to Aboriginal cultural heritage, all recorded sites have been accorded high social and cultural values.

7.1.5.2 Archaeological/scientific value

The scientific significance of all recorded sites is assessed as low as all sites represent artefacts in secondary contexts. These sites are described as having low scientific/archaeological significance based on the following factors: low density of artefacts; few formal tool types; widespread past and current erosion creating landform modification; and not possible to determine the original or primary context of the recorded artefacts.

7.1.5.3 Aesthetic value

All recorded sites have been assessed as having low aesthetic value. None of the Aboriginal sites recorded have significant aesthetic value as the integrity of the sensory landscape has been altered in historic and modern times. Additionally, the artefacts themselves are generally not remarkable.

7.1.5.4 Historic value

None of the Aboriginal sites recorded have an apparent direct relationship to known historical Aboriginal sites (such as missions or massacre sites). It is possible that the area saw some of the earliest contact between Aboriginals and non-Aboriginal settlers, however, none of the recorded Aboriginal sites display evidence that they constitute ‘contact’ or ‘post-contact’ Aboriginal sites. To that end, all recorded sites are assessed as having no historic value.

7.1.5.5 Overall Value

A series of guidelines have been developed by the Department of Planning and Environment to quantify and standardise impact assessments (DP&E 2016). All impacts are graded within a matrix and each heritage item assessed to arrive at a standardised 'value of impact'. For the proposed QPSF development all 27 recorded sites have been given the highest cultural value, and low scientific, aesthetic and historic values. It is recognised that even isolated, displaced artefacts can have value to the Aboriginal community. The intention of the guidelines is not to dismiss the cultural attachment the local community may have to the artefacts recorded here, but to try to quantify the overall value of the heritage impact. This value tries to establish the heritage impact in a regional context and so a value of 'low' should be read as meaning that the impact, at a broader level, will have a low value impact on the area's Aboriginal cultural heritage values. The proposed QPSF has been evaluated as having a low value heritage impact.

For those sites that can not be avoided, salvage and relocation has been recommended on the basis that:

- The cultural value of these sites and their importance to the Aboriginal community;
- The nature of the potentially impacted sites (all are isolated finds or a low density artefact scatters consisting of less than 10 artefacts per site);
- Being generally located in landforms of lower archaeological potential (i.e. in areas distant to reliable water);
- Being generally located in landforms with high previous disturbance from a range of factors including erosion and land use practices;
- The low archaeological values assigned to the sites preclude more intensive archaeological investigations; and
- Sites such as these have a very limited ability to further inform the community about the history and culture of the area.

7.1.6 MITIGATION MEASURES

7.1.6.1 Avoidance of Impact

A number of the recorded sites will not be impacted. Specifically:

- All three of the recorded artefact scatters on the QPSF site (OS1 – OS3) are located in areas that will be avoided due to ecological constraints; and
- 2 of the 23 isolated artefacts (Warrawee IF1 and Ponderosa IF1) are located in grid connection alignments that are no longer under consideration and will not be impacted.

As detailed design progresses those sites that will not be impacted by construction or operation of the solar farm will be identified and protected from inadvertent impact avoidance of more recorded sites may be possible.

7.1.6.2 Statement of Commitments

- An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared in consultation with the RAPs. The ACHMP will include the protocols for surface artefact salvage and site protection.
- Recorded sites that could be impacted during construction/operation would be salvaged under the methodology set out in **Section 7.1.6.2.**
- Sites that are able to be avoided will be clearly identified in the field and shown on plans to avoid inadvertent impacts.
- If further Aboriginal objects or human skeletal remains are noted during works the Chance Finds Protocol presented in **Section 7.1.6.3** will be followed.

7.1.6.3 Surface Artefact Collection

Stone artefact sites managed under the archaeological salvage will have surface artefacts mapped, catalogued, selectively photographed, collected and moved to safe-keeping.

The surface artefact collection will include the following methodology.

- All visible artefacts at a site should be flagged in the field;
- The site should be photographed after flagging and before recording;
- All artefacts should have the following artefact information recorded - location; artefact class; artefact type; size; reduction level; raw material;
- A selection of indicative and / or unusual artefacts from each site will be photographed;
- Once all recording is complete, the artefacts will be collected according to site with artefacts from each site being kept separate;
- The recording of the artefacts recovered will largely be completed in the field and this data would be incorporated into a report; and
- The salvaged artefacts should be reburied at an agreed upon location. This will take place in accordance with Requirement 26 “Stone artefact deposition and storage” in the *Code of Practice*. The location chosen for reburial will be an area where future developments will not occur and as close as possible to their original location. A site card will be submitted to Aboriginal Heritage Information Management System (AHIMS) to record the relocation area.

7.1.6.4 Chance Finds Protocol

The below is the protocol to be followed in the event that previously unrecorded or unanticipated Aboriginal object(s) are encountered.

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:

a. Not further harm the object;
b. Immediately cease all work at the particular location;
c. Secure the area so as to avoid further harm to the Aboriginal object;
d. Notify OEH as soon as practical on 131 555, providing any details of the Aboriginal object and its location; and
e. Not recommence any work at the particular location unless authorised in writing by OEH.

2. In the event that Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and OEH contacted.

3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:

a. The recording and assessment of the find(s);
b. The fulfilment of any legal constraints arising from the find(s), including complying with OEH directions; and

c. The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).

d. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from OEH.

7.2 HISTORIC HERITAGE

7.2.1 HISTORIC HERITAGE ASSESSMENT

A historic heritage assessment was undertaken as part of this EIS: a full copy of which is provided in **Appendix D**. The assessment followed the *Historical Archaeology Code of Practice* (Historical Code of Practice; Heritage Council 2006), the *Archaeological Assessments Guidelines* (Heritage Division 1996), and *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Division 2009).

7.2.2 RESULTS

A desktop search was conducted on the following databases to identify any previously recorded heritage items or places within the development site:

- National and Commonwealth Heritage Listings
- State Heritage Register (SHR)
- State Heritage Inventory (SHI)
- Parkes Local Environmental Plan 2012

No places or sites are listed in any of these databases within the development site.

Three sites were identified during the survey (weatherboard house, car bodies and a glass bottle). An assessment of these items was undertaken in accordance with the NSW Heritage Office guidelines and the Burra Charter (Australia ICOMOS 2013) and determined they have no heritage significance.

7.2.3 MITIGATION MEASURE

The protocol below would be followed in the event that previously unrecorded or unanticipated historic object(s) are encountered:

1. All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.

    a) The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted; and
    b) The site supervisor will be informed of the find(s).

2. If finds are suspected to be human skeletal remains, then NSW Police must be contacted as a matter of priority.

3. If there is substantial doubt regarding the historic significance for the finds, then gain a qualified opinion from an archaeologist as soon as possible. This can circumvent proceeding further along the protocol for items which turn out not to be significant. If a quick opinion cannot be gained, or the identification is that the item is likely to be significant, then proceed to the next step.

4. Immediately notify OEH (Heritage Division) at 131 555 of the discovery:

5. Facilitate, in co-operation with the appropriate authorities:

    a) The recording and assessment of the finds;
    b) Fulfilling any legal constraints arising from the find(s). This will include complying with OEH directions; and
    c) The development and conduct of appropriate management strategies. Strategies will depend on consultation with stakeholders and the assessment of the significance of the find(s).

6. Where the find(s) are determined to be significant historic items, any re-commencement of construction related ground surface disturbance may only resume in the area of the find(s) following compliance with any consequential legal requirements and gaining written approval from OEH.

Soil Resource

8.1 INTRODUCTION

A soil survey was carried out over the development site in September 2018 by Soil Management Designs. A full copy of this report is provided in **Appendix E**.

The aims of the assessment were to:

- Determine whether the soils are sodic and assess the risk of water erosion, particularly tunnel erosion, during and after installation of the solar panels and associated infrastructure.
- If the soils were found to be sodic, provide recommendations about gypsum (calcium sulphate) and lime (calcium carbonate) application to improve soil drainage when wet and reduce excessive hardness when dry.
- Identify any soil nutrient problems that exist so that suitable fertiliser can be added to improve pasture growth.
- Provide an overview of soil constraints relevant to construction of the solar farm (eg. shrink-swell potential and subsoil salinity).
- Identify the agricultural value of the site.
- Assess likely impacts of the solar farm on the soil resource and specify mitigation measures for minimising these impacts.

8.2 SITE DESCRIPTION

The majority of the site is gently sloping with a westerly aspect (slope <1.5%). It is underlain by colluvium/alluvium derived from mafic Ordovician parent material (Yarrimbah Formation; Raymond et al. 2000). Windblown dust also is likely to have been involved as a soil-forming material. The south-flowing creeks are tributaries of Goobang Creek, which joins the Lachlan River near Condobolin.

Land use at the study site in August 2018 was dryland cropping (barley and canola).

A search of the NSW Government's 'eSPADE' website (part of the NSW Natural Resource Atlas) was conducted to identify any existing soil profile information. There are no eSPADE soil profiles located in the area of interest. According to King (1998) the soil landscape unit at Quorn Park is Brolgan Plain, derived from Quaternary alluvium.

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) includes mapping of lands identified as BSAL. NSW Government BSAL mapping indicated that none of the site is BSAL (NSW Planning & Infrastructure, 2013).

8.3 SURVEY METHODOLOGY

8.3.1 FIELD WORK

The soil survey included an assessment of five detailed soil pit profiles dug with a backhoe (approximately 1.2 m deep). The field description methods were as described in the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009) and the *Guidelines for Surveying Soil and Land Resources, Chapter 29* (McKenzie et al., 2008). The soil profiles have been classified according to the Australian Soil Classification (Isbell, 2002).

The 1.2 m deep pit profiles were trimmed with a geological pick to allow high-resolution photography (4MB SLR images) and description of the undisturbed structure and root growth.

The following characteristics were assessed for the layers identified in each of the soil profiles:

- thickness of each layer (horizon);
- soil moisture status at the time of sampling;
- pH (using Raupach test kit);
- colour of moistened soil (using Munsell reference colours) and mottle characteristics;
- pedality of the soil aggregates;
- amount and type of coarse fragments (gravel, rock, manganese oxide nodules);
- texture (proportions of sand, silt and clay), estimated by hand;
- presence/absence of free lime and gypsum;
- root frequency; and
- dispersibility and the degree of slaking in deionised water (after 10 minutes).

The soil structure information was summarised to give SOILpak 'compaction severity' scores (McKenzie, 2001). The score is on a scale of 0.0 to 2.0, with a score of 0.0 indicating very poor structure for crop root growth and water entry/storage.

8.3.2 LABORATORY TESTING

All of the soil pits were sampled for laboratory analysis. The sampling intervals for laboratory analysis were as per the BSAL 'Interim Protocol' (NSW Government, 2013). The soil was analysed for exchangeable cations, pH, electrical conductivity, chlorides, topsoil nutrient status (nitrate-nitrogen, phosphorus, sulphur, zinc, copper, boron) and organic carbon content.

8.4 SURVEY RESULTS

8.4.1 SOIL TYPES

The Australian Soil Classification (ASC) (Isbell, 2002) was used to determine soil types at each of the five sampling sites. A single soil landscape unit covers the entire study area. It consists of a mosaic of the following soil types (Isbell, 2002):

- Chromosols, which have a strong texture contrast between the A and B horizons; the B horizon is non-sodic with a neutral to alkaline pH.
- Dermosols, which have a lack of strong texture contrast between topsoil and well structured subsoil.

8.4.2 CONSIDERATIONS

8.4.2.1 Water and Wind Erosion

Water erosion is unlikely to be a serious issue provided that a protective organic groundcover is maintained. It is recommended that perennial pasture be used. The stable subsoil conditions (as indicated by favourable dispersion and exchangeable sodium data) mean that tunnel erosion is very unlikely to occur.

8.4.2.2 pH and Nutrients

The main soil-related limitation to crop and pasture production is soil acidity. Lime (calcium carbonate) application will overcome this constraint. This is not an essential pre-requisite for management of the solar farm. However, there is an opportunity to do something as part of the solar farm development that would provide a net soil health benefit. Because soil ameliorants will be difficult to apply once the solar farm infrastructure has been built, it is recommended that lime be applied prior to solar panel installation, to provide both short-term and long-term soil health benefits beneath perennial pasture.

Subsoil pH is close to ideal for growth of a broad range of pasture and crop species.

8.4.2.3 Compaction

There was no obvious need for deep ripping to improve plant root growth across the study area.

8.4.2.4 Site Drainage and Trafficability

The favourable soil profile drainage characteristics in the upper half-metre of soil at the sites inspected indicates that the soil is unlikely to become badly boggy and impassable in wet weather.

8.4.2.5 Shrink-swell Capacity

There was no evidence of extreme shrink-swell characteristics in any of the subsoils. However, the low topsoil CEC values (a measure of shrink-swell potential as the soil is dried and re-wet) indicate a slow natural repair process following soil compaction damage.

8.4.2.6 Salinity

Salinity was not evident at any of the five sampling sites.

8.4.3 AGRICULTURAL VALUE

It is evident from the Land and Soil Capability (LSC) (NSW OEH 2012), Agricultural Land Classification (Hulme et al. 2002) and BSAL (NSW Government 2013) assessments that Quorn Park is high quality agricultural land.

Subsoil conditions for plant growth are particularly favourable because of unimpeded drainage (except at Pit 2), excellent capacity to store water and a near-ideal pH. However, the upper 15 cm of soil is strongly acidic and limiting to plant growth.

8.5 MITIGATION MEASURES

8.5.1 PRIOR TO CONSTRUCTION

- Application of lime (calcium carbonate; $CaCO_3$) will overcome acidity constraints. This will provide an enhanced capacity to establish and maintain groundcover. If possible, use non-inversion cultivation at a depth of 15 cm (around the contours if possible) to thoroughly mix the lime with acidic topsoil. Additional 0-15 cm soil testing is recommended to provide a detailed map showing lime application rates.
- Establish and maintain perennial pasture that provides 100% groundcover, even under very dry conditions. Aim for a pasture that includes a balanced mix of grasses, legumes and herbs. The presence of concentrations of plant available phosphorus in the topsoil means that improved pasture with introduced pasture species will be preferable to less productive native pasture species. Establishment of the pasture prior to installation will assist minimise that risk of soil erosion associated with construction soil surface disturbance.
- The soil is well supplied with phosphorus and nitrogen, but gypsum (calcium sulphate; $CaSO_4$) application is recommended to overcome sulphur deficiency.

8.5.2 DURING CONSTRUCTION

- Where possible, restrict traffic to clearly defined tracks, rather than having random unguided traffic creating compaction over a large proportion of the site.
- Minimise serious compaction by restricting construction activities during wet weather.
- Where deep trenching occurs for cable installation, aim to refill the trenches with subsoil first then topsoil.

8.5.3 DURING OPERATIONS

- Triennial topsoil testing is recommended to fine-tune the management of soil pH, nutrition and structure under the pasture, and to demonstrate progress with soil health over time.
- Although fire hazards need to be minimised, it is desirable that 100% groundcover be maintained through conservative sheep grazing practices (or slashing) so that erosion risk is minimised. The use of pasture species that create food/seed for burrow-creating soil fauna (eg. ants) will provide extra vertical bio-pores that will assist with water entry and subsoil aeration.
- The pasture beneath and near solar panels should only be grazed when the soil is dry and firm enough to avoid compaction via sheep trampling.

8.5.4 DURING DECOMMISSIONING

- Compaction from vehicles associated with solar panel dismantling and removal (and from traffic associated with the operational phase) would have to be removed via non-inversion chisel ploughing.

8.6 CONCLUSION

The anticipated improvement in soil assessment and management following conversion of the land use to solar power generation almost certainly will lead to an improvement in soil conditions for plant growth. The roots and fungi associated with diverse and vigorous pasture assist with soil aggregation and carbon sequestration. The creation of baseline soil data will also allow improvements in soil fertility to be demonstrated in later years.

Single axis tracking allows light beneath solar panels to be distributed across the surface of the ground. As the tracking technology rotates from east in the morning to west in the evening it moves a band of sunlight from west to east across the entire surface area of the site. On a cloudless day all of the pasture would receive at least some direct sunlight for photosynthesis. At other times of the day there would also be a significant amount of reflected sunlight at ground level.

There are benefits to the soil and pasture from the shading of the solar panels. Near-surface soil daytime temperatures will be reduced in summer, which is likely to create the following benefits:

- less water loss via evaporation; and
- a reduction in soil carbon loss (the rate at which soil organic matter decomposes and releases CO_2 declines as soil temperature is lowered).

In years with favourable soil moisture conditions in Spring, the shading from panels may slow down plant growth, relative to unshaded pasture. However, the stored soil water not used at that time would allow pasture to continue to grow strongly in early summer when the soil usually is too dry for optimal plant growth.

Consequently, night time rainfall on tilted ‘parked’ panels would produce runoff from the panels that will create plumes of water that penetrate quickly and deeply into the soil; analogous to soil water entry via drip irrigation lines. The end result would be more efficient water entry and better rainfall storage efficiency. Near-surface soil moisture often is lost via evaporation. Deeply penetrating plumes of rain water from the panel drip lines would be utilized efficiently by pasture plant roots, and there would be stimulation of earthworms and other beneficial soil organisms. Deep water movement and the creation of vertical worm channels will promote root growth into the deep subsoil, where the potential for carbon sequestration is greater than near the surface because of lower soil temperatures and slower decomposition rates for deposited organic matter.

With the principal land use and economic return being generation of solar power, there is more flexibility to achieve a grazing regime that protects groundcover and the soil resource.

Land Use

9.1 LAND USE

The development site and surrounding land is zoned RU1 – Primary Production. Under the provisions of the *Parkes Local Environmental Plan 2012* the objectives of this zoning 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.*
- *To encourage eco-tourism enterprises that minimise any adverse effect on primary industry production.*
- *To permit non-agricultural uses that support the primary production purposes of the zone.*
- *To permit small scale rural tourism uses associated with primary production and environmental conservation with minimal impact on primary production and the scenic amenity of the area.*
- *To encourage the provision of tourist accommodation in association with agricultural activities.*
- *To provide opportunities for employment-generating development that adds value to local agricultural production and integrates with tourism.*

The development site and surrounding lands are used for primary production, principally grazing and dryland cropping. An extractive industry is located on the neighbouring property to the west.

9.2 MINERAL RESOURCES

Two exploration leases (EL) cover the development site – refer **Figure 13**.

Modeling Resources Pty Ltd hold EL 7676 which is due to expire January 2021. The lease was first granted in January 2011 and was last renewed in March 2018. RED wrote to Modelling Resources in July 2018. Confirmation of Modeling Resource's receipt of this letter was received by RED and there has been no response from Modeling Resources Pty Ltd to date.

CMOC Mining Pty Ltd held EL 5323 which was due to expire July 2018 although MinView records that a renewal has been sought. In January 2018, pursuant to section 23A of the *Mining Act 1992*, an activity approval was also granted to CMOC Mining Pty Ltd to carry out prospecting operations. RED has instigated consultations with CMOC with the latest advice being that CMOC will advise RED if it has any concerns (20 November 2018).

There are no other known mineral, petroleum or extractive resources within or adjacent to the development.

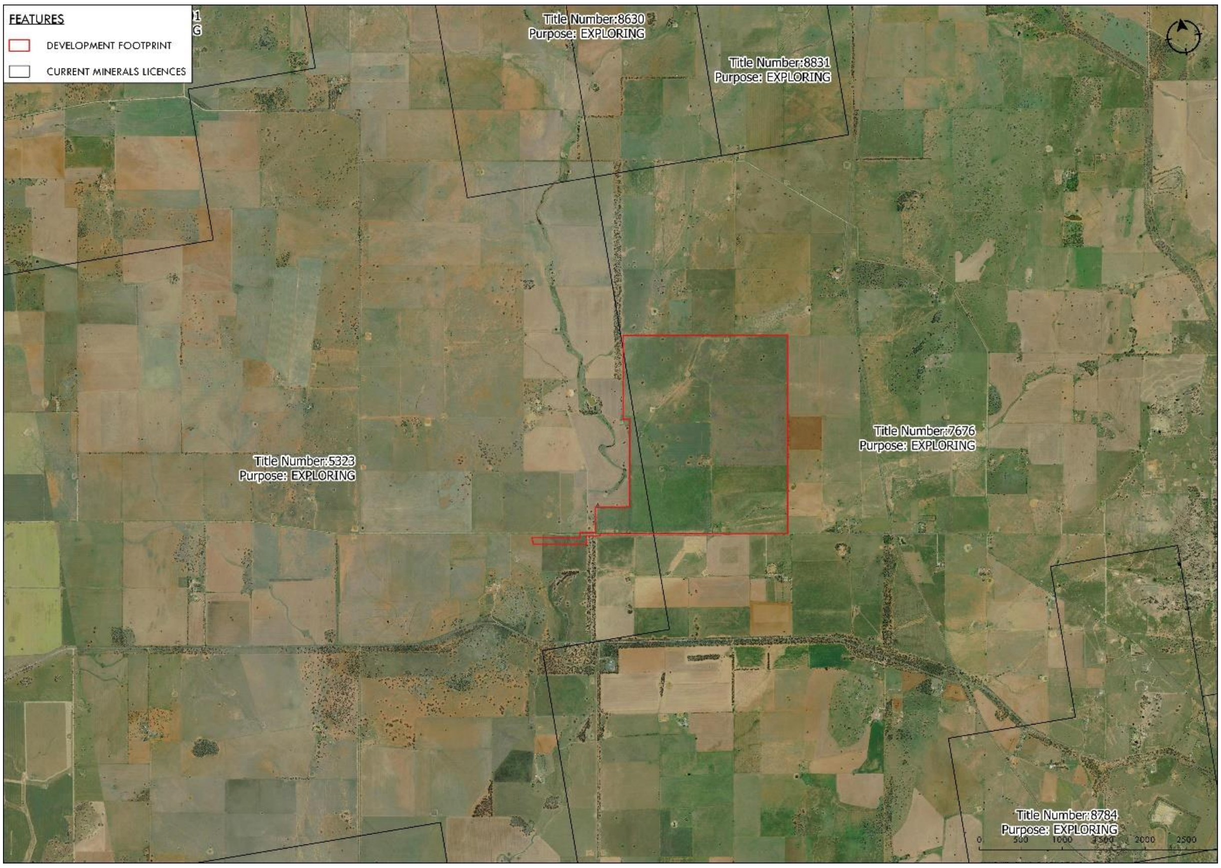

Figure 13: Exploration licences affecting the site

9.3 TRAVELLING STOCK RESERVE

Part of the Currajong TSR is located within Lot 7300 DP 1135641 (either side of McGraths Lane).

Access to the development site via McGraths Lane will generate traffic movements through this TSR and creates a potential interaction with stock. It is noted that McGraths Lane is an existing public road and this potential interaction already exists. Construction traffic for the proposed development will, however, increase the usage of McGraths Lane significantly, albeit temporary.

The need to manage stock and traffic interaction is not unusual in a functioning TSR and mitigation measures will include early and ongoing consultation with the CWLLS with respect to issued stock permits and construction schedules.

9.4 IMPACTS

The assessment of impacts on agricultural land use below addresses issues raised in:

- The NSW Department of Primary Industries policy document (No: 0-104, V1 25 May 2011) *Maintaining land for agricultural industries*;
- The NSW Department of Primary Industries Factsheet (Primefact 1134 October 2011) *Land Use Conflict Risk Assessment Guide*; and
- The NSW Department of Primary Industries (Primefact 1063 June 2013) *Infrastructure proposals on rural land.*

It is noted that notwithstanding DPI specified the EIS should address the requirements of its guideline *A guideline to identifying important agricultural lands in NSW* (April 2017), subsequent consultation with the DPI clarified that this guideline is not intended for this purpose.

9.4.1 LOSS OF AGRICULTURAL LAND

The stated purpose of the 2011 NSW Department of Primary Industries policy document *Maintaining land for agricultural industries* was[1]:

> *To guide the planning system in providing certainty and security for agricultural enterprises over the long term and to enable those enterprises to respond to future market, policy, technology and environmental changes. Key elements are;*
>
> - *land with the best combination of soil, climate, topography and water for agricultural production is a limited resource in New South Wales and should be maintained for future generations;*
> - *agricultural land should not be alienated directly through lands being used for non-agricultural purposes and indirectly by incompatible developments on adjacent land restricting routine agricultural practices; and*
> - *agricultural industries are a fundamental asset to the state of NSW as they provide a long term means of providing employment, raw materials and fresh safe secure food while supporting regional communities.*

In terms of the policy's scope:

> *This policy document provides direction to Industry and Investment staff and guidance to planning authorities and communities in developing and implementing environmental planning instruments relevant to agriculture or rural communities. These instruments include State Environmental Planning Policies, Regional Environmental Plans, Local Environmental Plans and Development Control Plans developed under the Environmental Planning and Assessment Act, 1979.*

As it relates to the proposed QPSF, and the conversion of land currently used for agricultural use to a solar farm, the policy states:

> *The conversion of land used by agricultural enterprises to other uses should only take place where fully justified in the strategic planning context. Considerations include;*
>
> - *all alternative sites and options for non-agricultural developments;*
> - *any decisions to convert agricultural land of high value to regional and state agricultural industries should be a last option; and*
> - *the impact of non-agricultural developments on agricultural business and infrastructure reliant on the surrounding agriculture production.*
>
> *It is recognised that changing community needs and aspirations may require a change in the use of agricultural land. Once land is converted to other uses, especially to residential or industrial uses, it is most unlikely to return to agricultural production. Since these decisions cannot be practically reversed. the long term social and economic costs and benefits (including intergenerational equity), need to be evaluated before a decision is made (i.e. triple bottom line or people, planet, profit assessment).*
>
> *The objective is not to prevent or discourage other land uses, but rather through planning ensure that land resources are efficiently allocated so as to maximise total benefit to the community. To achieve this goal, planning authorities should develop planning strategies for rural and agricultural industries when they develop strategies for other land uses. The determination of the economic, environmental and social contributions from agricultural land uses can be undertaken preferably through an agricultural industry study or regional rural land use study with emphasis on the major agricultural industries.*
>
> *Where a change in land use appears to be desirable, any changes to environmental planning instruments should only be made after open and informed consultation with the community. Spot rezonings and other ad hoc approaches to planning are undesirable. Changes should be*

[1] This policy was to be reviewed in April 2012.

implemented in a way that minimises the impact on existing agricultural enterprises, such as by phasing in the change and providing buffers between agricultural and non-agricultural properties.

With respect to the above the following is noted:

- the development site does not provide the best combination of soil, climate, topography and water for agricultural production;
- the land would be used for a non-agricultural purpose, but would not be an incompatible development as a consequence of restricting routine agricultural practices on adjacent lands;
- the strategic planning context remains a work in progress (see below);
- while it is unknown whether the site will be returned to agricultural use in the future, there is capacity to do so if the solar farm is decommissioned (ie. the land use can be practically reversed);
- the policy objective is not to prevent or discourage other land uses,
- the QPSF does not require any changes to an environmental planning instruments.

In terms of placing the QPSF development into strategic context for agricultural land there are several NSW Government initiatives relevant to the development.

Energy Zone

In its March 2018 submission to the *Integrated System Plan* consultation paper released by the Australian Energy Market Operator (AEMO) in December 2017, the NSW Government stated it is well-placed to identify the best locations for potential new Energy Zones in NSW, considering its unique position as the land use planner for NSW and ability to provide detailed data relating to a diverse range of state priorities. It noted that the development of Energy Zones in NSW could encourage investment in new electricity infrastructure and unlock additional generation capacity to meet the state's evolving energy needs; help ensure a secure and reliable energy future in NSW and place downward pressure on wholesale energy prices and support regional development.

The submission noted that the identification of Energy Zones in NSW would give the private sector greater certainty to make efficient long-term investment decisions, and would support recommendations from both the Independent Review into the Future Security of the National Electricity Market (Finkel Review) and NSW Energy Security Taskforce.

To this end, the NSW Government commissioned independent geospatial analysis overlaying 25 NSW data layers and identified the potential for ten Energy Zones in NSW. Parkes is located in one of these zones (refer **Figure 14**).

The Government's submission states:

> *These locations benefit from outstanding energy resources, have reduced environmental and planning constraints, are close to existing transmission and distribution infrastructure and load centres, and align with the Government's regional growth priorities, developed in consultation with regional communities.*

The submission noted that the NSW Government is well-placed to identify the best locations for NSW Energy Zones from a strategic cross-sector and state-wide perspective, accounting for a broader range of relevant considerations.

> *The NSW Government has a key role to play in ensuring that the most viable Energy Zones are identified by aligning locations with priorities in areas including land use planning such as regionally important farm land, biodiversity and heritage.*

The submission noted that detailed geospatial mapping analysis was undertaken, drawing together a range of data layers from NSW Government agencies to identify the most strategic locations for NSW Energy Zones. The analysis was carried out at a 50-metre resolution, overlayed 25 data layers, and included the following key criteria to identify the best locations for potential NSW Energy Zones.

- Energy resource and geography – the level of solar, wind and bioenergy resources and other factors impacting generation capacity in particular locations, including site slope, slope aspect, site elevation and geology.
- Cost-effectiveness – proximity to existing transmission infrastructure and load centres, encouraging efficient investment and limiting energy losses.
- Environmental, heritage and land-use considerations – potential land-use conflict or impacts on sites of environmental and heritage value, including Biophysical Strategic Agricultural Land.
- Contribution to a strong and diversified economy – NSW Government regional development priorities, developed in consultation with regional communities, as well as local and state-wide economic growth goals.
- Investor and community support – proximity to existing energy project pipeline where investors have demonstrated interest in particular locations, and proximity to regions with community support for renewable energy projects, as identified through the NSW Regional Plans.

The proposed QPSF is located within an area of the state that the NSW Government has identified as suitable as a Solar Energy Zone. It is also within close proximity to the Central West Energy Zone and will benefit from transmission network upgrades which are planned to increase the capacity for new generation to connect in the vicinity of Energy Zones.

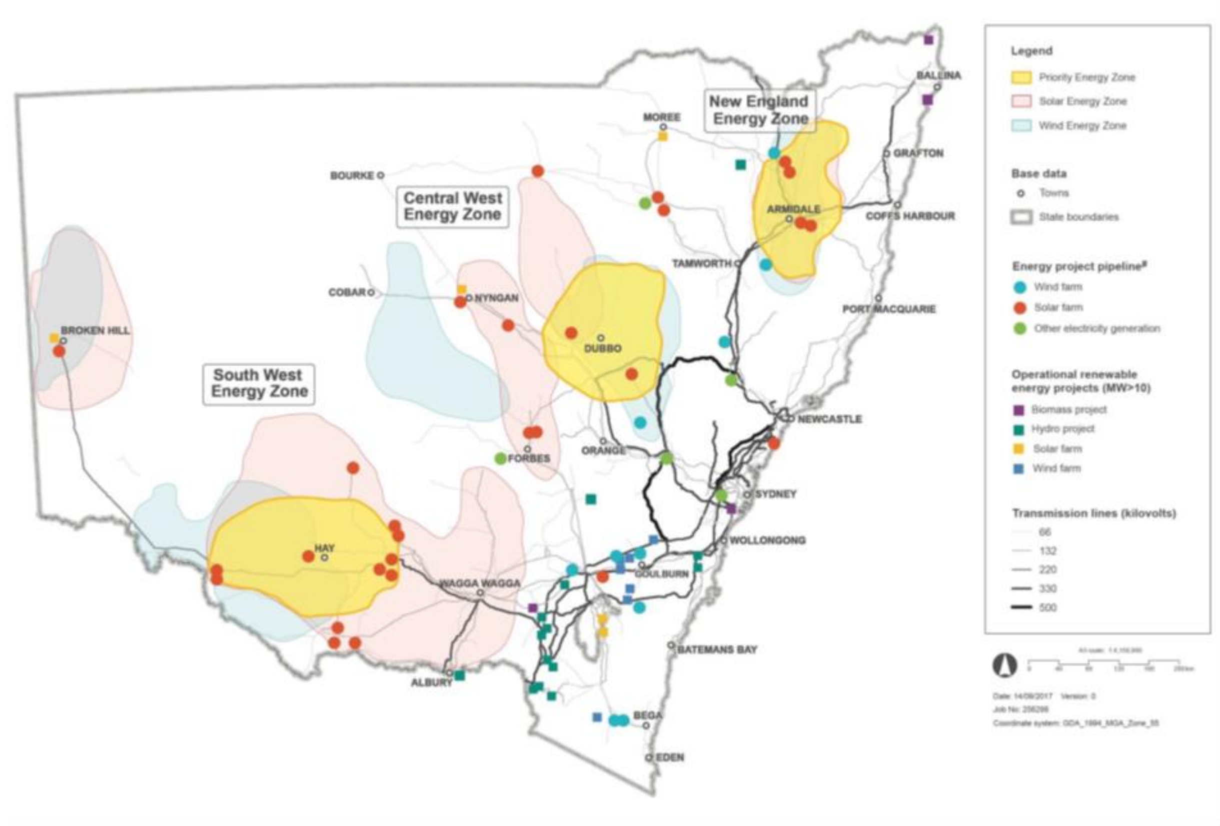

Figure 14: Potential Energy Zones in NSW (NSW Government, March 2018)

Important Agricultural Land

The *Central West and Orana Regional Plan 2036* is the NSW Government's strategy for guiding land use planning decisions for the Central West and Orana region for the next 20 years. The Central West and Orana region consists of 19 local government areas, including Parkes.

The NSW Government has established governance arrangements to oversee the implementation of the vision, goals and actions in the Regional Plan. Priorities for the Central West and Orana are

- growing and diversifying the economy,
- protecting environmental assets,
- providing efficient transport and infrastructure networks, and
- developing strong, resilient and connected communities.

Actions to support these outcomes represent the immediate areas of focus of the regional plan. Ten priority actions have been identified for implementation in 2017–2019. One of these actions is to prepare and release a *Regional Agricultural Development Strategy* that, amongst other things, will map important agricultural land. DPE has advised that the mapping important agricultural land project is on schedule to be completed mid-2019.

Similarly, the proposed *State Environmental Planning Policy (Primary Production and Rural Development) 2017* is intended to replace the Rural Lands SEPP. The Rural Lands SEPP currently makes provision for the identification of State Significant Agricultural Land. No land has been identified under these provisions to date. This provision is proposed to be retained and included in the new Primary Production and Rural Development SEPP. As stated in the Explanation of Intended Effect, this will provide continued opportunity for the SEPP to identify agricultural land of state significance, following the outcomes of regional and local planning processes. The provision in the new SEPP will enable identification and appropriate protection of State Significant agricultural land.

In the interim, the ability for any developer to comment on the loss of agricultural land as a result of its specific development, in a strategic and or regional context, is limited.

In this context, the following is noted. The Parkes LGA covers a total area of 595,492 ha. Available data from the Australian Bureau of Statistics (ABS) dataset National Regional Profile for Parkes LGA, 2004-2008 provides the total land areas for agricultural commodities in the Parkes LGA from 2006 (most recent data available). The data identifies the following:

- The total area of holdings for all agricultural land use is 550,573.40 ha, covering 92.46% of the Parkes LGA area.
- The total area for cereal crops for grain is 164,531.90 ha, covering 27.63% of the Parkes LGA.
- The total area for non-cereal broad acre crops for grain is 5,210.50 ha, covering 0.87% of the Parkes LGA.

Changing the land use of the development site from an agricultural use (whether it be for 30 years or for ever) is highly unlikely to diminish the productivity of the region in terms of primary production capabilities. In considering the cumulative impact of the built Parkes Solar Farm, and to be built Goonumbla Solar Farm, the DPE, the DPI – Agriculture and PSC previously determined that the operation of both these solar farms would not compromise the long-term use of the land for agricultural purposes. The DPE concluded that with an assumed combined size of 625 ha, this is a relatively small size and the combined loss of agricultural cropping land from the two solar farms would result in a negligible reduction in the overall productivity of the region.

In this context, it is reasonable to assume that loss of an additional 470 ha of agricultural land from production as a result of the QPSF would not exceed a threshold that would result in a significant reduction in the productivity of the region.

The DPE also noted that the loss of a small area of cropping land in the Parkes region must be balanced against:

- The broader strategic goals of the Commonwealth and NSW Governments for the development of renewable energy into the future.
- The environmental benefits of solar energy, particularly in relation to reducing GHG emissions.
- The economic benefits of solar energy in an area with good solar resources and capacity in the existing electricity infrastructure.

Another consideration is that the inherent agricultural capability of the land would not be adversely affected by the QPSF. To the contrary, Soil Management Designs notes that, subject to implementation of appropriate mitigation measures prior to and during construction and operations, the soil resource can be improved whilst rested from primary production and used as a solar farm. Specifically:

- Application of lime will overcome existing acidity constraints. This will provide an enhanced capacity to establish and maintain groundcover.
- The anticipated improvement in soil assessment and management following conversion to a solar farm almost certainly will lead to an improvement in soil conditions for plant growth. The roots and fungi associated with diverse and vigorous pasture assist with soil aggregation and carbon sequestration.
- There are benefits to the soil and pasture from the shading of the solar panels. Near-surface soil daytime temperatures will be reduced in summer, which is likely to create the following benefits:
    - Less water loss via evaporation.
    - A reduction in soil carbon loss; the rate at which soil organic matter decomposes and releases CO2 declines as soil temperature is lowered.
- In years with favourable soil moisture conditions in Spring, the shading from panels may slow down plant growth, relative to unshaded pasture. However, the stored soil water not used at that time would allow pasture to continue to grow strongly in early summer when the soil usually is too dry for optimal plant growth.

- Night time rainfall on tilted 'parked' panels would produce runoff from the panels that will create plumes of water that penetrate quickly and deeply into the soil; this is analogous to soil water entry via drip irrigation lines. The end result would be more efficient water entry and better rainfall storage efficiency as near-surface soil moisture often is lost via evaporation. Deeply penetrating plumes of rain water from the panel drip lines would be utilized efficiently by pasture plant roots, and there would be stimulation of earthworms and other beneficial soil organisms. Deep water movement and the creation of vertical worm channels will promote root growth into the deep subsoil, where the potential for carbon sequestration is greater than near the surface because of lower soil temperatures and slower decomposition rates for deposited organic matter.
- With the principal land use and economic return being generation of solar power, there is more flexibility to achieve a grazing regime that protects groundcover and the soil resource.

Supporting the above is a research paper published in November 2018 that addresses the environmental effects of solar panels on an unirrigated pasture that often experiences water stress at Oregon State campus in the United States. Changes to the microclimatology, soil moisture, water usage, and biomass productivity due to the presence of solar panels were quantified. The goal of this study was to show that the impacts of these factors should be considered in designing the solar farms to take advantage of potential net gains in agricultural and power production. Microclimatological stations were placed in the solar arrays two years after the solar array was installed. Soil moisture was quantified using neutron probe readings. Significant differences in mean air temperature, relative humidity, wind speed, wind direction, and soil moisture were observed. Areas under PV solar panels maintained higher soil moisture throughout the period of observation. A significant increase in late season biomass was also observed for areas under the PV panels (90% more biomass), and areas under PV panels were significantly more water efficient (328% more efficient) (https://doi.org/10.1371/journal.pone.0203256).

9.4.2 INFRASTRUCTURE ON RURAL LAND

The stated purpose of the DPI's *Infrastructure proposals on rural land* (Primefact, 2013) is to help consent authorities to maintain sustainable primary production and development opportunities and minimise land use conflict when assessing infrastructure proposals affecting rural resource lands. The QPSF and grid connection is an infrastructure proposal.

The Primefact notes that well planned infrastructure developments can be compatible with ongoing agricultural land uses, contingent on landholder consultation, design and effective planning controls.

> *To minimise impacts on agricultural resources and enterprises from infrastructure development proposals, DPI recommends that:*
>
> - *Proposals are clearly justified in a regional context and identify the merits and community benefit of the proposal.*
> - *Agricultural resource lands are identified and avoided. New infrastructure is located within existing infrastructure corridors wherever possible.*
> - *Land use conflicts are minimised.*
> - *Landholders are effectively consulted during planning, construction and rehabilitation works and the expectations of local communities are managed.*
> - *Development proposals identify suitable mitigatory/remediation responses for all likely agricultural impacts.*
>
> *Infrastructure impacts that are of particular significance for sustainable agriculture are:*
>
> - *Resource loss and fragmentation*
> - *Impacts on farming operations and livestock*
> - *Increased weed, biosecurity and bushfire risks*
> - *Site rehabilitation*

Each of these are discussed below.

Resource loss and fragmentation

The QPSF will not fragment rural resource lands to reduce the economic and environmental sustainability of neighbouring farming enterprise or constrain future development options for neighbours.

Surrounding land uses are dryland cropping and grazing and these activities can continue without impact. Neither surface nor groundwater resources would be compromised. The location of the grid connection on Lot 1 DP 1090411 has been refined in consultation with this land holders and is positioned in a location in the paddock that is acceptable and not sterilise use of the land for continued grazing and farming (noting that this connection could be either an overhear or underground connection) to an existing overhead 132 kV powerline that runs through this paddock. The safe movement of agricultural machinery movement where ground clearance may be limited would be managed through appropriate design if an overhead connection is ultimately selected.

The development does not propose subdivision and would not fragment the landscape.

Impacts on farming operations and livestock

The development will not result in interruptions to external farm access or farm services that may affect the efficient operation and sustainability of neighbouring agricultural businesses. Post construction the QPSF will generate negligible traffic and no neighbour's access to the local road network, power, communication or water would be impacted.

The ability to undertake aerial agricultural activities such as the application of seed, fertilisers or chemicals by surrounding land owners would not be impacted.

Increased biosecurity, pest and weed risks and impacts on livestock

Biosecurity for agriculture can rely on limiting vehicle and people movements on rural properties and being able to trace vehicles, people and stock movements if any disease outbreaks arise. The construction of the QPSF and grid connection works would result in temporary increases in vehicle movements on and off two rural properties. Pest animals may also be encouraged by food sources from construction works. Livestock can also be panicked or stressed by rapid vehicle movements or sudden noises which may result in injury or escape. These impacts are manageable through best practice construction management and the adoption of specific (enforceable) controls specifically designed to avoid impacts such as the introduction or spread of weeds, controlling noise, scheduling of certain construction tasks and neighbour consultation.

Site rehabilitation

In the longer term, what could effectively be an extended respite from farming could, in a relative sense, provide benefits to the land in terms of soil health. Compared to continued cropping over the next 30 years there would be a reduction in herbicide/insecticide/fungicide application; less ground disturbance and a capacity to retain groundcover and improve organic carbon levels in the soil. A solar farm, compared to dryland broad-acre farming, is a passive land use that would effectively rest the soil resource. If the solar far is to be decommissioned in the future the detail on how the land will be returned fit for agricultural purpose will be detailed in the Decommissioning Management Plan (refer **Section 9.5**).

9.4.3 LAND USE CONFLICT

The *Land Use Conflict Risk Assessment Guide* factsheet provides guidance on the practical measures to avoid and manage land use conflicts. Its primary focus is on conflicts affecting existing or proposed agricultural developments. The QPSF is not an agricultural development and as such many of the amenity and environmental issues associated with agricultural developments do not apply. For example, as a land use the QPSF does not introduce the rural amenity issues most common to land use conflict such as air quality due to agricultural activities (odour, dust, smoke and particulates); the use and enjoyment of neighbouring land (e.g. noise from machinery); soil erosion leading to land and water pollution; changes water availability; or stock access to waterways.

The QPSF does not compromise the capacity for immediate neighbours to continue existing or proposed primary production land uses at this locality. The development does not conflict with the NSW Government's *Right to Farm Policy* for neighbours. Infrastructure is low to the ground and would not compromise aerial agricultural spraying: noting that existing overhead power lines currently traverse the site.

Conversely, RED does not envisage any unacceptable risk to the solar panels from activities on adjacent farm land such as aerial spraying and dust generation. The existing surrounding land uses are known and the QPSF is not an incompatible land use with a potential to create ongoing land use conflicts. The QPSF is not a threat to continued primary production activities by neighbours. Harvesting sunlight is a passive land use. There would be no impact to any groundwater resource nor any significant change to surface hydrology in terms of modified flow patterns leaving the property.

As an owner of land in a rural environment, the owners of the QPSF will, like their neighbours, have responsibilities to manage the land appropriately. In particular this will include obligations to manage any noxious weeds and to control fuel loads. Management techniques for ensuring these outcomes include slashing and/or crash grazing, and periodic treatment for noxious and broad leave weeds as required.

9.5 MITIGATION MEASURES

9.5.1 BASELINE SOIL AGRONOMICS

Prior to construction activity commencing representative soil samples will be collected from across the site to establish baseline data on the pre-existing agronomic characteristic of the soil resource. This would include soil testing (0-15 cm) with a focus on organic carbon, nutrients, pH and soil structure. These parameters would become the default performance indicators for future decommissioning and site rehabilitation works (refer **Section 9.5.3**).

9.5.2 OPERATIONS ENVIRONMENT MANAGEMENT PLAN

An OEMP will be prepared prior to the QPSF commencing operation. The OEMP will include procedures, reporting, and the allocation of responsibilities designed to minimise environmental impacts. The OEMP will document the environmental procedures and controls that would be implemented to operate the solar farm as a responsible rural land owner.

The OEMP would comprise various sub-plans detailing the specific mitigation measures that would be implemented to avoid and manage potential environmental impacts and minimise risks. These would include plans covering land management, specifically relating to fuel loads, noxious weeds and soil health. Soil testing in the upper 30 cm in the vicinity of the five existing test pits will be undertaken on a triennial basis. Parameters sampled and monitored will focus on organic carbon, nutrients, pH and soil structure.

Whilst managing the fuel load (ie. groundcover) is important for managing the bushfire risk, overgrazing and creating areas denuded of any vegetative cover need to be avoided. The long term performance measure is to establish a healthy, self-sustaining, noxious weed free groundcover over the entire site that does not create a fuel hazard. How this can best be achieved, and maintained, through a combination of mechanical slashing and/or periodic crash grazing will require monitoring and implementation of adaptive management principles. Specifically, this will entail adapting the frequency, duration and intensity of grazing, and the timing of any mechanical slashing, to suit and accommodate the prevailing seasonal conditions.

Adaptive management principles will, however, be driven by the performance measure of maintaining a groundcover rather than agricultural production. That is, in a bad run of seasons when vegetative growth may be negligible and fuel load reduction is not needed, grazing would not be undertaken.

Each and every time a fuel reduction measure is undertaken relevant details will be recorded to provide a baseline for informing future management decisions. This will include a record of the details of the grazing regime (ie. when sheep arrived, head numbers and when they were taken off the site) or the date of slashing.

The general health of ground cover across the entire site will be monitored regularly, at times in the season that will provide timely information on weed treatment. Indicators of groundcover conditions will include:

- Vegetative cover and fuel load;
- Whether there are noxious weeds present;
- Whether landscape plantings are healthy;
- Whether there are any areas denuded of groundcover; and
- Whether there are any signs of localised erosion.

This information will be used to inform decisions about the need, timing and location for any impending fuel reduction or weed treatment.

9.5.3 SITE RESTORATION

9.5.3.1 Security

If the decision in 30 years is to decommission the solar farm the land will be restored to a condition that permits the resumption of agricultural use. The owner of the QPSF will have an obligation under the land agreement to decommission the solar facility at the end of its operating life and to reinstate the land to productive agricultural use. Failure to do so would be a breach of the agreement and the land owner would have legal recourse to ensure decommissioning is carried out. The land owner also has a financial guarantee to ensure the project owner carries out its decommissioning obligations should the facility be abandoned. In the event of abandonment, the residual value of the steel, copper cabling, solar modules and electrical equipment would far exceed the cost of decommissioning and the landowner would therefore be assured of the funds required to carry it out.

9.5.3.2 Decommissioning Management Plan

One year prior to the commencement of decommissioning activities a Decommissioning Management Plan (DMP) would be prepared in consultation with the landholder and submitted for approval by DPE. The DMP would include the following key elements:

- rehabilitation strategies and objectives;
- rehabilitation design criteria;
- productivity targets to ensure the re-establishment of agricultural production (if agreed as the final land use);
- expected timeline for rehabilitation works; and
- mitigation measures and monitoring.

9.5.3.3 Infrastructure Removal

All above ground infrastructure will be removed and decommissioning would include:

- disconnection of the solar farm from the grid;
- removal of PV modules, mounting posts, mounting frames and trackers;
- removal of all buildings and equipment;
- removal of any underground cabling shallower than 800 mm;
- removal of fencing (unless requested otherwise by the landholder);
- site rehabilitation to render the site fit for resumption of agricultural use.

9.5.3.4 Site Rehabilitation

Following infrastructure removal the following is expected to be undertaken to re-instate the site suitable for agricultural activities:

- removal of gravel from internal tracks and roads (unless requested otherwise by the landholder);
- removal of any concrete and foundations;
- deep ripping of any compacted areas to allow for the infiltration of water and to allow for cropping activities;
- re-establishment of groundcover in any areas where cropping is not to occur to ensure the stabilisation of soil resources;
- establishment of suitable erosion and sediment control measures (if required).

9.5.3.5 Performance Indicators

Soil samples would be collected from those same representative sites from which samples will be collected prior to construction and then triennially during the farm's operational life to validate the health of the soil resource and the associated cropping/grazing productivity of the property.

The prospect that significant remedial works will be required is remote. As detailed in the soils investigation (refer **Appendix E**), an improvement in the soil resource can be reasonably anticipated. Subject to adoption of appropriate mitigation measures prior to and during construction and operation, it is concluded that the triennial soil testing almost certainly will demonstrate an improvement in soil condition under the solar farm relative to the condition of the soil resource as part of an existing dryland crop production system.

Whilst the development removes the land from full primary production potential whilst under a solar farm, as a land use, the solar farm protects and can enhance the value of the soil resource. Performance indicators for validating this will include organic carbon, nutrients, pH and soil structure.

Visual

10.1 FARM INFRASTRUCTURE

Infrastructure associated with proposed solar farm would comprise the following elements:

- either single axis tracking or fixed tilt solar arrays with ~250,000 panels mounted approximately 1.4 m off the ground on galvanised frames and posts with the top edge of the panel up to 4 m above ground level at full tilt;
- 19 inverter stations interspersed throughout the arrays each of a 40 foot shipping container size with a height of approximately 2.5 m;
- a substation compound (approximately 40 m x 40 m) containing a 132kV/33kV transformer, electrical switch gear and protection equipment, as well as supporting structures for overhead cabling up to 14 m in height;
- an energy storage system consisting of either banks of Lithium-ion batteries with associated ancillary inverters, transformers and air conditioning equipment or containerised battery modules; occupying a footprint of no more than 120 m x 50 m;
- a control room building (5 m wide x 3.5 m deep x 2.7 m high);
- chain wire site perimeter fencing (2.4 metre-high);
- gravel internal maintenance access tracks and vehicle turnaround areas; and
- a new double circuit 132 kV transmission line (either overhead and mounted on mono poles approximately 28 m high or underground) to connect with Essential Energy’s 132 kV transmission line located approximately 700 m west of the site.

Isolated paddock trees and a stand of planted vegetation would be cleared to install the solar farm. The existing stand of vegetation along the southern boundary, west of the property access, would be retained. No screening vegetation is proposed for the boundaries as it is not required for visual impact mitigation for neighbours, and would be ineffective for homes further from, but at higher elevation than the farm.

10.2 EXISTING ENVIRONMENT

The locality is a rural environment with the dominant surrounding land use being primary production, specifically grazing and dryland farming. The development site is essentially flat with a very gentle fall to the south west. The site ranges in height from this low point in the south-west of 275 m AHD to a high point in the north-east of approximately 293 m AHD.

By reference to its historic use for broad acre farming, the site is largely cleared, containing isolated paddock trees and a small, east west aligned windrow of planted trees in the middle of the site. Riparian vegetation associated with Ridgey Creek is located immediately west of the site, and planted trees along the western half of the site’s southern boundary screens this portion of the property from Back Trundle Road (refer **Figure 15**).

Figure 15: Existing Vegetation Back Trundle Road (facing west)

Beyond the development site a low ridgeline is located to the north east (refer **Figure 16**) and the country rises in elevation further to the south west (refer **Figure 17**). From elevated locations to the east and more distant from the site there are views west across the plain.

TransGrid's Parkes Zone Substation is located to the south of the site, as is the constructed 65 MW Parkes Solar Farm and the approved (but not built) 70 MW Goonumbla Solar Farm. The Parkes National Logistics Hub (HUB) is located to the south-east. The HUB is a multi-modal transport facility strategically located at the cross roads of the Newell Highway connecting Brisbane and Melbourne, and the transcontinental railway linking the eastern seaboard to Perth. All these land uses are located south of Henry Parkes Way and are not visible from the proposed QPSF development site. The Parkes to Narromine Rail line is located approximately 1 km to the east (refer **Figure 2**).

Within 2 km of the site, there are 12 non-associated landowners, as depicted on **Figure 4** (**page 8**) and described in **Table 10.4**.

The character of the existing rural environment is characterised by a rural landscape. Within the landscape the topography is undulating and includes paddocks traversed by seasonal dryland gullies with blocks of native vegetation following some creeks, field boundaries and roads. There are scattered rural buildings including sheds and residential properties accessed by small roads and access tracks. This is not an intact rural landscape. Visual intrusions into the landscape include industrial development to the south-east of the site in the form of the Parkes Special Activation Precinct, a number of approved and constructed solar farms to the south, electrical transmission lines criss-crossing the landscape. These introduced elements contrast with the curved and organic nature of the rural landscape.

Figure 16: Ridge to north east

Figure 17: Ridge to south west

10.3 PLANNING CONTEXT

The development site is located on land zoned RU1 – Primary Production under the *Parkes Local Environmental Plan 2012*. This zoning does not have a stated objective relating to rural landscape character. The types of development permitted in this zone, subject to securing development consent, include:

> *Air transport facilities; Airstrips; Animal boarding or training establishments; Aquaculture; Bed and breakfast accommodation; Boat launching ramps; Boat sheds; Building identification signs; Business identification signs; Camping grounds; Caravan parks; Cellar door premises; Cemeteries; Community facilities; Correctional centres; Crematoria; Depots; Dual occupancies (attached); Dwelling houses; Eco-tourist facilities; Educational establishments; Environmental facilities; Extractive industries; Farm buildings; Farm stay accommodation; Flood mitigation works; Freight transport facilities; Helipads; Highway service centres; Home industries; Home occupations (sex services); Industrial training facilities; Information and education facilities; Intensive livestock agriculture; Jetties; Landscaping material supplies; Open cut mining; Plant nurseries; Recreation areas; Recreation facilities (major); Recreation facilities (outdoor); Roads; Roadside stalls; Rural industries; Rural supplies; Rural workers' dwellings; Secondary dwellings; Timber yards; Veterinary hospitals; Water recreation structures; Water storage facilities*

No recognised landscape conservation areas as listed in local, State or Commonwealth heritage registers and listings in the locale.

Parkes *Development Control Plan 2013* does contain general principles for development pertaining to visual impact and landscape character that apply across the Parkes Shire for all developments. These include:

- consideration of the character of a neighbourhood,
- maintaining the quality of the streetscape,
- appropriate building height, bulk and form
- retaining landscape qualities; and
- protecting visual privacy.

The Parkes Special Activation Precinct is located to the southeast of the site - **Figure** 3 **(page 2)**. A Draft SAP Structure Plan is currently the subject of public exhibition. The SAP Structure Plan identifies a 665 hectare solar sub-precinct to the south of Henry Parkes Way. The SAP Structure Plan provides a strong and clear indication of the changing nature of the local environment and assists in providing a context for this visual assessment. The release of the draft SAP structure plan also assists in identifying the future desired character for the locality.

10.4 ASSESSMENT METHOD

Work undertaken previously by Visual Planning + Design on assessing impacts of solar farms has established a methodology based on identifying the sensitivity of the viewer, identifying the magnitude of change created by the development and combining these characteristics to assign a level of likely visual impact.

Sensitivity refers to the susceptibility of a view to accommodate change without losing valued attributes. The descriptions provided **Table 10.1** are relevant considerations in assigning sensitivity levels.

Table 10.1 – Visual Sensitivity Levels

Sensitivity Level	Description
Low	Views where visual amenity is important at a neighbourhood scale, such as views seen from local roads, briefly glimpsed views to landscape features, and views from small groups of non-associated landowners.
Medium	View of high quality or experienced by concentrations of residents and/or local recreational users, and/or large numbers of road or rail users.
High	Heavily experienced view to a feature or landscape that is iconic to a major portion of a city or a non-metropolitan region, or an important view from an area of regional open space.

Another consideration in visual values are local, state or federal register or planning instruments, or other published documents, that identify the presence of significant landscape attributes in the locale. Visual values can also be gauged through consultation and engagement with neighbours.

Magnitude of change refers to the extent of change that would be experienced by receptors. Relevant considerations include the proportion of the view which is affected, the size and scale of the change, and the level of contrast and compatibility.

Principles have been developed by Iris Visual Planning + Design that relate to how well a solar farm can be absorbed into the landscape and what is considered to be more or less visually harmonious and are indictors of visual modification. The considerations for assigning the degree of modification are detailed in **Table 10.2**.

Table 10.2 – Indicators of Visual Modification

Indicator	Degree of Modification		
	High	Medium	Low
Landform	Flat	Undulating	Mountainous
Land cover	Fee trees and buildings	Scatter trees and buildings	Dense trees and/or building cover
Land use character	Rural or natural	Mixed residential and some farm buildings	Intensive agriculture or industrial
Distance	Foreground	Middle ground	Background
Extent of change visible	Large area of proposal visible	Moderate of proposal visible	Small area of proposal visible
Backdrop	Viewed against the sky	Viewed against background	Viewed against a hillside

Visual impact is the combined result of sensitivity together with the magnitude of the change. The considerations for assigning the degree of impact are detailed in **Table 10.3**.

Table 10.3 – Visual Impact Levels

Modification	Sensitivity		
	Low	Medium	High
High	Moderate	High	High
Medium	Minor	Moderate	High
Low	Negligible	Minor	Moderate

10.5 IMPACT ASSESSMENT

Views of the site were identified through site inspections, locating surrounding non-associated landowners and driving the local road network. The following observations are made.

- Views to the site from the south are restricted to north of Henry Parkes Way with the stands of roadside vegetation on the northern side of this road and at a similar elevation that shield views of the development site.
- Views of the site from the north are limited by a low ridge adjacent to the western portion of the northern boundary of the site.
- Views from the east and north/east extend back to 4 km from the site as the land rises and westerly views back across the plain are visible.
- Views from the west reach back up to 2 km where the land rises.

Figure 18 shows the surrounding topography, the locality of the receptors and where the development sits within this landscape. The extent and location of existing vegetation between the development site and neighbours is shown in **Figure 4**.

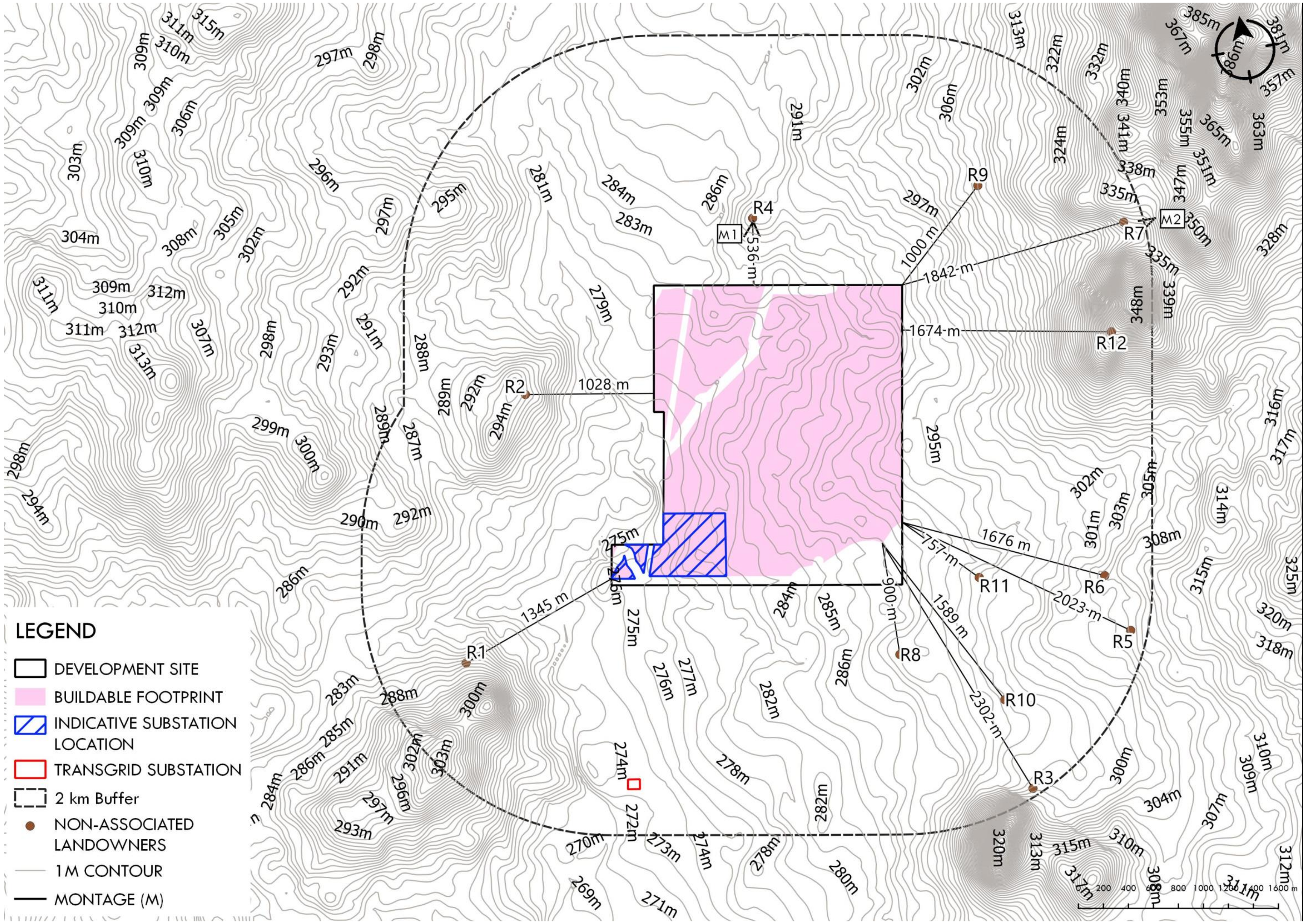

Figure 18: Topography

Visual absorption is the ability of a landscape to accommodate change without the loss of its valued attributes. At the more distant elevated locations to the east the views towards the development site are open and multilayered. Scattered trees and blocks of vegetation within paddocks, the Parkes to Narromine Rail line, farm sheds and associated infrastructure, roads and existing overhead powerlines break-up views of the site. This layering allows the development to sit low within the landscape without detracting from horizon features.

The site and immediately surrounding landscape include a mix of built form with small clusters of farm buildings and homesteads accessed by gravel and sealed roads. An extractive industry operates to the west of the site. The site is considered to have a medium visual absorption capacity due to the undulating landform, scattered vegetation cover and the mix of built form.

10.6 IMPACTED PARTIES

10.6.1 NEIGHBOURS

As noted, there are 12 non-associated landowners located within 2 km of the development site. None are located closer than 500 m from the development site boundary and for most, existing stands of vegetation within and surrounding the site and the curtilage of their homes shield views of the site. The individual distance of non-associated landowners from the solar farm is outlined in **Table 10.4** together with existing shielding that exists from current features.

Table 10.4 – Non-associated landowners

Non-associated landowners	Distance to development footprint (metres)	Elevation (m AHD)	Existing Shielding?	Form of shielding
R1	1345	285	Yes	Existing vegetation
R2	1028	294	Yes	Existing vegetation on Ridgey Creek
R3	2302	298	Yes	Roadside vegetation on Henry Parkes Way
R4	536	292	No	-
R5	2023	305	Yes	Existing vegetation
R6	1676	305	No	-
R7	1842	330	No	-
R8	900	291	No	-
R9	1000	307	No	-
R10	1589	294	No	-
R11	757	295	No	-
R12	1674	344	No	-

As a result of the above analysis, it is evident that none of the residencies within 2 km of the site has close unhindered views to the proposed solar infrastructure from their homes. It is therefore considered that the extent of visible landscape change would be low. Different parts of the solar farm would be visible from different parts of non-associated landowner dwellings. Due to the distances, elevation and intervening existing vegetation, there would be a low magnitude of change for most neighbours.

RED's consultation with all 12 neighbours resulted in four of these neighbours raising visual impact as a consideration, with two of them indicating an interest in possible screen plantings around the curtilage of their homes or property to screen visual impacts. These neighbours are located immediately to the north (R4) and north east (R7) (refer **Figure 18**).

These non-associated landowners have dwellings at higher elevation than the development site and no amount of perimeter screen planting at the solar farm would be effective in screening infrastructure from these non-associated landowners.

To assist in determining the magnitude of likely change to these non-associated residences, visual analysis in the form of photo montages have been produced by Premise.

Figure 19 and **Figure 21** show existing views of the development site from the curtilage of these dwellings and **Figure 20** and **Figure 22** show montages of how the development would be viewed from these properties. While the final layout of solar arrays and associated infrastructure within the development footprint will not been determined until Construction Certificate stage, the visual impact assessment here considers the worst case for each residence. In the worst case for each residence being assessed, the infrastructure is assumed to be as close as possible within the development footprint to that residence. In addition, the solar PV arrays will be the dominant feature of the infrastructure. The inverter stations, which are dispersed and have a low profile, and the control room, substation and energy storage system, which have a relatively low profile and will be far away, do not affect the assessment of visual impact for each receiver.

10.6.2 PUBLIC

For the broader public views of the development site are limited. At present these are restricted to motorists using Back Trundle Road and from lands to the east on the higher slopes. While the presence of the solar farm would be more visible from this higher area to the east, the farm would sit in the background, low in the landscape and occupy only a portion of the open plains when looking west. The character of the rural landscape in the foreground and middle ground from these areas would be retained. The existing landform of the development site would also be retained, and pasture established under the panels. This would assist in the integration of the visible areas of the solar farm into the surrounding landscape. There would be a low magnitude of change to these views which are of moderate sensitivity, resulting in a minor visual impact.

10.6.3 CONCLUSION

Provided below is a summary of the assessed visual impact for each receptor.

Table 10.5 – Visual Impact

Viewpoints	Sensitivity	Modification	Impact
Non-associated landowner - R1	Medium	Low	Minor
Non-associated landowner - R2	Medium	Medium	Moderate
Non-associated landowner - R3	Medium	Low	Minor
Non-associated landowner - R4	Medium	Medium	Moderate
Non-associated landowner - R5	Medium	Low	Minor
Non-associated landowner - R6	Medium	Low	Minor
Non-associated landowner - R7	Medium	Medium	Moderate
Non-associated landowner - R8	Medium	Low	Minor
Non-associated landowner - R9	Medium	Low	Minor
Non-associated landowner - R10	Medium	Low	Minor
Non-associated landowner - R11	Medium	Low	Minor
Non-associated landowner - R12	Medium	Low	Minor
Motorist Back Trundle Road	Low	Low	Low

10.7 GLARE

Solar PV panels are specifically designed to absorb not reflect solar energy. Reflected sunlight is lost energy and represents lost revenue. Glass used in solar PV systems can reflect just 2% of the light received (Spaven, 2012) and in comparative terms this is significantly lower than the reflectivity of other materials like concrete or bare soil.

10.8 LIGHTING

The only night lighting associated with the QPSF would be security lighting. Such lighting would be designed and operated to comply with *Australian Standard AS4282 Control of Obtrusive Effects of Outdoor Lighting*. In so doing there would be negligible light spill above the horizontal plane and no impacts to adjoining properties. It is also noted that the solar farm is located further than 200 km from the Siding Spring Observatory and falls outside the Dark Sky Region covered by the NSW Government's *Dark Sky Planning Guideline* (DPE, June 2016).

View Location R7
Existing view

Photomontage created by:

James Buckley - B.Arch(Hons) A.I.A
NSW Board of Architects registration No 8504

Photomontage Image created using:

AutoCAD 2016, Sketchup 2018, Thea Render, Adobe Photoshop

Base photograph details:

Camera:	Nixon Coolpix P600
Focal Length	35mm
Exposure:	1/1600 sec
ISO Speed:	ISO-100
F-Stop:	f/3.8, 4.3mm
Photo taken:	12.57pm on 17/01/2019
Location of photo:	38 deg 4 min 7 Sec South 148 deg 7 min 26 sec East
Dist to Infrastructure:	1.98 km
Altitude :	330 m
Height above ground:	1.6 m

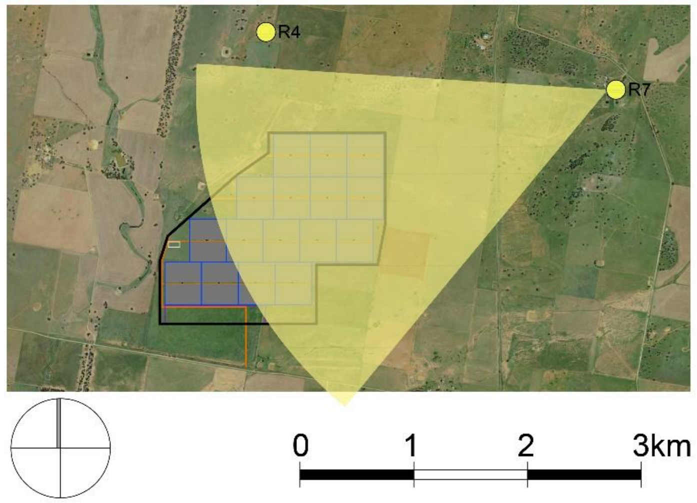

Figure 19: Existing View (R7)

View Location R7
Indicative proposed view

Photomontage created by:

James Buckley - B.Arch(Hons) A.I.A
NSW Board of Architects registration No 8504

Photomontage Image created using:

AutoCAD 2016, Sketchup 2018, Thea Render, Adobe Photoshop

Base photograph details:

Camera:	Nixon Coolpix P600
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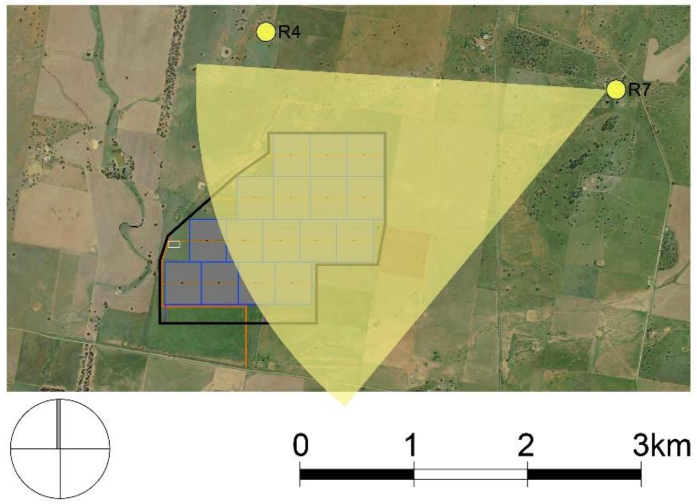

Figure 20: Montage (R7)

View Location R4
Existing view

Photomontage created by:

James Buckley - B.Arch(Hons) A.I.A
NSW Board of Architects registration No 8504

Photomontage Image created using:

AutoCAD 2016, Sketchup 2018, Thea Render, Adobe Photoshop

Base photograph details:

Camera:	Nixon Coolpix P600
Focal Length	35mm
Exposure:	1/1250 sec
ISO Speed:	ISO-100
F-Stop:	f/3.8, 4.3mm
Photo taken:	13.30pm on 17/01/2019
Location of photo:	38 deg 3 min 51 Sec South 148 deg 5 min 36 sec East
Dist to Infrastructure:	873 m
Altitude:	290 m
Height above ground:	1.6 m

LOCATION OF REAR PORCH AREA OF HOUSE FROM WHICH VIEWS TO THE SUBJECT LAND ARE AVAILABLE

LOCATION FROM WHERE PHOTOGRAPH FOR PHOTOMONTAGE TAKEN

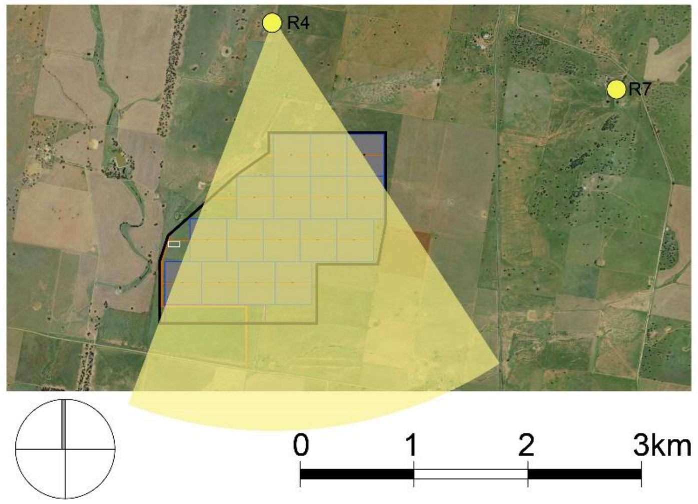

Figure 21: Existing View (R4)

View Location R4
Indicative proposed view

Photomontage created by:

James Buckley - B.Arch(Hons) A.I.A
NSW Board of Architects registration No 8504

Photomontage Image created using:

AutoCAD 2016, Sketchup 2018, Thea Render, Adobe Photoshop

Base photograph details:

Camera:	Nixon Coolpix P600
Focal Length	35mm
Exposure:	1/1250 sec
ISO Speed:	ISO-100
F-Stop:	f/3.8, 4.3mm
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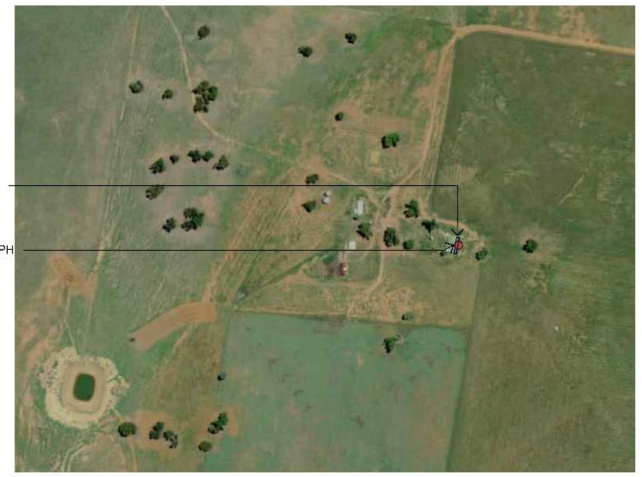

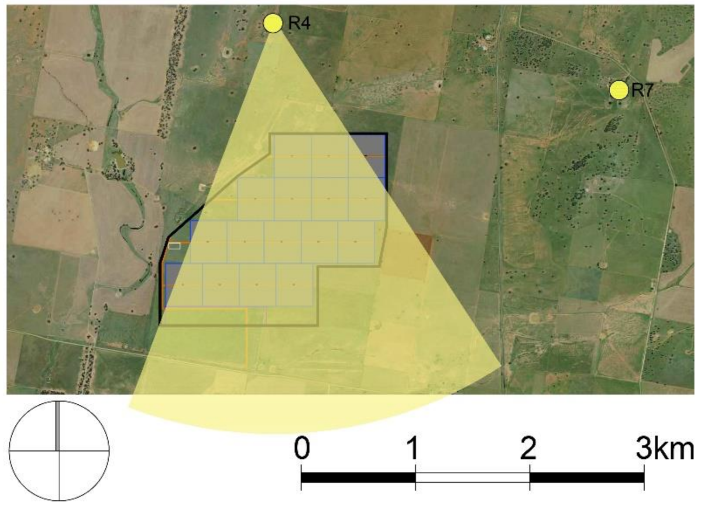

Figure 22: Montage (R4)

10.9 MITIGATION MEASURES

One measure is proposed to mitigate visual impacts as part of the proposed development.

10.9.1 OFF-SITE PLANTINGS

RED in its consultations with neighbors that raised visual impact as a consideration, for which on-site landscape plantings would not screen farm infrastructure, commits to continuing discussions for the establishment of plantings on neighbor's properties to screen views from the curtilage of these homes. This commitment extends to the two neighbors who expressed an interest in this offer (R4 and R7).

10.10 LANDSCAPING PLAN

The objective of the Landscaping Plan will be to provide visual impact mitigation through the establishment and maintenance of off-site plantings. These plantings will be planted prior to commencement of operations and consist of vegetation species that facilitate the best possible outcome in terms of visual screening and complement biodiversity values.

The Landscaping Plan will be prepared prior to construction start and will include a program to monitor and report on the effectiveness of these measures and include details of who would be responsible for monitoring, reviewing and implementing the plan, and timeframes for completion of actions.

Specifically, the Landscaping Plan will provide detail on the initial weed spray treatment; bed preparation, including specifications for initial deep ripping; representative soil testing to inform fertiliser selection; planting techniques (tube stock, fertilizer application. UV stabilized tree guards); native species selection and planting densities and ongoing maintenance.

Traffic

11.1 INTRODUCTION

Once built and operational the QPSF would generate negligible ongoing traffic. The farm will not be permanently staffed and visitation restricted to periodic routine maintenance and infrequent plant and equipment replacements. It would be during the construction of the farm that traffic movements would be significant.

A traffic impact assessment is provided in **Appendix G**. Provided below is a summary of the key findings of this assessment. As required by the SEARs, the traffic impact assessment has been prepared in accordance with the methodology outlined in Section 2 of the *RTA Guide to Traffic Generating Development 2002* (RTA Guide).

11.2 TRAFFIC GENERATION

To be conservative the estimated traffic generation has been based on the assumption that the largest delivery vehicle will be a 19 m Semi-trailer. If B-double trucks are used this will reduce the estimated heavy vehicle trips generated. For the purpose of road and intersection geometric assessments it has been assumed that B-doubles are used as a worst case scenario.

Vehicle trips as used in this document and in the traffic impact assessment at **Appendix G** are defined as per the RTA Guide. A trip is defined by the RTA Guide as a one way vehicular movement from one point to another, excluding the return journey.

The total estimated traffic trips generated during construction is approximately 13,060 vehicle trips. The peak daily trips are estimated to be 185 vehicles per day (60 light vehicles and 125 heavy vehicles). The peak hour traffic will at the beginning and end of the work day as crew arrive/leave the site generating an estimated peak of 30 vehicles per hour.

The estimated traffic generated during operation is up to 4 vehicle trips per day. There will also be isolated infrequent times of substantial maintenance that will generate some additional trips, including some heavy vehicle movements.

Henry Parkes Way and the main highways to be used to connect to Henry Parkes Way are pre-approved General Mass Limit (GML) and Concessional Mass limit (CML) roads and hence are expected to be able to cater for the construction and operation traffic from the development. If B-Doubles are utilised permits for the use of McGrath Lane and the portion of Back Trundle Road will need to be gained through the National Heavy Vehicle Accreditation Scheme (NHVAS).

Regular inspections and maintenance (if required) will be necessary to ensure the condition of McGrath Lane and Back Trundle Road are maintained.

11.3 HAULAGE ROUTES

Imported components will be delivered to either the port of Newcastle, Botany Bay and/or Port Kembla and transported to the site by road. It is anticipated that the following routes will be used by heavy and over-dimensional (OD) vehicles.

The anticipated route from Newcastle would be the Hunter Expressway – Golden Highway – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road (refer **Figure 23**). The anticipated route from Port Kembla would be the Princess Motorway – Hume Motorway – Lachlan Valley Way – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road (refer **Figure 24**). The anticipated route from Botany Bay would be the M5 Motorway – Hume Motorway – Lachlan Valley Way – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road (refer **Figure 25**).

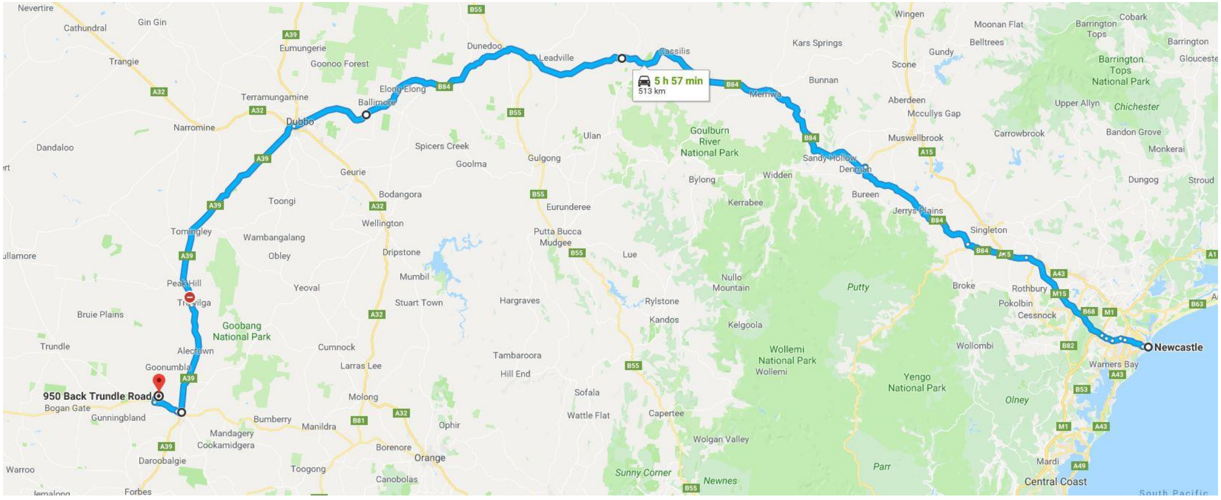

Figure 23: Haulage Route ex-Newcastle

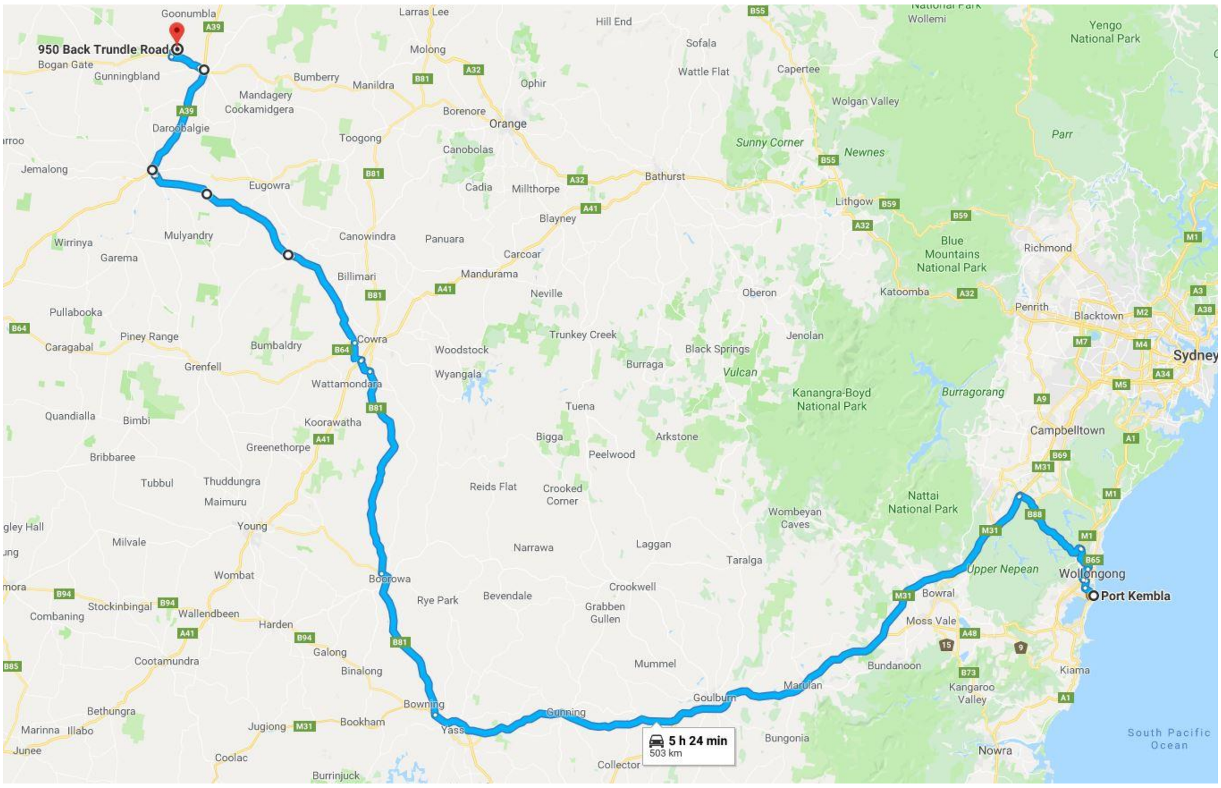

Figure 24: Haulage Route ex-Port Kembla

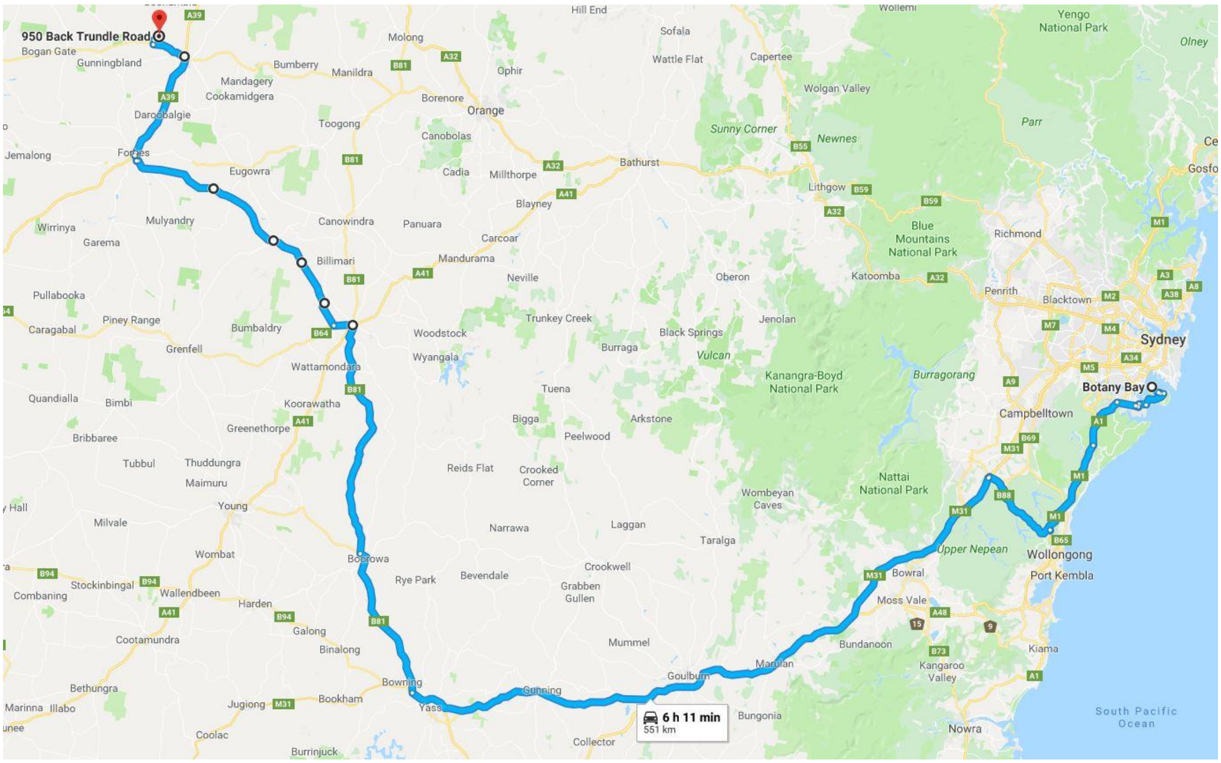

Figure 25: Haulage Route ex-Port Botany

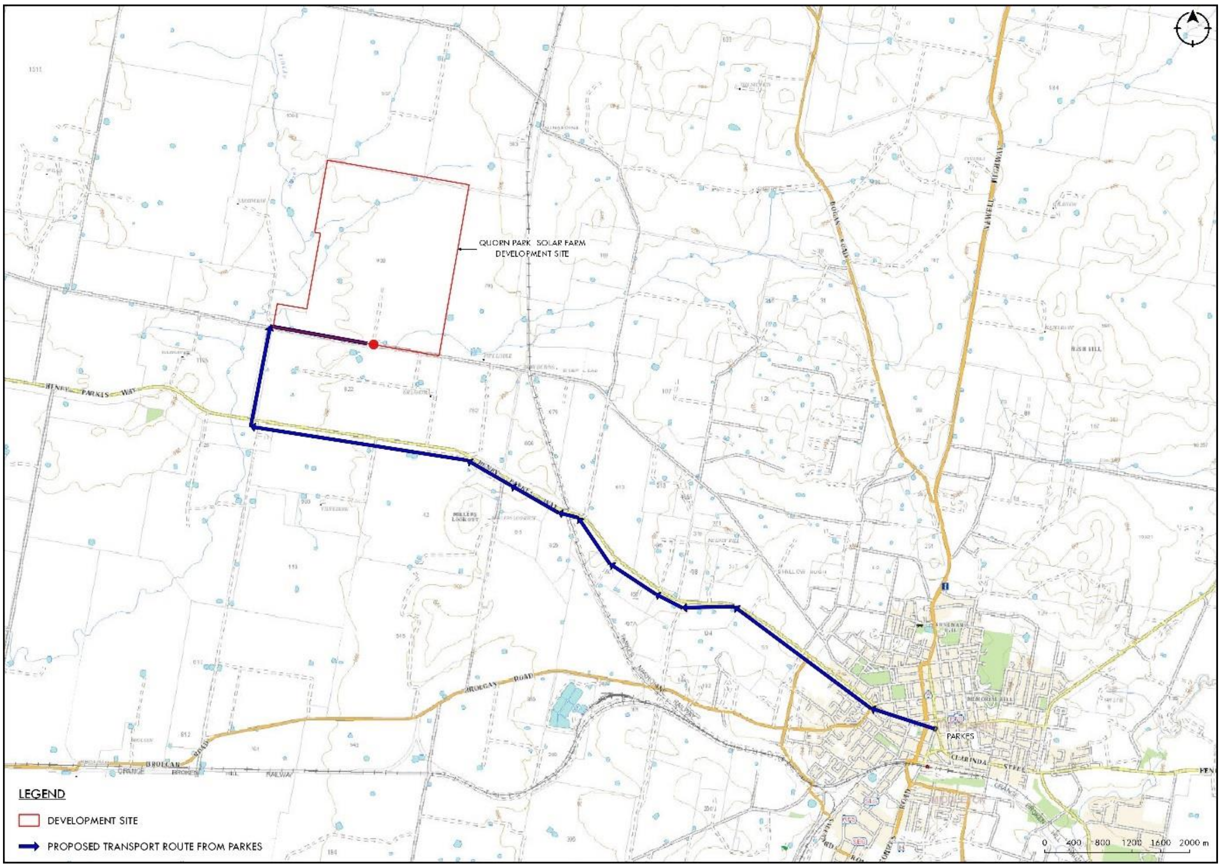

Figure 26: Haulage Route ex-Parkes

11.4 ACCESS

The site access location utilises the existing property access (**Figure 26**). The site access will be designed to cater for the largest vehicle accessing the site.

The development triggers the warrant for a Basic Right Turn treatment (BAR) and a Basic Left Turn treatment (BAL) at the intersection of McGrath Lane with Henry Parkes Way. It is proposed to upgrade the existing intersection to meet the Austroads standards for a BAR/BAL intersection.

A site inspection was carried out to check the existing sight distances at the key intersections in the vicinity of the site. The site inspection revealed that the sight distance at the intersections of Henry Parkes Way/McGrath Lane, McGrath Lane/Back Trundle Road and the Quorn Park property access are in excess of the required Safe Intersection Sight Distance (SISD) of 351 m.

11.5 MITIGATION MEASURES

11.5.1 ROAD UPGRADES

It is recommended that the intersection of Henry Parkes Way/McGrath Lane be upgraded to comply with a BAR/BAL intersection treatment.

11.5.2 TRAFFIC MANAGEMENT PLAN

A Traffic Management Plan (TMP) will be developed in consultation with the Parkes Shire Council and Roads and Maritime Service prior to the commencement of construction. The TMP will identify and provide management strategies to manage the impacts of projected related traffic including:

- Haulage of materials to site.
- The safe transportation of construction workers to site and return. In this regard, Roads and Maritime will require specific details on how the proponent will ensure the identified management measures employed to ensure the safety of staff travelling to and from the site each day will be controlled and enforced.

The TMP would be prepared and implemented in accordance with the final Development Consent issued for the solar farm and developed in consultation with Parkes Shire Council and RMS.

In general terms the TMP would include details on the following:

- Construction timeframe and staging of works,
- Measures to consult with other road users to minimise impacts (eg. liaison with school bus operators).
- Confirmation of anticipated additional traffic volumes generated by the farm,
- Confirmation of final HV and OD vehicle haulage routes to be used for all delivery vehicles,
- A process to review haulage route road conditions prior to the commencement of works,
- A process to carry out pre and post construction road dilapidation surveys to ensure McGrath Lane and Back Trundle Road roads are reinstated to pre-construction conditions,
- Requirements for any additional TMP(s) required for a specific work stage/process (e.g. delivery of oversize components),
- Qualify and identify any relevant mechanisms for OD vehicle permits and traffic management requirements.

Noise

12.1 INTRODUCTION

A noise study has been undertaken to assess the potential impacts of the construction and operation of the proposed solar farm on nearby sensitive receptors in accordance with the following NSW policies and guidelines:

- NSW Environment Protection Authority Noise Policy for Industry (EPA, 2017)
- NSW Assessing Vibration: a technical guideline (DEC, 2006);
- NSW Road Noise Policy (DECCW, 2011); and
- Interim Construction Noise Guideline (DECCW, 2009)

In accordance with the requirements of the above guidelines, computational modelling and first principle calculations have been undertaken to support the assessment of the potential for adverse amenity impacts as a result of the development.

A full copy of this study is provided in **Appendix F**. Provided below is a summary of the results and conclusions of the noise and vibration impact assessment.

12.2 CONSTRUCTION NOISE

12.2.1 DURATION OF CONSTRUCTION WORKS

The construction of the QPSF is expected to take approximately 36 weeks with a number of different activities undertaken over that time. **Table 12.1** presents an overview of each of the construction tasks along with their expected duration. It is noted that some of these tasks are likely to occur concurrently (e.g. site preparation and construction of the substation is likely to be undertaken at the same time as installation of the solar PV modules and cabling).

Table 12.1 – Construction Phases and Expected Duration

Construction Phase	Duration
Site preparation and construction of site substation	18 – 26 weeks
Installation of solar PV modules & cabling	12 – 26 weeks
Commissioning	6 - 8 weeks

Given the separation distance from the subject site to the nearest existing sensitive receptors there is potential for the duration of construction to be minimised through construction works outside standard hours. The assessment has therefore considered the potential for adverse amenity impacts associated with construction outside recommended standard hours: notwithstanding that DPE has advised works outside of standard construction hours will not be approved as part of the DA.

12.2.2 INTERIM CONSTRUCTION NOISE GUIDELINES

Guidance on the assessment and management of construction noise in NSW is provided in the *Interim Construction Noise Guideline 2009* (ICNG) published by the EPA.

The main objectives of the Guideline are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts;

- Encourage construction to be undertaken only during the recommended standard hours, unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage;
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts; and
- Provide guidelines for assessing noise generated during the construction phase of developments.

In achieving these objectives, the guideline provides a framework for the qualitative and quantitative assessment of potential construction noise impacts. **Table 12.2** presents construction noise criteria outlined in the Guideline. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Table 12.2 – NSW EPA Construction Noise Criteria – Residential Receivers

Time of Day	Management Level (Free field)	How to Apply
Recommended standard hours: Monday to Friday, 7 am to 6 pm Saturday, 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB (A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RB + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Where nearby sensitive uses are predicted to be noise affected, the proponent is required to apply reasonable and feasible noise mitigation measures. A noise mitigation measure is feasible if it is capable of being put into practice, and is practical given the project constraints. For construction outside standard hours, the assessment criteria has been determined based on the minimum allowable RBL as provided in the NPfI. That is, for the purposes of the assessment it is assumed that the RBL is 30 dB(A) for night periods thereby resulting in a noise affected limit of 35 dB(A) for construction outside standard hours.

12.2.3 CONSTRUCTION NOISE SOURCES

In terms of noise emissions, the site preparation activities and installation of the solar PV modules (specifically driving the support posts into the ground) are expected to represent those with the most significant potential for adverse impacts. The indicative project schedule has determined these two activities may occur concurrently. Therefore, for the purposes of the assessment, the impacts associated with these two elements have been assessed cumulatively.

Plant and equipment will include truck and dogs, excavators, wheeled loaders, piling rigs, tranna cranes, trenchers, generators, trucks and various powered hand tools.

It is noted that construction works are expected to progress across the site such that plant and equipment would only be in a single area for a short period of time. For example, each post takes approximately 25-30 seconds to drive into the ground thereby providing the ability to install a new pile approximately every 2.5 minutes. Given this, the potential for adverse impacts at any one receptor is expected to only occur for a short period of time.

12.2.4 ASSESSMENT OF IMPACTS

For the purposes of predicting impacts associated with noise emissions from the development site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software Cadna. Cadna incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions were undertaken in accordance with ISO Standard 9613 (1996) *Acoustics - Attenuation of sound during propagation outdoors*.

The model is utilised to assess the potential noise emissions from the site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

For the construction phase of the QPSF, predictive noise modelling has considered the range of potential impacts, noting that noise generating activities will progressively move across the site. As such, the highest noise levels would not be expected to be experienced at a single receptor for more than one day while construction equipment (eg. piling drill rig) is at the closest point to the receptor. The results of this modelling indicate compliance with the noise management levels for both standard construction hours (40 dBA) and outside construction hours (35 dBA) for all neighbours.

12.2.5 MITIGATION OF CONSTRUCTION NOISE LEVELS

Whilst compliance of the construction criteria is achieved at all receptors, controls are recommended to minimise the potential for adverse amenity impacts. Potential controls available to the construction contractor to minimise potential impacts include:

- Using broad-band reversing alarms on all mobile plant and equipment;
- Examining different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Selecting quieter items of plant and equipment where feasible and reasonable;
- Operating plant in a quiet and efficient manner;
- Reducing throttle setting and turn off equipment when not being used; and
- Regularly inspecting and maintaining equipment to ensure it is in good working order.

12.3 OPERATIONS NOISE

12.3.1 OPERATIONAL NOISE CRITERIA

12.3.1.1 Overview

The acoustic assessment has been completed in accordance with the procedure identified in the NPfI. The NPfI recognises that scientific literature has identified that both the increase in noise level above background levels (that is, intrusiveness of a source), as well as the absolute level of noise are important factors in how a community will respond to noise from industrial sources.

In response to this, the NPfI establishes two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These two criteria are then used to determine project trigger levels against which the proposed development will be assessed. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The derivation of the two sets of criteria are presented below. For residential dwellings, the noise criteria are assessed at the most-affected point (i.e. highest noise level) on or within the property boundary. Where the property boundary is more than 30 metres from the house, then the criteria applies at the most-affected point within 30 m of the house.

12.3.1.2 Intrusiveness Criteria

The project intrusiveness noise level is intended to protect against significant changes in noise levels as a result of industrial development. To achieve this, the *NPfI* describes intrusive noise as noise that exceeds background noise levels (as defined by the Rating Background Level or RBL) by more than 5 dB. Given the remote location of the development site and the lack of any significant activity in the area, the impact assessment has assumed baseline noise levels equivalent to the minimum background noise levels provided in the NPfI. **Table 12.3** presents the derivation of the intrusiveness criteria based on the minimum background noise level established by the INP.

Table 12.3 – Derived Intrusiveness Noise Criteria

Receptor	Intrusiveness $L_{Aeq,15\text{-}minute}$ Criteria		
	Day	Evening	Night
All nearby residential receptors	40 [b)]	35 [b)]	35 [b)]

a) Receptor noise limit applies at a location 30 m from the dwelling façade.
b) Minimum background noise level established by the NPfI + 5 dB.

12.3.1.3 Amenity Criteria

The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Review of the surrounding area has identified that that there are no industrial noise sources in the area with future industrial development in the area considered unlikely. As such, the project amenity noise criteria are equivalent to the indicative noise amenity area noise levels presented in **Table 12.4**.

Table 12.4 – Amenity Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dbA)	
			Total Industrial Noise	Project Specific
Residence	Rural	Day	50	50
		Evening	45	45
		Night	40	40

12.3.1.4 Project Trigger Levels

The project trigger level (i.e. the noise limit considered by the assessment) is the lower value of the project intrusiveness noise level and the project amenity level, after the conversion to L_{Aeq}, 15 min dB(A) equivalent level. **Table 12.5** presents the standardised intrusiveness noise level and the project amenity level as derived by adding 3 dB to each period of the day.

Table 12.5 – Project Trigger Level

Time of Day	Standardised L_{Aeq}, 15 min Noise Level (dB)		
	Intrusiveness Criteria	Project Specific ANL	Project trigger Level
Day	40	53	40
Evening	35	48	35
Night	35	43	35

12.3.1.5 Sleep Disturbance

NSW EPA have identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. Where noise levels at a residential location exceed:

- $L_{Aeq,\ 15\ min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

The predicted noise levels at residential locations do not exceed 40 dB(A) $L_{Aeq,\ 15\ min}$, therefore a detailed sleep disturbance assessment is not required. Further, given the noise sources associated with the operation of a solar farm are all continuous (inverters) or semi-continuous (tracking motors) during daylight hours, short-term instantaneous noise events are unlikely. As such, consideration of compliance against the L_{AF}max sleep disturbance limits is unwarranted.

12.3.2 NOISE SOURCES

The QPSF is to consist of solar PV plant and associated infrastructure producing up to 80 MWac of electricity for supply into the grid. It is expected that infrastructure installed on site will incorporate:

- 19 x SMA 5 MVA inverters (each comprising two 2.5 MVA inverters and transformer);
- 3,300 NEXTracker motors;
- 1 x Substation; and
- 10 x Battery storage units with each battery storage unit comprising containerised battery storage with HVAC systems on each end of the containers, inverters and transformers.

It is noted that the particular battery supplier for the project has not yet been selected. Selection will depend on engineering and commercial factors and will be made during the procurement stage of the project. For the purposes of this noise assessment, the major equipment suppliers have been considered and the worst case for noise emissions adopted. Alternative arrangements do not include containers to house the batteries but use all weather enclosures with the arrangement of HVAC's and inverters providing a lower overall noise impact.

The PV panels will be mounted onto fixed support structures by single axis tracking panels which track the suns movement across the day through the use of small motors which rotate the panel arc of the sun to maximise the solar effect. Noise emissions from the tracking motors are expected to occur for approximately one minute out of each 15-minute period (providing for up to five degrees' rotation per hour) during day periods.

Placement of the required inverters is also expected to be finalised during the detailed design phase of the project. For the purposes of the assessment the inverters are assumed to be located at even spacing across the site with all inverters located outside of what has been identified as an inverter buffer area.

A single substation is required for the proposed solar farm to allow connection to the grid and will be located within the zone indicated in **Figure 6** Development footprint. The final siting of the substation within the indicated zone has not yet been determined and will depend on engineering considerations including optimal sub surface conditions for foundations, layout of the modules and the route of the overhead high voltage lines for grid connection. The noise assessment has determined that there are no limitations on the siting of substation in order to achieve compliance with the adopted noise limits.

The battery storage system is likely to be located in close proximity to the substation and control room in order to share common infrastructure. For the purposes of the assessment, it has been assumed that the storage system could be located anywhere outside what has been identified as a battery storage buffer zone.

The buffer zones identify portions of the development site within which neither inverter stations nor the battery storage system should be located in order to ensure acoustic amenity values for neighbours is protected (refer **Figure 27**).

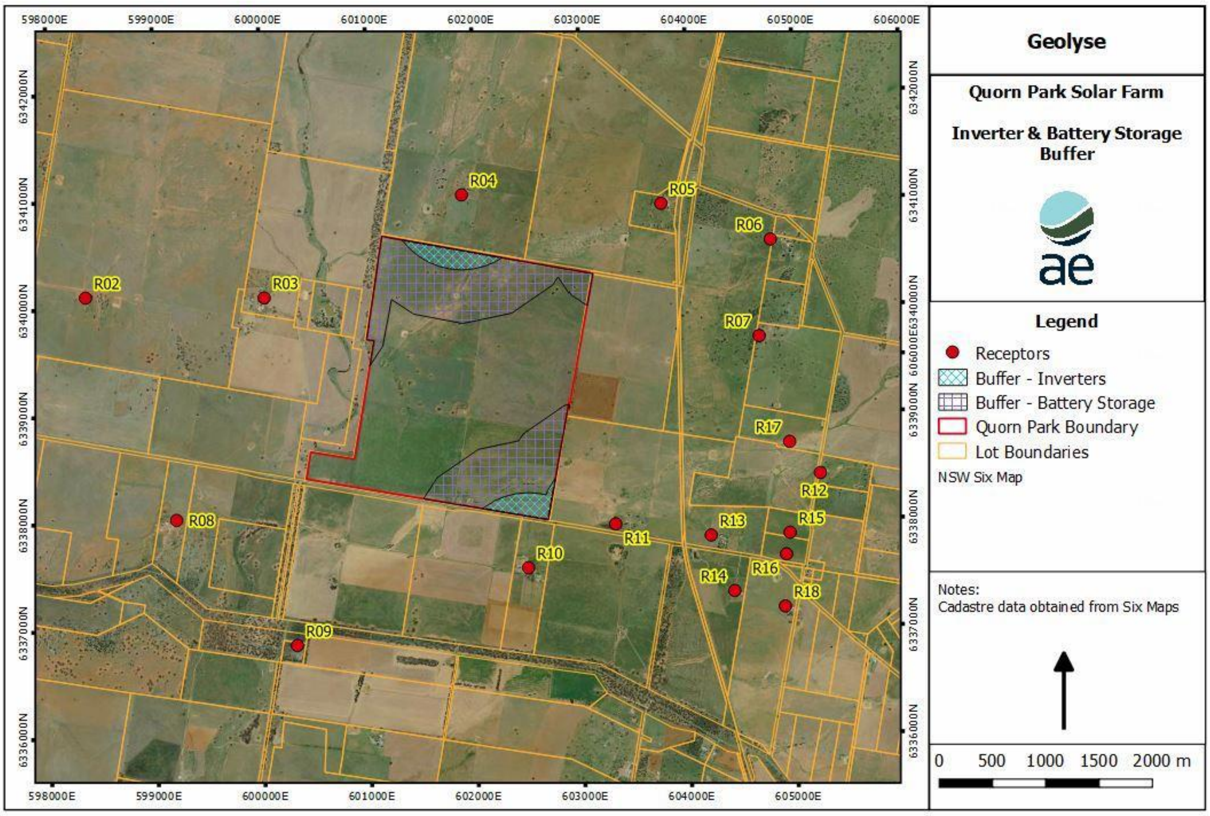

Figure 27: Noise Buffer Zones

12.3.3 ASSESSMENT OF IMPACTS

For the purposes of predicting impacts associated with noise emissions from the QPSF noise modelling was undertaken for a range of operating scenarios and meteorological conditions, including temperature inversions and/or gradient winds.

Subject to adoption of the inverter station and battery storage buffers identified above in detailed design of the farm layout, the predicted noise levels confirms compliance with the intrusive noise criteria established in accordance with the NPfI for all receptors for both day and night periods under worst-case meteorological conditions.

Given the predicted compliance with the noise limits derived in accordance with the NPfI, no further noise mitigation is considered necessary.

12.4 ROAD TRAFFIC NOISE

Noise impacts associated with vehicle movements during the operational phase of the QPSF project are expected to be negligible as visitation will be limited to periodic maintenance and infrequent plant and equipment replacements. During construction and any future decommissioning of the farm however, traffic movements will be more significant.

The assessment has considered the potential impacts associated with noise emissions from the maximum peak daily expected 60 light and 125 heavy vehicle movements from the site entry along the local access road (Back Trundle Road) onto McGrath Lane and Henry Parkes Way. All vehicle movements are expected to occur during standard construction hours however, as a worst-case, it has been assumed that vehicle movements associated with arrival of construction workers to site could occur over the one-hour period from 6 am – 7 am (i.e. during night periods).

The ICNG does not provide criteria for the assessment of construction road traffic. Given this, reference was made to the noise criteria provided in the NSW *Road Noise Policy* (RNP). The result of noise modelling undertaken in accordance with Calculation of Road Traffic Noise (CRTN) methodology, for maximum peak daily traffic during construction, indicate compliance with the RNP criteria.

12.5 VIBRATION ASSESSMENT

12.5.1 INTRODUCTION

There is potential for impacts as a result of vibration generated by plant and equipment during the construction phase. The assessment undertaken considered the potential for impacts on both human comfort and structural damage for the nearest residence to the construction works.

12.5.2 ASSESSMENT CRITERIA

The vibration criteria presented in the *Environmental Noise Management – Assessing Vibration: A Technical Guide* (2006) published by the NSW Department of Environment Climate Change and Water (DECCW) have been adopted for the assessment. The technical guide provides vibration criteria associated with amenity impacts (human annoyance) for the three categories of vibration:

- Continuous vibration (eg. road traffic, continuous construction activity);
- Impulsive vibration includes less than 3 distinct vibration events in an assessment period (eg. occasional dropping of heavy equipment); and
- Intermittent vibration includes interrupted periods of continuous vibration (eg. drilling), repeated periods of impulsive vibration (eg. pile driving) or continuous vibration that varies significantly in amplitude.

In order to assess potential damage to buildings, reference has been made to British Standard BS 7385-2: 1993 *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration*.

12.5.3 VIBRATION SOURCES

Table 12.6 presents vibration source levels for plant an equipment likely to be used during construction. equipment.

Table 12.6 – Vibration Source Levels – Peak Particle Velocity

Equipment Item	PV at 10 Metres (mm/s)	Sources
Piling	1 – 2	Rockhill D.J et. al. [b)]
Loaded trucks (rough surface)	5	USA DT [a)]
Loaded trucks (smooth surface)	1 – 2	USA DT [a)]
Excavator	2.5 – 4	DECCW

a) Transit Noise and Vibration Impact Assessment, US Department of Transportation, May 2006.
b) Rockhill, D.J., Bolton, M.D. & White, D.J. (2003) 'Ground-borne vibrations due to press-in piling operations'

12.5.4 POTENTIAL IMPACTS

Based on the vibration source levels at 10 metres peak particle velocities have been predicted at various separation distances. The predicted vibration levels indicate compliance with the continuous preferred vibration nuisance criteria for locations at a separation distance of 50-60 metres. Compliance with the building damage criteria is predicted at 10 metres from construction for each source.

It is noted, however, that the piling PPV at distances of 470 m (the distance to the nearest sensitive receptor from potential piling) is predicted to be within the maximum continuous criteria of 0.56 mm/s. This comparison with the continuous criteria (as a conservative approach) indicates that vibration levels associated with piling are not considered to be significant (which is expected given the significant separation distances).

12.6 CONCLUSION

The area surrounding the proposed development is sparsely populated with dominant activities including a range of agricultural and rural uses. The impact assessment has considered the potential for adverse impacts resulting from noise (construction, road traffic and operational) and vibration (construction) emissions on nearby residential uses.

The assessment of potential noise impacts has considered both construction during standard hours and outside standard hours. For construction during standard hours, adverse amenity impacts during the construction phase of the project are considered unlikely. For construction works undertaken outside standard hours, significant amenity impacts are considered unlikely where the management measures are implemented.

For the operational phase of the development, adverse amenity impacts are considered unlikely and compliance with applicable criterion achieved where the buffer separation distances for inverters and battery storage system are adopted for the final farm design.

Overall, based on the results of the assessment, the risk of adverse impacts as a result of the proposed QPSF is considered to be low with noise and vibration emissions complying with the applicable criteria. Hence, from an acoustic perspective, the proposed development site is considered acceptable for the proposed use.

Water

13.1 EXISTING ENVIRONMENT

13.1.1 SURFACE WATER

A feature of the development site that makes it suitable for a solar farm is its flat topography, with a very gentle drainage fall across the site towards the south west. The site is not mapped as Flood Prone Land nor has any known history of flooding or inundation.

Extensive drainage modification works have been undertaken across the development site historically in an attempt to harvest and store run-off into farm dams. These works include a series of contour banks and built channels. The location and function of these are shown in **Figure 5**.

Consequentially, with few exceptions the 'mapped' watercourses do not exist on-ground.

These exceptions include a Strahler 3rd order drainage line in the north west corner of the site, and a Strahler 3rd order drainage line running along the southern boundary of the site.

Ridgey Creek is located (at its closest point) approximately 100 m from the western boundary of the site. Ridgey Creek flows south west into Goobang Creek a tributary of the Lachlan River.

13.1.2 GROUNDWATER

A review of the NSW Department of Primary Industries (DPI) – Office of Water All Groundwater Map indicates that there are no registered groundwater bores within the development site and that there are four (4) registered groundwater bores within a 1 km radius. One of those bores had a recorded water bearing zone (WBZ) at depth of 37 m.

13.2 POTENTIAL IMPACTS

Neither the construction nor operation of the QPSF would have an adverse impact on surface water or groundwater resources.

13.2.1 SURFACE WATERS

The flat topography of the site will permit construction of the solar farm without the need for significant earthworks or any fundamental changes to landform: all to be undertaken in a very low risk environment in terms of erosion and sediment control.

Localised surface flow drainage patterns would not be impacted and the proposed development footprint provides buffers to the drainage lines based on avoidance and/or minimisation of significant impact. Specifically, the following considerations have informed the delineation of the development footprint.

- The constructed drainage channel passing through the north western corner of the site will be avoided. Avoidance of this corridor (as well as the drainage line below the farm dam that is fed by it) will provide continuity of flow paths leaving the site.
- A 40 m buffer from top of bank has been provided for:
  - the Strahler 1st order drainage line in the south east corner of the site,
  - the Strahler 3rd order drainage line running along the southern boundary of the development site; and
  - the Strahler 3rd order drainage line located in the north west corner of the site.

Provision of these buffers avoids disturbance to or impacts on drainage flow paths leaving the site.

Soil Management Designs also notes that subject to implementation of appropriate mitigation measures prior to and during construction and operations the capacity to maintain a groundcover over the site will be enhanced. Specifically:

- Application of lime will overcome existing acidity constraints and provide an enhanced capacity to establish and maintain groundcover.
- The anticipated improvement in soil assessment and management following conversion to a solar almost certainly will lead to an improvement in soil conditions for plant growth. The roots and fungi associated with diverse and vigorous pasture assist with soil aggregation and carbon sequestration.
- There are benefits to the soil and pasture from the shading of the solar panels. Near-surface soil daytime temperatures will be reduced in summer, which is likely to create less water loss via evaporation and a reduction in soil carbon loss.
- In years with favourable soil moisture conditions in Spring, the shading from panels may slow down plant growth, relative to unshaded pasture. However, the stored soil water not used at that time would allow pasture to continue to grow strongly in early summer when the soil usually is too dry for optimal plant growth.
- Night time rainfall on tilted ‘parked’ panels would produce runoff from the panels that will create plumes of water that penetrate quickly and deeply into the soil. The end result would be more efficient water entry and better rainfall storage efficiency as near-surface soil moisture often is lost via evaporation. Deeply penetrating plumes of rain water from the panel drip lines would be utilized efficiently by pasture plant roots, and there would be stimulation of earthworms and other beneficial soil organisms. Deep water movement and the creation of vertical worm channels will promote root growth into the deep subsoil, where the potential for carbon sequestration is greater than near the surface because of lower soil temperatures and slower decomposition rates for deposited organic matter.

Supporting the above is a research paper published in November 2018 that addresses the environmental effects of solar panels on an unirrigated pasture tin the United States. This study reported areas under PV solar panels maintained higher soil moisture and a significant increase in late season biomass (https://doi.org/10.1371/journal.pone.0203256). The enhanced capacity to retain groundcover would maintain if not improve the quality of water leaving the site and slow flow velocities.

The solar farm would not create vast areas of impermeable surface that would generate significant runoff. As noted above, the solar farm could result in be more efficient water entry and better rainfall storage efficiency. Internal access roads and compounds around the substation and energy storage system would be unsealed gravel and permit infiltration. Solar panels (whilst impermeable) do not create an impermeable surface as the ground underneath the solar panels would be grass. Stormwater can drain freely from the panels onto the underlying ground which remains impermeable, with the columns supporting the panels increasing the catchment roughness.

A study by Cook and McCuen (2013) *Hydrologic Response of Solar Farms* in the Journal of Hydrologic Engineering concluded that providing the underlying ground remains impermeable, solar panels do not have a significant effect on surface runoff volumes, peak flows or time to peak.

Potential impacts to water quality are really restricted to the construction phase and can be readily managed through installation and maintenance of standard erosion and sedimentation control measures. Post-construction, as a land use, a solar farm presents less potential risk to water quality than conventional primary production. With returns driven by passive harvesting of sunlight as opposed to primary production, ground disturbance will be significantly less, there will be less need for fertiliser inputs, there can be relatively less grazing pressure, and there would be less herbicide/pesticide/fungicide applications compared to dryland cropping.

There is no intent or need for any volumetric water licencing requirement. No water entitlement is needed or required to be purchased.

13.2.2 GROUNDWATER

Subsurface works would be limited to trenching (typically one metre depth), shallow excavation for foundation and hardstand for the substation and inverter assemblies, and driving array posts (<3 m) into the ground. The prospect of interfering with any groundwater resource through inflow or seepage is negligible. There is no requirement or intent to source groundwater for either construction or operation of the QPSF. The development does not involve any aquifer interference activity pursuant to the *NSW Aquifer Interference Policy.* No groundwater monitoring is proposed, or warranted.

13.3 MITIGATION MEASURES

13.3.1 CONSTRUCTION

Prior to works commencing a Construction Environmental Management Plan (CEMP) will be prepared. Notwithstanding that the very flat nature of the site negates the need for extensive earthworks, and the absence of any mapped waterway or drainage line within the development site, the CEMP will include a soil and water sub-plan that will provide detail on the erosion and sediment controls that will be employed throughout the construction phase.

Erosion and sedimentation impacts associated with construction can be minimised by undertaking works in accordance with provisions of the *Managing Urban Stormwater: Soils and Construction* series, in particular:

- *Managing Urban Stormwater: Soils and Construction*, Volume 1, 4th edition (Landcom 2004), known as 'the Blue Book'.
- *Volume 2A Installation of Services* (DECC, 2008a).
- *Volume 2C Unsealed Roads* (DECC, 2008b).

The soil and water sub-plan would be prepared in consultation with DPI – Water.

In addition to the above, the following measures would be implemented during construction.

- Storage, handling and use of any potentially hazardous materials (eg. fuel) would be in accordance with the WorkCover NSW *Guideline for Storage and Handling of Dangerous Goods* (2005).
- Activities with the potential for spills (refuelling) would not be undertaken within 50 m of any of the farm dams and a suitable spill response and containment kit will be available on site whenever and wherever this type of higher risk activity is undertaken.

13.3.2 OPERATIONS

Prior to operations an OEMP will be prepared. A key sub-plan within the OEMP will be procedures for maintaining a groundcover across the farm. The absence of groundcover would increase the potential for sediment laden run-off leaving the site. Whilst managing the fuel load (ie. groundcover) will be important for managing bushfire risk, overgrazing and creating areas denuded of any vegetative cover need to be avoided. The long term performance measure is to establish a healthy, self-sustaining, noxious weed free groundcover over the entire 470 ha property that does not create a fuel hazard. How this can best be achieved, and maintained, through a combination of mechanical slashing and/or periodic crash grazing will require monitoring and implementation of adaptive management principles.

Specifically, this will entail adapting the frequency, duration and intensity of crash grazing, and the timing of any mechanical slashing, to suit and accommodate the prevailing seasonal conditions. It will also require regular inspection across the site following intense rainfall events to check that drainage is stable and localised scouring hot-spots are not appearing.

Adaptive management principles will, however, be driven by the performance measure of maintaining a groundcover rather than agricultural production. That is, in a bad run of seasons when vegetative growth may be negligible and fuel load reduction is not needed, stock grazing would not be undertaken.

Risks and Hazards

14.1 INTRODUCTION

The SEARs requires that hazards and risks associated with the QPSF be considered through conduct of a preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and an assessment of all potential hazards and risks including, but not limited, to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure.

14.2 RISK SCREENING

A preliminary risk screening of the development, including the proposal to provide battery storage, conducted in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and *Applying SEPP 33* (DoP, 2011), indicates that the QPSF is not potentially hazardous and does not trigger the need for a Preliminary Hazard Analysis (PHA).

The SEPP 33 risk screening procedure is based on the quantity (and in some circumstances the location) of dangerous goods stored on-site, or the quantity and frequency of dangerous goods transported to the development. The guidelines require goods to be classified according the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code). A development which exceeds screening thresholds in the guidelines would be considered potentially hazardous and a PHA would need to be submitted with the development application. For quantities below the given thresholds the SEPP indicates that there is unlikely to be a significant off-site risk.

The dangerous goods to be stored at QPSF will be limited to Lithium-ion batteries (Class 9) and compressed non-flammable, non-toxic fire suppression gas (Class 2.2).

Both Class 9 and Class 2.2 dangerous goods are excluded from the risk screening requirement. The reasons for their exclusion are listed below:

- Class 2.2 — are non-flammable, non-toxic gases and are not considered to be potentially hazardous with respect to off-site risk.
- Class 9 — are miscellaneous dangerous goods, which the Guidelines state pose little threat to people or property. It is also noted in the guidelines that they may be substances which pose an environmental hazard, and the consent authority should consider whether or not a potential for environmental harm exists. These latter risks are discussed in **Section 14.4**.

The proposed QPSF is therefore not potentially hazardous and a PHA is not required.

Notwithstanding, WorkCover NSW must be notified, and manifests and emergency plans must be developed if more than 10 kL of Class 2.2 or 10 T of Class 9 dangerous goods is held on-site.

14.3 BUSHFIRE RISK

The development site is not mapped as bushfire prone land. The *Rural Fires Act 1997* places a duty of care on all land managers/owners to prevent a fire spreading on or from their land. This duty of care for the QPSF will be addressed through three stages, covering farm design, construction and operation. Further detail is provided in **Section 14.6**.

14.4 POTENTIAL HAZARDS

An energy storage system introduces potential hazards. Different battery storage systems have different design features and attributes built into their technology to prevent, minimise and contain potentially hazardous incidents. Suppliers of proprietary technology typically also have documented Emergency Response Guides.

Battery subassemblies are made up of rechargeable sealed lithium-ion cells similar to rechargeable batteries in consumer products. Cells are individually, hermetically sealed cylinders and contain lithium-ion electrodes and electrolyte. The cells do not contain metallic lithium.

As a battery is a source of energy an internal or external short circuit can cause overheating and provide an ignition source resulting in fire. Under normal conditions of use, the electrode materials and electrolyte they contain are not exposed, provided battery integrity is maintained and seals remain intact. Risk of exposure may occur only in cases of abuse (mechanical, thermal, electrical).

Potentially hazardous incidents include leaked battery pack coolant; leaked refrigerant; leaked cell electrolyte; rapid heating of individual cells due to exothermic reaction of constituent materials (cell thermal runaway), venting of cells and fire. Cell vent gases would be hot and likely flammable and could ignite on contact with an ignition source such as an open flame, spark or sufficiently heated surface.

Safeguards are built into the system design to keep the batteries safe and secure from abuse conditions. For example, all of the constituent component battery cells are sealed within metal enclosures, and these enclosures are then installed in a rigid external metal enclosure which is isolated from high voltage. Thermal control systems maintain battery cells at acceptable temperatures.

14.5 ELECTROMAGNETIC FIELDS

Electric and magnetic fields (EMF) are produced naturally as well as by human activity. The earth has both a magnetic field, produced in the earth's core, and an electric field, produced by electrical activity like storms in the atmosphere. Electrical equipment of all sizes and voltages produces EMF. Both fields drop away rapidly with distance from the source, or due to shielding by insulation or earth (in the case of buried installations).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has issued *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields*. The relevant authority in Australia is the Australian Radiation Protection and Nuclear Safety Agency (ARPNSA) and they refer to the ICNIRP guidelines. These supersede earlier guidelines published by National Health and Medical Research Council (NHMRC).

The ICNIRP EMF guidelines provide relevant limits for the general public for 50 Hz sources as follows:

- Electrical Field Strength (E): 5 kilo Volts per metre (kV/m)
- Magnetic Flux Density (B): 200 micro Teslas (µT)

EMF increases with voltage and proximity to the apparatus producing, transmitting or consuming electricity. EMF varies according to specific design and construction parameters such as conductor height, electrical load and phasing, and most importantly, whether the conductors are overhead or buried.

On the site of the QPSF the various EMF generating components would be the PV panels (1000-1500 V DC), the interconnecting buried cables (400 V), the direct to AC inverters (1000 V DC to 400 V AC), step up transformers to 33 kV AC, the buried 33 kV cables in the collection system, the 132 kV/33 kV substation equipment and overhead 132 kV cable connecting to the TransGrid substation.

Underground cables produce magnetic fields only as the electric field is shielded by the earth and is not detected at ground level. Above ground equipment will produce both magnetic and electric fields.

The components of QPSF that will emit the highest EMF are the 132 kV site substation and the 132 kV line connecting to the Essential Energy 132 kV line. However, the substation will not produce a significant electric field outside its boundary because of screening provided by the perimeter fence.

Equipment inside the substation will produce magnetic fields, however the field falls with distance quite rapidly, and at the perimeter fence or a few metres outside it, the magnetic field from inside the substation is usually approaching background levels. The largest magnetic fields round the perimeter of the substation almost certainly come from the overhead lines and underground cables entering it[2].

UK National Grid demonstrate that the magnetic field levels emitted from a 132 kV substation are well below the relevant limit identified above at all locations in and around the substation.

Figure 28 shows typical electric fields emitted by a 132 kV overhead line. The figure shows that even the maximum magnetic field level is less than 3 kV/m immediately under the line which is well under the ICNIRP EMF guideline limit of 5 kV/m.

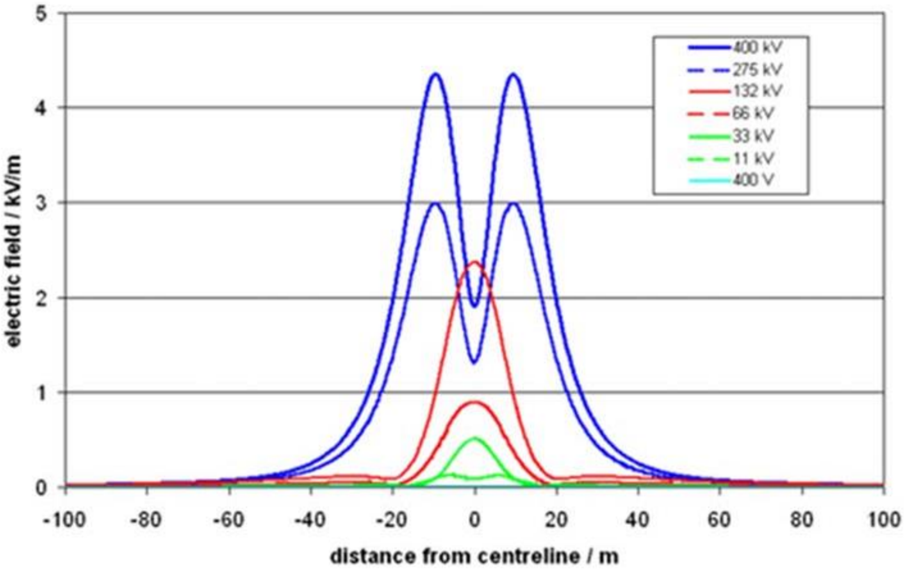

Figure 28: Typical Electric Field Limits (EMF, 2017)

[2] http://www.emfs.info/sources/substations/substations-ng

Figure 29 show the range of comparative magnetic field levels measured by the ARPANSA around powerlines compared to inside homes. The existing and proposed overhead powerlines are less than the recommended 200µT limit even if directly underneath the powerline.

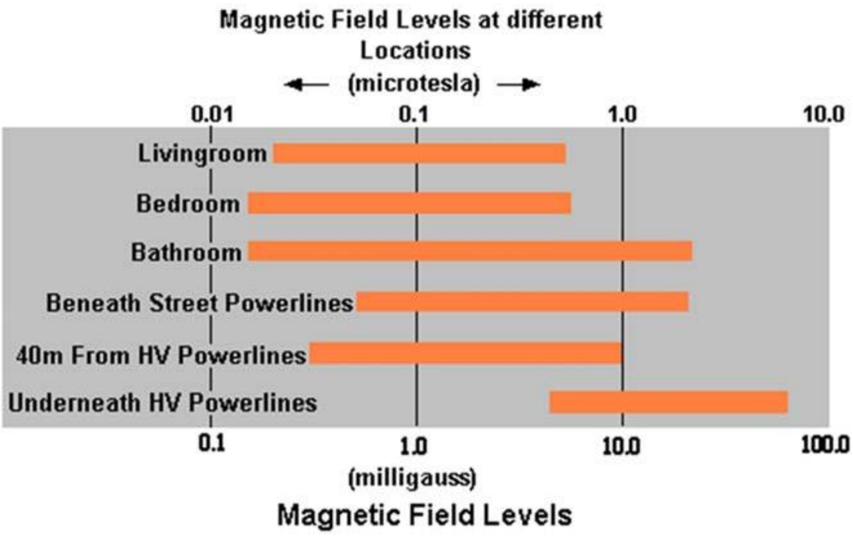

Figure 29: Typical Magnetic Field Levels (ARPANSA, 2015)

The QPSF will be operated as a commercial power generation facility. It will not be open to the general public. The closest house is located in excess of 500 m distant from the electrical equipment, and at that distance EMF emission levels will be no higher than what currently exist. Workers on the site will be appropriately trained notwithstanding that emission levels are extremely low.

14.6 MITIGATION MEASURES

14.6.1 INTRODUCTION

Measures to be implemented to avoid, minimise and be in a position to effectively and safely manage potential risks and hazards associated with the development include consultation with both the NSW Rural Fire Service (RFS) and Fire and Rescue NSW (FRNSW):

- during detailed design;
- during construction; and
- prior to commencement of operations (ie. export of electricity into the grid);
- during operations.

Detail on the intent, scope and outcomes of these consultations is provided below.

14.6.2 DETAILED DESIGN

As detailed design progresses, equipment suppliers selected, and the solar farm infrastructure layout is refined, it is proposed to consult with both the RFS and FRNSW. The intention of this consultation will be twofold.

1. To provide detail on the technology proposed (eg. the energy storage system to be installed) and the proposed farm layout to allow (if necessary) design refinement to incorporate any specific requirements the RFS/FRNSW may have.
2. To provide the requisite information that will be needed to prepare an Emergency Response Plan (ERP).

In terms of design principles to minimise risk, the farm layout will be designed to:

- provide a defendable space around infrastructure;
- ensure that appropriate access, egress and manoeuvrability within the solar farm is provided for first responders;
- provide for ongoing management and maintenance of bush fire protection measures; and
- ensure that services are adequate to meet the needs of firefighters.

14.6.3 CONSTRUCTION

- Prior to construction commencing contact will be made with the Local Brigade of the RFS and details about the construction schedule, contact numbers and site access arrangements will be shared.
- Two (2) 10 kL tanks, being Static Water Supplies dedicated exclusively for fire fighting purposes, will be located strategically around the site and appropriately plumbed for the duration of construction.
- The fuel load over the site prior to and during construction will be monitored and reduction measures implemented as required. These measures will be restricted to mechanical slashing or stock crash grazing.
- The following work practices would be implemented throughout construction:
  - No burning of vegetation or any waste material would take place on site;
  - Fire extinguishers will be available in all vehicles;
  - During the bushfire season (October to March) the fire danger status would be monitored daily (through the RFS website http://www.rfs.nsw.gov.au) and communicated to personnel;
  - Total Fire Ban rules will be adhered to. That is, RED (and any of its contractors) will not:
    - (in any grass, crop or stubble land) drive or use any motorised machine unless the machine is constructed so that any heated areas will not come into contact with combustible matter;
    - carry out Hot Works (eg. welding operations or use an angle grinder or any other implement that is likely to generate sparks), unless the necessary exemption from the RFS Commissioner has been obtained and work complies with all requirements specified in the exemption; and
- Any fuel or flammable liquid would be stored in a designated area and will be sign posted “Fuel Storage Area.”
- A register will be maintained that confirms the quantities and location of any flammable material stored on-site.

14.6.4 PRIOR TO OPERATIONS

The QPSF is located within a RFS Fire District. Notwithstanding, in the event of a significant fire event (either within the QPSF site or in close proximity to the solar farm), FRNSW will either assist the RFS or fulfil the role of designated combat agency. Either the RFS and/or FRNSW would be first responders.

Should a fire occur during the operational life of the QPSF it is recognized as important that the first responders have ready access to information which enables effective and safe control measures to be rapidly implemented.

Given the potential for electrical hazards associated with an energy generating facility, and potential risks to firefighters, both FRNSW and the RFS must be able to implement effective and appropriate risk control measures when managing an emergency incident in order to safely mitigate potential risks (including electrical hazards and venting electrolyte) to firefighters.

The detail required to prepare this plan will be contingent on the equipment proposed (eg. the type of battery storage system) and the farm layout and services. These features, as identified in **Section 14.6.2**, would have been communicated to and refined in consultation with both RFS and FRNSW during detailed design. As such, the operator of the QPSF will have had the information required to prepare an Emergency Response Plan (ERP) prior to commencement of operations (ie. export of electricity into the grid).

14.6.4.1 Emergency Response Plan

The ERP will address foreseeable on-site and off-site fire events and other emergency incidents (eg. fires involving solar farm infrastructure and equipment, bushfires in the immediate vicinity).

The ERP will detail the appropriate risk control measures that would need to be implemented in order to safely mitigate potential risks to the health and safety of firefighters, including electrical hazards. These measures would include the level of personal protective clothing required to be worn, the minimum level of respiratory protection required, minimum evacuation zone distances and a safe method of shutting down and isolating the solar farm (either in its entirety or partially, as determined by risk assessment). The ERP would also include any other risk control measures that may need to be implemented in a fire emergency due to any unique hazards specific to the farm.

Two copies of the ERP would be stored in a prominent *Emergency Information Cabinet* located in a position directly adjacent to the site's main entry.

The operator of the QPSF would then make contact with the relevant local emergency management committee (LEMC) and provide a copy of the ERP.

14.6.5 DURING OPERATIONS

Unmanaged grasslands can create a bushfire risk hazard. The performance measure for managing the bushfire risk will be to operate the QPSF and maintain the site in such a manner that no grass fire originates from within the QPSF site, and/or any approaching bushfire does not intensify as a consequence of entering the QPSF site because of excessive fuel loads.

The fuel load over the QPSF property will be constantly monitored and fuel load reduction measures implemented as required. These measures will be either mechanical slashing or crash grazing (sheep). Procedures for ensuring this outcome and demonstrating active management of the fuel load will be specified in the OEMP.

Hazard reduction burning is not proposed.

Air

15.1 CONSTRUCTION IMPACTS

Potential adverse air quality impacts associated with the solar farm are restricted to the construction phase. Any activity that entails the use of plant and equipment on soil has the potential to generate localised dust emissions.

These impacts can, however, be readily managed through the adoption of suitable mitigation measures during the construction effort. Such measures would include:

- Restricting vehicle movements and ground disturbance to the minimum area that is safely practicable.
- Undertaking dust suppression through strategic watering, as required.
- If necessary, temporary cessation of some works during excessively dry and windy conditions.

15.2 OPERATIONAL IMPACTS

The change in land use from cropping to a solar farm will reduce the potential for localised particulate emissions from this land. The principal source of dust is ground disturbance and wind exposure to an un-vegetated ground surface. In this context cropping (inclusive of bed preparation, sowing and harvesting) provides a greater risk exposure of fugitive particulates than a solar farm.

With the financial return on the land asset driven principally by passive harvesting of solar energy above ground, rather than broad acre farming and the associated periodic ground disturbance and changes to groundcover, the retention of groundcover over the site will be comparatively easier to maintain. As a source of particulates and localised dust emissions the solar farm will, in comparative terms, be a land use that has the potential to improve local air quality.

From a broader perspective the QPSF, with a maximum capacity of 80 MW_{AC}, will generate an estimated 200,000 megawatt hours (MWh) of electricity annually.

Indirect emissions of GHG are emissions generated in the wider economy as a consequence of an organisation's or individual's activities (particularly from its/their demand for goods and services), but which are physically produced by the activities of another organisation. The most important category of indirect emissions in Australia is from the consumption of electricity.

To this end the Department of Environment's (DoE) Australian National Greenhouse Accounts specifies indirect emission factors to calculate GHG emissions from the generation of electricity purchased and consumed as kilograms of carbon dioxide equivalent (CO_2e) per unit of electricity consumed (kgCO $_{2-e}$/kWh). For NSW the indirect emission factor for the consumption of purchased electricity from the grid is 0.82 kgCO_{2-e}/kWh (DoEE, July 2018).

Generating 200,000 MWh/year of electricity equates to a savings of approximately 164,000 tonnes of GHG a year.

Socio-Economic

16.1 RENEWABLES INDUSTRY

The *Central West and Orana Regional Plan* (DPE June 2017) presents a vision for a sustainable future for the Central West and Parke's region by growing and diversifying the economy over the next 20 years. Managing the region's energy resources sector in a sustainable way is identified as a key strategy for attaining the goal of a growing and diverse regional economy; where renewable energy industries are a sector that has significant economic and employment benefits for the region.

In its March 2018 submission to the Integrated System Plan consultation paper released by the Australian Energy Market Operator (AEMO) the NSW Government stated that the development of Energy Zones in NSW could encourage investment in new electricity infrastructure and unlock additional generation capacity to meet the state's evolving energy needs; help ensure a secure and reliable energy future in NSW and place downward pressure on wholesale energy prices and support regional development. To NSW Government commissioned independent geospatial analysis to identify potential Energy Zones in NSW. Parkes, and the proposed QPSF, is located in one of these zones.

The submission states these zones align with the Government's regional growth priorities, developed in consultation with regional communities, and offer cost-effectiveness due to proximity to transmission infrastructure and load centres; thereby encouraging efficient investment in locations where investors have demonstrated interest and community's support for renewable energy projects is identified through the Regional Plans.

More recently, in November 2018 the NSW Government's *NSW Transmission Infrastructure Strategy* reaffirmed this part of the State as the Central West Energy Zone.

16.2 LOCAL IMPACTS

The QPSF will generate local employment opportunities. At its peak construction will require up to 100 staff. Roles will vary from highly skilled electricians able to work with solar PV (LV and HV) to general labourers.

The project will bring economic benefits to Parkes in the form of new investment, ongoing revenue from operations, business opportunities for local suppliers and skills development opportunities for local workers.

Parkes is a prosperous and growing regional service centre that can readily accommodate the QPSF construction workforce without straining existing services or infrastructure. The QPSF would not increase demand on PSC's public amenities or services.

Waste Management

17.1 INTRODUCTION

Waste generation associated with the QPSF will be mainly restricted to the construction phase. Once operational the farm will not routinely generate any waste.

17.2 CONSTRUCTION

Solid waste generated during construction would include packaging materials, metal off-cuts, cabling, excess building materials, general refuse and other non-putrescible general solid wastes.

General refuse would be stored in secure covered skips. Dry port-a-loos would be provided for amenities throughout construction negating the need for on-site domestic sewage treatment.

17.3 OPERATIONS

The farm will operate independently and no permanent employees will be stationed on-site, apart from routine maintenance program operators that will only visit the farm when responding to performance issues.

17.4 RECOMMISSIONING/DECOMMISSIONING

The design life of the PV modules will be at least 30 years. At the end of their useful life modules and electrical equipment will be either replaced and the farm re-commissioned, or the farm will be decommissioned and the site returned to agricultural land use.

Recommissioning would involve removal of any obsolete equipment such as modules and inverters. Opportunities for recycling this equipment will be investigated at the time, with off-site lawful disposal at an approved waste management facility the fall back option.

Decommissioning would entail removing the grid connection infrastructure, including the interconnecting cable and substation equipment. Again, opportunities for recycling this equipment will be investigated at the time, with off-site lawful disposal at an approved waste management facility the fall back option.

Foundations would be broken up and removed off site. Modules and the racking system would be removed and it could be expected that a significant amount of the support structure could be reused or recycled off-site. Piles will be lifted out of the ground and recycled wherever possible. Cables are also likely to be worth removing and recycling. However underground cables which are deeper than 800 mm below ground level, and are stable and inert, may be left buried to avoid unnecessary ground disturbance. At this depth, leaving cabling in the ground would not impinge future farming.

The site control room and facilities would be lifted off their foundations and transported off site on flatbed trucks.

17.5 MITIGATION MEASURES

A Waste Management Sub-Plan will be prepared and form part of the CEMP prior to construction commencing. This sub-plan will include tracking of all waste leaving the site, identifying the waste classification, quantities and fate of materials to be recycled or disposed of.

Cumulative Impact

18.1 INTRODUCTION

The potential for cumulative impacts cover visual amenity, loss of agricultural land and amenity and traffic impacts associated with simultaneous construction activities.

Due to QPSF's location, existing vegetation and topography screening, only R2 would be likely to see another solar farm in addition to QPSF. R2's views to GSF and PSF are greater than 3.3km. There is therefore negligible cumulative visual impact from QPSF.

18.2 USE OF AGRICULTURAL LAND

Changing the land use of the development site from an agricultural use (whether it be for 30 years or forever) will not significantly diminish the productivity of the region in terms of primary production capabilities (refer **Section 9.4.1**).

In considering cumulative impact it is noted that the Parkes LGA is home to the built ~210 ha Parkes Solar Farm (PSF) and the DPE approved ~295 ha Goonumbla Solar Farm (GSF), both located to the south (refer **Figure 2**). The development site for the PQSF (Lot 508 DP 750152) is 470 ha. In terms of built, approved and proposed utility scale solar generation this represents a cumulative footprint of 970 ha.

No other utility scale solar farms are known for the locality. A search of DPE's major projects website (December 2018) does not list any SEARs requests for a solar farm for the Parkes LGA.

It is also relevant to note that QPSF has been sized to take advantage of the available capacity in the transmission network. The network has a limited capacity to connect new generation, typically determined by the thermal limits of cables and equipment.

With the 80 MW_{AC} QPSF, 56 MW_{AC} PSF and 70 MW_{AC} GSF, the network in the Parkes region will reach capacity. Any further generation in the region would require upgrades to the lines and equipment in the network and there are no such plans. TransGrid's published plans do not include upgrades in the region.

18.3 CONSTRUCTION ACTIVITY

The construction schedules for the GSF and QPSF do not coincide. The GSF is due to be constructed from the first quarter of 2019 and should be completed within approximately nine months. The GSF will have been built before QPSF moves to construction. The earliest likely date for commencing construction of QPSF would be the first quarter of 2020.

The first stage of the Inland Rail project is underway with track upgrades and construction of new track and a siding. This stage is expected to be completed by February 2019. There is no information on the timing of subsequent stages of the development. Although the scope of work is expected to be extensive, it will be staged and therefore may not coincide with QPSF construction traffic. Regardless of timing the location of the logistics terminal is between the Henry Parkes Way and Brolgan Road; some 4 km distant from the QPSF.

System Security and Reliability

19.1 REQUIREMENT

In May 2018 the DPE issued an *Electricity System Security and Reliability Environmental Assessment Requirement* factsheet, encouraging electricity generation project proponents to support electricity system security and reliability through project design. The factsheet notes that a way of demonstrating this is consideration of the capability of the project to contribute to the security and reliability of the electricity system, having regard to local system conditions.

The NSW Government has determined that it is appropriate that proponents of new electricity generation projects in NSW consider system security and reliability at the planning stage as this will:

- Encourage upfront consideration of the energy security and reliability capabilities that a project proponent could include in their project design.
- Support a smooth and orderly transition to a secure, reliable and modern energy system.

19.2 APPROVING AUTHORITY

The requirements for new generators to meet system security and reliability standards are issued by the Australian Energy Market Operator (AEMO). Their requirements continue to evolve as the generation mix and the operation of the network transition to a greater proportion of distributed renewable fuel sources. AEMO is a key stakeholder in the process of connecting QPSF to the network.

QPSF will meet the network's system security and reliability requirements for a number of reasons.

The proponents of the development have decades of experience in developing renewable energy projects in Australia and overseas. They are aware of the technical standards and the network operator's requirements for new generators connecting to the national electricity network (NEM). They have successfully negotiated connection agreements for several windfarms and solar farms elsewhere in the NEM, most recently four solar farms in New South Wales and Queensland which were required to meet AEMO's current system strength requirements.

The proponents have negotiated connection of the Goonumbla Solar Farm to the Parkes substation and know the technical operating parameters of the local network well. Through the connection process for Goonumbla Solar Farm RED developed a sound working relationship with TransGrid and Essential Energy.

Discussions are already underway with TransGrid and Essential Energy on the connection requirements for QPSF. A connection enquiry has been submitted and an engineering consultant has been engaged to model the network and design the connection. This includes liaising closely with TransGrid/Essential Energy and AEMO to ensure the latest system strength and reliability requirements are incorporated into the performance standards in the connection agreement.

AEMO is the final approving authority for the network connection and the facility cannot generate without their approval. There is a compelling commercial reason therefore to meet their standards.

19.3 FARM TECHNOLOGY

QPSF will meet system security and reliability requirements through a number of ways.

The inverters are the key pieces of equipment that affect the solar farm's ability to meet AEMO's performance standards. The solar farm will be modelled extensively with the cooperation of the inverter manufacturer's technical team in order to demonstrate that the equipment controller operates in a way which meets the National Electricity Regulations (NER) in all scenarios. Modelling the inverters and their interaction with the network is rigorous and comprehensive. AEMO, TransGrid/Essential Energy, the inverter manufacturer's technical team and RED's electrical engineering consultants apply their learning from other projects in order to continually refine the models and their approaches in order to meet ever more stringent performance requirements.

There are a number of components to the solar farm which will contribute to additional network support should it be required. The inverters provide active and reactive power support and may be operated in a variety of modes depending on the particular requirements of the network. In some cases, inverters are able to provide reactive power support during night time hours if needed.

Battery storage is a part of the application for consent for the QPSF. Battery storage can provide support by shifting energy to times of peak demand and providing frequency regulation. Early installations of batteries elsewhere in the NEM have demonstrated their ability to provide extremely rapid response network services. While the development application includes the provision of battery storage, the final decision on whether it would be included in the construction of facility will be determined by a thorough technical and commercial assessment. Battery storage may be added to the facility sometime after operations at the facility commence.

In some cases, additional equipment such as static var compensators or synchronous condensers are required in the facility substation in order to meet system strength requirements. In general, these are only included in the rare circumstances where the facility is unable to meet NER requirements as they are extremely costly and can have a highly negative impact on the commercial rationale for the project.

Mitigation Measures

20.1 INTRODUCTION

This section of the EIS provides a consolidated summary of all proposed safeguards and environmental mitigation measures that form part of the proposed development. It collates all commitments made in this EIS and includes a description of the measures that would be implemented to monitor and report on the environmental performance of the development.

20.2 ENVIRONMENTAL MANAGEMENT STRATEGY

Prior to the commencement of construction, the RED will prepare an Environmental Management Strategy for the development to the satisfaction of the Secretary. This strategy will:

(a) provide the strategic framework for environmental management of the development;

(b) identify the statutory approvals that apply to the development;

(c) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;

(d) describe the procedures that would be implemented to:

- keep the local community and relevant agencies informed about the operation and environmental performance of the development;
- receive, handle, respond to, and record complaints;
- resolve any disputes that may arise;
- respond to any non-compliance;
- respond to emergencies; and

(e) include:

- copies of any plans approved under the conditions of consent; and
- a clear plan depicting all the monitoring to be carried out in relation to the development.

Following the Secretary's approval, the RED will implement the Environmental Management Strategy.

In general terms, the strategy will be to avoided, minimised and managed potential environmental impacts through adoption of mitigation measures incorporated into all phases of the project, including:

- Detailed design;
- Construction;
- Operations; and
- Either decommissioning or recommissioning.

The approach for ensuring commitments are acted upon will be to prepare a number of management plans at relevant stages of the development. These will include:

- Construction Environmental Management Plan (CEMP);
- Operations Environmental Management Plan (OEMP); and either
- Decommissioning Management Plan (DMP); or
- Recommissioning Management Plan (RMP).

These management plans will include, but may not be restricted to, inclusion of all relevant safeguards and environmental mitigation measures identified in this EIS (and any associated Conditions of Approval). The timing and scope of these management plans is detailed below.

20.3 DETAILED DESIGN

20.3.1 RISK MANAGEMENT

As detailed design progresses, equipment suppliers selected, and the solar farm infrastructure layout is refined, it is proposed to consult with both the RFS and FRNSW. The intention of this consultation will be twofold.

1. To provide detail on the technology proposed (eg. the energy storage system to be installed) and the proposed farm layout to allow (if necessary) design refinement to incorporate any specific requirements the RFS/FRNSW may have.

2. To provide the requisite information that will be needed to prepare an Emergency Response Plan (ERP).

In terms of design principles to minimise risk, the farm layout will be designed to:

- provide a defendable space around infrastructure;
- ensure that appropriate access, egress and manoeuvrability within the solar farm is provided for first responders;
- provide for ongoing management and maintenance of bush fire protection measures; and
- ensure that services are adequate to meet the needs of firefighters.

20.3.2 OFFSETTING CREDITS

The biodiversity assessment undertaken is based on an assumed development footprint that could, as detailed design progresses, be further refined and result in less biodiversity impact, and therefore less offset credit obligations.

In this scenario a recalculation of the requisite credit obligations would be prepared in accordance with the biodiversity offset framework and a commensurate reduction in credit obligations would result.

20.4 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

Prior to construction commencing a CEMP will be prepared. The CEMP will document the environmental procedures and controls that would be implemented throughout construction. The CEMP would describe the role, responsibility, authority and accountability of all key personnel involved in construction and detail all monitoring that would be undertaken.

The CEMP would comprise various sub-plans detailing the specific mitigation measures that would be implemented to avoid and manage potential environmental impacts. These would include plans covering biodiversity, Aboriginal heritage, soil and water protection, dust, noise and vibration, waste management, and bushfire prevention. Mitigation measures relevant to these issues, as identified in this EIS, are detailed below.

20.4.1 LANDOWNER CONSULTATION

- Early, regular and honest consultations with neighbours and CWLLS will be a core commitment.

20.4.2 TRAFFIC MANAGEMENT

20.4.2.1 Road Upgrades

Prior to the commencement of construction the:

- intersection of Henry Parkes Way and McGraths Lane would be upgraded to the satisfaction of the RMS and PSC; and
- a pre-conditions survey of McGraths Lane and Back Trundle Road would be completed and provided to PSC.

20.4.2.2 Site Access

- All vehicular traffic associated with the development would travel to and from the site via Henry Parkes Way. McGraths Lane and Back Trundle Road.
- Prior to the commencement of construction the property entry point off Back Trundle Road would be constructed to the satisfaction of PSC with a Rural Property Access type treatment to cater for the largest vehicle accessing the site, in accordance with the *Austroads Guide to Road Design* and PSC *Engineering Guidelines - Subdivisions and Development Standards*.

20.4.2.3 Traffic Management Plan

A Traffic Management Plan (TMP) will be developed in consultation with the Parkes Shire Council and Roads and Maritime Service prior to the commencement of construction. The TMP will identify and provide management strategies to manage the impacts of projected related traffic including:

- Haulage of materials to site.
- The safe transportation of construction workers to site and return. In this regard, Roads and Maritime will require specific details on how the proponent will ensure the identified management measures employed to ensure the safety of staff travelling to and from the site each day will be controlled and enforced.

The TMP would include details on the following:

- Construction timeframe and staging of works,
- Measures to consult with other road users to minimise impacts (eg. liaison with school bus operators).
- Confirmation of anticipated additional traffic volumes generated by the farm,
- Confirmation of final HV and OD vehicle haulage routes to be used for all delivery vehicles,
- A process to review haulage route road conditions prior to the commencement of works,
- A process to carry out pre and post construction road dilapidation surveys to ensure McGrath Lane and Back Trundle Road roads are reinstated to pre-construction conditions,
- Requirements for any additional TMP(s) required for a specific work stage/process (e.g. delivery of oversize components),
- Qualify and identify any relevant mechanisms for OD vehicle permits and traffic management requirements.

20.4.3 SOIL AND WATER MANAGEMENT PLAN

- A Soil and Water Management Plan that complies with *Managing Urban Stormwater: Soils and Construction, 4th Edition* (Landcom, 2004) will be prepared.

20.4.4 SOIL RESOURCE MANAGEMENT

20.4.4.1 Baseline Data

- Immediately prior to construction activity commencing representative soil samples will be collected from the five test pit locations to establish baseline data on the pre-existing agronomic characteristic of the soil resource. This would include sampling for soil texture and structure, nutrients, acidity and organic matter.

20.4.4.2 Site Preparation

- Undertake 0-15 cm soil testing to provide a detailed map to inform lime application rates and ascertain the need or not for gypsum treatment if there is a sulphur deficiency.
- Apply lime to provide an enhanced capacity to establish and maintain groundcover. If possible, use non-inversion cultivation at a depth of 15 cm to thoroughly mix the lime with acidic topsoil.
- Establish and maintain perennial pasture that includes a balanced mix of grasses, legumes and herbs. Establishment of the pasture prior to installation (where practicable) will assist minimise that risk of soil erosion associated with construction soil surface disturbance.

20.4.4.3 During Construction

- Where possible, restrict traffic to clearly defined tracks, rather than having random unguided traffic creating compaction over a large proportion of the site.
- Minimise serious compaction by restricting construction activities during wet weather.
- Where deep trenching occurs for cable installation, aim to refill the trenches with subsoil first then topsoil.

20.4.5 INCIDENT MANAGEMENT

- Adequate procedures would be established including notification requirement to the Appropriate Regulatory Authority and other relevant authorities for any incident that causes or has the potential to cause material harm to the environment.

20.4.6 WEED MANAGEMENT

Weed management principles must include:

- All machinery, equipment and vehicles brought onto a property would be free of soil, seed or plant material.
- Declared noxious weeds must be managed consistent with the *Biosecurity Act 2015*.

20.4.7 ABORIGINAL HERITAGE

20.4.7.1 Avoidance of Impact

- Sites that are able to be avoided will be clearly identified in the field and clearly shown on plans to avoid inadvertent impacts.

20.4.7.2 Aboriginal cultural Heritage Management Plan

- An Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared in consultation with the RAPs. The ACHMP will include the protocols for surface artefact salvage and site protection.

20.4.7.3 Surface Artefact Collection

Recorded sites that could be impacted during construction/operation would be salvaged. Stone artefact sites managed under this archaeological salvage will have surface artefacts mapped, catalogued, selectively photographed, collected and moved to safe-keeping.

The surface artefact collection will include the following methodology.

- All visible artefacts at a site should be flagged in the field;
- The site should be photographed after flagging and before recording;
- All artefacts should have the following artefact information recorded - location; artefact class; artefact type; size; reduction level; raw material;
- A selection of indicative and / or unusual artefacts from each site will be photographed;
- Once all recording is complete, the artefacts will be collected according to site with artefacts from each site being kept separate;
- The recording of the artefacts recovered will largely be completed in the field and this data would be incorporated into a report; and
- The salvaged artefacts should be reburied at an agreed upon location. This will take place in accordance with Requirement 26 “Stone artefact deposition and storage” in the *Code of Practice*. The location chosen for reburial will be an area where future developments will not occur and as close as possible to their original location. A site card will be submitted to Aboriginal Heritage Information Management System (AHIMS) to record the relocation area.

20.4.7.4 Chance Finds Protocol

The below is the protocol to be followed in the event that previously unrecorded or unanticipated Aboriginal object(s) are encountered.

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:

    (a) Not further harm the object;

    (b) Immediately cease all work at the particular location;

    (c) Secure the area so as to avoid further harm to the Aboriginal object;

    (d) Notify OEH as soon as practical on 131 555, providing any details of the Aboriginal object and its location; and

    (e) Not recommence any work at the particular location unless authorised in writing by OEH.

2. In the event that Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and OEH contacted.

3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:

    (a) The recording and assessment of the find(s);

    (b) The fulfilment of any legal constraints arising from the find(s), including complying with OEH directions; and

    (c) The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).

4. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from OEH.

20.4.8 FUEL AND CHEMICAL STORAGE AND MANAGEMENT

- Storage, handling and use of any potentially hazardous materials would be in accordance with the WorkCover NSW *Storage and Handling of Dangerous Goods – Code of Practice* (2005).
- Activities with the potential for spills (refuelling) would not be undertaken within 50 m of any of the farm dams or drainage lines and a suitable spill response and containment kit will be available on site whenever and wherever this type of higher risk activity is undertaken.

20.4.9 WASTE MANAGEMENT

- Suitable waste disposal locations would be identified and used to dispose of litter and other wastes on-site. Suitable containers would be provided for waste collection.
- Work sites would be kept free of rubbish and cleaned up at the end of each working day.
- All waste that cannot be recycled would be disposed at a legally operating waste facility.
- No waste would be burnt or buried on-site.
- All opportunities for recycling would be implemented with the goal of minimising the waste generated by construction.
- All waste would be classified in accordance with the EPA's *Waste Classification Guidelines* and stored and handled in accordance with its classification.
- All waste would be removed from the site as soon as practicable, and ensure it is sent to appropriately licensed waste facilities for disposal.

20.4.10 NOISE AND VIBRATION

Controls to be adopted to minimise the potential for adverse amenity impacts; include:

- Using broad-band reversing alarms on all mobile plant and equipment;
- Examining different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Selecting quieter items of plant and equipment where feasible and reasonable.;
- Operating plant in a quiet and efficient manner;
- Reducing throttle setting and turn off equipment when not being used; and
- Regularly inspecting and maintaining equipment to ensure it is in good working order.

20.4.11 AIR QUALITY

Implementation of the following mitigation measures during construction would minimise potential impacts to air quality:

- Limit the area of soil disturbance at any one time.
- Place and maintain all disturbed areas, stockpiles and handling areas in a manner that minimises dust emissions (including windblown, traffic-generated or equipment generated emissions).
- Where required, utilise dust suppression.
- Where required, minimise vehicle movement and speed.
- Avoid dust generating activities during windy and dry conditions.
- Ensure all construction plant and equipment are operated and maintained to manufacturer's specifications in order to minimise exhaust emissions.
- Restricting vehicle movements and ground disturbance to the minimum area that is safely practicable.
- If necessary, temporary cessation of some works during excessively dry and windy conditions.

20.4.12 BUSHFIRE PREVENTION

- Prior to construction commencing contact will be made with the Local Brigade of the RFS and details about the construction schedule, contact numbers and site access arrangements will be shared.
- Two (2) 10 kL tanks, being Static Water Supplies dedicated exclusively for fire fighting purposes, will be located strategically around the site and appropriately plumbed for the duration of construction.
- The fuel load over the site prior to and during construction will be monitored and reduction measures implemented as required. These measures will be restricted to mechanical slashing or stock crash grazing.
- The following work practices would be implemented throughout construction:
  - No burning of vegetation or any waste material would take place on site;
  - Fire extinguishers will be available in all vehicles;
  - During the bushfire season (October to March) the fire danger status would be monitored daily (through the RFS website *http://www.rfs.nsw.gov.au*) and communicated to personnel;
  - Total Fire Ban rules will be adhered to. That is, RED (and any of its contractors) will not:
    - (in any grass, crop or stubble land) drive or use any motorised machine unless the machine is constructed so that any heated areas will not come into contact with combustible matter;
    - carry out Hot Works (eg. welding operations or use an angle grinder or any other implement that is likely to generate sparks), unless the necessary exemption from the RFS Commissioner has been obtained and work complies with all requirements specified in the exemption; and
- Any fuel or flammable liquid would be stored in a designated area and will be sign posted “Fuel Storage Area.”
- A register will be maintained that confirms the quantities and location of any flammable material stored on-site.

20.4.13 TRAVELLING STOCK RESERVE

- Prior to and throughout construction regular consultation will be undertaken with the CWLLS so both parties are fully aware of their uses of McGraths Lane and the TSR.
- The TSR would not be used to stockpile any materials associated with the QPSF.
- Construction work will not take place at night, avoiding the potential for either light or noise impacts on resting cattle at night.

20.4.14 INDUCTION

- All contractors undertaking any works on-site will, before commencing works, will be inducted on the requirements of the CEMP and their specific responsibilities.

20.5 OPERATIONS ENVIRONMENT MANAGEMENT PLAN

An OEMP will be prepared prior to the QPSF commencing operation. The QPSF will be operational after commissioning and equipment trials and electricity is being loaded into the transmission network.

The OEMP will include procedures, reporting, and the allocation of responsibilities designed to minimise environmental impacts. The OEMP will document the environmental procedures and controls that would be implemented to operate the solar farm as a responsible rural land owner.

The OEMP would comprise various sub-plans detailing the specific mitigation measures that would be implemented to avoid and manage potential environmental impacts and minimise risks. These would include plans covering land management (specifically relating to fuel loads and noxious weeds) and emergency preparedness. Mitigation measures relevant to these issues, as identified in this EIS, are detailed below.

20.5.1 EMERGENCY RESPONSE PLAN

The ERP will address foreseeable on-site and off-site fire events and other emergency incidents and be developed in consultation with both the RFS and FRNSW.

The ERP will detail the appropriate risk control measures that would need to be implemented in order to safely mitigate potential risks to the health and safety of firefighters, including electrical hazards. These measures would include the level of personal protective clothing required to be worn, the minimum level of respiratory protection required, minimum evacuation zone distances and a safe method of shutting down and isolating the solar farm (either in its entirety or partially, as determined by risk assessment). The ERP would also include any other risk control measures that may need to be implemented in a fire emergency due to any unique hazards specific to the farm.

Two copies of the ERP would be stored in a prominent Emergency Information Cabinet located in a position directly adjacent to the site's main entry.

The operator of the QPSF would then make contact with the relevant local emergency management committee (LEMC) and provide a copy of the ERP.

20.5.2 NEIGHBOUR ENGAGEMENT

- Ongoing and honest consultation with neighbours will be a core commitment.
- A procedure will be established for receiving, investigating and reporting any complaint received.

20.5.3 INCIDENT MANAGEMENT

- Adequate procedures would be established including notification requirements to the Appropriate Regulatory Authority and other relevant authorities for any incident that causes or has the potential to cause material harm to the environment.

20.5.4 SOIL RESOURCE

- Soil testing in the upper 30 cm in the vicinity of the five existing test pits will be undertaken on a triennial basis. Parameters sampled and monitored will focus on organic carbon, nutrients, pH and soil structure. This data set will enable improvements in soil fertility to be demonstrate over time.

20.5.5 GROUNDCOVER AND WEED MANAGEMENT

Performance Measure

The long term performance measure for effective groundcover management is to establish a healthy, self-sustaining, noxious weed free groundcover over the solar farm that does not create a fuel hazard.

Unmanaged grasslands can create a bushfire risk hazard. The performance measure for managing the bushfire risk will be to operate the QPSF and maintain the site in such a manner that no grass fire originates from within the QPSF site, and/or any approaching bushfire does not intensify as a consequence of entering the QPSF site because of excessive fuel loads. The fuel load over the QPSF property will be constantly monitored and fuel load reduction measures implemented as required. These measures will be either mechanical slashing or crash grazing (sheep).

Adaptive Management Principles

How this can best be achieved, and maintained, through a combination of mechanical slashing and/or periodic crash grazing will require monitoring and implementation of adaptive management principles.

Specifically, this will entail adapting the frequency, duration and intensity of crash grazing, and the timing of any mechanical slashing, to suit and accommodate the prevailing seasonal conditions. The pasture beneath and near solar panels should only be grazed when the soil is dry and firm enough to avoid compaction via sheep trampling.

Documentation

Each and every time a fuel reduction measure is undertaken relevant details will be recorded to provide a baseline for informing future management decisions. This will include a record of the details of the grazing regime (ie. when sheep arrived, head numbers and when they were taken off the site) or the date of mechanical slashing.

Monitoring

The general health of ground cover across the entire site will be monitored regularly, at times in the season that will provide timely information on weed treatment. Indicators of groundcover conditions in will include:

- Vegetative cover and fuel load;
- Whether there are noxious weeds present;
- Whether landscape plantings are healthy;
- Whether there are any areas denuded of groundcover; and
- Whether there are any signs of localised erosion.

This information will be used to inform decisions about the need, timing and location for any impending fuel reduction or weed treatment.

20.5.6 WASTE MANAGEMENT

- Suitable containers would be provided for waste collection.
- All waste that cannot be recycled would be disposed at a legally operating waste facility.
- No waste would be burnt or buried on-site.

20.5.7 BUSHFIRE PREVENTION

- The fuel load over the entire property will need to be constantly monitored and fuel load reduction measures will be implemented as required. These measures will be limited to either mechanical slashing or stock crash grazing (sheep). Prescriptive specification of the frequency of slashing/grazing is not appropriate as seasonal circumstances will vary.

20.6 DECOMMISSIONING/RECOMMISSIONING

20.6.1 TIMING

Either a DMP or a RMP would be submitted to DPE for approval 12 months before the decommissioning or recommissioning is scheduled to occur.

20.6.2 RECOMMISSIONING MANAGEMENT PLAN

Recommissioning would involve removal of any obsolete equipment such as modules and inverters and disposing off-site according to good practice, including recycling wherever possible.

The technology available at that time would be installed using the existing structures and infrastructure to the extent possible and the farm would be recommissioned.

While the capacity of the solar farm may increase due to intervening technological improvements, the development footprint would not increase.

20.6.3 DECOMMISSIONING MANAGEMENT PLAN

20.6.3.1 Timing and Scope

One year prior to the commencement of decommissioning activities a Decommissioning Management Plan (DMP) would be prepared in consultation with the landholder and submitted for approval by DPE. The DMP would include the following key elements:

- rehabilitation strategies and objectives;
- rehabilitation design criteria;
- productivity targets to ensure the re-establishment of agricultural production (if agreed as the final land use);
- expected timeline for rehabilitation works;
- noise impact assessment; and
- mitigation measures and monitoring.

20.6.3.2 Infrastructure Removal

All above ground infrastructure will be removed and decommissioning would include:

- disconnection of the solar farm from the grid;
- removal of PV modules, mounting posts, mounting frames and trackers;
- removal of all buildings and equipment;
- removal of any underground cabling shallower than 800 mm;
- removal of fencing (unless requested otherwise by the landholder);
- site rehabilitation to render the site fit for resumption of agricultural use.

20.6.3.3 Site Rehabilitation

Following infrastructure removal the following is expected to be undertaken to re-instate the site suitable for agricultural activities:

- removal of gravel from internal tracks and roads (unless requested otherwise by the landholder);
- removal of any concrete and foundations;
- deep ripping of any compacted areas to allow for the infiltration of water and to allow for cropping activities;

- re-establishment of groundcover in any areas where cropping is not to occur to ensure the stabilisation of soil resources;
- establishment of suitable erosion and sediment control measures (if required).

20.6.3.4 Performance Indicators

Soil samples would be collected from those same representative sites from which samples will be collected prior to construction and then triennially during the farm's operational life to validate the health of the soil resource and the associated cropping/grazing productivity of the property.

The prospect that significant remedial works will be required is remote. As detailed in the soils investigation (refer **Appendix E**), an improvement in the soil resource can be reasonably anticipated. Subject to adoption of appropriate mitigation measures prior to and during construction and operation, it is concluded that the triennial soil testing almost certainly will demonstrate an improvement in soil condition under the solar farm relative to the condition of the soil resource as part of an existing dryland crop production system.

Whilst the development removes the land from full primary production potential whilst under a solar farm, as a land use, the solar farm protects and can enhance the value of the soil resource. Performance indicators for validating this will include organic carbon, nutrients, pH and soil structure.

Justification

21.1 STRATEGIC FIT

Under the International Paris Agreement, Australia has committed to reducing GHG emissions by 26% to 28% below 2005 levels by 2030. One of the key initiatives to deliver on this commitment is the Commonwealth Government's RET. Under this target more than 20% of Australia's electricity would come from renewable energy by 2020. There is a high probability that the penetration of renewable energy will far exceed the 20% RET. The opposition Labor Party has a policy of 50% renewable energy by 2030. Demand for renewable energy is also high from corporations striving to reduce their electricity costs and to meet their own sustainability targets. There is also broad consensus that the electricity generation sector provides the lowest cost and easiest implemented mechanism to achieve economy wide emissions reductions.

At a State level the NSW Government has a Renewable Energy Action Plan (REAP) which promotes the development of renewable energy in NSW. At a regional level the *Central West and Orana Regional Plan* presents a vision for a sustainable future by growing and diversifying the economy over the next 20 years. Managing the region's energy resources in a sustainable way is identified as a key strategy for attaining this goal and renewable energy is identified as an industry linked to the Central West's future prosperity. The proposed QPSF is a large-scale renewable energy project that represents this industry and future.

It is located in an area of the State that has been identified by the NSW Government as favorable for a Solar Energy Zone: benefitting from an outstanding energy resource, reduced environmental and planning constraints, in proximity to existing transmission and distribution infrastructure and load centres, and aligned with the Government's regional growth priorities, developed in consultation with regional communities.

21.2 SITE SUITABILITY

The QPSF site was selected for development after an extensive screening process by RED. It was selected because it offers a number of key attributes which provide the opportunity to optimise the solar farm configuration and deliver lower cost energy.

It is close to the transmission network which has sufficient capacity for the output of the farm which offers a lower cost grid connection and avoids the need to build any significant new overhead lines or securing easements from multiple landowners not associated with the development.

The solar resource at the Quorn Park locality is also suitable with enough cloud-free days over the year to generate significant energy.

Importantly, the development of a solar farm at this location is a permissible development, and given surrounding topography, existing vegetation and location of most neighbours' dwellings, would have a very localised and limited impact on visual amenity values. The size of the development site itself has provided the ability to avoid significant ecological impacts, and the flat terrain will enable the farm to be constructed without significant earthworks.

Finally, the development site is secure from future residential encroachment. The site and surrounding lands are zoned RU1 Primary Production. Pursuant to the *Parkes Local Environmental Plan 2012* (LEP). The minimum lot size for the purposes of subdivision or dwelling development in the RU1 zone is 400 hectares.

21.3 ALTERNATIVES

The objective of the QPSF is to convert sunlight into carbon free electricity which can then be sold into the NEM. PV panels, either on north facing fixed tilt arrays or on east-west single-axis tracking modules, provides the best technological means for achieving this. The technology is proven and the site features will permit ease of construction.

The consequences of not carrying out the development would be to forgo the benefits the solar farm would provide in terms of increased local expenditure and employment opportunities within the Parkes region; as well as production of 200,000 MWh of clean electricity a year, displacing 164,000 tonnes of GHG emissions.

21.4 REASONS FOR APPROVAL

The benefits of the proposed QPSF are clear and significant. The farm will produce clean energy, displace GHG emissions, create employment opportunities during construction and inject new expenditure into the region. The costs, through the identification of site constraints and then avoiding these to inform the buildable development footprint, are minor and acceptable.

Native vegetation providing conservation values were identified in the ecological survey and have been accommodated such that impacts on these areas can be minimised. In the assessment of potential noise impacts the need to provide a suitable buffer distance from inverters and battery storage to dwellings was identified, and has subsequently been mapped as a design constraint such that acoustic amenity values will not be adversely impacted.

The process of refining the development footprint has been driven by the precautionary principle. That is, where there has been the possibility of serious or irreversible environmental impact, lack of full scientific certainty has not been used as a reason for not adopting avoidance measures to prevent environmental degradation. The decision to avoid areas of native vegetation has been guided by careful evaluation to avoid, wherever practicable, a potentially serious or irreversible impact. As a consequence of this decision biological diversity and ecological integrity will be maintained.

Similarly, in committing to provision of a buffer to the inverters to protect acoustic amenity values, RED has incorporated environmental factors in the valuation of assets and services. Specifically, the polluter pays principle that underpins ecologically sustainable development (ESD) requires those who may generate pollution (in this instance noise) should bear the cost of containment, avoidance or abatement. The buffers effectively provide avoidance.

The QPSF should be approved because the development site is suitable for a solar farm as it has good solar resources and available capacity in the existing electricity network. The site is very flat and has been largely cleared for agricultural uses.

The development would not result in any significant reduction in the overall agricultural productivity of the region and the lands can be returned to agricultural use if the solar farm is decommissioned in 30 years.

Transitioning the electricity sector from coal and gas fired power stations to renewable energy sources personifies the ESD principle of inter-generational equity. The QPSF should be approved as this will be an outcome whereby the present generation is making a land use decision that will help ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit for future generations.

The QPSF is a development that is in the public interest and should be approved.

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Appendix A

Environmental Assessment Requirements

Planning Services
Resource and Energy Assessments
Contact: Tim Stuckey
Phone: (02) 9274 6319
Email: Tim.stuckey@planning.nsw.gov.au

Colin Liebmann
Renewable Energy Developments
11 Lightcliff Avenue
Lindfield NSW 2070

Dear Mr Liebmann

Quorn Park Solar (SSD 9097)
Environmental Assessment Requirements

I have attached the Environmental Assessment Requirements for the preparation of an Environmental Impact Statement (EIS) for the Quorn Park Solar project.

The requirements are based on the information you have provided to date, and have been prepared in consultation with the relevant government agencies. The agencies comments are attached for your information (see Attachment 2).

Please note that the Department may alter these requirements at any time, and that you must consult further with the Department if you do not lodge a development application and EIS for the project within the next two years.

If your proposal contains any actions that could have a significant impact on matters of National Environmental Significance, then it will also require approval under the Commonwealth's *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

This approval is in addition to any approvals required under NSW legislation. If you have any questions about the application of the EPBC Act to your proposal, you should contact the Department of the Environment in Canberra (6274 1111 or www.environment.gov.au).

Please contact the Department at least two weeks before you plan to submit the development application and EIS for the project. This will enable the Department to:

- confirm the applicable fee (see Division 1AA, Part 15 of the *Environmental Planning and Assessment Regulation 2000*); and
- determine the required number of copies of the EIS.

It is important for you to recognise that the Department will review the EIS for the project before putting it on public exhibition. If it fails to adequately address these requirements, you will be required to submit an amended EIS.

Yours sincerely

CPreshaw 8/3/18

Clay Preshaw
Director
Resource and Energy Assessments
as nominee of the Secretary

Secretary's Environmental Assessment Requirements

Section 4.12(8A) of the *Environmental Planning and Assessment Act*
Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*

<table>
<tr><td>Application Number</td><td>SSD 9097</td></tr>
<tr><td>Proposal Name</td><td>Quorn Park Solar Project which includes:
the construction and operation of a photovoltaic generation facility with an estimated capacity of up to 160 MW; and
development of associated infrastructure, including a grid connection and battery storage facilities.</td></tr>
<tr><td>Location</td><td>Back Trundle Road, approximately 8.5 km northwest of Parkes, within the Parkes local government area.</td></tr>
<tr><td>Applicant</td><td>Renewable Energy Developments</td></tr>
<tr><td>Date of Issue</td><td>8 March 2018</td></tr>
<tr><td>General Requirements</td><td>The Environmental Impact Statement (EIS) for the development must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

In particular, the EIS must include:
a stand-alone executive summary;
a full description of the development, including:
details of construction, operation and decommissioning;
a site plan showing all infrastructure and facilities (including any infrastructure that would be required for the development, but the subject of a separate approvals process);
a detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development;
a strategic justification of the development focusing on site selection and the suitability of the proposed site with respect to potential land use conflicts with existing and future surrounding land uses (including other proposed or approved solar projects, rural residential development and subdivision potential);
an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including:
a description of the existing environment likely to be affected by the development;
an assessment of the likely impacts of all stages of the development, (which is commensurate with the level of impact), including any cumulative impacts of the site and existing or proposed developments (including the Goonumbla Solar and Parkes Solar projects), taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
a description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the development (including draft management plans for specific issues as identified below); and</td></tr>
</table>

	– a description of the measures that would be implemented to monitor and report on the environmental performance of the development; • a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and • the reasons why the development should be approved having regard to: – relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act and how the principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development; – the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses; and – feasible alternatives to the development (and its key components), including the consequences of not carrying out the development. The EIS must also be accompanied by a report from a suitably qualified person providing: • a detailed calculation of the capital investment value (CIV) (as defined in clause 3 of the Regulation) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; and • certification that the information provided is accurate at the date of preparation. The development application must be accompanied by the consent in writing of the owner/s of the land (as required in clause 49(1)(b) of the Regulation).
Specific issues	The EIS must address the following specific issues: • **Biodiversity** – including an assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW), a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW). • **Heritage** – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community; • **Land** – including: – an assessment of the impact of the development on agricultural land (including possible cumulative impacts on agricultural enterprises and landholders) and flood prone land, an assessment of any impacts to Crown lands, a soil survey to consider the potential for erosion to occur, and paying particular attention to the compatibility of the development with the existing land uses on the site and adjacent land (e.g. operating mines, extractive industries, mineral or petroleum resources, exploration activities, aerial spraying, dust generation, and biosecurity risk) during operation and after decommissioning, with reference to the zoning provisions applying to the land, including subdivision; and – measures to remediate the land following decommissioning in accordance with *State Environmental Planning Policy No 55 - Remediation of Land.*

	• **Visual** – including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners; • **Noise** – including an assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* (ICNG) and operational noise impacts in accordance with the *NSW Noise Policy for Industry 2017* and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria; • **Transport** – including an assessment of the site access routes (including Henry Parkes Way, Newell Highway, Back Trundle Road and McGraths Lane), site access points, any potential rail safety issues and likely transport impacts (including peak and average traffic generation, over-dimensional vehicles and construction worker transportation) of the development on the capacity and condition of roads (including on any Crown land), a description of the measures that would be implemented to mitigate any impacts during construction (including cumulative impacts from nearby developments), and a description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required); • **Water** – including: – an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including Ridgey Creek, drainage channels, wetlands, riparian land, Key Fish Habitat, groundwater dependent ecosystems and acid sulfate soils), related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts; – details of water requirements and supply arrangements for construction and operation; and – a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with *Managing Urban Stormwater: Soils & Construction* (Landcom 2004); • **Hazards and Risks -** including: – a preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development* and *Applying SEPP 33* (DoP, 2011), and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with *Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (*DoP, 2011) and *Multi-Level Risk Assessment* (DoP, 2011); and – an assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure (including the proposed transmission line and substation) against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.* • **Socio-Economic** – including an assessment of the likely impacts on the local community and a consideration of the construction workforce accommodation.

Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups, affected landowners, exploration licence holders, quarry operators and mineral title holders. This should also include consultation regarding land that is currently the subject of an Aboriginal Land Claim (Reserve 45953). In particular, you must undertake detailed consultation with affected landowners surrounding the development and Parkes Shire Council. The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.
Further consultation after 2 years	If you do not lodge a development application and EIS for the development within 2 years of the issue date of these SEARs, you must consult further with the Secretary in relation to the preparation of the EIS.
References	The assessment of the key issues listed above must take into account relevant guidelines, policies, and plans as identified. While not exhaustive, the following attachment contains a list of some of the guidelines, policies, and plans that may be relevant to the environmental assessment of this proposal.

ATTACHMENT 1

Environmental Planning Instruments, Policies, Guidelines & Plans

Biodiversity	
	Biodiversity Assessment Method (OEH)
	Threatened Species Assessment Guidelines - Assessment of Significance (OEH)
	Biosecurity Act 2015
	Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI)
	Policy and Guidelines for Fish Habitat Conservation and Management (DPI)
Heritage	
	Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH)
	Code of Practice for Archaeological Investigations of Objects in NSW (OEH)
	Guide to investigating, assessing and reporting on aboriginal cultural heritage in NSW (OEH).
	NSW Heritage Manual (OEH)
Land	
	Primefact 1063: Infrastructure proposals on rural land (DPI)
	Establishing the social licence to operate large scale solar facilities in Australia: insights from social research for industry (ARENA)
	Local Land Services Act 2013
	Australian Soil and Land Survey Handbook (CSIRO)
	Guidelines for Surveying Soil and Land Resources (CSIRO)
	The land and soil capability assessment scheme: second approximation (OEH)
Noise	
	NSW Noise Policy for Industry (EPA)
	Interim Construction Noise Guideline (EPA)
	NSW Road Noise Policy (EPA)
Transport	
	Guide to Traffic Generating Developments (RTA)
	Austroads Guide to Road Design & relevant Australian Standards
	Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development
Water	
	Managing Urban Stormwater: Soils & Construction (Landcom)
	Floodplain Development Manual (OEH)
	Guidelines for Controlled Activities on Waterfront Land (DPI Water)
	Water Sharing Plans (DPI Water)
	Floodplain Management Plan (DPI Water)
	Guidelines for Watercourse Crossings on Waterfront Land (DPI Water)
Hazards and Risks	
	Hazardous Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DPE)
	Multi-Level Risk Assessment (DPE)
Waste	
	Waste Classification Guidelines (EPA)
Electromagnetic Interference	

	ICNIRP Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields
Environmental Planning Instruments	
	State Environmental Planning Policy (State and Regional Development) 2011
	State Environmental Planning Policy (Infrastructure) 2007
	State Environmental Planning Policy (Rural Lands) 2008
	State Environmental Planning Policy No. 44 – Koala Habitat Protection
	State Environmental Planning Policy No. 55 – Remediation of Land
	Parkes Local Environmental Plan 2012

ATTACHMENT 2

Agency Comments

OUT18/3069

Mr Tim Stuckey
Resource and Energy Assessments
NSW Department of Planning and Environment

Tim.stuckey@planning.nsw.gov.au

Dear Mr Stuckey

Quorn Park Solar Farm (SSD 9097)
Comment on the Secretary's Environmental Assessment Requirements (SEARs)

I refer to your email of 16 February 2018 to the Department of Industry in respect to the above matter. Comment has been sought from relevant branches of Crown Lands & Water and Department of Primary Industries.

Any further referrals to Department of Industry can be sent by email to landuse.enquiries@dpi.nsw.gov.au.

The department has reviewed the draft SEARs and Preliminary Environmental Assessment and recommends the following amendments to the draft SEARs:

Specific Issues

Land The EIS should also be required to specifically address:

- Impacts to Important Agricultural Lands and Biophysical Strategic Agricultural Land; and
- Consultation regarding land that is currently the subject of an Aboriginal Land Claim (Reserve 45953).

Yours sincerely

Alison Collaros
A/Manager, Assessment Advice
2 March 2018

Planning & Environment
Resources & Geoscience

02/03/2018

Tim Stuckey
Environmental Assessment Officer
Planning Services

Emailed: tim.stuckey@planning.nsw.gov.au

Our Reference: OUT18/3743

Dear Mr Stuckey

Re: Quorn Park Solar Project (SSD9097) Request for SEARs

Thank you for the opportunity to provide advice on the above matter. This is a response from the NSW Department of Planning & Environment – Division of Resources & Geoscience, Geological Survey of New South Wales (GSNSW).

The Division acknowledges the Draft SEARs requirements within the Specific Issues – Land section for the Proponent include in the Environmental Impact Statement (EIS) an assessment of the developments compatibility with existing land uses on the site and adjacent land and the requirement for consultation during the preparation of the EIS with exploration licence holders, quarry operators and mineral title holders.

Based on regional geology, as well as current and historical exploration, the area is considered highly prospective for precious and base metal deposits. Accordingly, the Preliminary Environmental Assessment (PEA) acknowledges current exploration titles and future mining potential of the proposal area.

The Division specifically requires the proponent to:

1. The proponent has acknowledged the presence of mineral exploration licences EL7676 and EL5323 within section 4.1 of the PEA and has indicated that consultation with landholders will be made and impacts to existing land resources will be assessed. The proponent must **make contact with the titleholders** to determine their level of interest. This should include a letter of notification of the Project to the title holder including a map indicating the solar farm in relation to the exploration licence boundaries, and a letter of response from the title holder to the proponent.

EL5323
Title Holder:
CMOC Mining Limited
PO Box 995
Parkes NSW 2870

Title Agent:
Hetherington Exploration & Mining Titles Services
Level 7, Suite 702
92 Pitt St
Sydney NSW 2000

EL7676
Title Holder:
Modelling Resources
PO Box 785
West Perth WA 6872

2. **Clarify sequence of land use** from both exploration licence holders. Timeframes for exploration activities should be clearly described and demonstrated through evidenced consultation with titleholders. Details of the coordination deed agreed between the parties should be forwarded to the Division in regards to resource utilisation, access and sterilisation of resources subject to a potential Mining Lease granted under the Mining Act 1992.

3. **Review and update** the above for new mineral and energy titles that may be granted in the vicinity of the subject site during all decision making stages of the Project. This is to ensure that other stakeholders with interests in the subject area are made aware of the Project.

4. **Generate a map** to be included in the EIS which includes the affected exploration licences and to address any land use compatibility considerations

GSNSW requests to be consulted in relation to the proposed location of any biodiversity offset areas or any supplementary biodiversity offset measures required for the project to ensure there is no consequent reduction in access to prospective land for mineral exploration, or potential for sterilisation of mineral resources

Geoscience Information Services

The GSNSW has a range of online data related to mineral exploration, land use and general geoscience topics:

The location of current exploration and mining titles in NSW, explanations of mining and production titles and the roles of community and government in the decision making process for mining/resource projects may be accessed by the general public using the following online utilities:

http://commonground.nsw.gov.au

https://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscience-information/services/online-services/minview

Queries regarding the above information, and future requests for advice in relation to this matter, should be directed to the GSNSW Land Use team at landuse.minerals@industry.nsw.gov.au.

Yours sincerely

Cressida Gilmore
Manager - Land Use

NSW EPA

Your reference : SSD 9097
Our reference : SF18/12149; DOC18/96900-1
Contact : Joshua Loxley, 02 6883 5326

Tim Stuckey
Resource and Energy Assessment
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

20 February 2018

Dear Mr Stuckey

Quorn Park Solar Project (SSD 9097)

I refer to your email dated 16 February 2018 requesting the Environment Protection Authority (EPA) provide comment on the Draft Secretary Environmental Assessment Requirements (Draft SEARs) for the proposed Quorn Park Solar Project (SSD 9097) (the Proposal).

Based on the information provided, an environment protection licence with the EPA under the Protection of the Environment Operations Act 1997 (POEO Act) is not required as the Proposal does not constitute a "scheduled" activity under the POEO Act. As the Proposal is not a scheduled activity and is not being conducted by a public authority, Parkes Shire Council is the Appropriate Regulatory Authority (ARA) under the POEO Act.

The EPA has considered the Proposal's Scoping Report prepared by Geolyse and the Department of Planning & Environment (DPE) Draft SEARs. The EPA considers that the Proposal may potentially cause dust and impacts to waters during construction and operation. These risks can be mitigated through good site control and housekeeping in accordance with relevant guidelines.

The EPA recommends the SEARs require any Environmental Assessment to include measures which address potential dust and impacts to waters including:

- measures to minimise dust emissions from the project site as well as along access roads leading to the site during construction;
- measures to protect surface waters during and after construction for sediment and erosion controls in accordance with EPA endorsed publication *"Managing Urban Stormwater – Soils and Construction" Landcom 4th Edition March 2004*; and
- measures for appropriate storage (bunding) of chemicals and fuels to reduce risks of spills contaminating waterways and land both during and after construction.

If you have any questions, or wish to discuss this matter further please contact Mr Joshua Loxley at the EPA's Central West Dubbo office by telephoning 02 6883 5326 or by email at central.west@epa.nsw.gov.au.

Yours sincerely

SHERIDAN LEDGER
A/Manager Regional Operations
Environment Protection Authority

Fire & Rescue NSW

File Ref. No: BFS18/416 (8000002773)
TRIM Doc. No: D18/13771
Contact: Senior Firefighter Lachlan Haar

2 March 2018

The Department of Planning & Environment
C/- Tim Stuckey
GPO Box 39
SYDNEY NSW 2001

tim.stuckey@planning.nsw.gov.au

Dear Mr Stuckey

Request for Input
Secretary's Environmental Assessment Requirements (SEARs)
Quorn Park Solar Farm (SSD9097)
Black Trundle Road Parkes

I refer to the above development proposal's SEARs. Fire & Rescue NSW (FRNSW) have reviewed the SEARs and the following comments and recommendations are submitted for consideration.

FRNSW notes that the facility's proposed location is within a NSW Rural Fire Services' (RFS) Fire District. Notwithstanding the above, in the event of a significant fire event (either on or off-site in close proximity to the development) or hazardous material incident FRNSW will be responded to either assist the RFS or to fulfill the role of designated combat agency.

It is FRNSW experience that small and large scale photovoltaic installations present unique electrical hazard risks to our personnel when fulfilling their emergency first responder role (N.b. the Fire Brigades Act 1989 imposes specific statutory functions and duties upon the Commissioner of FRNSW).

In addition, the Work Health and Safety (WHS) Act 2011 (and its subordinate Regulation) classify FRNSW as an entity conducting a business or undertaking (PCBU). Clauses 34 and 35 of the WHS Regulation impose specific obligations upon a PCBU to identify hazards and manage risks at workplaces.

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 incident at the proposed site.

Recommendations

Should a fire or hazardous material incident occur, it is important that first responders have ready access to information which enables effective control measures to be quickly implemented. Without limiting the scope of the emergency response plan (ERP), the following matters are recommended to be addressed:

1. That a comprehensive ERP is developed for the site.

2. That the ERP specifically addresses foreseeable on-site and off-site fire events and other emergency incidents, (e.g. fires involving solar panel arrays, bushfires in the immediate vicinity or potential hazmat incidents).

3. That the ERP detail the appropriate risk control measures that would need to be implemented in order to safely mitigate potential risks to the health and safety of firefighters and other first responders (including electrical hazards). Such measures would include the level of personal protective clothing required to be worn, the minimum level of respiratory protection required, decontamination procedures, minimum evacuation zone distances and a safe method of shutting down and isolating the photovoltaic system (either in its entirety or partially, as determined by risk assessment).

4. Other risk control measures that may need to be implemented in a fire emergency due to any unique hazards specific to the site should also be included in the ERP.

5. That two copies of the ERP (detailed in recommendation 1 above) be stored in a prominent 'Emergency Information Cabinet' which is located in a position directly adjacent to the site's main entry point/s.

6. Once constructed and prior to operation, that the operator of the facility make contact with the relevant local emergency management committee (LEMC). The LEMC is a committee established by virtue of Section 28 of the State Emergency and Rescue Management Act 1989. LEMCs are required to be established so that emergency services organisations and other government agencies can proactively develop comprehensive inter agency local emergency procedures for significant hazardous sites within their particular local government area. The contact details of members of the LEMC can be obtained from the relevant local council.

For further information please contact Fire Safety Assessment Unit, referencing FRNSW file number BFS18/416 (8000002865). Please ensure that all correspondence in relation to this matter is submitted electronically to firesafety@fire.nsw.gov.au.

Yours sincerely

M. Castelli

Mark Castelli
Team Leader
Fire safety Assessment Unit

Heritage Council of New South Wales

Level 6, 10 Valentine Avenue
Parramatta NSW 2150
Locked Bag 5020
Parramatta NSW 2124

Telephone: 61 2 9873 8500
Facsimile: 61 2 9873 8599
heritagemailbox@environment.nsw.gov.au
www.heritage.nsw.gov.au

File No: EF14/9793
Ref No: DOC18/95735

Mr Tim Stuckey
Environmental Assessment Officer
Resource and Energy Assessments
Department of Planning & Environment
GPO Box 39
SYDNEY NSW 2001

Sent by e-mail to: tim.stuckey@planning.nsw.gov.au

Dear Mr Stuckey

Request for SEARs, Quorn Park Solar Farm, Back Trundle Road (SSD 9097).

Reference is made to your email and supporting documentation received on 16 February 2018, requesting SEARs from the Heritage Council of NSW, for the proposed Quorn Park Solar Farm, Back Trundle Road (Lot 508 DP 750152), within the Parkes Local Government Area.

A search reveals that there are no State Heritage Register items within the State Significant Development site or in the vicinity however, there may be the potential for historical archaeological relics. Based on this, is recommended that the following SEARs be included.

- The EIS must include a Historical Archaeological Assessment (HAA) prepared by a suitably qualified and experienced Historical Archaeologist in accordance with the Heritage Division, Office of Environment and Heritage guidelines, *Archaeological Assessments Guidelines*, 1996, and *Assessing Significance for Historical Archaeological Sites and 'Relics'*, 2009.

- The HAA should identify what relics, if any, are likely to be present within the SSD site or in the vicinity, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.

If you have any questions regarding the above matter, please contact Liliana Duran, Heritage Assessment Officer, at the Heritage Division, Office of Environment and Heritage on telephone 9873 8611 or by e-mail: liliana.duran@environment.nsw.gov.au.

Yours sincerely

01/03/2018

Katrina Stankowski
A/STL, Regional Heritage Assessments North
Heritage Division
Office of Environment & Heritage

As Delegate of the Heritage Council of NSW

DOC18/103582
SSD 9097

Mr Tim Stuckey
Environmental Assessment Officer
Resource Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Mr Stuckey,

Quorn Park Solar Project – SSD 9097

I refer to your email dated 16 February 2018 seeking input into the Department of Planning and Environment Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Assessment (EIS) for the Quorn Park Solar Project (SSD 9097).

OEH has considered your request and provides SEARs for the proposed development in **Attachments A** and **B**.

OEH recommends the EIS needs to appropriately address the following:

1. Biodiversity and offsetting
2. Aboriginal cultural heritage
3. Historic heritage
4. Water and soils
5. Flooding

Please note that for projects **not** defined as pending or interim planning applications under Part 7 or the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* the Biodiversity Assessment Methodology (BAM) **must** be used to assess impacts to biodiversity in accordance with the *Biodiversity Conservation Act 2016* (BC Act). For this project the BAM must be used, unless a waiver (see below) is granted.

Eligibility for a Biodiversity Development Assessment Report waiver

Section 7.9(2) of the *Biodiversity Conservation Act 2016* (BC Act) provides that applications for State significant development are to be accompanied by a biodiversity development assessment report (BDAR) unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values. The preliminary environmental assessment indicates that this project may be eligible for the requirement for a BDAR to be waived.

Should the proponent wish to apply for a waiver a standalone request will need to be submitted to the Department of Planning and Environment (DPE). The request must be accompanied by supporting information that adequately demonstrates that the proposal is not likely to have any

PO Box 2111 Dubbo NSW 2830
Level 1, 48-52 Wingewarra Street Dubbo NSW 2830
Tel: (02) 6883 5330 Fax: (02) 6884 8675
ABN 30 841 387 271
www.environment.nsw.gov.au

significant impact on biodiversity values. Guidance on waiving a BDAR is currently being developed by OEH, in the absence of these final guidelines please contact our office for guidance on preparing your request. **If there is any doubt about whether the impacts are likely to be significant, then the requirement for a BDAR will not be waived**.

If the waiver is granted after SEARs have been issued, the proponent may then also need to apply to DPE to have the SEARs re-issued.

If you have any questions regarding this matter please contact Michelle Howarth, Senior Conservation Planning Officer on 02 6883 5339 or email michelle.howarth@environment.nsw.gov.au .

Yours sincerely

PETER CHRISTIE

Director Regional Operations
North West

22 February 2018

Contact officer: MICHELLE HOWARTH
6883 5339

Attachment A - Environmental Assessment Requirements

Attachment B - Guidance Material

ATTACHMENT A

Standard Environmental Assessment Requirements

Biodiversity

1. Biodiversity impacts related to the proposed Quorn Park Solar project 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 *Biodiversity Conservation Act 2016* (s6.12), *Biodiversity Conservation Regulation 2017* (s6.8) and Biodiversity Assessment Method, unless OEH and DPE determine that the proposed development is not likely to have any significant impacts on biodiversity values.
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.
3. The BDAR must include details of the measures proposed to address the offset obligation as follows;
    - 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.

    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.
4. The BDAR must be submitted with all spatial data associated with the survey and assessment as per Appendix 11 of the BAM.
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 s6.10 of the *Biodiversity Conservation Act 2016*.

Aboriginal cultural heritage

6. The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the Quorn Park Solar Project and document these in ~~the~~ an Aboriginal Cultural Heritage Assessment Report (ACHAR). This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW (OEH 2010), and guided by the *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW, 2011) and consultation with OEH regional branch officers.
7. Consultation with Aboriginal people must be undertaken and documented in accordance with the Aboriginal cultural heritage consultation requirements for proponents 2010 *(DECCW)*. The

	significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the ACHAR.
8.	Impacts on Aboriginal cultural heritage values are to be assessed and documented in the ACHAR. The ACHAR must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the ACHAR must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.
Historic heritage	
9.	The EIS must provide a heritage assessment including but not limited to an assessment of impacts to *State and local heritage* including conservation areas, natural heritage areas, places of Aboriginal heritage value, buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall: a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996), b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria), c. include a statement of heritage impact for all heritage items (including significance assessment), d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.
Water and soils	
10.	The EIS must map the following features relevant to water and soils including: a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map). b. Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method). c. Wetlands as described in s4.2 of the Biodiversity Assessment Method. d. Groundwater. e. Groundwater dependent ecosystems. f. Proposed intake and discharge locations.
11.	The EIS must describe background conditions for any water resource likely to be affected by the Quorn Park Solar Project, including: a. Existing surface and groundwater. b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.

c. Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.

d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.

e. Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions http://www.environment.nsw.gov.au/research-and-publications/publications-search/risk-based-framework-for-considering-waterway-health-outcomes-in-strategic-land-use-planning

12. The EIS must assess the impacts of the Quorn Park Solar Project on water quality, including:

a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the Quorn Park Solar Project protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.

b. Identification of proposed monitoring of water quality.

c. Consistency with any relevant certified Coastal Management Program (or Coastal Zone Management Plan)

13. The EIS must assess the impact of the Quorn Park Solar Project on hydrology, including:

a. Water balance including quantity, quality and source.

b. Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.

c. Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.

d. Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).

e. Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.

f. Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.

g. Identification of proposed monitoring of hydrological attributes.

Flooding and coastal hazards

14. The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:

a. Flood prone land.

b. Flood planning area, the area below the flood planning level.

c. Hydraulic categorisation (floodways and flood storage areas).

d. Flood hazard

15. The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP, flood levels and the probable maximum flood, or an equivalent extreme event.
16. The EIS must model the effect of the proposed Quorn Park Solar Project (including fill) on the flood behaviour under the following scenarios: a. Current flood behaviour for a range of design events as identified in 14 above. This includes the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.
17. Modelling in the EIS must consider and document: 18. Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies. 19. The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood, or an equivalent extreme flood. 20. Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories. 21. Relevant provisions of the NSW Floodplain Development Manual 2005.
22. The EIS must assess the impacts on the proposed Quorn Park Solar Project on flood behaviour, including: a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure. b. Consistency with Council floodplain risk management plans. c. Consistency with any Rural Floodplain Management Plans. d. Compatibility with the flood hazard of the land. e. Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land. f. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site. g. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses. h. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council. i. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council. j. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the NSW SES. k. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.

ATTACHMENT B

Guidance Material

Title	Web address
	Relevant Legislation
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/#/view/act/2016/63/full
Coastal Management Act 2016	https://www.legislation.nsw.gov.au/#/view/act/2016/20/full
Commonwealth Environment Protection and Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+203+1979+cd+0+N
Fisheries Management Act 1994	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+38+1994+cd+0+N
Marine Parks Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+64+1997+cd+0+N
National Parks and Wildlife Act 1974	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+80+1974+cd+0+N
Protection of the Environment Operations Act 1997	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
Water Management Act 2000	http://www.legislation.nsw.gov.au/maintop/view/inforce/act+92+2000+cd+0+N
Wilderness Act 1987	http://www.legislation.nsw.gov.au/viewtop/inforce/act+196+1987+FIRST+0+N
	Biodiversity
Biodiversity Assessment Method (OEH, 2017)	https://biodiversity-ss.s3.amazonaws.com/Uploads/1494298079/Biodiversity-Assessment-Method-May-2017.pdf
Biodiversity Development Assessment Report	https://www.legislation.nsw.gov.au/#/view/act/2016/63/part6/div3/sec6.12
Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact (OEH, 2017)	https://biodiversity-ss.s3.amazonaws.com/Uploads/1494298198/Serious-and-Irreversible-Impact-Guidance.PDF
Accreditation Scheme for Application of the Biodiversity Assessment Metho Order 2017	https://www.legislation.nsw.gov.au/regulations/2017-471.pdf
Biodiversity conservation actions	www.environment.nsw.gov.au/resources/bcact/ancillary-rules-biodiversity-actions-170496.pdf
Reasonable steps to seek like-for-like biodiversity credits for the purpose of applying the variation rules	www.environment.nsw.gov.au/resources/bcact/ancillary-rules-reasonable-steps-170498.pdf
OEH Threatened Species Website	www.environment.nsw.gov.au/threatenedspecies/
NSW BioNet (Atlas of NSW Wildlife)	www.bionet.nsw.gov.au/
NSW guide to surveying threatened plants (OEH 2016)	www.environment.nsw.gov.au/resources/threatenedspecies/160129-threatened-plants-survey-guide.pdf
OEH threatened species survey and assessment guideline information	www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm

Title	Web address
BioNet Vegetation Classification - NSW Plant Community Type (PCT) database	www.environment.nsw.gov.au/research/Vegetationinformationsystem.htm
OEH Data Portal (access to online spatial data)	http://data.environment.nsw.gov.au/
Fisheries NSW policies and guidelines	http://www.dpi.nsw.gov.au/fisheries/habitat/publications/policies,-guidelines-and-manuals/fish-habitat-conservation
List of national parks	http://www.environment.nsw.gov.au/NationalParks/parksearchatoz.aspx
Revocation, recategorisation and road adjustment policy (OEH, 2012)	http://www.environment.nsw.gov.au/policies/RevocationOfLandPolicy.htm
Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010)	http://www.environment.nsw.gov.au/protectedareas/developmntadjoiningdecc.htm
Heritage	
The Burra Charter (The Australia ICOMOS charter for places of cultural significance)	http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf
Statements of Heritage Impact 2002 (HO & DUAP)	http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf
NSW Heritage Manual (DUAP) (scroll through alphabetical list to ‘N’)	http://www.environment.nsw.gov.au/Heritage/publications/
Aboriginal Cultural Heritage	
Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/commconsultation/09781ACHconsultreq.pdf
Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010)	http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf
Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011)	http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf
Aboriginal Site Recording Form	http://www.environment.nsw.gov.au/resources/parks/SiteCardMainV1_1.pdf
Aboriginal Site Impact Recording Form	http://www.environment.nsw.gov.au/resources/cultureheritage/120558asirf.pdf
Aboriginal Heritage Information Management System (AHIMS) Registrar	http://www.environment.nsw.gov.au/contact/AHIMSRegistrar.htm
Care Agreement Application form	http://www.environment.nsw.gov.au/resources/cultureheritage/20110914TransferObject.pdf
Water and Soils	
Acid sulphate soils	
Acid Sulfate Soils Planning Maps via Data.NSW	http://data.nsw.gov.au/data/
Acid Sulfate Soils Manual (Stone et al. 1998)	http://www.environment.nsw.gov.au/resources/epa/Acid-Sulfate-Manual-1998.pdf

Title	Web address
Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et al. 2004)	http://www.environment.nsw.gov.au/resources/soils/acid-sulfate-soils-laboratory-methods-guidelines.pdf This replaces Chapter 4 of the Acid Sulfate Soils Manual above.
Flooding and Coastal Erosion	
Reforms to coastal erosion management	http://www.environment.nsw.gov.au/coasts/coastalerosionmgmt.htm
Floodplain development manual	http://www.environment.nsw.gov.au/floodplains/manual.htm
Guidelines for Preparing Coastal Zone Management Plans	Guidelines for Preparing Coastal Zone Management Plans http://www.environment.nsw.gov.au/resources/coasts/130224CZMPGuide.pdf
NSW Climate Impact Profile	http://climatechange.environment.nsw.gov.au/
Climate Change Impacts and Risk Management	Climate Change Impacts and Risk Management: A Guide for Business and Government, AGIC Guidelines for Climate Change Adaptation
Water	
Water Quality Objectives	http://www.environment.nsw.gov.au/ieo/index.htm
ANZECC (2000) Guidelines for Fresh and Marine Water Quality	www.environment.gov.au/water/publications/quality/australian-and-new-zealand-guidelines-fresh-marine-water-quality-volume-1
Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones	http://deccnet/water/resources/AWQGuidance7.pdf
Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (2004)	http://www.environment.nsw.gov.au/resources/legislation/approvedmethods-water.pdf

NSW RURAL FIRE SERVICE

NSW GOVERNMENT

The Secretary
Department of Planning & Environment
GPO Box 39
Sydney NSW 2001

Your reference: SSD 9097
Our reference: D18/660

Attention: Tim Stuckey

Dear Sir/Madam,

Request for input into SEARs – Quorn Park Solar Project (SSD 9097)

Reference is made to correspondence dated 16 February 2018 seeking input to the request for Secretary's Environmental Assessment Requirements for the above State Significant Development in accordance with the *Environmental Planning and Assessment Act 1979*.

The New South Wales Rural Fire Service advises that the preparation of an Environment Impact Statement should incorporate a bush fire assessment report prepared by a suitably qualified person that addresses the aim and objectives of *Planning for Bush Fire Protection 2006* and which recommend measures to prevent a fire occurring within the site from developing into a bush/grass fire risk to the surrounding area.

If you have any queries regarding this advice, please contact Craig Casey, Development Assessment and Planning Officer, on 1300 NSW RFS.

Yours sincerely,

Kalpana Varghese

Kalpana Varghese
Acting Team Leader Development Assessment and Planning
Planning and Environment Services

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27 February 2018

SF2018/064198; WST18/00028

The Manager
Resource and Energy Assessments
Department Planning and Environment
PO Box 39
SYDNEY NSW 2001

Attention: Mr Tim Stuckey

Dear Mr Stuckey

SSD9097: Lot 508 DP 750152; Back Trundle Road, Parkes; Quorn Park Solar Farm
Request for Secretary's Environmental Assessment Requirements (SEARs)

Thank you for your email on 16 February 2018 referring the *Scoping Report* for the Quorn Park Solar Farm Project to, and requesting SEARs from, Roads and Maritime Services.

The proposal includes construction and operation of a 160 megawatt solar plant on rural land west of Parkes. The proposed solar plant is expected to take 18 months to construct. Traffic impacts associated with the proposal are expected to be primarily confined to the construction and decommissioning stages. Access to the subject land is currently obtained from Back Trundle Road and it is assumed vehicular access to the site will be obtained via Henry Parkes Way (MR61), McGrath Lane and Back Trundle Road.

Following review of the *Scoping Report* and an inspection of the site, Roads and Maritime has identified and recommends the following issues be addressed in the Environmental Assessment:

- A traffic impact study prepared in accordance with the methodology set out in Section 2 of the RTA's *Guide to Traffic Generating Developments 2002* and including:
  - Hours, days and periods of construction.
  - Schedule for phasing/staging of the project.
  - Traffic volumes:
    - Existing background traffic.
    - Project-related for each stage including construction, operation and decommissioning.
    - Projected future traffic, including background, Goonumbla Solar Farm project, Inland Rail construction and project-related traffic.

  - Traffic volumes are to also include a description of:
    - Ratio of light vehicles to heavy vehicles.
    - Peak times for existing traffic.
    - Peak times for project-related traffic.
    - Transportation hours.
    - Project related traffic interaction with existing and projected background traffic.
  - The origin, destination and routes for:
    - Employee and contractor light traffic.
    - Heavy traffic.
    - Oversize and over mass traffic.
- A description of all oversize and over mass vehicles and the materials to be transported.
- Details of access requirements to and from Henry Parkes Way and an analysis of affected intersections with Henry Parkes Way, along the haulage route.
- The impact of generated traffic and measures employed to ensure efficiency and safety on the public road network during construction, operation and decommissioning of the project.
- The need for improvements to the road network, and details of improvements proposed such as road widening and intersection treatments, to cater for and to mitigate the impact of project-related traffic. Proposed road facilities, access and intersection treatments are to be identified and be in accordance with *Austroads Guide to Road Design* and Roads and Maritime Supplements, including safe intersection sight distance.
- Local climate conditions that may affect road safety for vehicles used during construction, operation and decommissioning of the project (eg fog, dust, wet weather, etc)
- The layout of the internal road network, parking facilities and infrastructure within the project boundary.
- A Traffic Management Plan is to be developed in consultation with the Parkes Shire Council and Roads and Maritime prior the commencement of haulage and/or construction operations. The TMP is to identify and provide management strategies to manage the impacts of projected related traffic including:
  - Haulage of materials to site.
  - The safe transportation of construction workers from accommodation facilities to site and return. In this regard, Roads and Maritime will require specific details on how the proponent will ensure the identified management measures employed to ensure the safety of staff travelling to and from the site each day will be controlled and enforced.

Roads and Maritime appreciates the opportunity to contribute to the SEARs and requests that a copy of the SEARs be forwarded to Roads and Maritime at the same time they are sent to the applicant.

Should you require further information please contact the undersigned on 02 6861 1453.

Yours faithfully

Andrew McIntyre
Manager Land Use Assessment
Western Region

Appendix B

SEAR CHECKLIST

Table 1 – SEARs Checklist

	Requirement	Section
General Requirements	The EIS must include: - An Executive Summary	**Executive Summary**
	a full description of the development, including: – details of construction, operation and decommissioning;	**Section 2.1.3 –** Farm Construction **Section 2.1.4 –** Farm Operation **Section 2.1.5 & 2.1.6 –** Farm Recommissioning/ Decommissioning
	– a site plan showing all infrastructure and facilities (including site access location, site access routes, site compounds, laydown areas, substation, carpark and any other ancillary infrastructure that would be required for the development, but the subject of a separate approvals process);	**Figure 5 –** Buildable Footprint
	– a detailed constraints map identifying the key environmental and other land use constraints that have informed the final design of the development	**Figure 4 –** Development Site Features
	• a strategic justification of the development focusing on site selection and the suitability of the proposed site with respect to potential land use conflicts with existing and future surrounding land uses (including other proposed or approved solar projects, rural residential development and subdivision potential),	**Section 21 –** Justification
	• an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: – a description of the existing environment likely to be affected by the development; – an assessment of the likely impacts of all stages of the development (which is commensurate with the level of impact), including any cumulative impacts of the site and existing or proposed developments (including the Goonumbla Solar and Parkes Solar projects) taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice; – a description of the measures that would be implemented to avoid, mitigate and/or offset the impacts of the development (including draft management plans for specific issues as identified below); – a description of the measures that would be implemented to monitor and report on the environmental performance of the development;	**Section 5 –** Environmental Issues **Section 6 –** Biodiversity **Section 7 –** Heritage **Section 8 –** Soil Resource **Section 9 –** Land Use **Section 10 –** Visual **Section 11 –** Traffic **Section 12 –** Noise **Section 13 –** Water **Section 14 –** Risks and Hazards **Section 15 –** Air **Section 16 –** Socio-economic **Section 17 –** Waste Management **Section 18 –** Cumulative Impact **Section 19 –** System Security/Reliability
	• a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS; and	**Section 20 –**Mitigation Measures
	• the reasons why the development should be approved having regard to the biophysical, economic and social costs and benefits of the development.	**Section 21.4** – Reasons for Approval

Table 1 – SEARs Checklist

	Requirement	Section
	In addition to the matters set out in Schedule 1 of the EP&A Reg, the development application must be accompanied by:	
	• a report from a suitably qualified person that includes a detailed calculation of the capital investment value (CIV) (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; and certification that the information provided is accurate at the date of preparation	**Provided with the Development Application**
	• the consent in writing of the owner of the land (as required in clause 49(1)(b) of the Environmental Planning and Assessment Regulation 2000).	**Provided with the Development Application**
Specific Issues	The EIS must address the following specific issues:	
	• Biodiversity –; including an assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW), a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW).	**Appendix C** – Biodiversity Assessment
	• Heritage – including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, including adequate consultation with the local Aboriginal community;	**Appendix D** – Aboriginal Cultural Heritage Assessment
	• Land – including – an assessment of the impact of the development on agricultural land (including possible cumulative impacts on agricultural enterprises and landholders) and flood prone land, an assessment of any impacts to Crown lands, a soil survey to consider the potential for erosion to occur, and paying particular attention to the compatibility of the development with the existing land uses on the site and adjacent land (e.g. operating mines, extractive industries, mineral or petroleum resources, exploration activities, aerial spraying, dust generation, and biosecurity risk) during operation and after decommissioning, with reference to the zoning provisions applying to the land, including subdivision; and	**Section 9** Land Use
	– measures to remediate the land following decommissioning in accordance with State Environmental Planning Policy No 55 - Remediation of Land.	**Section 20.6** – Decommissioning Management Pan
	• Visual – including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for onsite perimeter planting, with evidence it has been developed in consultation with affected landowners;	**Section 10 –** Visual
	• Noise – including an assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* (ICNG) and operational noise impacts in accordance with the *NSW Noise Policy* for Industry (INP), and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria;	**Appendix F –** Noise Impact Assessment

Table 1 – SEARs Checklist

Requirement		Section
	• Transport; including an assessment of the site access routes (including Henry Parkes Way, Newell Highway, Back Trundle Road and McGraths Lane), site access points, any potential rail safety issues and likely transport impacts (including peak and average traffic generation, over-dimensional vehicles and construction worker transportation) of the development on the capacity and condition of roads (including on any Crown land), a description of the measures that would be implemented to mitigate any impacts during construction (including cumulative impacts from nearby developments), and a description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required)	**Appendix G –** Traffic Impact Assessment
	• Water – including – an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources (including Ridgey Creek, drainage channels, wetlands, riparian land, Key Fish Habitat, groundwater dependent ecosystems and acid sulfate soils), related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce and mitigate these impacts; – details of water requirements and supply arrangements for construction and operation; and – a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom 2004);	**Section 13 –** Water
	• Hazards and Risks - including: – a preliminary risk screening in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011), and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011); and – an assessment of all potential hazards and risks including but not limited to bushfires, spontaneous ignition, electromagnetic fields or the proposed grid connection infrastructure (including the proposed transmission line and substation) against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric,Magnetic and Electromagnetic Fields.	**Section 14 –** Hazards and Risks
	• Socio-economic – including an assessment of the likely impacts on the local community and a consideration of the construction workforce accommodation.	**Section 16** – Socio-Economic Impact
Consultation	During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, infrastructure and service providers, community groups, affected landowners, exploration licence holders, quarry operators and mineral title holders. This should also include consultation regarding land that is currently the subject of an Aboriginal Land Claim (Reserve 45953). In particular, you must undertake detailed consultation with affected landowners surrounding the development and Parkes Shire Council. The EIS must describe the consultation process and the issues raised and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	**Section 4** – Consultation

Table 1 – SEARs Checklist

	Requirement	Section
Department of Industry	Impacts to Important Agricultural Lands and Biophysical Strategic Agricultural Land; and Consultation regarding land that is currently the subject of an Aboriginal Land Claim (Reserve 45953).	**Section 9** **Section 4**
Planning and Environment	The proponent has acknowledged the presence of mineral exploration licences EL7676 and EL5323 within section 4.1 of the PEA and has indicated that consultation with landholders will be made and impacts to existing land resources will be assessed. The proponent must make contact with the titleholders to determine their level of interest. This should include a letter of notification of the Project to the title holder including a map indicating the solar farm in relation to the exploration licence boundaries, and a letter of response from the title holder to the proponent. Clarify sequence of land use from both exploration licence holders. Timeframes for exploration activities should be clearly described and demonstrated through evidenced consultation with titleholders. Details of the coordination deed agreed between the parties should be forwarded to the Division in regards to resource utilisation, access and sterilisation of resources subject to a potential Mining Lease granted under the Mining Act 1992. Review and update the above for new mineral and energy titles that may be granted in the vicinity of the subject site during all decision making stages of the Project. This is to ensure that other stakeholders with interests in the subject area are made aware of the Project. Generate a map to be included in the EIS which includes the affected exploration licences and to address any land use compatibility considerations.	**Section 9.2**
Environment Protection Authority	Potential dust and impacts to water.	**Section 13** **Section 15**
Fire and Rescue	Emergency Response Plan	**Section 14**
Rural Fire Service	Bushfire assessment	**Section 14**
Heritage Council	The EIS must include a Historical Archaeological Assessment (HAA) prepared by a suitably qualified and experienced Historical Archaeologist in accordance with the Heritage Division, Office of Environment and Heritage guidelines, Archaeological Assessments Guidelines, 1996, and Assessing Significance for Historical Archaeological Sites and 'Relics', 2009. The HAA should identify what relics, if any, are likely to be present within the SSD site or in the vicinity, assess their significance and consider the impacts from the proposal on this potential resource. Where harm is likely to occur, it is recommended that the significance of the relics be considered in determining an appropriate mitigation strategy. If harm cannot be avoided in whole or part, an appropriate Research Design and Excavation Methodology should also be prepared to guide any proposed excavations.	**Appendix D**

Table 1 – SEARs Checklist

	Requirement	Section
Office of Environment and Heritage	The EIS needs to appropriate address the following: • Biodiversity and offsetting • Aboriginal cultural heritage • Historic heritage • Water and soils • Flooding	 **Appendix C** **Appendix D** **Appendix D** **Section 13** **Section 8** **Section 13**
Roads and Maritime Services	Roads and Maritime Services recommends the following be addressed in the EIS: • Traffic Impact Study including: – Hours, days and periods of construction – Schedule for phasing/staging of the project – Traffic volumes (existing, project related, projected future traffic) – Description of light to heavy vehicle ratios, peak times for existing and project-related traffic, transportation hours, project related traffic interaction with existing and projected background traffic. – Origin and destination routes for employee and contractor light traffic, heavy traffic, oversize and over mass traffic. • Description of oversize and over mass vehicles and materials to be transported • Details of access requirements to Henry Parkes Way and analysis of affected intersections. • Shortest and least trafficked route to be given priority for the movement of materials and machinery. • Impact of generated traffic and measures employed to ensure efficiency and safety on the public road during all stages of the project including decommissioning. • The need for improvements to the road network and details of improvements proposed. • Proposed road facilities, access and intersection treatments, including safe sight intersection sight distance. • Local climate conditions that may affect road safety during all stages of the project. • Layout of the internal road network, parking facilities and infrastructure within the project boundary.	**Appendix G**
	• Traffic Management Plan to be developed in consultation with Parkes Shire Council and Roads and Maritime prior to commencement of haulage and/or construction operations.	

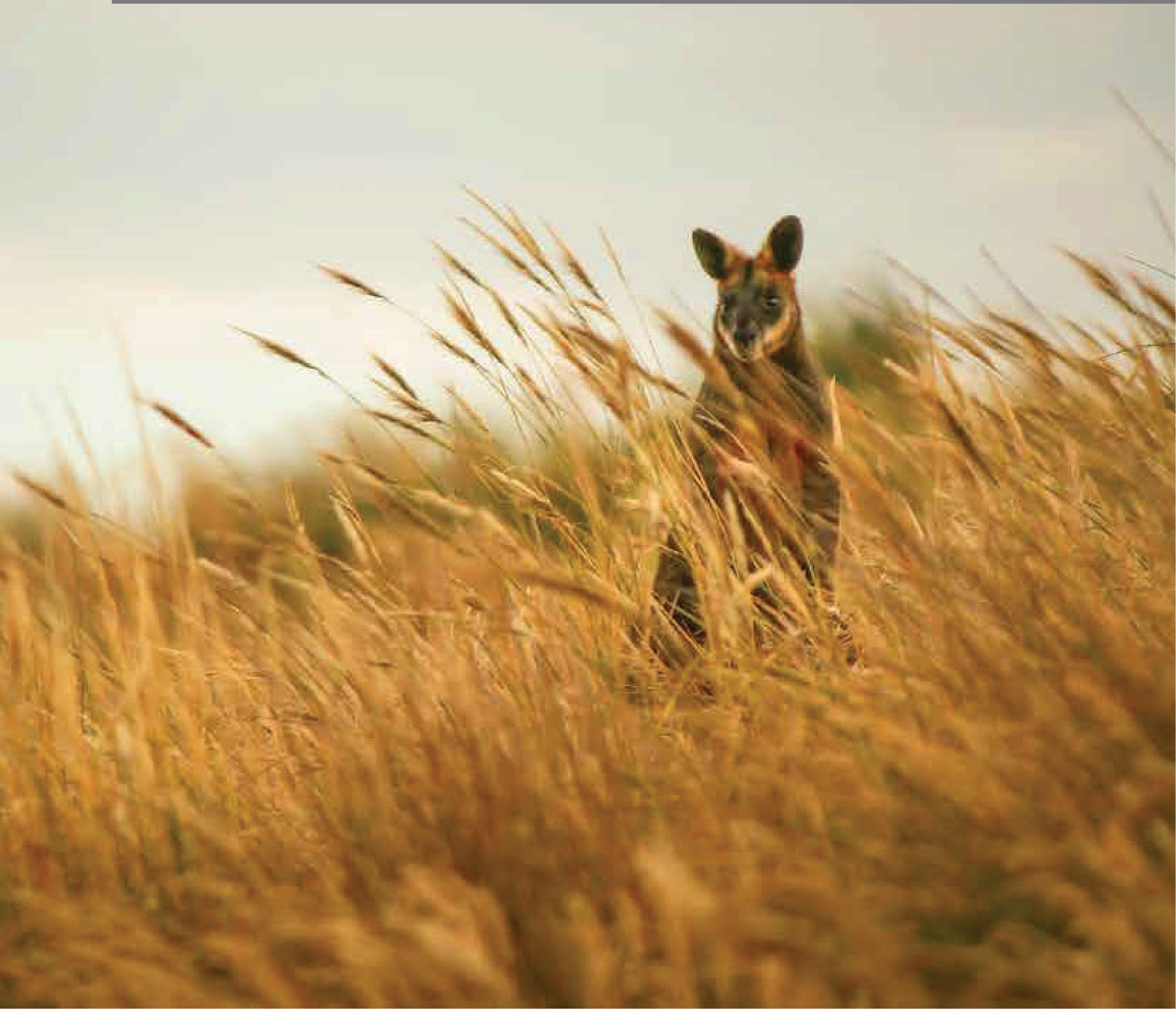
Appendix C1

BIODIVERSITY ASSESSMENT

Quorn Park Solar Farm

Biodiversity Development Assessment Report

Prepared for Quorn Park Solar Farm Pty Ltd
December 2018



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Quorn Park Solar Farm

Biodiversity Development Assessment Report

Prepared for Quorn Park Solar Farm Pty Ltd
December 2018

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Quorn Park Solar Farm

Biodiversity Development Assessment Report

Report Number

J17182 RP#1

Client

Quorn Park Solar Farm Pty Ltd

Date

7 December 2018

Version

v1 Final

Prepared by

Eugene Dodd
Senior Ecologist
7 December 2018

Approved by

Nathan Garvey
Associate Director - Ecology
7 December 2018

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Project Background

Geolyse Pty Ltd is preparing an Environmental Impact Statement (EIS) on behalf of the Quorn Park Solar Farm Pty Ltd for the proposed Quorn Park Solar Farm (QPSF). The proposed QPSF is located approximately 10 km north-west of Parkes in the NSW South Western Slopes Interim Biogeographic Regionalisation of Australia (IBRA) region. The QPSF will include a solar farm with a connection to the electricity grid.

The project has been deemed State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). Therefore, a development application (DA) for the project is required to be submitted under Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The NSW Minister for Planning, or the Minister's delegate, is the consent authority.

This Biodiversity Development Assessment Report (BDAR) forms part of the DA and associated Environmental Impact Statement (EIS) for the project. It documents the biodiversity assessment methods and results, the initiatives built into the project design to avoid and minimise biodiversity impacts, and the additional mitigation and management measures proposed, including offset requirements, to address any residual impacts not able to be avoided.

1.2 Assessment requirements

On 8 March 2018 RED received the Secretary's Environmental Assessment Requirements (SEARs). The relevant requirements of the SEARs, and where they are addressed in this report, are outlined in Table 1.1.

Table 1.1 Requirements of the SEARs and where they are addressed in this report

SEARs requirement	Where addressed in this report
An assessment of the biodiversity values and the likely biodiversity impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW).	This BDAR.
A detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time.	Section 6.2.
A strategy to offset any residual impacts of the development in accordance with the *Biodiversity Conservation Act 2016* (NSW)	Section 6.5.

1.3 Development proposal

The QPSF will include a solar farm with a connection to the electricity grid. The solar farm will be located north of Back Trundle Road, which will include solar panel arrays and associated infrastructure, including access tracks. Connection to the grid will be through via 'Option 3' (refer to Figure 1.1). Two other grid connections, Option 1 and Option 2 were initially considered during the preliminary stages of the project and are discussed further during the avoidance section of this report (Section 6.1). It is understood that access to the development site will be on existing roads and these are of sufficient width to avoid the need to clear any roadside vegetation.

1.4 Project boundary and site description

The **development site** is most frequently referred to within the report and is the potential disturbance footprint of the solar array areas and associated infrastructure and represents a worst-case scenario. It is noted that the actual impact footprint is likely to be somewhat smaller that presented. The development site will allow flexibility for the final design of the solar arrays. It is not yet known if the grid connection will involve a narrow trench in the case of underground cables, or pole and wire placement, with impact footprint largely restricted to 200m spaced poles. To ensure that a sufficient impact area is assessed a clearance of a 5 m corridor was assumed for the transmission line.

The **study area** includes the entire area surveyed at commencement of the project and includes 3 potential grid connections. This layer is discussed in the context of survey effort and in the consideration of avoidance in Section 6.2.

1.5 Information sources

1.5.1 Publications and databases

In order to provide context for the development site, information about flora and fauna species, populations, ecological communities and habitats was obtained from the following databases:

- Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife (Bionet) for previous threatened species records, within 10 km of the development site (search undertaken 09/07/2018);
- Commonwealth Department of Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for MNES, including threatened species likely to occur within the development site (most recent search undertaken 05/12/2018); and
- the NSW Plant Community Types (PCT), as held within the Bionet Vegetation Classification System.

1.5.2 Spatial Data

Spatial data encompassing the study area and development site was provided by UPC. Base map data was obtained from DFSI NSW databases, with cadastral data obtained from DFSI digital cadastral database. Mapping for stream orders was obtained from DPI (2013).

The following spatial datasets were utilised during the development of this report:

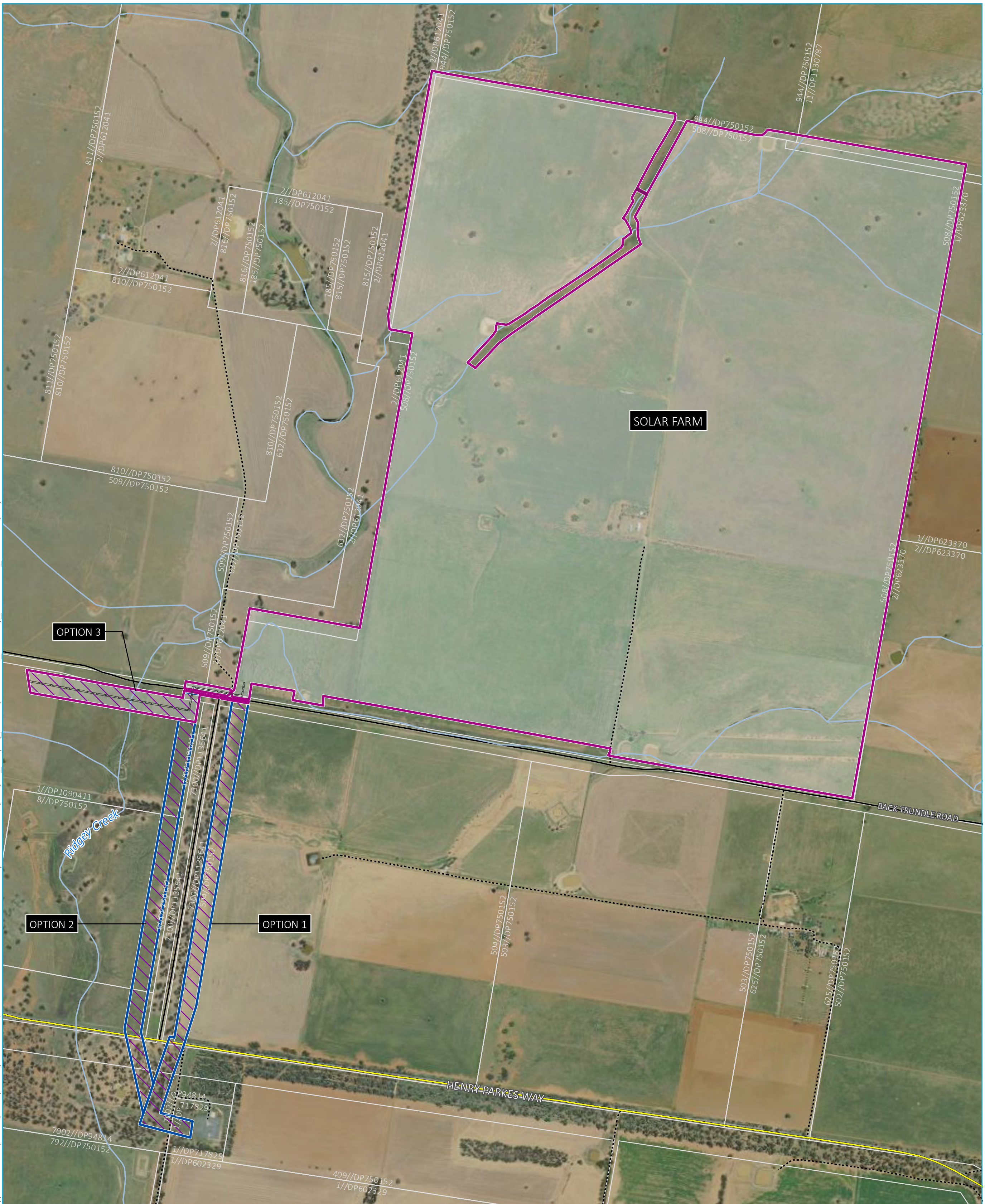
- State Vegetation Type Map: Central West / Lachlan Region Version 1.3. VIS_ID 4468 (OEH 2015);
- Mitchell Landscapes Version V3.1 (OEH 2016a);
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 (DoEE 2013);
- Directory of important wetlands (DoEE 2010); and
- NSW Wetlands (DECC 2010).

Mapping undertaken during the site assessment was conducted using a hand-held GPS unit (GDA94), mobile tablet computer and aerial photo interpretation. Mapping has been produced using a Geographic Information System (GIS; ArcGIS 10.5).

1.6 Legislative requirements

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 2017* (BC Act);
- NSW *Fisheries Management Act 1994* (FM Act); and
- NSW *Biosecurity Act 2015* (BIOSECURITY Act).



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Source: EMM (2018); DFSI (2017); GA (2015)

0 250 500
m
GDA 1994 MGA Zone 55
N

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Development site
- Study area
- Grid connection options
- Proposed electricity transmission line easement / access corridor
- Cadastral boundary

Quorn Park Solar Farm

Quorn Park Solar Farm
Biodiversity development assessment
Figure 1.1

creating opportunities

2 Legislative context

This chapter provides a brief outline of the key biodiversity legislation and government policy considered in this assessment.

2.1 Commonwealth

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, heritage places and water resources which are defined as MNES (Matters of National Environmental Significance) under the EPBC Act. These are:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;
- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- water resources, in relation to coal seam gas or large coal mining development.

Under the EPBC Act, an action that may have a significant impact on a MNES is deemed to be a ‘controlled action’ and can only proceed with the approval of the Commonwealth Minister for the Environment. An action that may potentially have a significant impact on a MNES is to be referred to DoEE for determination as to whether or not it is a controlled action. If deemed a controlled action the project is assessed under the EPBC Act for approval.

The project is unlikely to have a significant impact on MNES and is, therefore, not required to be referred to DoEE for approval. Further information is provided in Section 7.1 of this report.

2.2 State

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act was enacted to encourage the consideration and management of impacts of proposed development or land-use changes on the environment and the community. The EP&A Act is administered by the NSW Department of Planning and Environment (DPE).

The EP&A Act provides the overarching structure for planning in NSW; however, it is supported by other statutory environmental planning instruments, which are outlined below.

i State Environmental Planning Policies (Part 3 Division 3.3)

State Environmental Planning Policies (SEPPs) outline policy objectives relevant to state wide issues. The SEPP relevant to the current development is SEPP No. 44 Koala Habitat Protection.

SEPP 44 aims to encourage the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range and to reverse the current trend of koala-population decline. It applies to areas of native vegetation greater than one hectare and in Councils listed in Schedule 1 of SEPP 44. The development site is located in the Parkes LGA, which is listed in Schedule 1, therefore Koala habitat has been considered within this assessment.

Further consideration of SEPP 44 is provided in Section 7.2.1 of this report.

2.2.2 Biodiversity Conservation Act 2016

In August 2017, the BC Act commenced operation and changed the way impacts to biodiversity are assessed and offset in NSW, with offsetting required for any projects exceeding certain clearing thresholds outlined in the *Biodiversity Conservation Regulation 2017* (BC Regulation). On 8 March 2018 RED received the Secretary's Environmental Assessment Requirements (SEARs) stating that an EIS must be prepared and will require a biodiversity assessment under the BC Act, including preparation of a BDAR under the BAM unless it can be demonstrated that the QPSF will not have any significant impact on biodiversity values. As the project will impact on biodiversity values the BAM has been used to assess and offset impacts to biodiversity in accordance with the BC Act.

2.2.3 Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through the Assessment of Significance process under Section 220ZZ of the FM Act.

Two key objectives of the FM Act are to conserve fish stocks and key fish habitats, and conserve threatened species, populations and ecological communities of fish and marine vegetation. When reviewing applications, the Department of Primary Industries (DPI) will assess the likelihood of impacts to waterways in relation to their sensitivity (TYPE) and waterway class (CLASS). Mapped key fish habitat within the development site is limited to Ridgey Creek and two of its tributaries, this is discussed further in Section 5.1.

None of these sites support key fish habitat or habitat for threatened species. No further consideration is given beyond Section 5.1.

2.2.4 Biosecurity Act 2015

The Biosecurity Act has superseded the *Noxious Weeds Act 1993*, which is now been repealed. The primary object of the Biosecurity Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. The Biosecurity Act stipulates management arrangements for weed biosecurity risks in NSW, with the aim to prevent, eliminate and minimise risks. Management arrangements include:

- any land managers and users of land have a responsibility for managing weed biosecurity risks that they know about or could reasonably be expected to know about;
- applies to all land within NSW and all waters within the limits of the State; and

- local strategic weed management plans will provide guidance on the outcomes expected to discharge duty for the weeds in that plan.

The Biosecurity Act is discussed further in Section 7.2.

3 Landscape features

The identification of landscape features at the development site was determined using Section 4 of the BAM (OEH 2017a), as summarised within this chapter. Landscape features are shown in Figure 3.1 (location map) and Figure 3.2 (site map).

3.1 Landscape features

3.1.1 Bioregions and landscapes

The development site occurs within the NSW South Western Slopes IBRA Bioregion and the Lower Slopes IBRA subregion (Figure 3.1). These were used in the assessment.

A total of two BioNet NSW Landscapes (formerly Mitchell Landscapes) intersect with the development site:

- Goonumbla Hills; and
- Bimbi Plains.

Goonumbla Hills occupies the majority of the site at 69 %. Bimbi Plains also occurs within the south-west of the development site, occupying 31%. For the purposes of the BAM assessment, the Goonumbla Hills BioNet NSW Landscape was selected, given it occupies the largest area of the development site (Figure 3.2).

3.1.2 Waterways and wetlands

The development site is part of the Lachlan catchment. The Lachlan catchment covers an area of approximately 84,700 km^2. The Lachlan River rises near Gunning and terminates in the great Cumbung Swamp near Oxley, 1450 river kilometres to the west (DPI 2018).

A total of four second order watercourses and one third order watercourse are mapped within the study area. These are no longer discernible at ground level, due to current and historical land use and damming of the watercourses both within and outside of the study area. These mapped watercourses are vegetated by terrestrial species and no longer provide any aquatic habitat. One forth order watercourse, Ridgey Creek, intersects the grid connection (Option 1). At the point of the intersection Ridgey Creek has poorly defined channel, largely limited to a sedge and grass dominated swale. Aquatic habitat is described further in Section 5.1.

No wetlands occur within or close to the study area, with the closest important wetland listed on the Directory of Important Wetlands in Australia (DIWA) the Lake Cowal/Wilbertroy Wetland, over 80 km to the south-east.

3.1.3 Connectivity

The study area exists within an largely cleared landscape dominated by agricultural land and does not include any biodiversity corridors mapped by local council or The NSW Office of Environment and Heritage (OEH).

From aerial imagery and existing vegetation mapping, two connectivity corridors were identified which are likely to provide some landscape connectivity. The north western corner of the solar farm area is adjacent to a woodland corridor approximately 90 m in width, extending for 2.6 km. Habitat is largely limited to the corridor itself, with no further connectivity beyond.

The solar farm area and the three easement options are adjacent to vegetation corridors along McGrath's Lane and roadside travelling stock routes which extend both eastwards and northwards along the Henry Parkes Way, for a total of approximately 12 km.

Habitat connectivity features within the development site are largely limited to rows of planted vegetation which are not connected to any other areas of treed habitat. The development will not significantly impact any of the identified corridors as clearing will be limited to a worst-case scenario of a 5 m width (in the case of the transmission easements) in planted woodland areas. Aside from vegetated corridors, there was a lack of significant geological features, such as ridgelines, valleys and large watercourses that may be used as flight corridors for migratory species across the development site.

3.1.4 Areas of geological significance and soil hazard features

The development site and buffer area (1500 m) does not contain karst, caves, crevices, cliffs or other areas of geological significance. Similarly, there are no soil hazard features that occur within the development site or buffer area.

3.1.5 Areas of outstanding biodiversity value

There are no areas of outstanding biodiversity value, as declared by the Minister, within the development site or study area.

3.2 Assessment of site context

Site context has been assessed in accordance with Section 4.3 of BAM (OEH 2017a) for site-based developments.

3.2.1 Native vegetation extent

Mapping of native vegetation within a 1,500 m buffer of the development site was undertaken using State Vegetation Type Map: Central West / Lachlan Region Version 1.3. VIS_ID 4468 (OEH 2015).

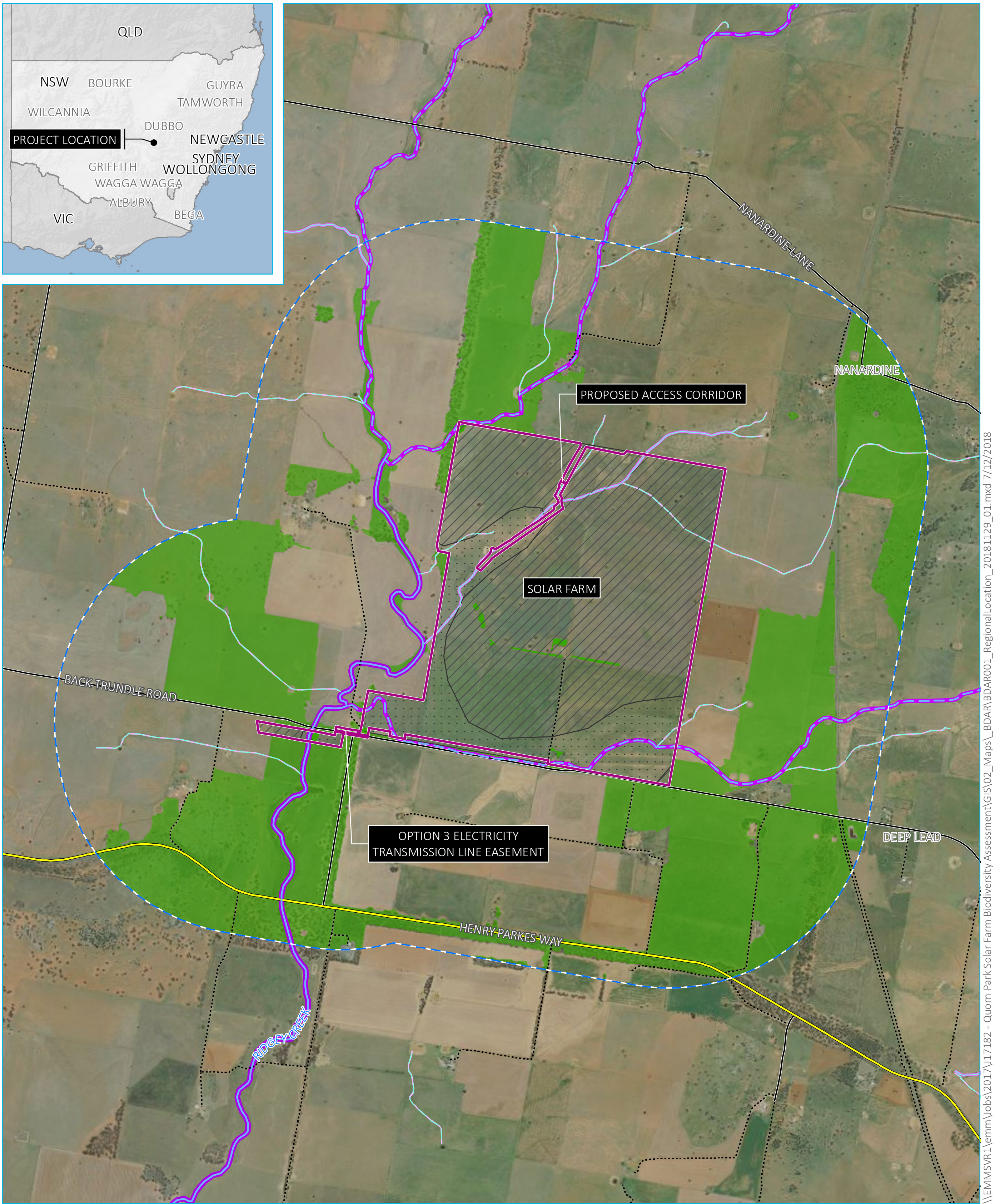
Regional mapping of plant community types (PCTs) within the 1,500 m buffer includes:

- PCT 45 - Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion;
- PCT 76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions;
- PCT 70 - White Cypress Pine woodland on sandy loams in central NSW wheatbelt;
- PCT 80 - Western Grey Box - White Cypress Pine tall woodland on loam soil on alluvial plains of NSW South Western Slopes Bioregion and Riverina Bioregion;
- PCT 201 - Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion;
- PCT 250 - Derived tussock grassland of the central western plains and lower slopes of NSW;
- PCT 267 - White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion; and

- PCT 796 - Derived grassland of the NSW South Western Slopes.

Native vegetation within the development site were primarily assessed and mapped through extensive field surveys, with aerial imagery used to assist with verification of PCT boundaries. Plots, undertaken in accordance with the BAM, were used to determine vegetation integrity scores across the vegetation types.

The native vegetation extent area of the combined development site and the 1,500 m buffer is 875.52 ha. The total area of land within the 1,5000 m buffer is 2802.91 ha, therefore the percentage native vegetation cover is 31 %.



Source: EMM (2018); DFSI (2017); GA (2015); Strahler (2013); DOEE (2017); OEH (2017)

0 500 1,000
m
GDA 1994 MGA Zone 55
N

KEY

Development site
Main road
Local road
Vehicular track
1500 m buffer

Native vegetation
Mitchell Landscapes
Bimbi Plains
Goonumbla Hills

Strahler stream order
1st order stream
2nd order stream
3rd order stream
4th order stream

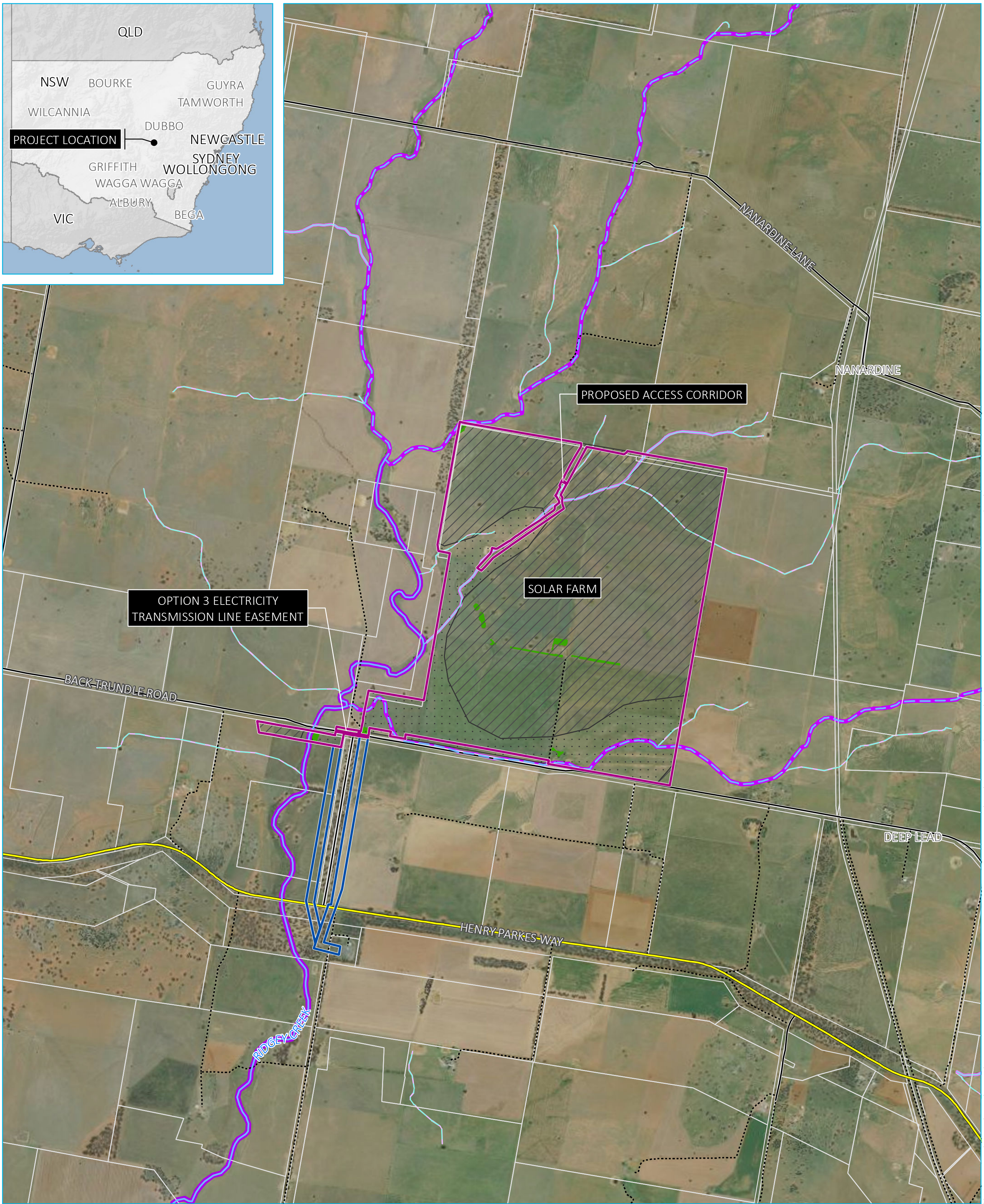
Riparian buffer
10 m
20 m
30 m
40 m

Location map

Quorn Park Solar Farm
Biodiversity development assessment
Figure 3.1

EMM
creating opportunities

NOTE:
- Entire site is located within Parks Shire Council Local Government Area
- Entire site is located within IBRA region NSW South Western Slopes and IBRA subregion Lower Slopes (NSS02)



Source: EMM (2018); DFSI (2017); GA (2015); Strahler (2013); DOEE (2017); OEH (2017)

0 500 1,000 m
GDA 1994 MGA Zone 55
N

KEY

- Development site
- Study area
- Cadastral boundary
- Main road
- Local road
- Vehicular track
- Native vegetation

Mitchell Landscapes

- Bimbi Plains
- Goonumbla Hills

Strahler stream order

- 1st order stream
- 2nd order stream
- 3rd order stream
- 4th order stream

Riparian buffer

- 10 m
- 20 m
- 30 m
- 40 m

NOTE:
- Entire site is located within Parks Shire Council Local Government Area
- Entire site is located within IBRA region NSW South Western Slopes and IBRA subregion Lower Slopes (NSS02)

Site map

Quorn Park Solar Farm
Biodiversity development assessment
Figure 3.2

EMM
creating opportunities

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4 Native vegetation

The extent of native vegetation within the development site was determined using Section 5 of the BAM (OEH 2017a), as summarised within this chapter.

4.1 Background review

A review of the State Vegetation Type Map: Central West / Lachlan Region Version 1.3. VIS_ID 4468 (OEH 2015) was undertaken to inform the site investigations. Three PCTs were identified within the development site:

- 250 - Derived tussock grassland of the central western plains and lower slopes of NSW;
- 45 - Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion; and
- 76 - Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions.

In addition to the three PCTs, several areas remained unmapped, which at the time of the desktop analysis were considered to cropped from analysis of aerial imagery.

4.2 Methods

4.2.1 Detailed vegetation mapping and habitat assessment

The initial field assessment was undertaken throughout the study area, across four days from 23 to 26 July 2018. This included including vegetation mapping, habitat assessment and mapping and assessment of all paddock trees.

A significant part of the study area was traversed on foot and by vehicle with vegetation mapped and aligned with NSW PCTs (refer to Section 4.3.3). These PCTs were stratified into vegetation zones based on their broad condition state and grouped according to their quality and levels of disturbance.

Where there was some uncertainty about correct PCT alignment, or to justify PCT alignment, a series of rapid vegetation assessments (RVAs) were undertaken, with the three dominant species in the overstorey, midstorey and groundcover recorded. Vegetation was mapped in the field using GPS-enabled tablet computers using Collector for ArcGIS™.

4.2.2 Vegetation integrity assessment

Following the stratification of vegetation zones within the study area, native vegetation integrity was assessed using data obtained via a series of plots as per the methodology outlined in Section 5 of the BAM (OEH 2017a). A total of 16 plots were collected from the development site and surrounds across five days between 15 and 19 October 2018. 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 plots 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, based on a 20 x 20 m plot, 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). A total of eleven plots were undertaken within or in close proximity (200 m) to the development site and therefore used in determining vegetation integrity scores. A total of seven plots located within the initial study area were considered too distant from the development site and were excluded from the BAM calculations. Datasheets are provided in Appendix A while compiled plot data is provided in Appendix B.

4.2.3 Paddock tree assessment

Paddock trees were assessed in accordance with Appendix 1 of the BAM (OEH 2017a). Given that regulatory maps for Category 1 and Category 2 land are yet to be produced, native trees were included within the paddock tree assessment if:

- they were outside of mapped woodland zones; and
- the ground cover was cropped or exotic grassland.

All paddock trees were assigned to the most likely PCT based on the tree species, landscape position and the surrounding mapped PCTs. Assigning a PCT enabled the determination of the large tree benchmark, used to calculate the category of paddock tree.

4.3 Results

4.3.1 Vegetation description

The majority of the development site is used for cropping, with clear evidence of sustained management including ploughing and planting of crops. Native vegetation is highly modified by both historical and ongoing management practices including clearance of the original vegetation, cropping, addition of fertilisers, ploughing and weed invasion. No vegetation within the development site is considered intact, given that each vegetation zone has at least one of its strata removed or highly modified.

Native remnant canopy vegetation is limited to paddock trees and small patches of woodland with an entirely cleared midstorey. Several discrete areas of derived grassland remain, where the ground cover is predominantly native; however, midstorey and canopy species have been removed.

Planted native wind breaks are present, with a mixture of canopy and midstorey species that do not reflect any PCT. In these areas, the groundcover is a mixture of exotic grasses and forbs.

Exotic vegetation within the development site includes exotic cropping and occasional planted exotic trees.

Each PCT is described in further detail within the following section.

4.3.2 Plant community types

Site investigations, including determination of PCTs using the methods described in Section 4.2.1 and 4.2.2, identified the presence of three PCTs within the development site (Figure 4.1). The PCT, vegetation formation and vegetation class (Keith 2004) are described within Table 4.1. In addition to the three PCTs identified within the development site, dams and cropping and exotic vegetation were also identified (Figure 4.1).

Table 4.1 Plant community types in the development site and corresponding formation and class

Plant community type	Vegetation formation	Vegetation class	Area (ha)
82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy woodlands	Floodplain transition woodland	0.33 ha
278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Grassy woodlands	Western slopes grassy woodlands	0.04 ha
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Grassy woodlands	Western slopes grassy woodlands	2.96

A remnant woodland zone and a derived grassland zone of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion was identified in the broader study area (refer to 6.1). As these two zones have now been avoided, discussion of these vegetation zones are largely limited to Section 6.1 avoidance.

4.3.3 Vegetation zones

Each of the PCTs identified within the development site was stratified into vegetation zones based on broad condition state, as per the method outlined in Section 4.2.2, and allocated a condition class. This process identified six vegetation zones as per the descriptions in Table 4.2.

Table 4.2 Vegetation zones mapped within the development site

Vegetation zone	Plant community type	Ancillary code	Area (ha)
1	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Derived shrubland	0.10
2	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Planted	0.22
3	278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Derived native grassland	0.04
4	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Derived native grassland	0.67
5	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Woodland	0.58
6	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Planted	1.71

In addition to the PCTs identified, areas dominated by exotic vegetation were also present, including cropping, and exotic trees. Descriptions of each vegetation zone and exotic vegetation types are provided in Table 4.3 – Table 4.9, with their locations shown on Figure 4.1.

Table 4.3 Vegetation zone 1 description

Zone 1 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland	
PCT ID	82
Common name	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion
Condition class	Derived shrubland
Extent within development site	0.10 ha
Description	This community occurs adjacent to Back Trundle Road and is maintained as a transmission line easement. The canopy and midstorey is cleared with low shrubs largely limited to Dean's Wattle (*Acacia deanei*) and Hopbush (*Dodonaea viscosa* subsp. *spatulata*). Native ground cover is sparse with the dominant species, Redgrass (*Bothriocloa macra*) and Kangaroo Grass (*Themeda australis*). Other native forbs and grasses include Corregated Sida (*Sida corrugata*), Knottybutt Grass (*Paspalidium constrictum*), *Convolvulus angustissimus* and Purple Burr-daisy (*Calotis cuneifolia*). Exotic grasses dominate this community with the most prevalent Wild Oats (*Avena fatua*), African Lovegrass (*Eragrostis curvula*) and Great Brome (*Bromus diandrus*).
Survey effort	One plot within the development site (Plot 13).
Condition description	This community is part of an existing transmission line with trees and large shrubs cleared to maintain access to the overhead transmission lines. The ground cover has a high weed prevalence.
Characteristic species used for identification of PCT	Several characteristic species of PCT 82 were recorded within the vegetation zone including; Dean's Acacia, Corrugated Sida and Knottybutt Grass. In addition, this vegetation zone is adjacent to woodland which is dominated by Western Grey Box (*Eucalyptus microcarpa*) with occasional Kurrajong (*Brachychiton populneus* subsp. *populneus*) and Wilga (*Geijera parviflora*). These are characteristic species of PCT 82 and it is likely that species were historically present in the vegetation zone, are now absent owing to clearance.
Justification of evidence used to identify the PCT	PCT 82 occurs within the Lachlan plains IBRA subregion, in which the development site is located. The landscape position stated in VIS for the Lachlan plains is; terraces on old alluvial plains or undulating peneplain landforms overlaying a range of underlying rock types. This range of landforms does not preclude this PCT from occurring within the development site. The characteristic species recorded within the zone and in the adjacent and continuous woodland has the best fit match for PCT 82.
Status	Commonwealth EPBC Act: not listed. The zone was assessed against the potentially aligned Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia: Endangered Ecological Community (EEC), using the guide for identification, assessment and management of the community (DSEWPC 2012). The community does not meet the listing criteria for the EEC as the trees, do not cover at least 10 % of the patch, and over 50% of the ground cover is made up of exotic species, rather than perennial native species. NSW BC Act: Listed - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - endangered ecological community listing This PCT is aligned with the EEC and in contrast to the commonwealth listing the scientific determination (OEH 2011) specifically includes disturbed sites, providing that vegetation, either understorey, or overstorey, or both, would under appropriate management, respond through natural regeneration. In the case of this zone, cessation of management for the transmission easement would likely result in regeneration of the canopy and midstory species to some extent. Therefore, this zone is considered to form part of the EEC under the BC Act.
Estimate of percent cleared value of PCT	75 %

Table 4.3 Vegetation zone 1 description

Zone 1 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland	
Photograph 4.1 Zone 1 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland (Plot 13)	

Table 4.4 Vegetation zone 2 description

Zone 2 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_planted	
PCT ID	82
Common name	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion

Table 4.4 Vegetation zone 2 description

Zone 2 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_planted	
Condition class	Planted
Extent within development site	0.22 ha
Description	This community occurs parallel to Back Trundle Road and consists of a linear mixed Eucalyptus planting. The majority of this community has been avoided through design with a small portion cleared for a transmission easement and another small disjunct portion for the solar array. The canopy is composed of a mixture of Eucalypt species including Fuzzy Box (*Eucalyptus conica*), Poplar Box (*Eucalyptus populnea*), Mugga Ironbark (*Eucalyptus sideroxylon*), and tentatively identified Brittle Gum (*Eucalyptus mannifera*). Midstorey species are largely limited to Deans's Wattle and regenerating White Cypress Pine. The ground cover is mostly native with a good diversity of native grasses and forbs, including; *Austrostipa nodosa*, Red Grass, Purple Burr-daisy, *Digitaria divaricatissima, Lomandra filiformis* subs *coriacea* and Corrugated Sida. Prevalent ground cover weeds included Wild Oats, and Vervain (*Salvia verbenaca*).
Survey effort	Two plots within the development site (Plot 9 and 10).
Condition description	This community does not include the structural attributes of a mature woodland, with a lack of fallen timber, tree hollows and developed midstorey. The planted eucalypt provides some habitat value however, and the ground cover is predominately native, with a relatively low weed prevalence.
Characteristic species used for identification of PCT	Historically the areas are likely to have been native woodland, then cleared of canopy species. PCT 82 has been attributed based on the landscape position and due the presence of PCT 82 immediately adjacent to the planted area. Several characteristic species of PCT 82 were recorded within the vegetation zone including Western Grey Box, Poplar Box, White Cypress Pine, Dean's Acacia, Corrugated Sida and Purple Burr-daisy. In addition, this vegetation zone is adjacent to woodland which dominated by Western Grey Box with occasional Kurrajong and Wilga.
Justification of evidence used to identify the PCT	PCT 82 occurs within the Lachlan plains IBRA subregion, in which the development site is located. The landscape position stated in VIS for the Lachlan plains is; terraces on old alluvial plains or undulating peneplain landforms overlaying a range of underlying rock types. This range of landforms does not preclude this PCT from occurring within the development site. The characteristic species recorded within the zone and in adjacent and continuous woodland has the best fit match for PCT 82.
Status	Commonwealth EPBC Act: Listed - Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia The zone was assessed against the potentially aligned Commonwealth EPBC Act EEC and given the native ground cover diversity and canopy with characteristic species present, the zone meets the EEC listing. NSW BC Act: Listed - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - endangered ecological community listing This PCT is aligned with the EEC and the scientific determination (OEH 2011) specifically includes disturbed sites, providing that vegetation, either understorey, or overstorey, or both, would under appropriate management, respond through natural regeneration. The zone has characteristic ground cover species and a regenerating canopy. Therefore, this zone is considered to form part of the EEC under the BC Act.
Estimate of percent cleared value of PCT	75 %

Table 4.4 Vegetation zone 2 description

Zone 2 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_planted

Photograph 4.2

Zone 2 - 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland (Plot 9)

Table 4.5 Vegetation zone 3 description

Zone 3 - 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion_derived native grassland	
PCT ID	278
Common name	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion
Condition class	Derived native grassland
Extent within development site	0.04 ha

Table 4.5 Vegetation zone 3 description

Zone 3 - 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion_derived native grassland	
Description	This community occurs in a cleared swale in the eastern portion of the proposed grid connection alignment. The canopy and midstorey has been entirely cleared with the ground cover dominated by a mixture of native and exotic species. The reed, *Juncus flavidus* was the dominant native species, with other native species including, *Carex inversa, Redgrass*, Kidney Weed (*Dichondra repens*) and Ringed Wallaby Grass (*Rytidosperma caespitosum*). The most dominant exotic species was Wild Oats, with Vervain, Subterranean Clover (*Trifolium subterraneum*) also present.
Survey effort	One plots within the development site (Plot 12).
Condition description	This community is heavily degraded with no canopy species, mid-story species and a ground cover with low native diversity. There is a paucity of fallen timber, leaf litter and hollow bearing trees.
Characteristic species used for identification of PCT	Historically the area is likely to have been riparian native woodland, given that the inundation is occasional, and insufficient to create a naturally treeless wetland. PCT 278 has been attributed based on the landscape position and alignment of the dominant species, *Juncus flavidus*, with the PCT characteristic groundcover species. Other aligned groundcover species include *Carex inversa*, Wood Sorrel (*Oxalis perennans*) and Swamp Dock (*Rumex brownii*)
Justification of evidence used to identify the PCT	PCT 278 occurs within the Lachlan plains IBRA subregion, in which the development site is located. The landscape position stated in VIS includes gullies and on creek flats in hilly terrain or along creeks on plateaux. The position of this zone is in a creek flat between low rises, matching the VIS attribute. The characteristic species recorded within the zone has the best fit match for PCT 278.
Status	Commonwealth EPBC Act: not listed The zone was assessed against the potentially aligned White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Critically Endangered Ecological Community (CEEC). This vegetation zone does not meet the condition thresholds in the Commonwealth listing advice, as there is insufficient forb diversity to be considered the derived native grassland (DNG) variant. These areas are considered degraded and are no longer a viable part of the ecological community (DEEH 2006). NSW BC Act: Listed White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (EEC). This PCT is directly aligned with the EEC and in contrast to the Commonwealth listing, the NSW guidelines and the NSW Scientific Committee final determination (NPWS Undated, OEH 2002) specifically include highly disturbed sites which would, under appropriate management, respond to natural regeneration. Therefore, this zone is considered the EEC under the BC Act.
Estimate of percent cleared value of PCT	80 %

Table 4.5 Vegetation zone 3 description

Zone 3 - 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion_derived native grassland	
Photograph 4.3 Zone 3 - 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion_derived native grassland	

Table 4.6 Vegetation zone 4 description

Zone 4 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland	
PCT ID	437
Common name	Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland
Condition class	Derived native grassland
Extent within development site	0.67 ha

Table 4.6 Vegetation zone 4 description

Zone 4 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland	
Description	This community occurs in the extreme north-east corner of the solar farm area and within a swale bisecting the solar farm area. Most of the swale has been avoided through design, with impacts limited to a single access track. The canopy and midstorey has been entirely cleared with the ground cover dominated by the exotic Annual Ryegrass (*Lolium rigidum*) with other exotic species including Subterranean Clover, Soft Broome, (*Bromus molliformis*) and Heronsbill *(Erodium brachycarpum*). The most prevalent native species include Ringed Wallaby Grass, Smallflower Wallaby Grass (*Rytidosperma setaceum*) and Curly Windmill Grass (*Enteropogon acicularis*). Despite a reasonable native ground cover diversity, the coverage of native species was very low.
Survey effort	One plot within the development site (Plot 7).
Condition description	This community is heavily degraded with no canopy species, no mid-story species and a groundcover with low native coverage diversity. There is a paucity of fallen timber or other structural complexity.
Characteristic species used for identification of PCT	PCT 437 is described as a tall woodland dominated by Yellow Box (*Eucalyptus melliodora*), sometimes with Rough-barked Apple and (*Angophora floribunda*) or Kurrajong (*Brachychiton populneus*) present. Whilst no trees were recorded within this vegetation zone, paddock trees are present in the surrounding cropped areas, dominated by large Yellow Box with more occasional Kurrajong and Inland Grey Box. PCT 437 is the best match for this canopy composition. Furthermore, several ground cover species recorded within zone are characteristic species of the PCT; *Goodenia pinnatifida, Juncus subsecundus*, Corrugated Sida, Red Grass and Wood Sorrel.
Justification of evidence used to identify the PCT	PCT 437 occurs within the South Western Slope IBRA region, in which the development site is located. The landscape position stated in VIS includes valley flats, plains and hillslopes, which includes the landforms within the development site. The characteristic species recorded within the zone has the best fit match for PCT 437, with no other PCTs dominated by Yellow Box identified.
Status	<u>Commonwealth EPBC Act</u>: not listed The zone was assessed against the potentially aligned White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Critically Endangered Ecological Community (CEEC). This vegetation zone does not meet the condition thresholds in the Commonwealth listing advice, as the patch is not predominantly native, which is required to be considered the derived native grassland (DNG) variant. These areas are considered degraded and are no longer a viable part of the ecological community (DEEH 2006). <u>NSW BC Act:</u> Listed White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (EEC). This PCT is directly aligned with the EEC and in contrast to the commonwealth listing, the NSW guidelines and the NSW Scientific Committee final determination (NPWS Undated, OEH 2002) specifically include highly disturbed sites which would under appropriate management respond to natural regeneration. Therefore this zone is considered EEC under the BC Act.
Estimate of percent cleared value of PCT	80 %

Table 4.6 Vegetation zone 4 description

Zone 4 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland	
Photograph 4.4 Zone 4 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived grassland (Plot 7).	

Table 4.7 Vegetation zone 5 description

Zone 5 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland	
PCT ID	437
Common name	Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland
Condition class	Woodland
Extent within development site	0.58 ha
Description	This community occurs in two adjacent small patches within the solar farm area. A single canopy species, Yellow Box, was recorded within the zone, with a total of nine trees recorded within the entire zone. Native ground cover was very sparse with a four species identified; *Austrostipa nodosa*, *Einadia polygonoides*, Wingless Bluebush (*Maireana enchylaenoides*) and Corrugated Sida. Dominant exotic groundcover species includes Willow-leaved Lettuce (*Lactuca saligna*) and London Rocket (*Sisymbrium irio*).
Survey effort	One plot within the development site (Plot 4).

Table 4.7 Vegetation zone 5 description

Zone 5 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland	
Condition description	This community is limited to a discrete patch of highly degraded and disturbed remnant vegetation. No midstorey species were recorded and the groundcover is sparse and dominated by exotic species.
Characteristic species used for identification of PCT	PCT 437 is described as a tall woodland typically dominated by Yellow Box (*Eucalyptus melliodora*) sometimes with Rough-barked Apple and (*Angophora floribunda*) or Kurrajong (*Brachychiton populneus*). Yellow box is the dominant species with the vegetation zone and therefore aligns well with PCT 437. Two species (50%) recorded within the ground cover, Corregated Sida and *Einadia polygonoides,* align with the community.
Justification of evidence used to identify the PCT	PCT 437 occurs within the South Western Slope IBRA region, in which the development site is located. The landscape position stated in VIS includes valley flats, plains and hillslopes, which includes the landforms within the development site. The characteristic species recorded within the zone has the best fit match for PCT 437, with no other PCTs dominated by Yellow Box identified.
Status	Commonwealth EPBC Act: not listed The zone was assessed against the potentially aligned White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Critically Endangered Ecological Community (CEEC). This vegetation zone does not meet the condition thresholds in the Commonwealth listing advice, as the patch does not have a predominantly native ground cover. These areas are considered degraded and are no longer a viable part of the ecological community (DEEH 2006). NSW BC Act: Listed White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community (EEC). This PCT is directly aligned with the EEC and in contrast to the commonwealth listing, the NSW guidelines and the NSW Scientific Committee final determination (NPWS Undated, OEH 2002) specifically include highly disturbed sites which would under appropriate management respond to natural regeneration. Therefore this zone is considered EEC under the BC Act.
Estimate of percent cleared value of PCT	80 %

Table 4.7 Vegetation zone 5 description

Zone 5 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland

Photograph 4.5

Zone 5 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland (plot 4)

Table 4.8 Vegetation zone 6 description

Zone 6 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_planted	
PCT ID	437
Common name	Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_planted
Condition class	Planted
Extent within development site	1.71 ha
Description	This community occurs as planted windrows and in discrete revegetation areas in the central portion of the solar array. Historically the areas are likely to have been woodland. PCT 437 has been attributed based on the landscape position and due to its prevalence in the surrounding area. The canopy is composed of a mixture of Eucalypt species which do not reflect the likely original canopy species; these include White Box (*Eucalyptus albens*), Fuzzy Box, Poplar Box, River Red Gum (*Eucalyptus camaldulensis*) Belah (*Casuarina cristata*) and Mugga Ironbark, midstorey species were limited to Dean's Wattle. The groundcover was very sparse with a low diversity of native species and weeds. The most prevalent native species included Red Grass, Kidney Weed, *Einadia polygonoides* and Wingless Bluebush. Exotic groundcover species includes Wild Clary (*Salvia verbenaca*) and Wild Oats.
Survey effort	One plot within the development site (Plot 8).
Condition description	This community is limited to a discrete patch of highly degraded and disturbed remnant vegetation. No midstorey species were recorded and the groundcover is very sparse. Surrounding land use (mostly cropping) and associated edge impacts contribute even further to the existing poor condition of this zone.
Characteristic species used for identification of PCT	No characteristic canopy species of the PCT and few ground cover species were recorded. The PCT was assigned based on landscape position and the surrounding remnant paddock trees, which were dominated by Yellow Box.
Justification of evidence used to identify the PCT	PCT 437 occurs within the South Western Slope IBRA region, in which the development site is located. The landscape position stated in VIS includes valley flats, plains and hillslopes, which includes the landforms within the development site. The characteristic species recorded within the zone has the best fit match for PCT 437, with no other PCTs dominated by Yellow Box identified.
Status	Commonwealth EPBC Act: not listed The zone was assessed against the potentially aligned White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Critically Endangered Ecological Community (CEEC). This vegetation zone does not meet the condition thresholds in the Commonwealth listing advice, as the patch does not have a predominantly native ground cover. And the characteristic species of the community are no longer present. NSW BC Act: Listed White Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community EEC). Whilst the guidelines specifically include highly disturbed sites the zone has been irrevocably altered, regenerating to a community which is dominated by Eucalypt species which are not characteristic of the PCT. Furthermore, the ground cover is sparse and no longer indicative of the EEC. The community is not likely to respond to management and therefore is not considered part of the EEC.
Estimate of percent cleared value of PCT	80 %

Table 4.8 Vegetation zone 6 description

Zone 6 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_planted

Photograph 4.6

Zone 6 - 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_planted (plot 8)

4.3.4 Assessment of patch size

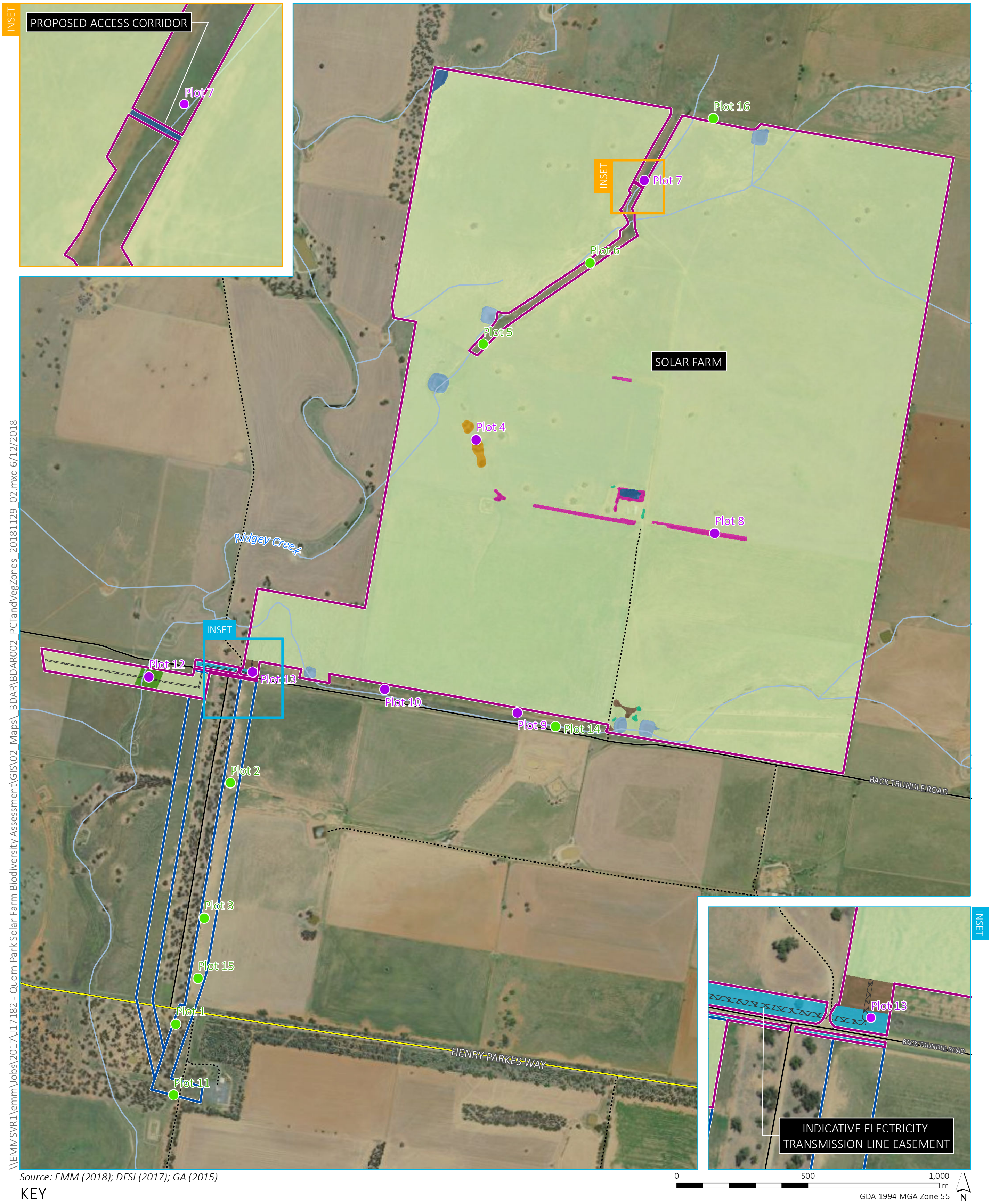
Patch size was assessed in accordance with Section 5.3.2 of the BAM (OEH 2017a) and the Biodiversity Assessment Method Operational Manual – Stage 1. NSW Office of Environment and Heritage, Sydney (OEH 2018). None of the vegetation zones were considered intact vegetation, given that at least one of their strata were absent. Patch size is therefore zero for all zones.

4.3.5 Vegetation integrity score

The vegetation integrity score for each vegetation zone is presented in Table 4.10.

Table 4.9 Current vegetation integrity score for the vegetation zones within the development site

Vegetation zone	Plant community type	Ancillary code	Area (ha)	Vegetation integrity score
1	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Derived native grassland	0.10	33.6
2	82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Planted	0.22	47.1
3	278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Derived native grassland	0.04	33.5
4	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Derived native grassland	0.67	23.8
5	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Woodland	0.58	30.7
6	437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Planted	1.71	37.6



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Source: EMM (2018); DFSI (2017); GA (2015)

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line

Plot locations

- Included in BAM assessment
- Excluded from BAM assessment
- Development site
- Study area
- Proposed electricity transmission line easement

Plant community types and condition

- 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern PCT Cobar Peneplain Bioregion Derived native shrubland
- PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion Planted
- PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion Derived native grassland
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Derived native grassland
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Planted
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Woodland
- Exotic trees
- Cropped
- Dam

Plant community type and vegetation zone mapping withing the development site, including plot locations

Quorn Park Solar Farm
Biodiversity development assessment
Figure 4.1

EMM
creating opportunities

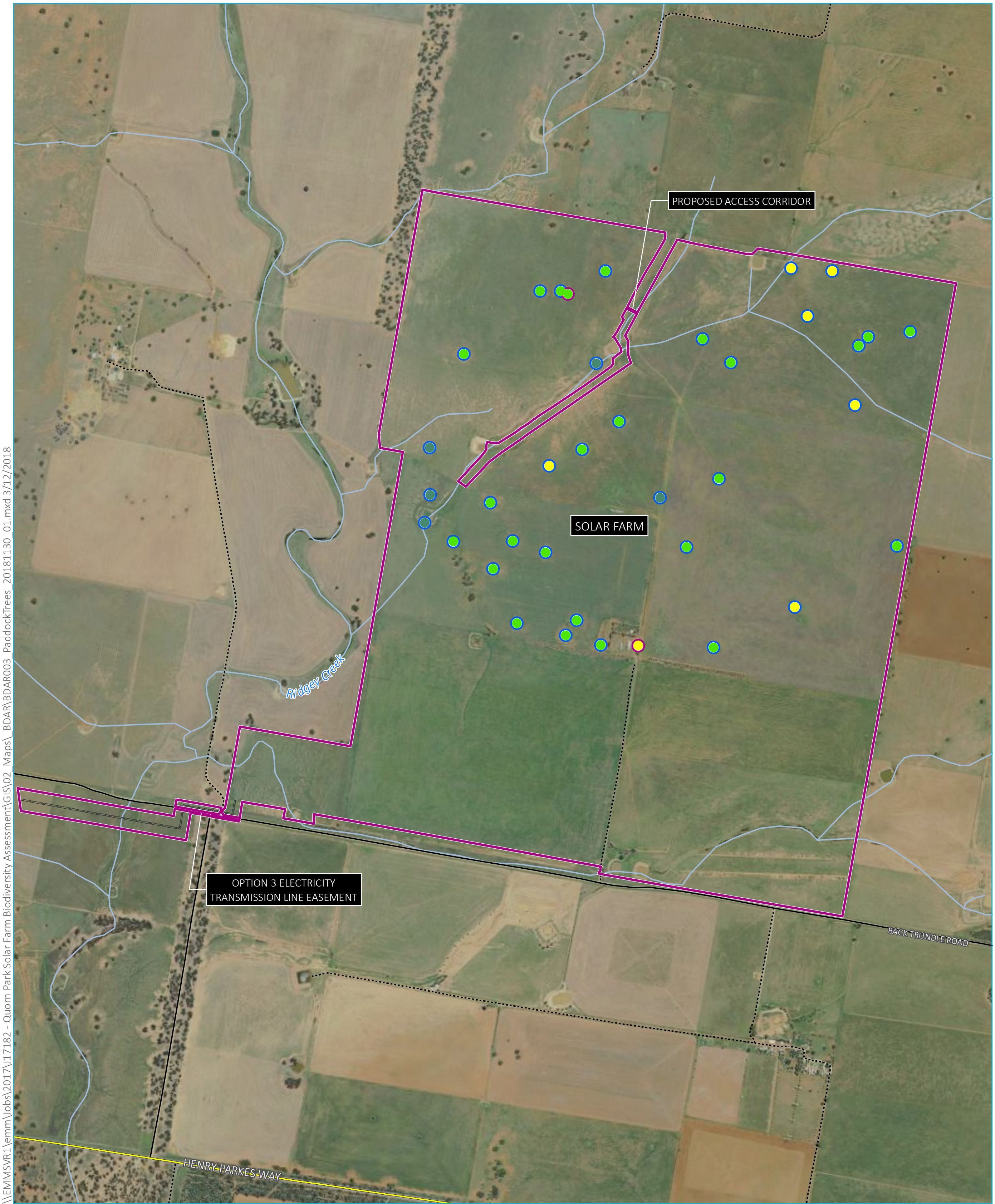
4.3.6 Paddock tree assessment

A total of 37 paddock trees were assessed, comprising three different species. Yellow Box was the most frequently recorded (25), followed by Kurrajong (7) and Grey Box (5). All paddock trees were assigned to PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion, based on their landscape position and the dominance of Yellow Box.

A summary of the paddock trees categorised according to the BAM (OEH 2017a) is provided in Table 4.11, with the full results provided in Appendix C and displayed on Figure 4.2.

Table 4.10 Paddock trees assigned in accordance with Appendix 1 of the BAM

Category	Non-hollow bearing	Hollow bearing trees	Total
1 (0-<20cm DBH)	0	0	0
2 (20- <50 cm DBH)	2	0	2
3 (> 50 cm DBH)	25	12	37



Source: EMM (2018); DFSI (2017); GA (2015)

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Development site
- Proposed electricity transmission line easement

Paddock tree

- *Brachychiton populneus*
- *Eucalyptus melliodora*
- *Eucalyptus microcarpa*
- Category 2
- Category 3

Paddock trees within the development site

Quorn Park solar farm
Biodiversity development assessment
Figure 4.2

EMM
creating opportunities

5 Threatened Species

5.1 Fauna habitat assessment

Concurrent with the vegetation mapping, a habitat assessment was undertaken seeking to identify the following fauna habitat features within the development site:

- habitat trees including large hollow-bearing trees;
- availability of flowering shrubs and feed tree species;
- waterway condition;
- quantity of ground litter and logs; and
- searches for indirect evidence of fauna.

This habitat assessment identified that the majority of the development site is highly disturbed, only supporting fauna species which are able to persist in highly modified agricultural landscapes.

The grassland and cropped areas have low habitat value, primarily providing foraging habitat for seed eating and insectivorous birds including Red-rumped Parrot (*Psephotus haematonotus*), Australasian Pipit (*Anthus novaeseelandiae*) and the exotic European Starling (*Sturnus vulgaris*). A single native mammal species was observed, the Eastern Grey Kangaroo (*Macropus giganteus*), which is able to persist in open areas and cross fence lines. The European Hare (*Lepus europaeus*) was also moderately abundant.

Habitat resources within remnant woodland areas of the development site (PCT 437_woodland) are largely limited to the trees themselves, given the absence of any midstorey species and lack of functional leaf litter. Some woody debris was present; however, the lack of any other supporting habitat features, such as dense tussock grasses and shrub means that the understorey habitat is considered very poor and unlikely to support many species except those most disturbance tolerant.

Scattered trees within the development site provide similar fauna habitat to the remnant woodland; however, the scattered trees tended to be larger and therefore likely to have a higher nectar yield for nectivorous birds. Bird surveys conducted during Yellow Box flowering recorded few species however, and it is likely that the large gaps between the trees (low density) increase foraging energy expenditure, reducing the viability of the foraging resource.

Planted native woodland provides different habitat features compared to remnant woodland. Trees were a mix of species occurring as dense and somewhat stunted low woodland. No hollows were present and nectar production is likely to be low given the small size of the trees. Despite a lack of fallen timber; shelter and structural complexity of the habitat was higher than other habitats due to the presence of some planted midstorey species and reduced spacing between trees. Most of the planted areas were also fenced, leading to a more structurally complex groundcover.

Several small farm dams exist within the development site however the habitat quality is considered low considering the eroded banks and the absence of submerged, emergent and marginal aquatic vegetation.

The majority of the mapped lower order (Strahler first, second and third order) streams within the development site have been so extensively modified by the construction of dams and retention banks that no channel or surface water is now evident. This includes two tributaries of Ridgey Creek which are mapped as Key Fish Habitat. These watercourses are considered defunct from an aquatic fauna habitat perspective.

One fourth order watercourse, Ridgey Creek, intersects the proposed grid connection alignment. At the point of the intersection Ridgey Creek has a poorly defined channel, largely limited to a sedge and grass dominated swale. This area does not have any capability to support fish species given the lack of permanent water, a defined channel or the presence of any pools. There is potential that the habitat may support frogs, including the threatened Sloane's Froglet (*Crinia sloanii*), given that it has the ability to breed in small areas of ephemeral habitat.

5.2 Ecosystem credit species assessment

A list of ecosystem credit species predicted to occur within the development site, based on the PCTs present and generated by the calculator associated within the BAM (OEH 2017a) is provided in Table 5.1. The potential for these species to occur within the development site was assessed in accordance with Section 6.2 of the BAM (OEH 2017a).

Table 5.1 Assessment of ecosystem credit species within the development site

Scientific name	Common name	Justification for exclusion
Anthochaera phrygia	Regent Honeyeater (Foraging)	Excluded from PCT 437_derived native grassland, as no foraging resources (feed trees) are present.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	As this species has the potential to forage in open areas, all habitat types have been included.
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	Included in all vegetation types (278_DNG) as has the potential to forage in open areas.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Foraging)	Considered as outside of the Narrandera, Leeton and Griffith LGAs. Excluded from all habitat/vegetation types as there are no feed trees present.
Certhionyx variegatus	Pied Honeyeater	Excluded from PCT 82 derived native grassland as no woodland habitat present.
Chalinolobus picatus	Little Pied Bat	As this species has the potential to forage in open areas, all habitat types have been included.
Chthonicola sagittata	Speckled Warbler	Excluded from PCT 82 derived native grassland and 278 derived native grassland as no woodland habitat is present in these zones.
Circus assimilis	Spotted Harrier	As this species has the potential to forage in open areas, all habitat types have been included.
Climacteris picumnus victoriae	Brown Treecreeper (Eastern subspecies)	Excluded based on geographic limitation (east of Newell Highway).
Daphoenositta chrysoptera	Varied Sittella	Excluded from PCT 437_derived native grassland and PCT 82 derived native grassland as no woodland habitat present.
Dasyurus maculatus	Spotted-tailed Quoll	Excluded from PCT 278 derived native grassland as no woodland habitat present.
Falco hypoleucos	Grey Falcon	Not excluded.
Glossopsitta pusilla	Little Lorikeet	Excluded from PCT 437 derived native grassland as no woodland habitat present.
Grantiella picta	Painted Honeyeater	Excluded from all habitat/vegetation types as mistletoe does not occur as greater than 5 per hectare (habitat constraint).
Grus rubicunda	Brolga	Not excluded.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	Excluded from all habitat/vegetation types as there are no foraging resources (suitable waterbodies and adjacent habitat) present.

Table 5.1 Assessment of ecosystem credit species within the development site

Scientific name	Common name	Justification for exclusion
Hieraaetus morphnoides	Little Eagle	Not excluded.
Lathamus discolor	Swift Parrot (foraging)	Excluded from PCT 437_derived native grassland and PCT 82 derived native grassland as no foraging resources (feed trees) are present.
Lophochroa leadbeateri	Major Mitchell's Cockatoo (Foraging)	Not excluded.
Lophoictinia isura	Square-tailed Kite	Not excluded.
Melanodryas cucullata cucullata	Hooded Robin (South-eastern form)	Excluded from PCT 82 derived native grassland and 278 derived native grassland as no woodland habitat present.
Neophema pulchella	Turquoise Parrot	Not excluded.
Petroica boodang	Scarlet Robin	Not excluded.
Petroica phoenicea	Flame Robin	Excluded from PCT 82 derived native grassland and 278 derived native grassland as no woodland habitat present.
Phascolarctos cinereus	Koala (foraging)	Excluded from all vegetation types as woodland areas have poor connectivity and are too small in size, with too few feed trees to support the species. Furthermore, field surveys failed to detect Koala.
Polytelis swainsonii	Superb Parrot (Foraging)	Not excluded.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Excluded from PCT 82 derived native grassland and 278 derived native grassland as no woodland habitat present.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Not excluded.
Stagonopleura guttata	Diamond Firetail	Not excluded.
Tyto novaehollandiae	Masked Owl (Foraging)	Not excluded

5.3 Species credit species assessment

5.3.1 Habitat constraints assessment

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 5.2.

Table 5.2 Assessment of habitat constraints and geographical features within the development site

Scientific name	Common name	Feature	Sensitivity to gain	Habitat constraint present and justification
Aprasia parapulchella	Pink-tailed Legless Lizard	Rocky areas; Or within 50m of rocky areas	High	The development site does not contain or is adjacent to rocky areas. This species has not been considered further.
Austrostipa wakoolica	A spear-grass	South of Narranderra	Moderate	The development site is north of Narranderra and the species has not been considered further.
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs	High	Fallen/and standing dead timer is largely abscent from the development site and the species has not been considered further.
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Outside Narrandera, Leeton and Griffith LGAs	High	The development is outside of the three LGAs therefore the species requires further consideration.
Calyptorhynchus lathami – Endangered population	Glossy Black-Cockatoo , Riverina population. (Breeding)	Only in Carrathool, Griffith, Leeton & Narrandera LGAs	High	The development is outside of the endangered population area and therefore the population does not require further consideration.
Crinia sloanei	Sloane's Froglet	Semi-permanent/ephemeral wet areas; Containing relatively shallow sections; with submergent and emergent vegetation, or within 500 m of wet area/ swamps; Within 500 m of swamps/waterbodies; Within 500 m of waterbody.	Moderate	The development site contains a swale which is considered an ephemeral wet area. The species requires further consideration.
Leptorhynchos orientalis	Lanky Buttons	West of Narrandera/Lockhart Road and North of Urana/Lockhart Road	Moderate	The development site is not with the specified occurrence area and the species has not been considered further
Swainsona murrayana	Slender Darling Pea	western half of sub-CMA	Moderate	The development site is within the eastern half of the CMA, therefore the species has not been considered further.

Five species and one endangered population require no further assessment as due to the abscence of specific habitat types or based on geographic constraints; Pink-tailed Legless Lizard (*Aprasia parapulchella*), *Austrostipa wakoolica*, Bush Stone-curlew (*Burhinus grallarius*), Glossy Black-cockatoo (*Calyptorhynchus lathami*) – Endangered population, Lanky Buttons (*Leptorhynchos orientalis*) and Slender Darling Pea (*Swainsona murrayana*).

The remaining two species, Glossy Black-Cockatoo (*Calyptorhynchus lathami*) (Breeding habitat) and Sloane's Froglet (*Crinia sloanei*), require further assessment and are considered in Section 5.3.2.

5.3.2 Identifying candidate species credit species for further assessment

To develop a list of species credit species for further assessment, an assessment was undertaken in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017a), as shown in Table 5.3.

Table 5.3 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Flora			
A spear-grass	*Austrostipa metatoris*	Yes	Potential habitat for the species exists within native grassland and woodland areas of the development site.
Pine Donkey Orchid	*Diuris tricolor*	Yes	Potential habitat for the species exists within native grassland and woodland areas of the development site.
Silky Swainson-pea	*Swainsona sericea*	Yes	Potential habitat for the species exists within native grassland and woodland areas of the development site.
Mammals			
Squirrel Glider	*Petaurus norfolcensis.*	Yes	Potential habitat for this species exists adjacent to the development site in woodland areas of PCT 82 Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion. Limited habitat exists within the development site; however, the species has been included as a candidate species on a conservative basis.
Koala (Breeding)	*Phascolarctos cinereus*	Yes	Potential habitat for this species exists adjacent to the development site in woodland areas of PCT 82 Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion. Limited habitat exists within the development site; however, the species has been included as a candidate species on a conservative basis.
Birds			
Regent Honeyeater (breeding)	*Anthochaera phrygia*	No	Mapped important areas are considered species credits under the BAM (OEH 2017a). There are no mapped ‘key breeding areas’ or ‘other breeding areas’ mapped close to the development site, with the closest the Capertee key breeding area, over 170 km east. Furthermore the development site is on the western boundary of the species distribution, mapped as ‘species may occur’ (Figure 1, National Recovery Plan (DoE 2016).
Gang-gang Cockatoo (Breeding)	*Callocephalon fimbriatum*	Yes	Several hollow bearing trees exist as paddock trees within the development site. These have the potential to provide nesting habitat for Gang-gang Cockatoo, though given the sparse nature of the paddock trees the habitat is considered suboptimal.

Table 5.3 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Glossy Black-Cockatoo (Breeding)	*Calyptorhynchus lathami*	No	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur (*Casuarina* and *Allocasuarina* species). Dependent on large hollow-bearing eucalypts for nest sites. No *Casuarina* and *Allocasuarina* were recorded within the entire development site or the surrounding landscape. The species needs to forage for much of the day in order to obtain sufficient food, especially during the breeding season (Garnett & Crowley 2000). Therefore the energetic demand of foraging over such large distances would negate breeding within the development site. Habitat is considered degraded in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017a).
White-bellied Sea-eagle (breeding)	*Haliaeetus leucogaster*	No	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass. No suitable foraging habitat exists with the development site, or in the surrounding locality. The species is unlikely to breed within the development site given it would be energetically unviable to raise chick given the lack of adjacent foraging resources. None of the habitat features required for breeding are present and the species presence is discounted in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a).
Little Eagle (breeding)	*Hieraaetus morphnoides*	No	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch of open woodland or along tree-lined watercourses, where pairs build a large stick nest in winter. There is no intact remnant woodland or tree lined watercourses within the development site and the species is unlikely to utilise the site for nesting. None of the habitat features required for breeding are present and the species presence is discounted in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a).
Swift Parrot (breeding)	*Lathamus discolor*	No	Mapped important areas are considered species credits under the BAM (OEH 2017a). These areas do not require survey. The development site is not within a mapped important area for the Swift Parrot, and breeding only occurs in Tasmania.
Major Mitchell's Cockatoo (breeding)	*Lophochroa leadbeateri*	Yes	Several hollow bearing trees exist as paddock trees within the development sitre. These have the potential to provide nesting habitat for Major Mitchell's Cockatoo, though given the sparse nature of the paddock trees the habitat is considered suboptimal.

Table 5.3 Species credit species and status and habitat suitability assessment

Common name	Scientific name	Candidate species	Justification
Square-tailed Kite (Breeding)	*Lophoictinia isura*	No	The species is found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses, with nest sites typically located along or near watercourses. Timbered watercourses are absent from the Development Site and the species is not anticipated to breed within the development site. None of the habitat features required for breeding are present and the species presence is discounted in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a).
Superb Parrot (Breeding)	*Polytelis swainsonii*	Yes	The species inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Given the potential for the species to utilise isolated trees the species has the potential to nest within the development site.
Masked Owl (Breeding)	*Tyto novaehollandiae*	No	The Masked Owl requires large hollows for breeding greater than 40 cm wide and 100 cm deep, in trees greater than 90 cm diameter (DEC 2016). Habitat assessment of trees within the development site did not identify any suitable hollows with the potential to support the species. None of the habitat features required for breeding are present and the species presence is discounted in accordance with Step 2 of Section 6.4 of the BAM (OEH 2017a).
Amphibians			
Sloane's Froglet	*Crinia sloanei*	Yes	Sloane's Froglet typically occurs in periodically inundated watercourses and has been recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. The species has the potential to occur within a swale area of Ridgey Creek.

This assessment identified the following species as candidate species requiring further assessment:

- *Austrostipa metatoris*;
- Pine Donkey Orchid;
- Silky Swainson-pea;
- Koala;
- Squirrel Glider;
- Superb Parrot (breeding)
- Gang-gang Cockatoo (breeding);
- Major Mitchell's Cockatoo (breeding); and
- Sloane's Froglet.

Targeted surveys were undertaken, and the presence or abscence of these species in the development site determined, in accordance with Section 6.4 of the BAM (OEH 2017a). The exception to this is the Sloane's Froglet. This species is most detectable during July and August and survey for the species have not being undertaken. The species will be assumed present in areas of suitable habitat for the species.

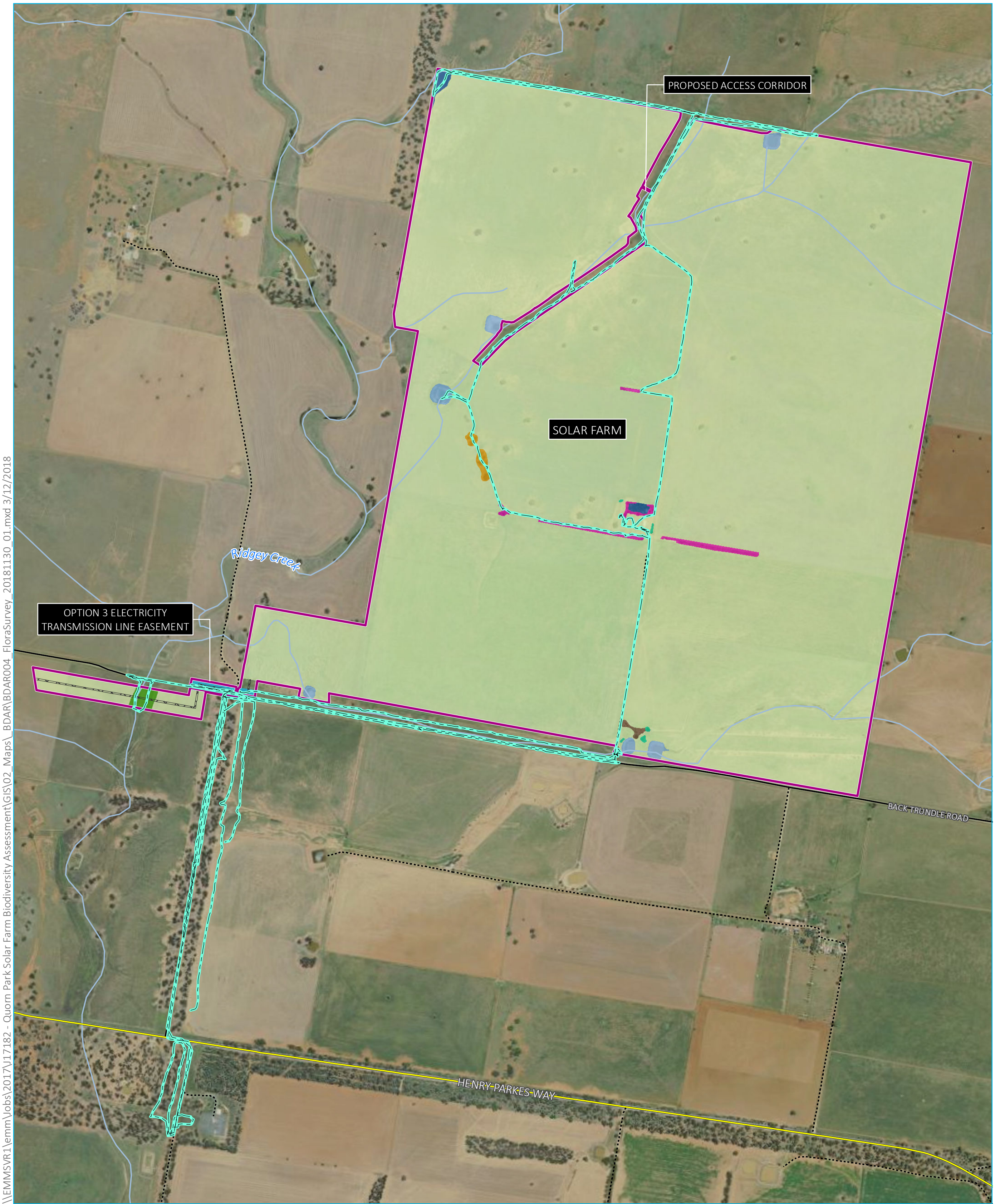
Survey methods and outcomes for all other species are discussed further below.

5.3.3 Targeted survey methods

i Targeted flora surveys

Targeted flora surveys have been undertaken in accordance with OEH (2016c) and DoE (2013) guidelines, adopting systematic parallel transects spaced at intervals of 10 m. Field surveys were conducted over five days from 15-19 October 2018, which is a suitable seasonal timing to detect all three target species; *Austrostipa metatoris*, Pine Donkey Orchid and Silky Swainson-pea. Preceding rainfall at nearby Parkes Airport included; 17.8 mm during August, 17.2 mm during September and 21 mm during early October (BOM 2018).

Targeted flora survey locations are illustrated in Figure 5.1, with the survey effort displayed, representing a single track from a handheld GPS. A second person walked parallel at approximately 10 m separation distance. All native vegetation within the development site was surveyed, including along roadside and tracksides. Additional survey effort was also conducted within the original wider study area, which include woodland and grassland habitats of a higher condition than the refined development site (refer to Figure 6.1). A total of 15.7 km was surveyed.



Source: EMM (2018); DFSI (2017); GA (2015)

0 500 1,000 m

GDA 1994 MGA Zone 55

N

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Development site
- Proposed electricity transmission line easement
- Targeted flora survey tracks

Plant community types and condition

- 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern PCT Cobar Peneplain Bioregion Derived native grassland
- PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion Planted
- PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion Derived native grassland
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Derived native grassland
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Planted
- PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Woodland
- Exotic trees
- Cropped
- Dam

Targeted flora survey effort

Quorn Park Solar Farm
Biodiversity development assessment
Figure 5.1

creating opportunities

ii Spotlighting

Three spotlighting surveys were undertaken by two observers between 16 and 19 October 2018, targeting Squirrel Glider and Koala with a total survey length of 4km (refer to Figure 5.2). Observers moved at a speed of 10 m per minute, with all animals observed recorded. DSEWPaC (2011a) recommends two parallel 200 m transects per 5 ha site, therefore given the smaller size of potential habitat present, survey guidelines have been exceeded.

iii Koala scat searches

Searches for Koala scats were based on the SAT Koala Survey Methodology (Phillips and Callaghan 2011) and undertaken during October 2018. Two SAT locations were selected (Figure 5.2) in areas where the relative chance of detection were highest; taking into account patch size, connectivity and the amount of feed tree species listed for the Central and Southern Tablelands koala management area.

One primary feed tree was recorded within the development site, River Red Gum. Secondary feed trees recorded within the development site included Inland Grey Box, Yellow Box, White Box and Brittle Gum. All of the habitat within the development site consisted of either scattered trees or small isolated patches of habitat, which are unlikely to support the species. With the exception of Yellow Box, feed trees were found in planted windrows where trees were small in size and unlikely to provide foraging resources of sufficient quality for Koala. In order to maximise the detection chance SAT searches were undertaken in Inland Grey Box woodland adjacent to the development site, which had good connectivity to large patches of vegetation and a high density of remnant Inland Grey Box. Refer to Figure 5.2 for targeted koala survey locations.

iv Arboreal trapping

Arboreal trapping was used to target the Squirrel Glider. Limited habitat occurs within the current development site, and this area is unlikely to support the Squirrel Glider. Survey effort was focused on remnant Grey Box woodland which has a high tree density, some midstorey species present, larger patch sizes and more optimal connectivity. Two transects of ten Elliot B or cage traps were placed at 2-4 m above the ground, approximately 50 m apart (refer to Figure 5.2). A single transect was used along McGraths Lane given the narrow habitat width, and in two parallel lines separated by 50 m, south of Henry Parkes way. Trapping included the following:

- traps were baited with a mixture of peanut butter, rolled oats and honey;
- a mixture of water and honey was sprayed on tree trunk;
- traps were checked early in the morning and closed for the day; and
- traps were re-opened and rebaited in the late afternoon.

v Hollow nesting birds – breeding surveys

Seven bird surveys were conducted during the morning or late afternoon, between 16 to 19 October 2019. Pedestrian transects were undertaken, with key focus on areas of high habitat value with the largest density of tree hollows. A total of 25.8 km of survey effort was undertaken. Key focus was given to Major Mitchell's Cockatoo, Gang-gang Cockatoo, and Superb Parrot; in addition to checking tree hollows for any signs of activity, observations were made of any foraging birds or transiting birds, so that they could be followed to any nesting location. Survey transects are shown on Figure 5.2 and survey timing and effort are displayed in Table 5.4.

Table 5.4 Survey effort for hollow nesting birds

Survey	Date	Time	Weather
Bird 1	16/10/18	0930 - 1015	Moderate wind, 85% cloud, 20C
Bird 2	16/10/18	1650 – 1750 (x2 observers)	Moderate wind, 80% cloud, warm 27C
Bird 3	17/10/18	0650 - 0740	No wind, rain overnight
Bird 4	17/10/18	0755 - 0910	No wind, no rain, 95% cloud, 18 C
Bird 5	18/10/18	0700 - 0900	No wind, no rain, 10% cloud, 14-18C
Bird 6	19/10/18	0650 - 0830	No wind, 1% cloud, 15.5oC
Bird 7	19/10/18	1900 - 1930	No wind, no rain, no cloud, 22C

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Source: EMM (2018); DFSI (2017); GA (2015)

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Development site
- Proposed electricity transmission line easement
- Koala SAT
- Trap location

Bird survey tracks

- Bird survey 1
- Bird survey 2
- Bird survey 3
- Bird survey 4
- Bird survey 5
- Bird survey 6
- Bird survey 7

Spotlighting tracks

- Spotlighting 1
- Spotlighting 2
- Spotlighting 3

Targeted fauna survey effort

Quorn Park solar farm
Biodiversity development assessment
Figure 5.2

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5.3.4 Targeted survey results

No threatened species were recorded within the development site opportunistically or during targeted surveys. Sloane's Froglet was not surveyed due to seasonal constraints. This species was assumed present where potential habitat was identified.

A summary of species credit species predicted to occur within the development site, based on the PCTs present and as predicted by the credit calculator is provided in Table 5.6. This includes an assessment of whether the development site provides suitable habitat and whether the species will be impacted by the development. The potential for a species to occur within the development site was assessed in accordance with Step 3 of Section 6.4 of the BAM (OEH 2017a).

Table 5.5 Species credit species, habitat suitability and targeted survey results

Common name	Scientific name	Biodiversity risk weighting	Habitat present within the development site	Recorded during field surveys	Impacted by development	Justification
A spear-grass	*Austrostipa metatoris*	1.5	Potential habitat exists within native grassland and woodland areas	No	No	Field surveys did not detect the species
Pine Donkey Orchid	*Diuris tricolor*	1.5	Potential habitat exists within native grassland and woodland areas	No	No	Field surveys did not detect the species
Silky Swainson-pea	*Swainsona sericea*	2	Potential habitat exists within native grassland and woodland areas	No	No	Field surveys did not detect the species
Squirrel Glider	*Petaurus norfolcensis.*	2	Sub-optimal habitat within woodland areas, more optimal habitat outside of the development site.	No	No	Field surveys did not detect the species
Koala (Breeding)	*Phascolarctos cinereus*	2	Sub-optimal habitat within woodland areas, more optimal habitat outside of the development site.	No	No	Field surveys did not detect the species
Major Mitchell's Cockatoo (breeding)	*Lophochroa leadbeateri*	2	Potential breeding habitat within scattered paddock trees	No	No	Field surveys did not detect the species
Gang-gang Cockatoo (breeding);	Gang-gang Cockatoo (breeding);	2	Potential breeding habitat within scattered paddock trees	No	No	Field surveys did not detect the species
Superb Parrot (Breeding)	*Polytelis swainsonii*	2	Potential breeding habitat within scattered paddock trees	No	No	Field surveys did not detect the species
Sloane's Froglet	*Crinia sloanei*	1.5	Potential habitat within PCT_278_DNG.	No	Yes - assumed	This species was assumed present within PCT 278_DNG.

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 the proponent to design a development that further avoids, minimises and mitigates impacts.

6.1 Potential direct, indirect and prescribed impacts

The main direct impacts of projects are generally associated with direct impacts arising from the clearing of native vegetation communities and loss of species habitat and associated indirect impacts. Potential direct impacts that could arise from the project, prior to any avoidance, minimisation or mitigation, include:

- clearing of native vegetation and threatened species habitat; and
- disturbance of watercourse beds and banks during trenching or for access requirements.

Unmitigated, the project has the potential to result in minor indirect or minor prescribed impacts. Prescribed impacts, as per Section 8.2.1.2 of the BAM (OEH 2017a), that could occur as a result of project include:

- fauna vehicle strike from construction traffic;
- impacts to surface water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses;
- impacts to groundwater water quality and quantity due to sediment runoff and/or contaminant runoff into adjacent watercourses; and
- fragmentation of habitats and associated impacts to connectivity and fauna movement.

Unmitigated indirect impacts that could occur as a result of the project include:

- increased noise, vibration and dust levels;
- artificial lighting impacting nocturnal species behaviour; and
- increase in weeds and pathogens.

Increased vehicle movements associated with the project have the potential to result in increased fauna vehicle strikes and associated fauna mortality. The risk of significant impacts is considered very minor given the lack of threatened fauna recorded and the low general fauna abundance. Mitigation measures outlined in Section 6.2 will reduce this risk.

Construction activities that take place in the vicinity of watercourses have the potential to impact on aquatic ecology by the release of sediment-laden water that could arise on-site following mobilisation of soils/sediments. 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. Most mapped watercourses within the development site no longer have any discernible channel and have no surface water present for the majority of the time, due to extensive damming and diversion with contour banks. Any original riparian vegetation is also non-existent, having been historically cleared.

One ephemeral watercourse within the development site, Ridgey Creek, has the potential to provide habitat for the Sloane's Froglet. Ridgey Creek may require a single trench to bisect it if underground transmission lines are utilised for the grid connection.

The project does not require large inputs or storage of chemicals/liquids which pose a risk to groundwater contamination. Potential impacts are limited to low volume sources such as fuel and oil from construction equipment. Appropriate procedures will be included in the construction environmental management plan (CEMP) to reduce the chance of any spill occurring and minimise potential impacts if they were to occur.

The project is not likely to impact groundwater during construction, operation and decommissioning due to the limited amount of surface disturbance activities required during the installation and decommissioning of project infrastructure.

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 vegetation clearance on fragmentation is anticipated to be negligible, given that no significant fauna movement corridors currently exist within the development site, which is a result of high levels of existing fragmentation and small patch sizes.

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. No threatened species are anticipated to rely on any of the habitats currently present and no sensitive receptors have been identified.

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. Mitigation measures to reduce the chance of weed spread are outlined in Section 6.2.

Infection of native plants by *Phytophthora cinnamomi* is listed as a key threatening process under the BC Act and EPBC Act. *P.cinnamomi* 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 *P.cinnamomi* can lead to:

- 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. cinnamomi is known to occur within the region, however it is less common than east of the range and it remains unknown if it currently exists within the development site. No tree dieback has been recorded within the development site.

6.2 Measures to avoid, minimise and mitigate impacts

Quorn Park Solar Farm, in consultation with EMM, has undertaken significant steps to avoid, minimise and mitigate impacts, as per the process outlined below:

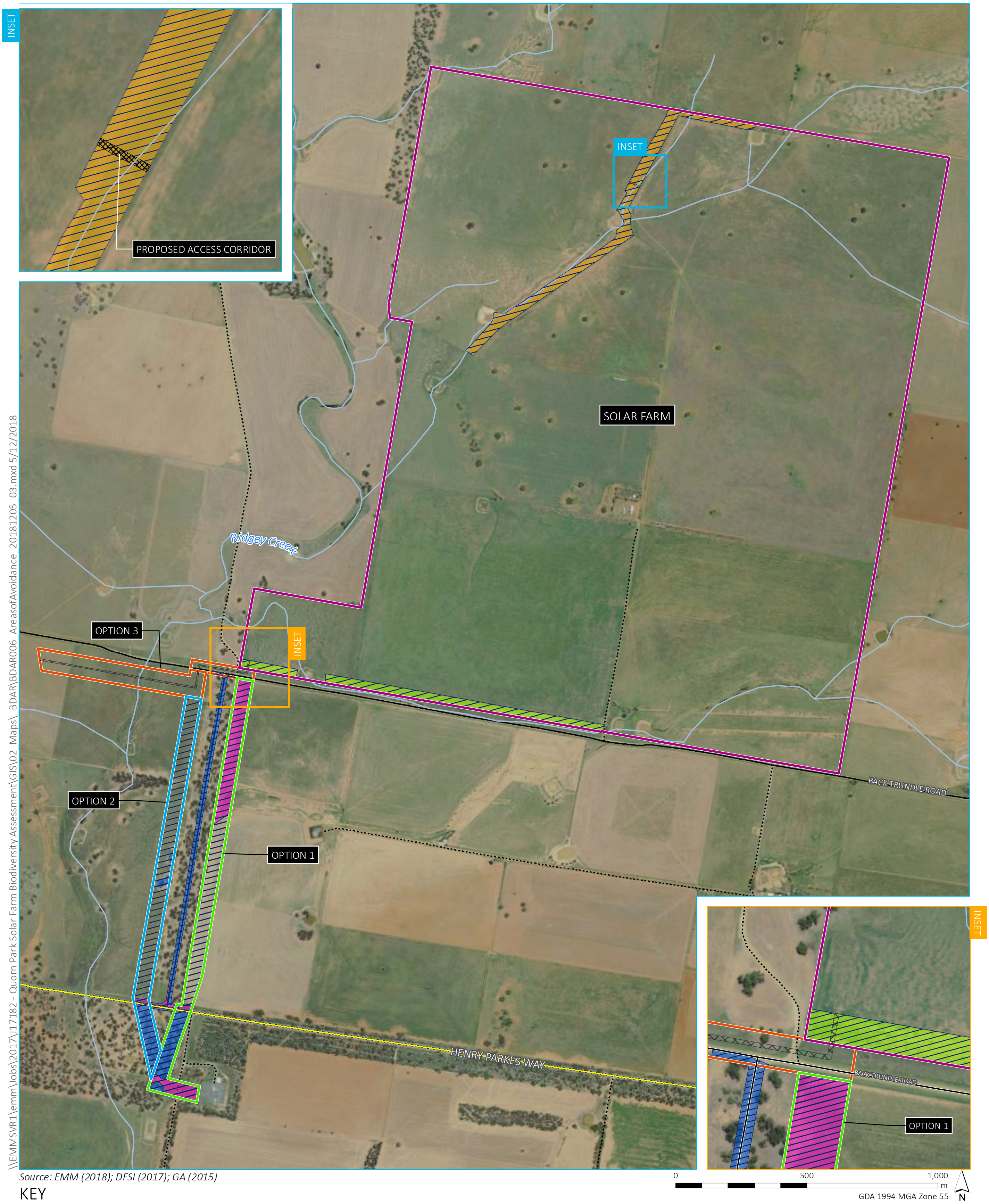
- identification of biodiversity values through comprehensive, rigorous and thorough biodiversity surveys;
- communication of identified values to the project team; and
- consultation between the design team and project ecologists to consider direct and indirect impacts and work through an iterative design process, with multiple iterations of design footprint to achieve a feasible project with least biodiversity impact.

The original study area presented included 3 transmission line options and an 'entire' solar farm area for which a biodiversity constraints assessment was completed, including vegetation mapping, habitat mapping and BAM plots. The detailed vegetation plots provided an estimate of the vegetation integrity score, which was used to assess the quality of vegetation present, in addition to the habitat-based assessment for threatened species.

The original study area, inclusive of grid connection Option 1 and 2, contains PCT 82 in a remnant woodland form which has the highest likelihood of providing habitat for threatened species (through targeted surveys did not detect any). This area also had the highest vegetation integrity score. Option 1 also contains PCT 82 in a derived native grassland form. Both of the woodland and grassland condition types are EPBC Act and BC Act listed TECs. The selection of Option 3 grid connection substantially reduced the amount of clearance to these TECs (refer to Figure 6.1).

Additional avoidance through design was also undertaken in the solar farm area. Clearance of PCT 82_planted was largely avoided by retaining the windrow parallel to Back Trundle Road. A swale also exists within the solar farm area containing PCT 437 derived native grassland, which is a BC act listed TEC and a candidate for serious and irreversible impacts (SII). This has largely been avoided by the development site (refer to Figure 6.1).

Avoidance of the highest value vegetation has resulted in the residual impact being reduced significantly, however some residual impacts remain. Avoidance of all native vegetation within the central portion of the solar array would result in significant disruption to the layout of modules. To retain trees it would require significant buffers of around 10x their height in order to avoid shading on the modules. The costs associated with additional structures, cabling, roads etc and suboptimal operating performance due to the buffers would be a significant impact on the financial viability of the project. The buffers would also have to be managed to keep grass down, potentially requiring more fencing.



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Source: EMM (2018); DFSI (2017); GA (2015)

KEY

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line

Project elements
- Development site

Grid connection options
- Option 1
- Option 2
- Option 3
- Areas of avoidance
- Proposed electricity transmission line easement / access corridor

Plant community types
- 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion Derived native grassland
- 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion woodland
- 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion Planted
- 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion Derived native grassland

Key areas of avoidance

Quorn Park Solar Farm
Biodiversity development assessment
Figure 6.1

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6.3 Serious and irreversible impacts

White Box Yellow Box Blakely's Red Gum Woodland is considered a potential entity to meet the serious and irreversible impacts (SII) principle (refer *Appendix 3 - Guidance to assist a decision-maker to determine a serious and irreversible impact* of the BAM (OEH 2017a)).

Two zones of PCT 437 and one zone of 278 meets the TEC listing of White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland), comprising a total of 1.29 ha. This community is assessed in accordance with Section 10.2.2.1 of the BAM below:

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

A total of 6.73 ha of Box Gum Woodland was recorded within the original study area. A total of 5.44 ha was avoided through changes to the design of the solar array. Avoidance is discussed in Section 6.2 above.

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

The condition of the three vegetation zones is described in detail in section 4.3.4. Two of the vegetation zones occur as derived grassland forms with high levels of disturbance, low native vegetation cover and a complete absence of midstorey or canopy species (refer to Photographs 4.3 and Photograph 4.4.) The woodland zone was also highly disturbed with a very sparse groundcover, a lack of midstorey species, with biodiversity values limited largely to a small patch of remnant trees (refer to Photograph 4.5). This is represented by low vegetation integrity scores, as per the table below. No threatened species were recorded within any of the TECs within the development site. Risks of indirect impacts to the TEC as a result of the project are low and further reduced to negligible levels through mitigation measure outlines in 6.2.

Plant community type	Ancillary code	Area (ha)	Vegetation integrity score
278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Derived native grassland	0.04	33.5
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Derived native grassland	0.67	23.8
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Woodland	0.58	30.7

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

No condition thresholds have been provided to date.

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

Central West and Lachlan Regional Native Vegetation Mapping was used to calculate the area of PCTs in the surrounding area which align with the TEC, with 325 ha mapped within a 1000 ha buffer and 2,957 ha mapped within 10,000 ha. Based on this mapping the clearance of 1.29 ha will represent a loss of 0.4% of the TEC within a 1,000 ha area and 0.04% within a 10, 000 ha area.

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

Vegetation mapping to PCT level was obtained for 55% of the IBRA subregion, of which 221,774 ha includes PCT aligned with the TEC. The removal of 1.29 ha will contribute to a removal of 0.0006 % of the TEC.

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

The total area of the TEC mapped within the IBRA region is 8,684 ha, with the 292 ha mapped within the subregion. Note that the vegetation mapping only covers a portion of the IBRA region and subregion, therefore the actual amount will be higher than stated.

g) **the development, clearing or biodiversity certification proposal's impact on:**

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

The project will have minimal abiotic influence on the TEC with groundwater and surface water unlikely to be significantly altered.

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

The ecosystem functioning of the TEC is already substantially altered given the surrounding agricultural land use (cropping). The operation of a solar farm is anticipated to have very minor indirect impacts and none which are likely to exacerbate impacts to any functionally important species.

j) **the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC**

The TEC is currently surrounded by cropping and therefore is subjected to current high levels of disturbance. Changing the surrounding land use from cropping to a solar farm would likely increase soil stabilisation and reduce inputs from weeds, fertilisers and herbicides/insecticides, therefore having a net positive benefit.

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

The TEC within the development site is not considered important given the low species diversity, small patch sizes, lack of threatened species and high disturbance levels. The patches are also highly fragmented by cropping and small areas of removal are unlikely to contribute significantly to fragmentation.

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

The current TECs within the EEC are isolated, small in size and degraded with no recruitment of canopy species. They are a poor representation of the TEC. All impact will be offset under the BAM which, owing to management will result in a functionally superior and viable community compared to that in the development site.

6.4 Identification of impacts requiring offsets

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10 of the BAM (OEH 2017a). The biodiversity assessment undertaken is based on an assumed development footprint that could, as detailed design progresses, be further refined and result in less biodiversity impact, and therefore less offset credit obligations. In this scenario a recalculation of the requisite credit obligations would be prepared in accordance with the biodiversity offset framework and a commensurate reduction in credit obligations would result.

Impacts to native vegetation requiring offsets include:

- 0.10 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland;
- 0.22 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_planted;
- 0.04 ha of PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion;
- 0.67 ha of PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland;
- 0.58 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland;
- 1.71 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion; and
- direct impacts to 37 paddock trees assigned to 437-Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion.

A summary of the ecosystem credits required for all vegetation zones and paddock trees, including changes in vegetation integrity score, is provided in Table 6.1. A total of 88 ecosystem credits are required to offset the residual impacts of the project. A credit report for area offsets and paddock trees is provided in Appendix D.

Offsets will be provided in accordance with the biodiversity offset framework outlined in Section 6.5.

Table 6.1 Summary of ecosystem credits required for all vegetation zones for the development site

PCT	Vegetation zone name	Area (ha)	Vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity score	Credits required
82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Derived shrubland	0.10	33.6	0.0	33.6	2
82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Planted	0.22	41.7	0.0	47.1	5
278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Derived native grassland	0.04	33.5	0.0	33.5	1
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Derived native grassland	0.67	23.8	0	23.8	8
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Woodland	0.58	30.7	0	30.7	9
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Planted	1.71	37.6	0	37.6	32
437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion	Paddock trees	-	-	-	-	31

6.4.1 Impacts on threatened species

One threatened species, Sloane’s Froglet was assumed present within PCT 278_derived native grassland. The area impacted is 0.04 ha. The species has a biodiversity risk rating of 1.5 and it generated 1 species credit.

6.4.2 Impacts not requiring offsets

Areas not requiring assessment in accordance with Section 10.4 of the BAM (OEH 2017a) include:

- existing roads;
- cleared and highly disturbed land, particularly associated with cropping; and
- watercourses/dams.

6.5 Biodiversity offset framework

The following section outlines several methods which Quorn Park Solar Farm can use to compensate the projects impacts. The development of the overall offset strategy for the project is yet to be achieved, though Quorn Park Solar Farm are committed to satisfying all offset requirements before any impacts for the project occur. Quorn Park Solar Farm may use a single method or a combination of the three methods outlined below.

Preparation of this strategy has considered the following steps:

1. Identifying if suitable credits are available on the market to meet offset requirements;
2. Finding potential on-site or off-site offset sites with the biodiversity values required to compensate for the project's impacts; and
3. Payment into the Biodiversity Conservation Trust.

6.5.1 Purchasing credits

Providing suitable credits are available, Quorn Park Solar Farm may be able to purchase existing credits available on the market and retire these to satisfy offset obligations. Initially, like-for-like options should be fully investigated before any variation criteria is explored under clause 6.2 of the BC Regulation. Like-for-like attributes for each of the PCTs are outlined below;

- PCT 82 may be offset with PCTs which meet the TEC (including PCT's 76, 80, 81, 82, 101, 110, 237, 248);
- PCT 437 requires hollows to be present in the offset vegetation;
- PCT 437 and 278 may be offset with PCTs which meet the TEC (including 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;
- Offset PCTs may include those from Lower Slopes, Bogan-Macquarie, Inland Slopes, Lachlan Plains, Murray Fans, Murrumbidgee and Nymagee IBRA subregions; or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site;
- Sloane's Froglet must be offset with the exact same species credits in any IBRA subregion in NSW.

6.5.2 Payment into the Biodiversity Conservation Trust

Payment into the Biodiversity Conservation Trust (BCT) can be achieved once conditions of consent are provided, which specify the number and type of credits to be retired. This option is low risk and removes any further obligation for Quorn Park Solar Farm, once payment is made. It also removes any risk of the project not being able to meet offset obligations, other than any financial constraints. An administration fee and a risk loading are applied to credits purchased through the BCT, which may result in higher per credit costs.

The BAM calculator provides a current credit price for the ecosystem credits required. Three ecosystem credit types are required for the project (PCT 82, 278, and 437), all of which generate the same price per credit of $2,515.29 (based on pricing obtained in December 2018). A total of 88 ecosystem credits are required to offset the project, therefore the total payment required is $221, 345.52.

A single species credit is required for Sloane’s Froglet, at $626.99.

The combined cost of the species credits and ecosystem credits is $221,972.51. Note that these credit prices are market based and may fluctuate, typically updated on a quarterly basis.

6.5.3 Establishment of a biodiversity stewardship site

Quorn Park Solar Farm may wish to establish a biodiversity stewardship agreement by acquiring suitable land or using any existing land holdings. This involves permanent conservation and management of the biodiversity values on the land. This is likely to be the most onerous option for Quorn Park Solar Farm and the longest to implement; however, it may result in the least expensive method of meeting offset obligations.

7 Assessment of Biodiversity Legislation

7.1 Environment Protection and Biodiversity Conservation Act 1999

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 7.1. One assessment of significance has been completed for the Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - endangered ecological community (Appendix F). The assessment concluded that no significant impacts on threatened entities are predicted to result from the project. Referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

Table 7.1 Assessment of the project against the EPBC Act

MNES	Project specifics	Potential for significant impact
Threatened species	Five flora species and 14 fauna species have been recorded or are predicted to occur within the locality. The majority of these species are considered unlikely to occur within the development site owing to the high levels of disturbance present.	Significant impact unlikely to result from the project.
Threatened ecological communities	One endangered ecological community, listed under the EPBC Act, were recorded within the development site, Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions - endangered ecological community listing. The planted vegetation zone of this PCT meet the EEC listing based on the largely native ground cover. An assessment of significance was conducted for PCT 82, and it was concluded that the project will not have a significant impact given the small quantum of impact (0.22 ha) and the low condition of the vegetation.	Significant impact unlikely to result from the project.
Migratory species	Ten migratory species have been recorded or are predicted to occur within the locality. The development site does not provide important habitat for an ecologically significant proportion of any of these species.	Significant impact unlikely to result from the project.
Wetlands of international importance	The development site does not flow directly into a Ramsar site and the project is not likely to result in a significant impact. The nearest Ramsar wetland is the Hattah-kulkyne lakes, approximately 500-600 km upstream.	Significant impact unlikely to result from the project.

7.2 Environmental Planning and Assessment Act 1979

7.2.1 SEPP No 44

Two Koala feed tree species, as defined within Schedule 1 of the SEPP, were identified within the development site; Poplar Box and White Box. These trees species comprise considerably less than 15% of the tree species within the development site and are restricted to planted wind rows. The planted trees are small in size and within discrete isolated patches of vegetation with no landscape connectivity to any areas of known Koala habitat. Scat surveys (SAT tests) in more optimal areas of habitat outside of the development site did not reveal any evidence of Koala and the species is not anticipated to occur within the vicinity. The vegetation within the development site is not considered potential Koala habitat as defined under SEPP 44.

7.3 Biosecurity Act

No weeds of national significance (WoNS), were identified within the development site.

One regional priority weed for the Central West region was identified within the development site; Blue Heliotrope (*Heliotropium amplexicaule*). Regional priority weeds are classified under a Biosecurity Duty. The development site is considered part of the core infestation area for this species and therefore land managers should reduce impacts from the plant on priority assets. Land managers should mitigate the risk of the plant being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.

Several species were recorded which are have a general biosecurity duty including; Bromus (*Bromus diandrus*), Saffron Thistle (*Carthamus lanatus*), African Lovegrass (*Eragrostis curvula*), Paspalum (*Paspalum dilatatum*), *Phyla canescens*, and *Solanum elaeagnifolium*. These are species that may have a high weed risk though there is insufficient knowledge of the risk or impact to define a feasible regional response. For plants with a general biosecurity duty, the intention is to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

8 Conclusion

This assessment has been completed in accordance with the BAM (OEH 2017a) on behalf of RED.

The development site is situated in a heavily cleared agricultural landscape dominated by cropped areas and exotic pasture and native pasture. Woodland areas within the development site are fragmented and highly disturbed.

Measures to avoid and minimise impacts to vegetation were considered during the initial design stages of the project, resulting in avoidance of significant biodiversity values and minimisation of impacts on other areas of native vegetation. Particular efforts were made to avoid those woodland areas with larger patch size and greater connectivity to other areas of habitat outside of the development site.

Impacts to native vegetation requiring offsets include:

- 0.10 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_derived_shrubland, generating 2 credits;
- 0.22 ha of PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion_planted, generating 5 credits;
- 0.04 ha of PCT 278 - Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion, generating 1 credits;
- 0.67 ha of PCT 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_derived native grassland, generating 8 credits;
- 0.58 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion_woodland, generating 9 credits;
- 1.71 ha of 437 - Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion, generating 32 credits;
- direct impacts to 37 paddock trees assigned to 437-Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion, generating 31 credits;

The total number of ecosystem credits required to offset the project is 88.

Based on both habitat assessments and field surveys, the development site has low importance for threatened flora or fauna species. Targeted surveys did not detect any threatened species. One species, Sloane's Froglet was assumed present as targeted surveys could not be conducted owing to seasonal constraints. This generated a single species credit.

One candidate for SII, White Box Yellow Box Blakely's Red Gum Woodland was recorded within the development site with the total area impacted, reduced to 1.29 ha through avoidance. The vegetation was highly degraded and of low quality with its loss unlikely to cause serious and irreversible impacts to the TEC given the low magnitude of impact and its poor quality.

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. The assessment concluded that no significant impacts on threatened entities are predicted to result from the project. Referral of the project to the Commonwealth Minister for the Environment for assessment is not required.

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Appendix A

BAM Fieldsheets

Appendix B

BAM plot and transect data

Scientific Name	Common Name	Exotic	High Threat Weed	BAM Growth Form Group	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance	Cover	Abundance
					Plot 4	Plot 4	Plot 7	Plot 7	Plot 8	Plot 8	Plot 9	Plot 9	Plot 10	Plot 10	Plot 12	Plot 12	Plot 13	Plot 13
Acacia deanei	Dean's wattle			Shrub (SG)	-	-	-	-	2	10	1	20	0.5	4	-	-	1	3
Alternanthera denticulata	Lesser Joyweed			Forb (FG)	-	-	0.1	5	-	-	-	-	-	-	-	-	-	-
Alternanthera nana	Hairy Joyweed			Forb (FG)	-	-	-	-	-	-	0.1	5	-	-	-	-	-	-
Anthosachne scabra	Common Wheatgrass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arctotheca calendula	Capeweed	*		#N/A	-	-	0.1	100	-	-	-	-	-	-	-	-	-	-
Asperula conferta	Common Woodruff			Forb (FG)	-	-	-	-	-	-	-	-	-	-	0.1	10	-	-
Astragalus hamosus	Yellow Milk-vetch	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atriplex spinibractea	Spiny-fruit Saltbush			Forb (FG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Austrostipa sp.				Grass & grasslike (GG)	-	-	-	-	-	-	-	-	0.1	5	-	-	-	-
Austrostipa aristiglumis	Plains Grass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Austrostipa nodosa				Grass & grasslike (GG)	0.1	5	-	-	0.1	30	1	50	-	-	-	-	-	-
Austrostipa scabra subsp scabra	Speargrass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	2	50	-	-	-	-
Austrostipa verticillata	Slender Bamboo Grass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	0.1	3
Avena fatua	Wild Oats	*		#N/A	-	-	0.2	50	0.1	10	10	>1000	10	>1000	5	500	10	1000
Avena sativa	Oats	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boerhavia coccinea	Tarvine			Forb (FG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bothriochloa macra	Red Grass			Grass & grasslike (GG)	-	-	0.2	20	0.1	10	25	500	2	50	0.2	20	-	-
Bromus diandrus	Great Brome	*	*	#N/A	-	-	-	-	-	-	-	-	-	-	-	-	3	300
Bromus molliformis	Soft Brome	*		#N/A	-	-	0.2	300	-	-	-	-	-	-	0.1	50	0.1	20
Bromus rubens	Red Brome	*		#N/A	-	-	0.1	2	-	-	-	-	-	-	-	-	-	-
Callitris glaucophylla	White Cypress Pine			Tree (TG)	-	-	-	-	-	-	0.2	2	3	20	-	-	-	-
Calotis cuneifolia	Purple Burr-daisy			Forb (FG)	-	-	-	-	-	-	-	-	0.1	10	-	-	-	-
Calotis lappulacea	Yellow Burr-daisy			Forb (FG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Capsella bursa-pastoris	Shepherd's Purse	*		#N/A	0.1	20	0.1	10	-	-	-	-	-	-	0.1	5	-	-
Carex inversa				Grass & grasslike (GG)	-	-	0.5	100	-	-	-	-	-	-	0.1	30	10	500
Carthamus lanatus	Saffron Thistle	*	*	#N/A	-	-	0.1	5	-	-	0.1	20	-	-	-	-	-	-
Casuarina cristata	Belah, Muurrgu			Tree (TG)	-	-	-	-	3	2	-	-	-	-	-	-	-	-
Cheilanthes sieberi				Fern (EG)	-	-	-	-	-	-	-	-	0.1	2	-	-	-	-
Chloris truncata	Windmill Grass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cirsium vulgare	Spear Thistle	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Citrullus lanatus	Wild Melon	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Convolvulus angustissimus				Other (OG)	-	-	0.1	20	-	-	-	-	0.1	5	-	-	-	-
Conyza sp.		*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cynodon dactylon	Couch			Grass & grasslike (GG)	-	-	0.3	50	-	-	-	-	-	-	-	-	-	-
Dichondra repens	Kidney Weed			Forb (FG)	-	-	0.1	100	0.1	100	-	-	0.1	20	0.1	50	-	-
Digitaria divaricatissima	Umbrella Grass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	0.2	10	-	-	-	-
Dodonaea viscosa subsp. cuneata	Wedge-leaf Hop-bush			Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dodonaea viscosa subsp. spatulata				Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Echium plantagineum	Paterson's Curse	*		#N/A	-	-	0.1	30	-	-	-	-	-	-	0.1	20	0.1	30
Einadia polygonoides				Forb (FG)	0.1	5	-	-	2	100	-	-	-	-	-	-	-	-
Enteropogon acicularis				Grass & grasslike (GG)	-	-	1	50	-	-	-	-	-	-	-	-	-	-
Epilobium billardiereanum				Forb (FG)	-	-	-	-	-	-	-	-	-	-	-	-	0.1	10
Eragrostis curvula	African Lovegrass	*	*	#N/A	-	-	-	-	-	-	-	-	-	-	3	50	0.2	5
Eragrostis sp. (Native)				Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eremophila debilis	Winter Apple			Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erodium brachycarpum	Heronsbill	*		#N/A	-	-	0.2	500	-	-	-	-	-	-	-	-	-	-
Erodium cicutarium	Common Storksbill	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucalyptus albens	White Box			Tree (TG)	-	-	-	-	7	4	-	-	-	-	-	-	-	-
Eucalyptus camaldulensis	River Red Gum			Tree (TG)	-	-	-	-	0.5	2	-	-	-	-	-	-	-	-
Eucalyptus conica	Fuzzy Box			Tree (TG)	-	-	-	-	-	-	2	1	2	2	-	-	-	-
Eucalyptus melliodora	Yellow Box			Tree (TG)	30	3	-	-	-	-	-	-	-	-	-	-	-	-
Eucalyptus microcarpa	GreyBox			Tree (TG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucalyptus populnea	Poplar Box			Tree (TG)	-	-	-	-	20	10	3	2	2	1	-	-	-	-
Eucalyptus sideroxylon	Mugga Ironbark			Tree (TG)	-	-	-	-	5	3	-	-	1	1	-	-	-	-
Eucalyptus sp. 1				Tree (TG)	-	-	-	-	-	-	-	-	5	2	-	-	-	-
Eucalyptus sp 2. (potentially mannifera)				Tree (TG)	-	-	-	-	-	-	7	4	-	-	-	-	-	-
Euphorbia drummondii	Caustic Weed			Forb (FG)	-	-	-	-	-	-	0.1	10	-	-	-	-	-	-
Fumaria densiflora	Narrow-leaved Fumitory	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gamochaeta calviceps	Cudweed	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Geranium solanderi	Native Geranium			Forb (FG)	-	-	-	-	-	-	-	-	-	-	0.1	10	0.1	20
Glycine tabacina				Other (OG)	-	-	-	-	-	-	-	-	0.1	50	-	-	-	-
Goodenia pinnatifida				Forb (FG)	-	-	0.1	30	-	-	0.1	20	-	-	-	-	-	-
Hakea sp 1.				Shrub (SG)	-	-	-	-	-	-	0.2	1	-	-	-	-	-	-
Heliotropium amplexicaule	Blue Heliotrope	*	*	#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hordeum leporinum	Barley Grass	*		#N/A	3	100	-	-	-	-	-	-	-	-	0.1	10	-	-
Juncus flavidus				Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	30	150	-	-
Juncus sp. 1				Grass & grasslike (GG)	-	-	0.1	1	-	-	-	-	-	-	-	-	0.5	10
Juncus subsecundus				Grass & grasslike (GG)	-	-	0.1	20	-	-	-	-	-	-	-	-	-	-
Lactuca saligna	Willow-leaved Lettuce	*		#N/A	-	-	-	-	-	-	0.5	500	0.3	500	-	-	-	-
Lolium rigidum	Wimmera Ryegrass	*		#N/A	-	-	40	>1000	-	-	-	-	0.1	20	10	1000	0.1	100
Lomandra filiformis subsp coriacea	Wattle Mat-rush			Grass & grasslike (GG)	-	-	-	-	-	-	0.1	3	0.1	2	-	-	-	-
Maireana decalvans	Black Cotton Bush			Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maireana enchylaenoides	Wingless Bluebush			Forb (FG)	0.1	30	-	-	0.2	30	-	-	-	-	-	-	-	-
Maireana microphylla	Small-leaf Bluebush			Shrub (SG)	-	-	-	-	-	-	-	-	0.1	1	-	-	-	-
Marrubium vulgare	White Horehound	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marsilea hirsuta	Nardoo			Fern (EG)	-	-	-	-	-	-	-	-	-	-	0.1	2	-	-
Medicago laciniata	Cut-leaved Medic	*		#N/A	-	-	-	-	-	-	-	-	-	-	0.1	20	-	-
Medicago minima	Woolly Burr Medic	*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Medicago truncatula	Barrel Medic	*		#N/A	-	-	-	-	-	-	0.1	50	-	-	-	-	0.1	10
Modiola caroliniana	Red-flowered Mallow	*		#N/A	-	-	0.1	30	-	-	-	-	-	-	-	-	0.1	10
Oxalis perennans	Wood Sorrel			Forb (FG)	-	-	0.2	500	0.1	2	0.1	50	0.1	20	0.1	50	0.1	30
Paspalidium constrictum	Knottybutt Grass			Grass & grasslike (GG)	-	-	-	-	-	-	-	-	0.1	10	-	-	-	-
Paspalum dilatatum	Paspalum	*	*	#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phalaris paradoxa	Paradoxa Grass	*		#N/A	-	-	-	-	-	-	-	-	-	-	0.1	10	-	-
Phalaris sp		*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phyla canescens		*	*	#N/A	-	-	-	-	-	-	-	-	-	-	15	>1000	-	-
Polygonum aviculare	Wireweed	*		#N/A	-	-	-	-	-	-	-	-	-	-	0.1	3	-	-
Pratia concolor	Poison Pratia			Forb (FG)	-	-	-	-	-	-	-	-	-	-	-	-	0.2	200
Romulea sp.		*		#N/A	-	-	0.2	100	-	-	-	-	-	-	-	-	-	-
Rumex brownii	Swamp Dock			Forb (FG)	-	-	0.1	20	-	-	-	-	-	-	0.1	5	-	-
Rumex crispus	Curled Dock	*		#N/A	-	-	-	-	-	-	-	-	-	-	0.2	30	0.3	100
Rumex tenax	Shiny Dock			Forb (FG)	-	-	0.1	5	-	-	-	-	-	-	-	-	-	-
Rytidosperma caespitosum	Ringed Wallaby Grass			Grass & grasslike (GG)	-	-	5	100	-	-	7	300	3	200	0.5	50	20	300
Rytidosperma richardsonii	Wallaby Grass			Grass & grasslike (GG)	-	-	-	-	-	-	1	50	-	-	-	-	-	-
Rytidosperma setaceum	Smallflower Wallaby Grass			Grass & grasslike (GG)	-	-	2	100	-	-	-	-	-	-	-	-	-	-
Salsola australis				Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salvia verbenaca	Vervain	*		#N/A	-	-	0.1	2	0.2	50	1	300	0.5	200	-	-	0.1	20
Sclerolaena muricata	Black Rolypoly			Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Senna artemisioides subsp. zygophylla				Shrub (SG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sida corrugata	Corrugated Sida			Forb (FG)	0.1	10	0.1	50	0.1	5	0.2	100	0.1	30	-	-	-	-
Sisymbrium irio	London Rocket	*		#N/A	0.5	100	-	-	-	-	-	-	-	-	-	-	-	-
Sisymbrium sp		*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Solanum elaeagnifolium		*	*	#N/A	-	-	0.1	10	-	-	-	-	-	-	0.1	20	0.1	50
Sonchus oleraceus	Common Sowthistle	*		#N/A	0.1	3	-	-	-	-	-	-	-	-	0.1	2	-	-
Themeda triandra				Grass & grasslike (GG)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifolium subterraneum	Subterranean Clover	*		#N/A	-	-	0.02	50	-	-	0.1	10	-	-	-	-	0.1	30
Urtica urens	Small Nettle	*		#N/A	0.1	5	-	-	-	-	-	-	-	-	-	-	-	-
Vittadinia cuneata	Fuzzweed			Forb (FG)	-	-	0.1	5	-	-	0.2	200	-	-	-	-	-	-
Vittadinia gracilis	Woolly New Holland Daisy			Forb (FG)	-	-	-	-	-	-	-	-	0.1	20	-	-	-	-
Vulpia sp.		*		#N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wahlenbergia communis	Tufted Bluebell			Forb (FG)	-	-	-	-	-	-	0.1	2	0.1	20	-	-	-	-

plot	pct	area	patch size	condition class	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to10	funTreeStem10to20	funTreeStem20to30	funTreeStem30to50	funTreeStem50to80	funTreeRegen	funHighThreatExotic
4	437	0.58	0	437_woodland	55	601080	6339250	170	1	0	1	3	0	0	30	0	0.1	0.3	0	0	4	2	53	57	0	0	0	0	1	0	0
7	437	0.67	0	437_DNG	55	601943	6340270	20	0	0	8	8	0	1	0	0	9.2	0.9	0	0.1	0	0	82.8	0	0	0	0	0	0	0	0.2
8	437	1.71	0	437_planted	55	601228	6339550	275	5	1	2	5	0	0	35.5	2	0.2	2.5	0	0	0	0	99.8	0	1	1	1	0	0	0	0
9	82	0.22	0	82_planted	55	601228	6339570	307	4	2	5	7	0	0	12.2	1.2	34.1	0.9	0	0	0	0	91.4	0	1	1	0	0	0	2	0.1
10	82	0.22	0	82_planted	55	601677	6339910	275	5	2	7	6	1	2	13	0.6	7.5	0.6	0.1	0.2	0	0	88	0	1	1	0	0	0	2	0
12	278	0.04	0	278_DNG	55	601787	6338190	195	0	0	4	5	1	0	0	0	30.8	0.5	0.1	0	0	0	73.8	0	0	0	0	0	0	0	18.1
13	82	0.1	0	82_DNG	55	601293	6338280	110	0	1	4	4	0	0	0	1	30.6	0.5	0	0	0	0	82.6	0	0	0	0	0	0	1	3.3

Appendix C

Paddock trees results

Scientific name	Common name	DBH (cm)	Hollow bearing (Y/N)	BAM paddock tree catergory
Eucalyptus melliodora	Yellow Box	31	N	2
Brachychiton populneus	Kurrajong	38	N	2
Eucalyptus microcarpa	Grey Box	80	N	3
Eucalyptus microcarpa	Grey Box	89	N	3
Eucalyptus microcarpa	Grey Box	114	N	3
Brachychiton populneus	Kurrajong	73	N	3
Brachychiton populneus	Kurrajong	96	N	3
Brachychiton populneus	Kurrajong	99	N	3
Brachychiton populneus	Kurrajong	111	N	3
Eucalyptus melliodora	Yellow Box	51	N	3
Eucalyptus melliodora	Yellow Box	74	N	3
Eucalyptus melliodora	Yellow Box	91	N	3
Eucalyptus melliodora	Yellow Box	99	N	3
Eucalyptus melliodora	Yellow Box	100	N	3
Eucalyptus melliodora	Yellow Box	103	N	3
Eucalyptus melliodora	Yellow Box	105	N	3
Eucalyptus melliodora	Yellow Box	107	N	3
Eucalyptus melliodora	Yellow Box	130	N	3
Eucalyptus melliodora	Yellow Box	137	N	3
Eucalyptus melliodora	Yellow Box	141	N	3
Eucalyptus melliodora	Yellow Box	150	N	3
Eucalyptus melliodora	Yellow Box	158	N	3
Eucalyptus melliodora	Yellow Box	182	N	3
Eucalyptus melliodora	Yellow Box	184	N	3
Eucalyptus melliodora	Yellow Box	190	N	3
Eucalyptus microcarpa	Grey Box	135	Y	3
Eucalyptus microcarpa	Grey Box	150	Y	3
Brachychiton populneus	Kurrajong	84	Y	3
Brachychiton populneus	Kurrajong	88	Y	3
Eucalyptus melliodora	Yellow Box	132	Y	3
Eucalyptus melliodora	Yellow Box	133	Y	3
Eucalyptus melliodora	Yellow Box	134	Y	3
Eucalyptus melliodora	Yellow Box	148	Y	3
Eucalyptus melliodora	Yellow Box	162	Y	3
Eucalyptus melliodora	Yellow Box	230	Y	3
Eucalyptus melliodora	Yellow Box	245	Y	3
Eucalyptus melliodora	Yellow Box	246	Y	3

Appendix D

Credit reports

BAM Credit Summary Report

Proposal Details

Assessment Id

00011741/BAAS17009/18/00011742

Proposal Name

J17182 QPSF Development Assessment

BAM data last updated *

07/11/2018

Assessor Name

Ariane Weiss

Report Created

05/12/2018

BAM Data version *

4

Assessor Number

BAAS18003

* 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	Candidate SAII	Ecosystem credits
Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion								
3	278_278_DNG	33.5	0.0	0.25	High Sensitivity to Potential Gain	2.00	TRUE	1
							Subtotal	**1**

Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion								
1	82_82_DNG	33.6	0.1	0.25	High Sensitivity to Potential Gain	2.00	TRUE	2
2	82_82_planted	47.1	0.2	0.25	High Sensitivity to Potential Gain	2.00	TRUE	5
							Subtotal	**7**
Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion								
4	437_437_DNG	23.8	0.7	0.25	High Sensitivity to Potential Gain	2.00	TRUE	8
5	437_437_planted	37.6	1.7	0.25	High Sensitivity to Potential Gain	2.00	TRUE	32
6	437_437_woodland	30.7	0.6	0.25	High Sensitivity to Potential Gain	2.00	TRUE	9
							Subtotal	**49**
							Total	**57**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Crinia sloanei / Sloane's Froglet (Fauna)						
278_278_DNG	33.5	0.04	0.25	1.5	False	1
					Subtotal	**1**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00011741/BAAS17009/18/00013461	QPSF Paddock Tree Calc	07/11/2018
Assessor Name	**Report Created**	**BAM Data version ***
Ariane Weiss	05/12/2018	4

Assessor Number

BAAS18003

* 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.

Paddock Trees Credit Requirement

Class	Contains hollows	Number of trees	Ecosystem credits
437-Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion			
2	False	1.0	1
2	False	1.0	1
3	False	3.0	2
3	False	4.0	3
3	False	16.0	12
3	True	2.0	2
3	True	2.0	2
3	True	8.0	8
			31
			31

Appendix E

Protected Matters Search Tool Results

Australian Government

Department of the Environment and Energy

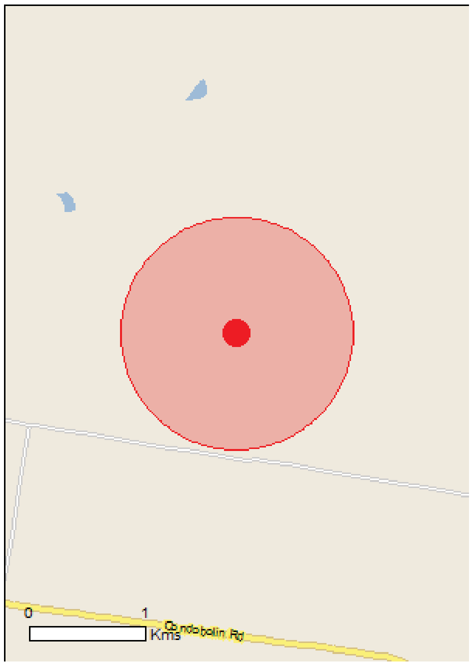
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

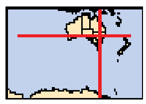
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 05/12/18 16:29:18



Coordinates

Buffer: 1.0Km



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:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	19
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:	17
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:	None
Regional Forest Agreements:	None
Invasive Species:	24
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	700 - 800km upstream
Hattah-kulkyne lakes	500 - 600km upstream
Riverland	600 - 700km upstream
The coorong, and lakes alexandrina and albert wetland	800 - 900km upstream

Listed Threatened Ecological Communities		[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	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

Name	Status	Type of Presence
Fish		
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
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 may occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Species or species habitat may occur within area
Plants		
Androcalva procumbens		
[87153]	Vulnerable	Species or species habitat may occur within area
Austrostipa metatoris		
[66704]	Vulnerable	Species or species habitat may occur within area
Austrostipa wakoolica		
[66623]	Endangered	Species or species habitat likely to occur within area
Swainsona recta		
Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Tylophora linearis		
[55231]	Endangered	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 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 may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	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

Name	Threatened	Type of Presence
		area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may 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 may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

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		
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		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, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-33.08258 148.09134

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.

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Appendix F

EPBC Act Assessments of Significance

F.1 Significance impact guidelines

In determining the significance of impact associated with the project, the relevant criteria listed in the *Matters of National Environmental Significance – Significance Impact Guidelines 1.1* (DoE 2013) was applied. This assessment has been undertaken for the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia endangered ecological community.

F.2 Assessments of significance

Significant impact assessments have been prepared for species listed under the EPBC Act, in accordance with the criteria above.

F.2.4 Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Table E.3 provides an assessment of significance for the removal of 0.22 ha of the listed community, in accordance with the relevant assessment criteria for endangered communities.

Table F.3 Assessment of significance for Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Criteria	Discussion
1. Reduce the extent of an ecological community	The community consists of a planted overstory and a mostly native ground cover. A total of 0.22 ha of the listed community will be removed as a result of the project. A total of 4.23 ha of the community with the same condition has been avoided through design. A much larger area of more optimal, remnant woodland exists outside of the development footprint. The community is well represented alongside McGraths Lane, and in road reserves adjacent Henry Parkes Way.Therefore, the project will only result in a small reduction of the listed community in the immediate vicinity of the study area. It is considered unlikely that the proposed action will result in a significant reduction of the community extent.
2. Fragment or increase fragmentation	The listed community may provide some habitat linkage along the northern side of Back Trundle Road, however this link is not continuous, with gaps of between canopies and a largely absent mid story. This link is therefore only likely to be favourable for species which are able to cross open areas. An easement of 5m width will be cleared within the community and it is anticipated that there will be no isolation of habitat as a result of the proposal, therefore no significant isolation or fragmentation impacts are anticipated.
3. Adversely affect critical habitat	The community identified within the study area meets the minimum condition criteria outlined in the EPBC Act Policy statement for the community (DSEWPaC 2012). However, the 0.22 ha area of the community within the study area is not a good example of the community given that the mid story is largely absent, and the canopy has been historically cleared and replanted with a mixture of species which are no longer characteristic of the community. Therefore overall, critical habitat in the locality will not be adversely impacted by the removal 0.22 ha of this vegetation.
4. Modify or destroy abiotic factors necessary for survival	The current community occurs directly adjacent to the cropped land. Abiotic factors appear to have adversely affected the community with weed species evident on the boundaries of the community. No significant abiotic impacts are anticipated to the community adjacent to the study area more than already exists within the site. Weed control protocols will be undertaken in accordance with the proponent's relevant processes and procedures, to ensure plant entering the

Table F.3 Assessment of significance for Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia

Criteria	Discussion
	project are is weed free, so as to not impact upon the remaining community adjacent to the study area.
5. Cause a substantial change in species composition	The TEC is currently surrounded by cropping and therefore is subjected to current high levels of disturbance. Changing the surrounding land use from cropping to a solar farm would have a benefit to the adjacent retained community. It is anticipated that there would be increased soil stabilisation and reduce inputs from weeds, fertilisers and herbicides/insecticides. There is not likely to be a substantial change to species composition.
6. Cause a substantial reduction in quality or integrity	The project will remove the canopy and any mid story present within an area of up to 0.22 ha. The groundcover will be allowed to regenerate after disturbance. All other areas of retained habitat have been subjected to the indirect impacts of vehicle movements and agricultural impacts for a long period of time, e.g the potential importation of invasive species or increased dust levels. The majority of weeds species recorded adjacent to the community are common exotic pasture species associated with surrounding agricultural land use. Weed control protocols will be undertaken in accordance with the proponent's relevant processes and procedures, to ensure plant entering the project are is weed free, so as to not impact upon the remaining community adjacent to the study area. Therefore, it is unlikely that the project will cause a substantial reduction in quality or integrity of the remaining community adjacent to the development footprint.
7. Interfere with recovery	There is currently no adopted national recovery plan for this community. The clearance of 0.22 ha of the community will slightly reduce the extent of the listed community within the development footprint. However, note that the community to be impacted is not an exemplary example of the community. To minimise adverse environmental impacts, particularly on the community, the proposed impact area has been refined.
Conclusion	Although the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia identified within the study area meets the condition criteria for inclusion as the TEC under the EPBC Act, the vegetation is not an exemplary example of the community, given its small size, fragmentation and planted mixed canopy. Therefore overall, critical habitat in the locality will not be adversely impacted by the removal of this vegetation because impact from the project is only on a small area (0.22 ha) and is considered insignificant.

Appendix C2

PROJECT ACCESS FROM BACK TRUNDLE ROAD

21 October 2019

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Re: Quorn Park Solar Farm - Project access from Back Trundle Road

1 Introduction

Geolyse Pty Ltd (now part of Premise Pty Ltd) have prepared an Environmental Impact Statement (EIS) on behalf of Quorn Park Solar Farm Pty Ltd for the proposed Quorn Park Solar Farm (QPSF). A Biodiversity Development Assessment Report (BDAR) was produced by EMM Consulting Pty Ltd (EMM) to accompany the EIS (EMM 2018).

The QPSF project is currently being assessed by the Department of Planning, Industry and Environment (DPIE) who have sought additional information regarding any biodiversity impacts resulting from upgrades to the area between Back Trundle Road and the solar farm, required to facilitate vehicle access.

2 Project access

Proposed access to the solar farm is via Back Trundle Road, utilising an existing perpendicular gravel track . In order to accommodate the swept path of the largest vehicles it may be necessary to widen the apex of the bend. Additional clearance will be limited to maintained and highly disturbed exotic grassland dominated by Wild Oats (*Avena fatua*) and Vervain (*Salvia verbenaca*) (refer to Plate 2.1 and Photograph 2.1).

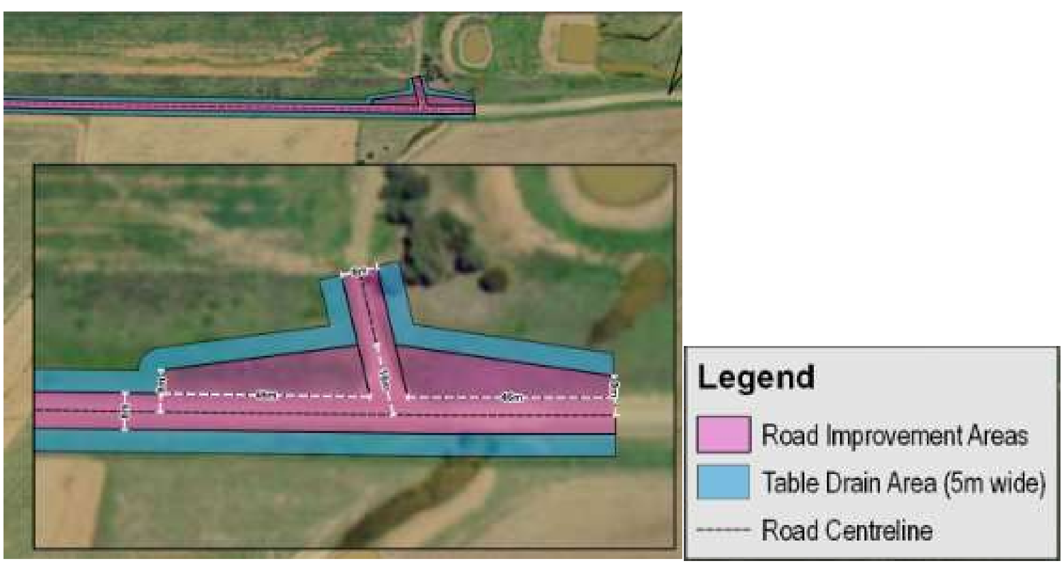

Plate 2.1 Potential road improvements (Geolyse reference 217510_010A_EV01-EV05)

Photograph 2.1 Proposed solar farm access route using access tracks leading from Back Trundle Road.

Note that planted trees occur either side of the proposed access route (Photograph 2.1), including Mugga Ironbark (*Eucalyptus sideroxylon*); however, no clearance of these trees will be required and the existing trees will not impacted.

This assessment is based on clearing for road improvement areas only. We understand that clearing for the table drain area is no longer required (D.Walker pers. comm. 21 October 2019).

3 Closing

The proposed upgrades to the solar farm entry point will have negligible biodiversity impact given that a small area of exotic grassland will be affected.

Yours sincerely

Eugene Dodd
Senior Ecologist
edodd@emmconsulting.com.au

4 References

EMM Consulting (2018) Quorn Park Solar Farm Biodiversity Assessment Report, prepared for Quorn Park Farm Pty Ltd.

Appendix D

ABORIGINAL CULTURAL HERITAGE ASSESSMENT

View across the south of the solar farm site.

Aboriginal Cultural Heritage Assessment Report & Historic Heritage Assessment Report

Quorn Park Solar Farm

Parkes Local Government Area

November 2018

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

for Quorn Park Solar Farm Pty Ltd

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ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT COVER SHEET

Report Title	Aboriginal Cultural Heritage Assessment Report & Historic Heritage Assessment: Quorn Park Solar Farm, Parkes LGA.
Author(s) Name	Stephanie Rusden
Author(s)' Organisation Name (if applicable)	OzArk Environment & Heritage Management Pty Limited
Author(s) contact details	Email: stephanie@ozarkehm.com.au Phone: 02 6882 0118
Address of Subject Area	Lot 508 DP750152 Back Trundle Road Parkes NSW 2870 Parkes Local Government Area
Report prepared for	Geolyse Pty Ltd on behalf of Quorn Park Solar Farm Pty Ltd Contact Person: Andrew Brownlow Address: 154 Peisely Street, Orange NSW Email: abrownlow@geolyse.com Phone: 02 6393 5000 Fax: 02 6393 5050
Date of Report	November 2018
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<tr><td>Document Description</td><td colspan="3">Aboriginal Cultural Heritage Assessment Report & Historic Heritage Assessment: Quorn Park Solar Farm, Parkes LGA.</td></tr>
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V2.3 OzArk to Client with impact footprint update 12/11/18</td></tr>
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Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environmental & Heritage Management (OzArk) has been engaged by Geolyse Pty Ltd on behalf of Quorn Park Solar Farm Pty Ltd (the proponent) to complete an Aboriginal Cultural Heritage Assessment Report (ACHAR) and a historic heritage assessment of approximately 486 hectares (ha) of land (the Project Site) which has the potential to be impacted by the proposed Quorn Park Solar Farm (the Project), within the Parkes Local Government Area.

The Project is classified as a State Significant Development (SSD) under the provisions of Part 4 Division 4.7 of the *Environmental Planning and Assessment Act 1979* in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011*.

The proposed development includes the construction of the solar farm, grid connection and road improvements to Back Trundle Way, McGrath Lane and Henry Parkes Way.

The long-term and existing use of the Project Site is agricultural production, including both livestock grazing and cropping. Under the provisions of the Parkes Local Environmental Plan 2012, the Project Site is zoned 'RU1 Primary Production'.

The field survey was completed over three days from Monday 10 September to Wednesday 12 September 2018. Registered Aboriginal Parties (RAPs) from the Peak Hill Local Aboriginal Land Council (PHLALC) and Rob Clegg participated in the survey.

A total of 27 previously unrecorded Aboriginal sites were recorded during the field survey of the Project Site. Recorded Aboriginal sites include 23 isolated finds (Ridgey Creek-IF1, Warrawee-IF1, Ponderosa-IF1, Quorn Park-IF1 to Quorn Park-IF20) and four artefact scatters (Ridgey Creek-OS1 and Quorn Park-OS1 to Quorn Park-OS3). All of the recorded sites have been assessed as having low scientific significance. This is because the sites are low density artefact scatters or isolated finds located in landforms which have been highly disturbed and where further subsurface archaeological deposits are unlikely. In some instances, the assessment of low scientific significance is because the recorded sites are well-represented within the region and are unlikely to yield further scientific data.

The historic heritage assessment was completed concurrently with the Aboriginal heritage field assessment. A total of three historic heritage sites were identified during the survey (QP-HS01, QP-HS02 and ML-HS01). The recorded sites were evaluated to determine their heritage significance. All sites were assessed as having no heritage significance as they did not satisfy any of the established heritage significance criteria.

<u>Aboriginal cultural heritage</u>

As a consequence of the proposed impacts to Aboriginal cultural heritage sites within the Project Site, the following archaeological recommendations are made in an effort to responsibly manage

Aboriginal cultural heritage sites *in situ*, or where appropriate, mitigate the loss of cultural heritage at those sites within the impact footprint:

1) Should development consent for the Project be granted, the Statement of Commitments set out in **Section 7.4** will be followed.
2) All land-disturbing activities must be confined to within the assessed Project Site. Should the parameters of the proposed work extend beyond the assessed area, then further archaeological assessment may be required.
3) Inductions for staff undertaking the proposed activity shall include the legislative protection requirements for Aboriginal sites and items in NSW and the relevant fines for non-compliance.

Historic heritage

Recommendations concerning historic heritage within the Project Site are as follows.

4) The activities of the project can proceed without further historic heritage investigation provided that all ground disturbance activities are confined to within the Project Site. If the parameters of the proposed activity extend beyond the study area, then further archaeological assessment may be required.
5) This assessment has concluded that there is a low likelihood that the proposed activity would harm historic items. If objects are encountered that are suspected to be historic heritage items, all work must stop and the *Unanticipated Finds Protocol* (**Appendix 5**) should be followed.
6) Inductions for staff undertaking the proposed activity shall include the legislative protection requirements for historic sites and items in NSW and the relevant fines for non-compliance.

CONTENTS

FIGURES

TABLES

PLATES

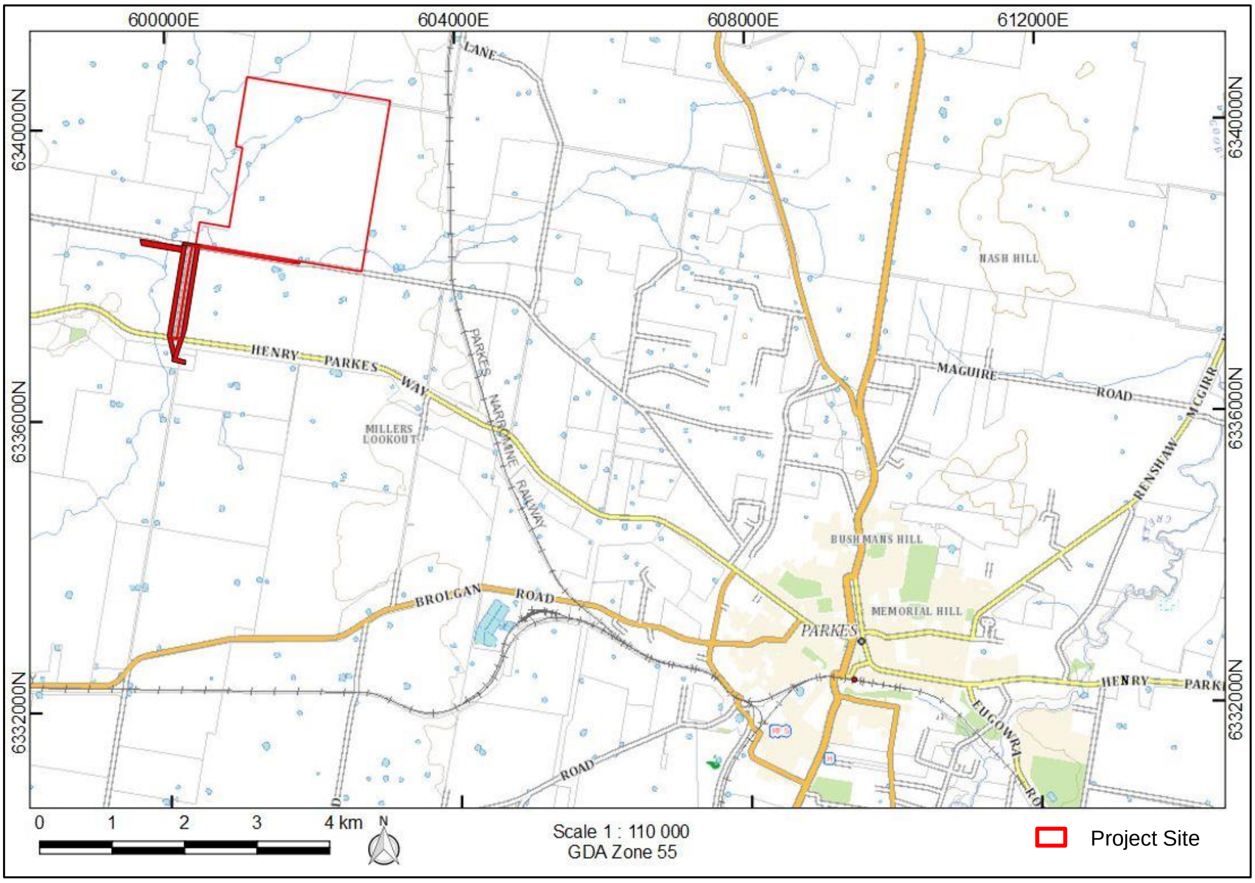
1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROJECT

OzArk Environmental & Heritage Management (OzArk) has been engaged by Geolyse Pty Ltd on behalf of Quorn Park Solar Farm Pty Ltd (the proponent) to complete an Aboriginal Cultural Heritage Assessment Report (ACHAR) and a historic heritage assessment of approximately 486 hectares (ha) of land (the Project Site) which has the potential to be impacted by the proposed Quorn Park Solar Farm (the Project), within the Parkes Local Government Area (LGA) (**Figure 1-1**).

The proponent is seeking development consent to develop the Project. The Project is classified as a State Significant Development (SSD) under the provisions of Part 4 Division 4.7 of the *Environmental Planning and Assessment Act 1979* in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011*. This ACHAR forms part of the Environmental Impact Statement (EIS) prepared to accompany the development application to the Department of Planning and Environment (DP&E).

Figure 1-1: Location map of the Project Site in relation to Parkes.



1.2 PROPOSED WORK

The Project includes the construction of the solar farm, grid connection and road improvements. These individual components include the following:

- Solar farm: the solar farm site footprint will be contained in an area of 475.7ha within Lot 508 DP750152 (**Figure 1-2**).
- Grid connections: to connect the solar farm to an existing substation in Lot 1 DP717289 (**Figure 1-3**). These include:
  - Option 1: North of Condobolin Road, within Lot 504 DP750152, immediately adjacent to the western fence line, approximately 60 metres (m) wide. The option crosses Condobolin Road, remaining west of Pat Meredith Drive (in Lot 7002 DP94814) until crossing to the east to the existing substation.
  - Option 2: North of Condobolin Road, within Lot 8 DP750152 and Lot 1 DP1090411, offset from the eastern fence line by 20m and approximately 60m wide. This option crosses Condobolin Road and crosses Lot 7002 DP94814 where it joins the Option 1 alignment.
  - Option 3: Within Lot 1 DP1090411, offset from the northern fence line by a minimum of 20m, extending west from Option 2, approximately 80m wide and extends for a distance of approximately 560m.
- Road improvements: Potential road and intersection improvements may be required (**Figure 1-4**).

Figure 1-2: Aerial imagery of the proposed solar farm site (source: Geolyse 2018).

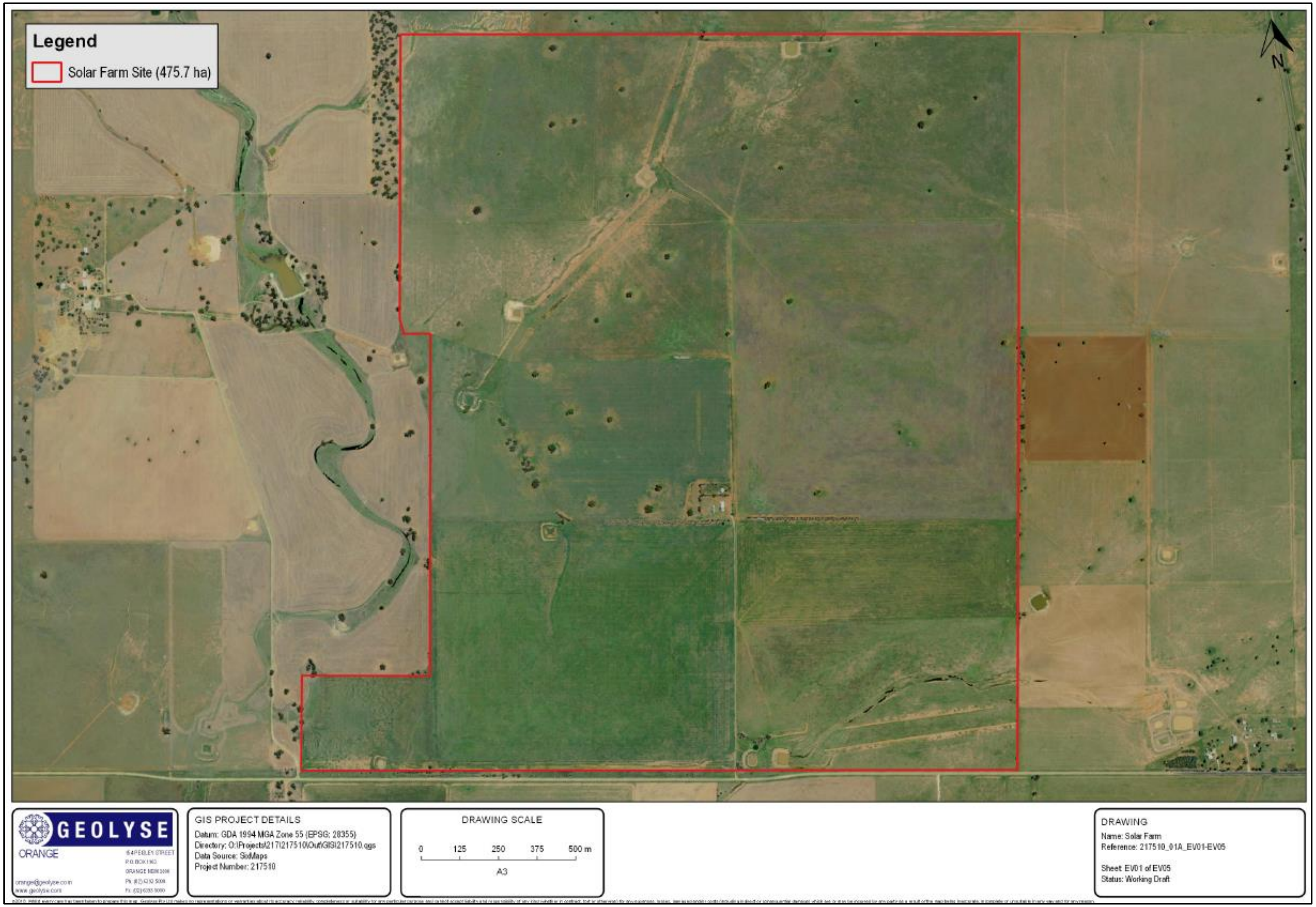


Figure 1-3: Figure showing the grid connection options (source: Geolyse 2018).

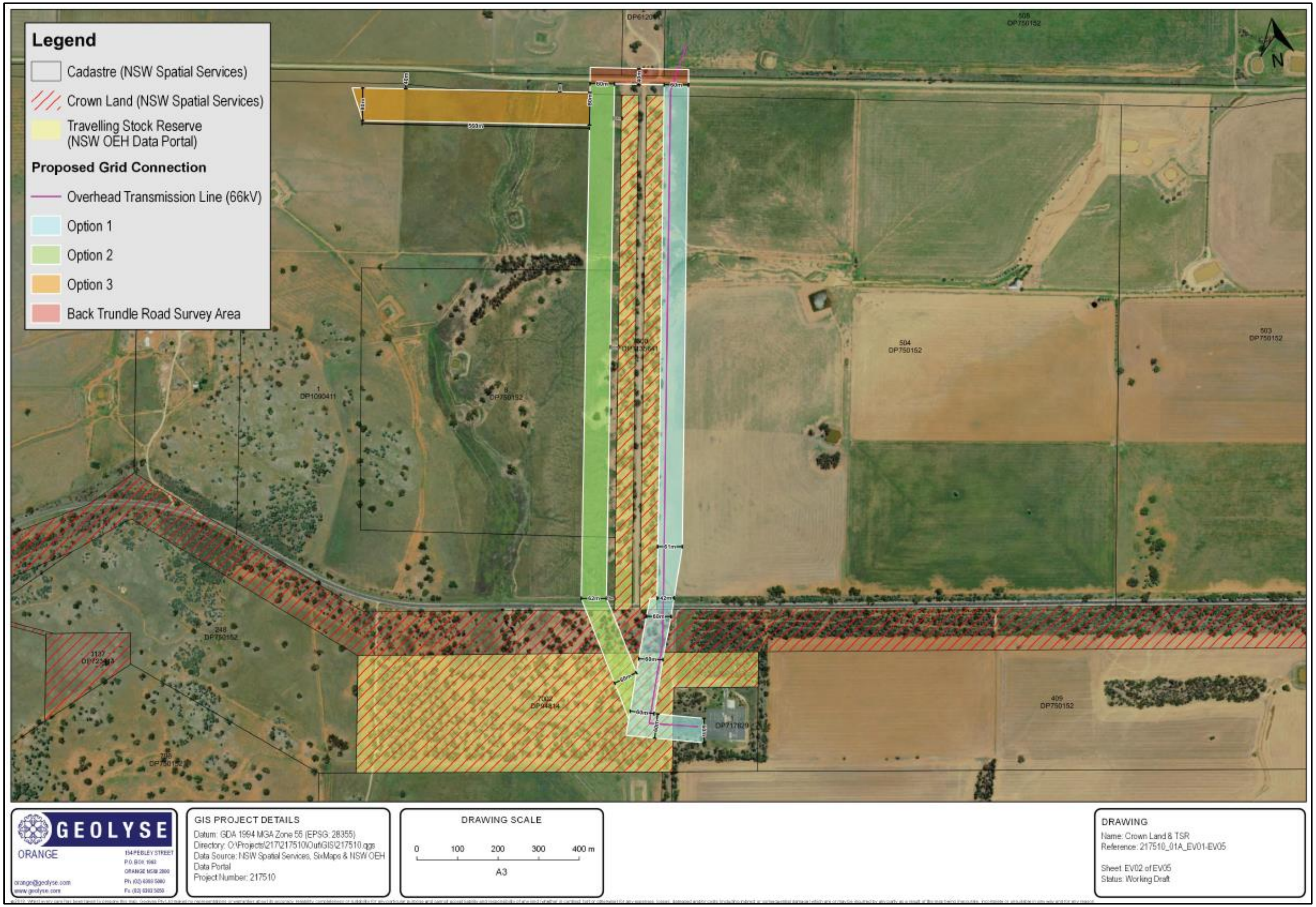
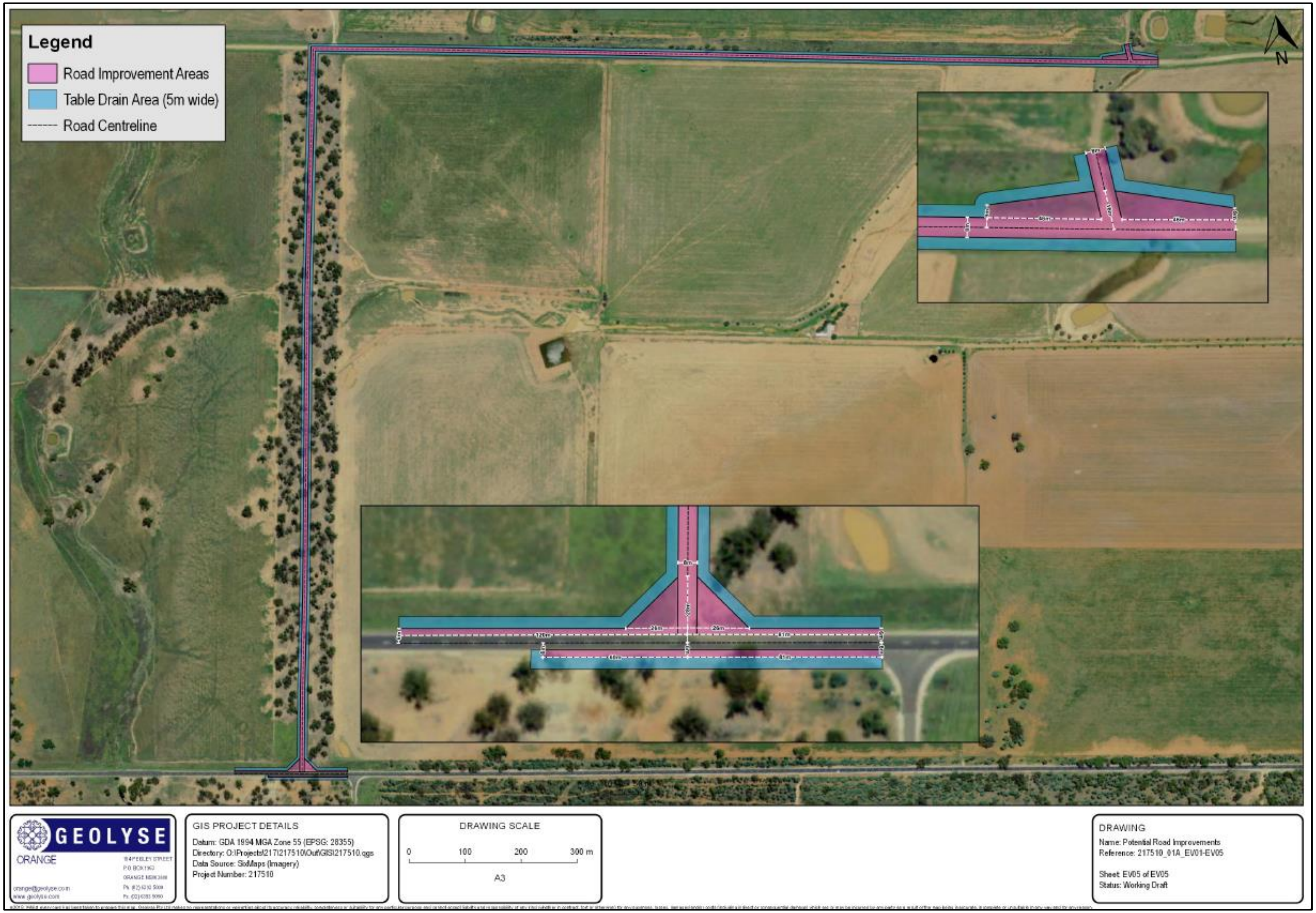


Figure 1-4: Figure showing the potential road improvement areas along Back Trundle Road and McGrath Lane (source: Geolyse 2018).



1.3 PROJECT SITE

The Project Site includes the proposed solar farm site, three grid connection options, and the portions of Back Trundle Way and McGrath Lane highlighted on **Figure 1-4**.

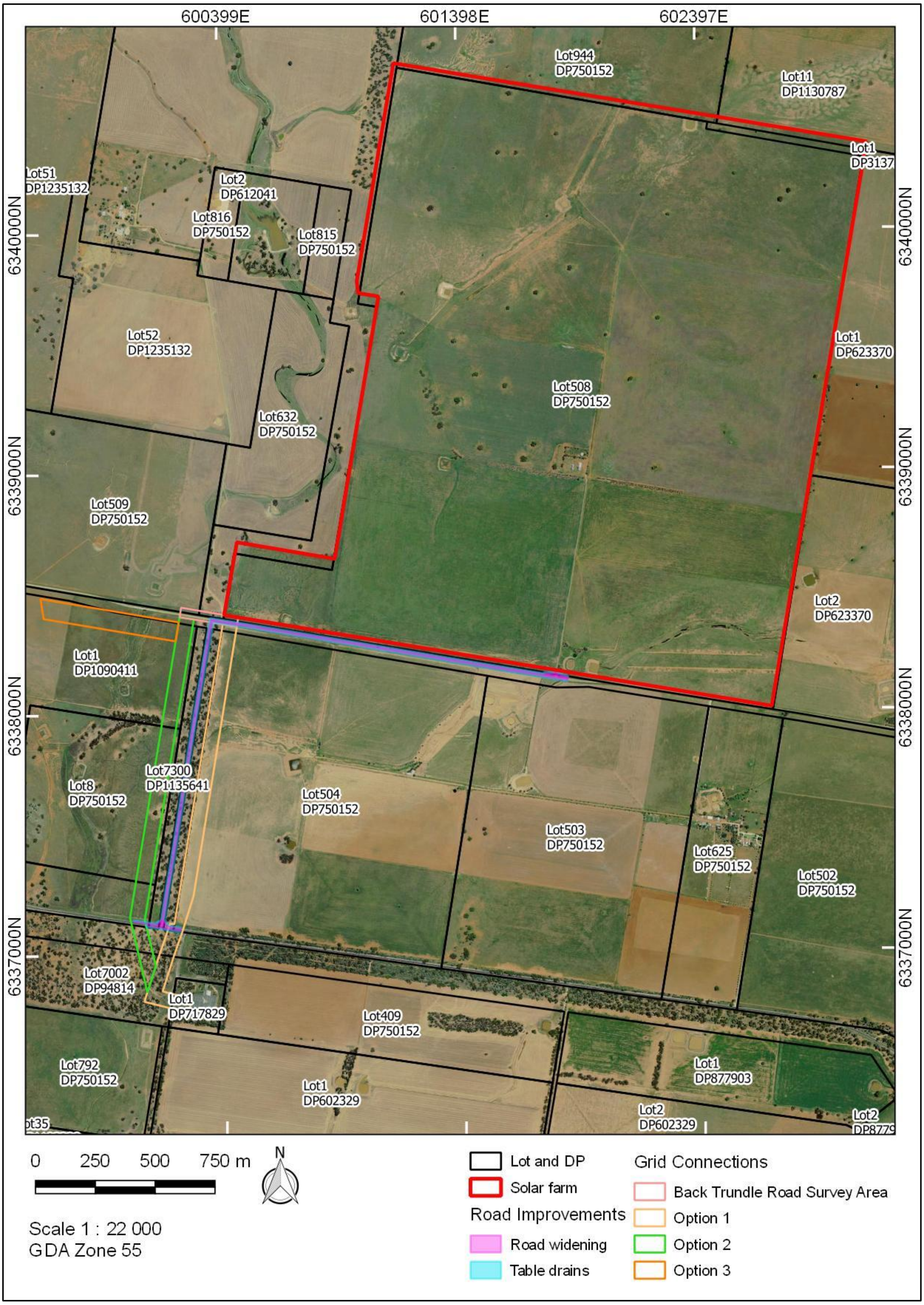
The Project Site for this assessment is approximately 486ha in size, including a number of land titles and encompassing portions of three rural properties: Quorn Park, Warrawee and Ponderosa (**Table 1-2** and **Figure 1-5**). The Project Site is located approximately 7.6 kilometres (km) northwest of Parkes and is accessed via Back Trundle Road.

The long-term and existing use of the Project Site is agricultural production, including both livestock grazing and cropping. Under the provisions of the Parkes Local Environmental Plan 2012 (Parkes LEP), the Project Site is zoned 'RU1 Primary Production'. All land adjoining the Project Site is also zoned RU1 Primary Production.

Table 1-1: Land titles within the Project Site.

Lot	Deposited Plan (DP)	Tenure
Lot 1	DP 717829	Freehold - TransGrid
Lot 1	DP 1090411	Freehold – Warrawee property
Lot 8	DP 750152	Freehold – Warrawee property
Lot 504	DP 750152	Freehold – Ponderosa property
Lot 508	DP 750152	Freehold – Quorn Park property
Lot 7002	DP 94814	Crown land (Travelling Stock Reserve)
McGrath Lane		Council public road
Back Trundle Road – 1.5km		Council public road
Henry Parkes Way – 100m		Council public road

Figure 1-5: Aerial showing the components of the Project Site with cadastral data.



1.4 RELEVANT LEGISLATION

Cultural heritage is managed by a number of state and national Acts. Baseline principles for the conservation of heritage places and relics can be found in the *Burra Charter* (Australia ICOMOS 2013). The *Burra Charter* has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The *Burra Charter* generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a state level.

A number of Acts of parliament provide for the protection of heritage at various levels of government.

1.4.1 State legislation

Environmental Planning and Assessment Act 1979 (EP&A Act)

This Act, amended by the *Environmental Planning and Assessment Amendment Act 2017,* establishes requirements relating to land use and planning. The framework governing environmental and heritage assessment in NSW is contained within the following parts of the EP&A Act:

- **Part 4:** Local government development assessments, including heritage. May include schedules of heritage items;
    - **Division 4.7:** Approvals process for state significant development.

National Parks and Wildlife Act 1974 (NPW Act)

Amended during 2010, the NPW Act provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (Part 6), an Aboriginal object is defined as: any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area which has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the NPW Act to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, such as:

- The harm was authorised by and conducted in accordance with the requirements of an *Aboriginal Heritage Impact Permit* (AHIP) under Section 90 of the Act;
- The defendant exercised 'due diligence' to determine whether the action would harm an Aboriginal object; or
- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the Office of Environment and Heritage (OEH) Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on Aboriginal Heritage Information Management System (AHIMS).

Heritage Act 1977 (Heritage Act)

The *Heritage Act 1977* (Heritage Act) is applicable to the current assessment. This Act established the Heritage Council of NSW. The Heritage Council's role is to advise the government on the protection of heritage assets, make listing recommendations to the Minister in relation to the State Heritage Register, and assess/approve/decline proposals involving modification to heritage items or places listed on the Register. Most proposals involving modification are assessed under Section 60 of the Heritage Act.

Automatic protection is afforded to 'relics', defined as 'any deposit or material evidence relating to the settlement of the area that comprised New South Wales, not being Aboriginal settlement, and which holds state or local significance' (note: formerly the Act protected any 'relic' that was more than 50 years old. Now the age determination has been dropped from the Act and relics are protected according to their heritage significance assessment rather than purely on their age). Excavation of land on which it is known or where there is reasonable cause to suspect that 'relics' will be exposed, moved, destroyed, discovered or damaged is prohibited unless ordered under an excavation permit.

1.4.2 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Matters of National Environmental Significance listed under the EPBC Act include the National Heritage List and the Commonwealth Heritage List, both administered by the Commonwealth Department of the Environment and Energy. Ministerial approval is required under the EPBC Act for proposals involving significant impacts to National/Commonwealth heritage places.

1.4.3 Applicability to the Project

The current Project will be assessed under Part 4, Division 4.7 of the EP&A Act. As a Division 4.7 consent, management of Aboriginal cultural heritage can be conducted under an approved *Aboriginal Cultural Heritage Management Plan* (ACHMP) rather than an AHIP.

The Secretary's Environmental Assessment Requirements (SEARs) issued for the Project (issued 8 March 2018) pertaining to Aboriginal cultural heritage and historic heritage have been followed in this assessment.

Any Aboriginal sites within the study area are afforded legislative protection under the NPW Act.

It is noted there are no Commonwealth or National heritage listed places within the study area, and as such, the heritage provisions of the EPBC Act do not apply.

1.5 ASSESSMENT APPROACH

The current assessment follows the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010). Field assessment and reporting followed the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011).

The Aboriginal cultural values assessment follows the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs; DECCW 2010b).

The historic archaeological assessment follows the *Historical Archaeology Code of Practice* (Historical Code of Practice; Heritage Council 2006), the *Archaeological Assessments Guidelines* (Heritage Division 1996), and *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Division 2009).

The ACHAR is presented in **Sections 2** to **7** of this report while the historic heritage assessment is presented in **Sections 8** to **11** of this report. Recommendations regarding Aboriginal cultural heritage and historic heritage are provided in **Sections 12** to **13**.

ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT

2 THE ARCHAEOLOGICAL AND ABORIGINAL CULTURAL HERITAGE VALUES ASSESSMENT

2.1 PURPOSE AND OBJECTIVES

The purpose of the current study is to identify and assess heritage constraints and to manage/mitigate potential impacts relevant to the proposed work consistent with the legislative requirements outlined in **Sections 1.4** to **1.5**.

2.1.1 Aboriginal archaeological and cultural heritage values assessment objectives

The current assessment will apply the Code of Practice and the ACHCRs to complete an Aboriginal cultural heritage assessment, in order to meet the following objectives:

Objective one: To undertake an Aboriginal archaeological survey of the Project Site as per the Code of Practice.

Objective two: To undertake an Aboriginal cultural values assessment of sites located within the Project Site with the potential to be impacted by the Project, in consultation with Registered Aboriginal Parties (RAPs) and consistent with the ACHCRs.

Objective three: To assess the significance of any recorded Aboriginal sites, objects or places likely to be impacted by the project, in consultation with RAPs, consistent with the Code of Practice and ACHCRs.

Objective four: To assess the likely impacts of the proposed works to any recorded Aboriginal sites, objects or places, and to develop management recommendations, in consultation with RAPs, consistent with the Code of Practice and ACHCRs.

2.2 DATE OF ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk from Monday 10 September to Wednesday 12 September 2018.

2.3 OZARK INVOLVEMENT

2.3.1 Field assessment

The fieldwork component of the heritage assessment was undertaken by:

- Archaeologist: Stephanie Rusden (OzArk Project Archaeologist, BS University of Wollongong, BA University of New England); and
- Archaeologist: Marc Cheeseman (OzArk Project Archaeologist, BA[Hons], University of Queensland).

2.3.2 Reporting

The reporting component of the heritage assessment was undertaken by:

- Report author: Stephanie Rusden;
- Contributor: Marc Cheeseman (**Section 6.3**); and
- Reviewer: Ben Churcher (OzArk Principal Archaeologist; BA[Hons], Dip Ed).

3 Aboriginal Cultural Heritage Consultation Requirements

The Aboriginal cultural values assessment has followed the ACHCRs. Information regarding the ACHCRs, detailing the main stages, follows.

A log and copies of all correspondence with agencies and RAPs is presented in **Appendix 1**.

<u>Stage 1: Notification of the development and registration of interest:</u>

- Advertisement placed in the Parkes Champion-Post on Friday 6 July 2018 (**Appendix 1**).
- Letter seeking information from agencies sent on 4 July 2018 (**Appendix 1**[1]). Letters were sent to NTS Corp Ltd, Local Land Services, Office of the Registrar (ALRA), Native Title Tribunal, OEH, Peak Hill Local Aboriginal Land Council (PHLALC) and Parkes Shire Council.
- By the closing date for registration concerning this Project, three groups or individuals registered to be consulted as RAPs. They are as follows:
    - PHLALC
    - Rob Clegg
    - Binjang Wellington Wiradjuri Aboriginal Corporation

<u>Stage 2/3: Presentation of information about the proposed development and gathering information about cultural significance:</u>

- On 7 August 2018 all RAPs were sent:
    - Development overview (**Appendix 1**);
    - Survey methodology (**Appendix 1**).
- Stage 2/3 28 day review period closed on 5 September 2018. No comments were provided by the RAPs on the proposed survey methodology nor were any cultural values regarding the Project Site and its surrounds provided.

<u>Field survey participation</u>

Fieldwork was undertaken from 10-12 September 2018. The following RAPs or representatives of RAPs participated in the fieldwork program:

- 10–12 September 2018: Anthony Wilson (PHLALC);
- 10 September 2018: Rob Clegg; and
- 12 September 2018: Lyn Bell (PHLALC).

[1] Please note that **Appendix 1** contains only a sample of each stage letter sent. Should OEH require every letter sent to all agencies and RAPs, OzArk can provide these.

Stage 4: Review of draft ACHAR

The draft ACHAR was sent on 9 October 2018 to all RAPs. A 28-day review period was provided closing on the 7 November 2018.

Feedback was received from Rob Clegg on 7 November 2018. Mr Clegg requested that artefacts be relocated only where they are going to be disturbed. No comments or feedback was received from the remaining RAPs regarding the contents of this ACHAR.

Following the closure of the Stage 4, the impact footprint of the Project was amended to include the Option 2 electricity alignment which was discounted following the survey. Due to the change in the impact footprint and the subsequent impact to Warrawee-IF1 (43-3-0145), the updated ACHAR was distributed to all RAPs with an additional 14-day review period. Feedback was received from Mr Clegg, acknowledging the impact to the additional site. Mr Clegg also added that he would like a monitor on site during any ground disturbance work. It was noted by OzArk archaeologist, Stephanie Rusden, that a monitor was not warranted due to the low likelihood of additional Aboriginal artefacts being present.

4 LANDSCAPE CONTEXT

An understanding of the environmental contexts of a Project Site is requisite in any Aboriginal archaeological investigation (DECCW 2010). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. In addition, natural geomorphic processes of erosion and/or deposition, as well as humanly activated landscape processes, influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

The Project Site is located within the South Western Slopes (SWS) bioregion (Lower Slopes subregion) (NPWS 2003) and includes two Mitchell (2002) landscape units: Goonumbla Hills and Bimbi Plains (**Figure 4-1**).

4.1 TOPOGRAPHY

The landforms of the Goonumbla Hills landscape unit (Mitchell 2002) includes extensive undulating low hills (Mitchell 2002: 60). General elevation across this landscape type ranges from 290 to 390m, with a local relief of up to 70m.

The Bimbi Plains landscape unit (Mitchell 2002) is typified by alluvial plains (Mitchell 2002: 59). General elevation across this landscape type ranges from 200 to 250m, with a local relief of 30 to 150m.

The topography of the Project Site is most consistent with the Bimbi Plains landscape unit being largely flat and undifferentiated (**Figure 4-2**). While there are minor variations in the topography of the Project Site, such as the slight rise in the central portion of the solar farm site, these are not pronounced enough to be mapped in a way that is meaningful for the archaeological understanding of the Project Site.

Figure 4-1: Map showing the Mitchell (2002) landscape units and waterways in relation to the Project Site.

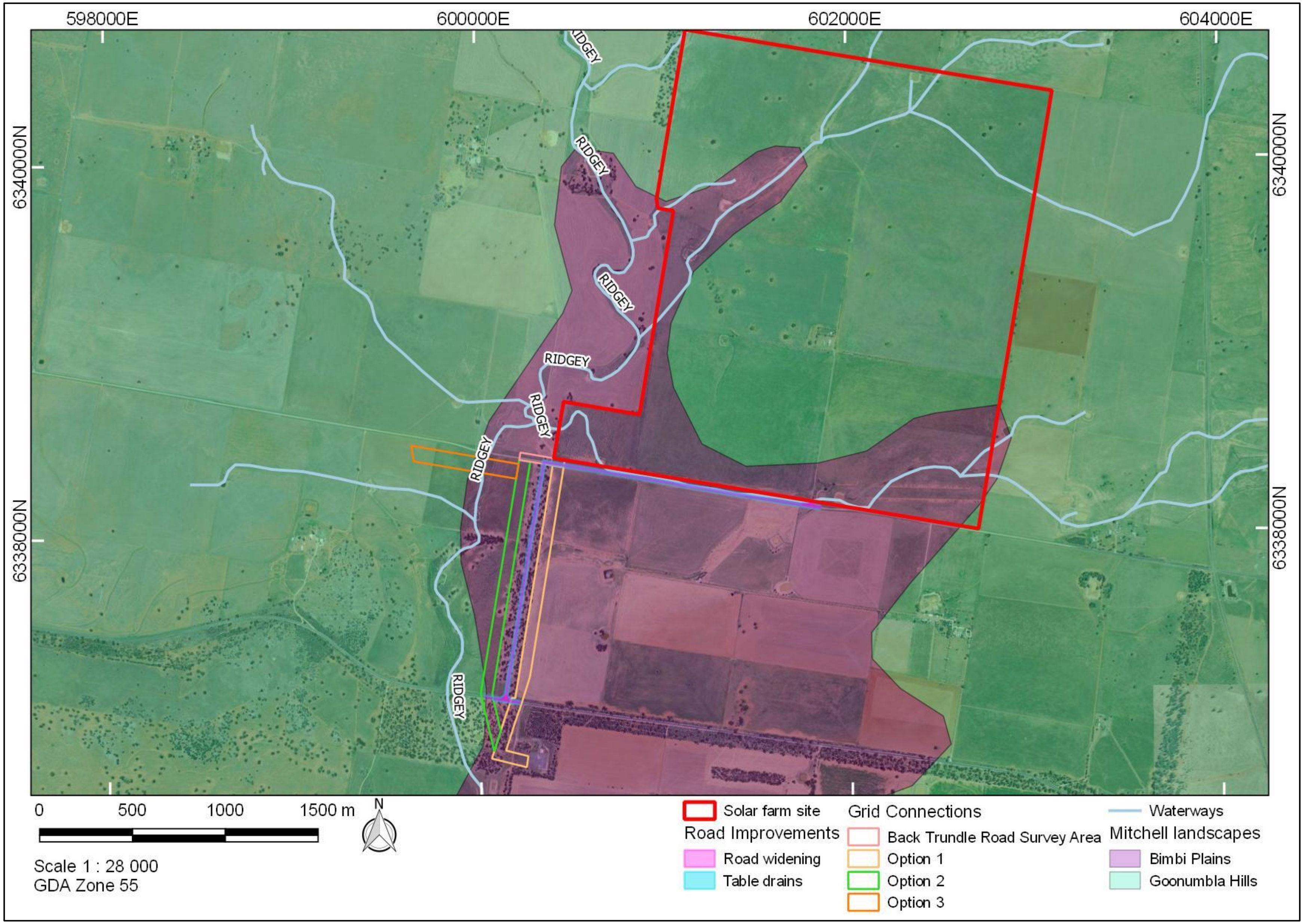


Figure 4-2: Topography of the Project Site.

	
1. View east, showing flat landforms within the Bimbi Plains landscape unit and within the proposed solar farm site.	2. View northeast, showing a highly ephemeral drainage line within the Bimbi Plains landscape unit and the proposed solar farm site.

4.2 GEOLOGY AND SOILS

Understanding land formation processes is an important part of assessing the availability of exploitable resources in the landscape and predicting the ability of that landscape to preserve archaeological material (DECCW 2010).

The SWS bioregion lies wholly in the eastern part of the Lachlan Fold Belt which consists of a complex series of north to north-westerly trending sedimentary and volcanic rocks (NPWS 2003). Within this bioregion, common materials include quartz and quartzite, basalt, and granites with generally softer rocks such as shale or slate in the valleys between ranges and occasional limestone outcrops.

Sedimentology of the Goonumbla Hills is defined by stony yellow earths, thin brown structured loams on the hills merging with red-brown and red texture-contrast soils on the flats (Mitchell 2002: 60). Sedimentology of the Bimbi Plains is defined by gravelly clay loams and red brown clays, red-brown texture-contrast soils on higher slopes and gradational profiles of clay loams and clays along creeks (Mitchell 2002: 59).

The soil of the Project Site consists of red-brown clay loam which been subject to pasture improvement. The primary mode of geomorphic activity within the Project Site is erosion as a result of historical land clearing, cultivation and grazing.

4.3 HYDROLOGY

Hydrological features of the Project Site are largely limited to an ephemeral, unnamed drainage features which generally transect the Project Site on a southwest to northeast alignment (**Figure 4-3**). One named creek line, Ridgey Creek, traverses grid connection Option 3 in the west of the Project Site. Ridgey Creek is a non-perennial creek line which is a tributary of Brolgan Creek.

Parkes' primary waterway is Goobang Creek, a tributary of the Lachlan River, located at its closest 7.5km southwest of the Project Site.

4.4 VEGETATION

Vegetation across the majority of the Project Site has been largely modified by land clearance since European settlement for the purposes of agriculture and ground covering vegetation is largely comprised of exotic cereals and weeds. Isolated stands of remnant native vegetation are present throughout the proposed solar farm site, with areas of greater vegetation density present along the road corridor of McGrath Lane and south of Henry Parkes Way to the existing substation. Native vegetation remaining within the Project Site includes grey box, white cypress pine and kurrajongs.

4.5 CLIMATE

Climate statistics from Parkes airport, located approximately 12.6km southeast of the Project Site, indicate that temperatures range from a monthly mean maximum of 33.5° Celsius (C) in January to a monthly mean minimum of 2.3°C in July and August. Average annual precipitation is 647.6 millimetres (mm) with high rainfall periods between October and March and the highest rainfall occurring in January (62.2mm) (BoM 2018).

4.6 LAND-USE HISTORY

Aboriginal people in prehistory are known to have used fire-stick farming, or controlled burns, to alter vegetation ecosystems to promote the growth of desirable plants. Though it cannot be said at this time whether fire-stick farming was undertaken within the Project Site, it is becoming increasingly believed that Aboriginal fire regimes were widespread (Gammage 2011) and therefore should be considered as a possible early land-use practice.

Squatters began to occupy the SWS bioregion in the 1830s with cattle and sheep grazing becoming the dominant land use in the early days of European settlement. By the end of the 1800s grazing was expanded due to improved pastures. In the interim, the bioregion has been subjected to a variety of landscape disturbances due to: pastoralism, mining, vegetation clearance, erosion, feral animal introductions, river regulation and plant cultivation (HO and DUAP 1996).

The long-standing and existing use of the Project Site is agricultural production, including both livestock grazing and crop cultivation.

4.6.1 Existing levels of disturbance

Disturbance, historical or natural, potentially alters the archaeologically record. It can do this in a variety of ways, directly or indirectly. For example, land clearing directly removes a particular site type: usually scarred trees or stone arrangements. Indirectly, land clearing accelerates soil erosion, potentially resulting in previously buried occupation / activity sites becoming exposed and altered / damaged.

The Project Site has moderate to high levels of disturbance mostly consisting of impacts related to the area's agricultural use. Disturbances across the Project Site are summarised below:

- **Agriculture and Pastoralism.** Farming and grazing are fundamental to the local economy and dominate land-use throughout the area. The Project Site is wholly contained within farming and grazing land which has had the following impacts:
  - **Vegetation removal.** The Project Site has been subject to significant levels of vegetation removal (**Section 4.4**). Culturally modified trees may have been removed during the land clearance phase in the area, thereby distorting the archaeological landscape by removing this site type;
  - **Cultivation.** The entirety of the Project Site has been subjected to repeated cultivation. Repeated cultivation since the commencement of European settlement will have altered soil profiles and potentially disturbed the integrity of sites and any potential sub-surface archaeological deposits. Research into the impacts upon archaeological sites as a result of agricultural practices, termed plough zone archaeology, has demonstrated that artefacts can move in excess of 8m per season of cultivation (Frink 1984; Gaynor 2001);
  - **Grazing.** The Project Site has been used historically and is currently used for low-intensity livestock grazing. The presence of hoofed livestock is likely to have resulted in trampling and compaction of the ground surface which accelerates soil loss; and
  - **Farm Infrastructure and remediation works.** The Project Site has an overall low level of disturbance generated by the construction of dams, contour banks, agricultural buildings and fencing. Earthworks associated with contour banking and dams can reveal lithic artefacts which may have been otherwise concealed by low ground surface visibility (GSV).
- **Dwellings.** A low level of disturbance is generated by the construction of the one dwelling located within the Project Site.
- **Transport.** One graded road transects the central portion of the proposed solar farm site from the entrance off Back Trundle Road to the dwelling. The Project Site also includes the table drains associated with Back Trundle Road and McGrath Lane. A limited number of farm tracks also intersect the Project Site. In the case of unsealed tracks, this disturbance tends to provide exposures, thus enabling the identification of otherwise obscured artefacts.

- **Erosion.** Erosion includes sometimes gully erosion and sheet wash erosion, primarily adjacent to waterways. Varying scales of erosion on the archaeological landscape has the capacity to completely remove archaeological sites. However, in the process of erosion, many archaeological sites can become freshly exposed.

4.7 CONCLUSION

Topography and hydrology: The flat landforms which dominate the Project Site would not have been an impediment to movement or occupation (camping) in the past. However, occupation of this area in antiquity by Aboriginal people would most likely have been limited to transient inhabitation resulting from movement across the landscape to other areas which provide more stable resources such as water provided by Goobang Creek.

Geology: Landforms surrounding the Project Site, i.e. hills, which comprise outcropping rock are not present within the Project Site itself and therefore no sources of stone procurement for tool manufacture will be identified.

Soils: The soils that characterise the majority of the Project Site are relatively stable. However, repeated ground surface disturbance by ploughing and vegetation clearing will have allowed the soil to become more susceptible to erosion.

Vegetation: Mature, native species known to be present within the Project Site would have provided resources for Aboriginal people in the past, however, resources likely to have supported a large population of people would have been present closer to the banks of more permanent water sources in the region. Given the presence of mature native vegetation, it is possible that some site types such as culturally modified trees may exist within the Project Site. However, broad-scale vegetation clearance, a characteristic of the area reduces the likelihood that any culturally modified trees remain present.

Climate: The climate would not have been an impediment to year-round occupation.

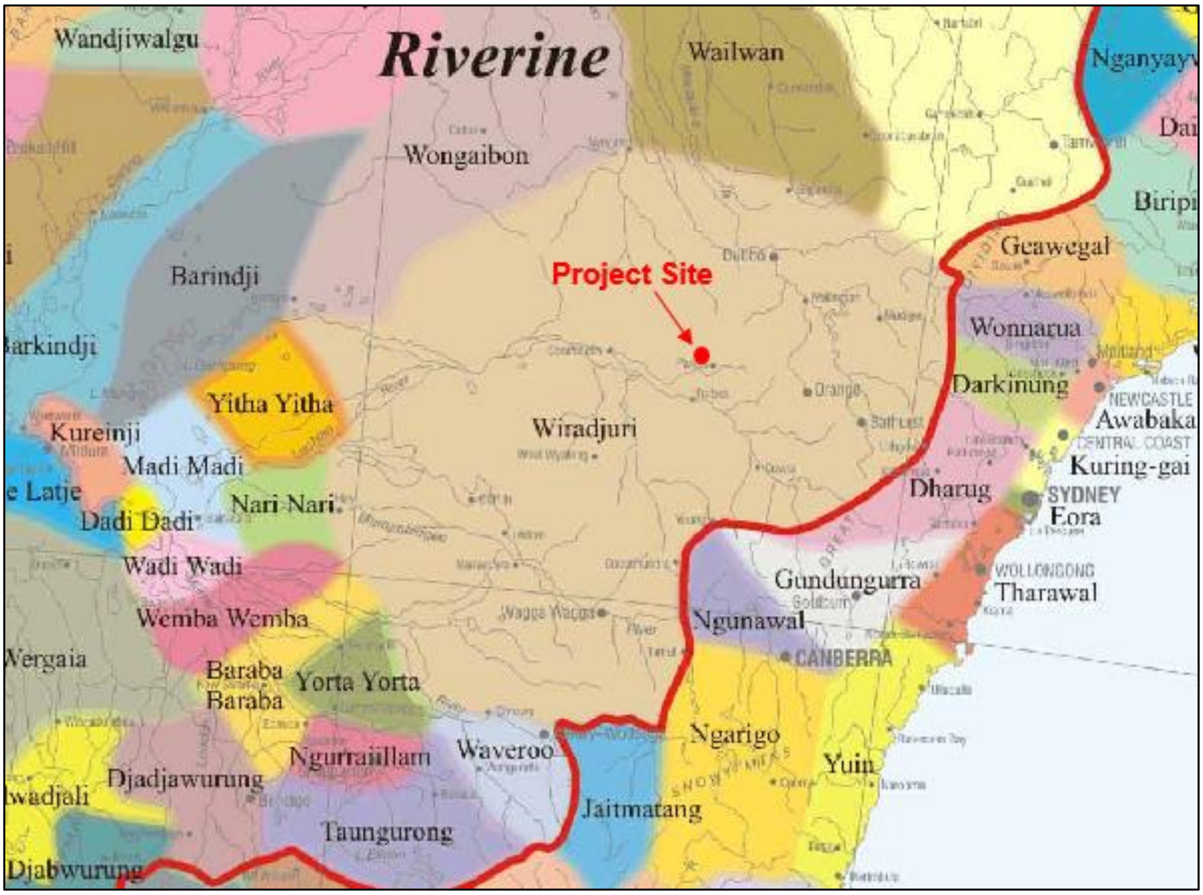
Land use: Disturbances arising from past land use have resulted in localised, significant changes to the landscape. The majority of the Project Site has been subject to extensive levels of disturbance from continued ploughing and cultivation. In other sections of the Project Site, these activities have resulted in less modification to the landscape although vegetation clearing, the construction of a homestead and associated farm infrastructure would have exacerbated soil movement leading to the dispersal or covering of stone artefact sites. As noted above, initial vegetation clearing would also have removed culturally modified trees, had they existed in the area. Unobtrusive sites such as open artefact scatters and isolated finds have a greater ability to withstand disturbances and persist within the landscape, however where present, such sites are likely to be disturbed.

5 ABORIGINAL ARCHAEOLOGY BACKGROUND

5.1 ETHNO-HISTORIC SOURCES OF REGIONAL ABORIGINAL CULTURE

At the time of European settlement, the Project Site was situated within the territory of people belonging to the Wiradjuri tribal and linguistic group (Tindale 1974 and Horton 1994; **Figure 5-1**). The Wiradjuri tribal area is situated within the Murray Darling Basin, covering three primary physiographic divisions: the riverine plains in the west, the transitional western slopes in between and the highlands or central tablelands in the east (White 1986).

Figure 5-1: A portion of Horton's (1994) map showing the location of ethno-linguistic groups in relation to the Project Site.



Episodes of early contact between Indigenous and European cultures from the nearby Lachlan Valley (around 30km south) were documented by the explorers Oxley and Cunningham in May 1817. Later in 1835 came accounts of contact with native groups by Surveyor Mitchell on his expedition, which had set out to explore the Bogan River (Unger nd: 3; Kass 2003: 6). In April 1835, Mitchell's party encountered a group of natives on the outskirts of what is today the town of Parkes. From this meeting, Mitchell learned that what had been named the Hervey Range by Oxley in 1817 was in fact known to the locals as 'Goobang', which derived from the Aboriginal word *Coleong Coobung*, which meant place of many wattles (Kass 2003: 9).

When Mitchell's party left their camping spot, several natives reportedly followed them, one of whom speared a large kangaroo, while others used new tomahawks to extract honey from tree branches. It is recorded that the natives accompanied the expedition for four days before retreating upon the appearance of further natives. This was interpreted by Mitchell as the original group of natives having reached their tribal boundary (Unger nd: 5).

Ethnographic information gleaned from this expedition noted the primary meat portion of their diet consisted of possum, kangaroo and emu; women fished using a moveable dam of twisted dry grass to corral fish so they could be picked out of the water and collected freshwater mussels; and starchy plant roots were eaten (Kass 2003: 6).

5.2 REGIONAL ARCHAEOLOGICAL CONTEXT

The most relevant research-based studies over the central west and Lachlan Valley were undertaken by Kelton (1996), English *et al* (1998) and OzArk (2016). Although centred a little further east and north of the township of Parkes, these studies together still provide baseline data for placing past Aboriginal sites within a regional landscape context. The following is a summary of the salient points learned from these studies:

In 1996, Kelton completed research based assessment of Aboriginal scarred trees and other archaeological sites in the Lachlan Valley region. Kelton highlighted that sites found within the Lachlan Valley reflect diversity and different levels of past Aboriginal occupation, hunter-gatherer lifestyle and technology, as well as varying forms of resource extraction. Research into site registrations in the Lachlan Valley display that those with the greatest frequency are open campsites and scarred trees. Around 220 Aboriginal scarred and carved trees were recorded in the Lachlan Valley by 1996, commonly found on yellow box, grey box, river red gum, fuzzy box and bimble box (Kelton 1996). According to Kelton, scarred trees can be expected to occur over almost all landform units, however, frequency tends to increase with proximity to water. Kelton also noted differences in the types of culturally modified trees concluding that scars result from what may be considered 'normal' routine domestic purposes associated with the hunter-gatherer lifestyle, and carving which results from more culturally complex traditions, including the marking of burials and or ceremonial sites (also known as Bora Grounds). The second most numerous site type, the open campsite, was noted at 210 locations in 1996 (Kelton 1996). Within the Lachlan Valley, open campsites tend to be located in close proximity to reliable water sources such as rivers, creeks, billabongs and lakes, and gilgai formations, playa lakes, ephemeral drainages, and usually at elevated terrace locations, or along non-flood prone, elevated ground nearby these formations.

In 1998, English et al undertook survey of Goobang National Park which includes the Hervey Ranges, located 18km northeast of the Project Site, and described a settlement pattern similar to the ones described above (English et al 1998: 196). A 2001 report issued by the NSW National

Parks and Wildlife Service (NPWS) details the findings of this survey, shedding some insight to the nature of settlement patterns in the region and noting the importance of the Hervey Ranges. These investigations note a widespread use of the resources in the Hervey Ranges with the watercourses of the lower slopes and undulating plains seeing the most extended and repeated occupation. It also records the importance of the Hervey Ranges to the Wiradjuri as a traveling route, landmark and its possibility of having important ceremonial value.

More recently in 2016, OzArk was engaged by the Central West Local Land Services (CWLLS) to formulate and test a predictive model for Aboriginal site location within Travelling Stock Reserves (TSRs) across the CWLLS area. In formulating a predictive model for site location, Mitchell (2002) landscapes were used to understand the underlying landform type. The resolution of the Mitchell landscape units was too fine to be of use and OzArk (2016) used a higher-level classification within the Mitchell landscape units to describe the landscapes within the CWLLS area. Landscapes were divided into the following types:

- Channels and floodplains;
- Alluvial plains;
- Slopes;
- Uplands; and
- Downs.

Previously recorded AHIMS sites were plotted against these landscape types and the following observations made:

- A high number of sites (n=876) were located within slopes landscapes, however, this result could be due to the fact that Dubbo is located within a slopes landscape and the highest number of sites in the CWLLS area is recorded in and around Dubbo;
- The highest density of sites is within channels and floodplains landscapes (n=927);
- Alluvial plains landscapes have the third highest density of sites (n=770);
- Relatively small numbers of sites are recorded in uplands (n=5) and plateau (n=34) landscapes; and
- A moderate number of sites are recorded in downs landscapes (n=255). Three or four clusters of sites exist in downs landscapes, which may have skewed the data. If the veracity of all site recordings in this category could be verified, it is suspected that the actual number of sites in downs landscapes would be lower.

OzArk (2016) divided the CWLLS area into two stream orders—major watercourses (normally named rivers) and minor watercourses (normally named creeks and their larger tributaries)—and buffers were established for each watercourse type as follows:

- **Drainage 1 buffer:** 200m either side of a major watercourse; and
- **Drainage 2 buffer:** 100m either side of a minor watercourse.

As such, the OzArk (2016) CWLLS predictive model made predictions based on the landscape type and distance to watercourses. The predictive model was tested by assessing 32 TSRs within the CWLLS area located in a variety of landscape types with variable distances to water. As a result of the assessment, 59 sites were recorded. Twenty six (44%) of the recorded sites were modified trees, 22 (37%) were artefact scatters and 11 (19%) were isolated finds. The majority of recorded sites were located in channels and floodplains landscapes (35 sites or 59% of all sites), followed by 10 in slopes landscapes, four in alluvial plains landscapes and one in a downs landscape. No sites were recorded in uplands or plateau landscapes.

Table 5-1 demonstrates that the most archaeologically sensitive landscape in the CWLLS area is channels and floodplains, followed by slopes landscapes. Other landscape types have a low representation but demonstrate that low densities of sites exist in other landscape types.

Table 5-1: Association of all recorded sites to landscape units (OzArk 2016).

Landscape unit	Number of sites	Percentage of total (n=59)
Channels and floodplains	36	61
Alluvial plains	6	10
Slopes	14	23
Downs	1	2
Uplands	2	4
Plateau	0	0

Site types associated with the landscapes most-frequently recording sites (channels and floodplains and slopes) show that channels and floodplains landscapes are more likely to contain modified trees and that slopes landscapes are more likely to contain artefact scatters and isolated finds (**Table 5-2**).

Table 5-2: Frequency of site types in association with landscape types (OzArk 2016).

Site type	Channels and floodplains	Slopes	Alluvial Plains
Artefact scatter	11 (30.5%)	7 (50%)	3 (50%)
Isolated finds	4 (11%)	3 (21%)	3 (50%)
Modified trees	21 (58.5%)	4 (29%)	0 (0%)

In terms of drainage buffers, OzArk (2016) found that 27 sites (or 46% of all sites) were recorded with the Drainage 1 buffer and 10 sites (or 17% of all sites) were recorded within the Drainage 2 buffer. Therefore, more than 63% of all sites were recorded within the two drainage buffers, with a clear bias toward Drainage 1 buffers.

5.3 LOCAL ARCHAEOLOGICAL CONTEXT

5.3.1 Desktop database searches conducted

A desktop search was conducted on the following databases to identify any potential previously-recorded heritage within the Project Site. The results of this search are summarised in **Table 5-3** and presented in detail in **Appendix 2**.

Table 5-3: Aboriginal heritage: desktop-database search results.

Name of Database Searched	Date of Search	Type of Search	Comment
Commonwealth Heritage Listings	28/8/2018	Parkes LGA	No places listed on either the National or Commonwealth heritage lists are located within the Project Site.
National Native Title Claims Search	28/8/2018	NSW	No Native Title Claims cover the Project Site. Lot 7002 DP94814 and Lot 7300 DP 1135641 are affected by an Aboriginal Land Claim pursuant to sections 36 or 37 of the *Aboriginal Land Rights Act 1983*.
State Heritage Register (SHR)	28/8/2018	Parkes LGA	None of the Aboriginal places noted occur within the Project Site.
OEH AHIMS	2/8/2018	10 x 10km centred on the Project Site.	30 sites were returned within the designated search area (**Section 5.3.1.1**).
Local Environment Plan (LEP)	28/8/2018	Parkes LEP of 2012	None of the Aboriginal places noted occur within the Project Site.

5.3.1.1 AHIMS search results

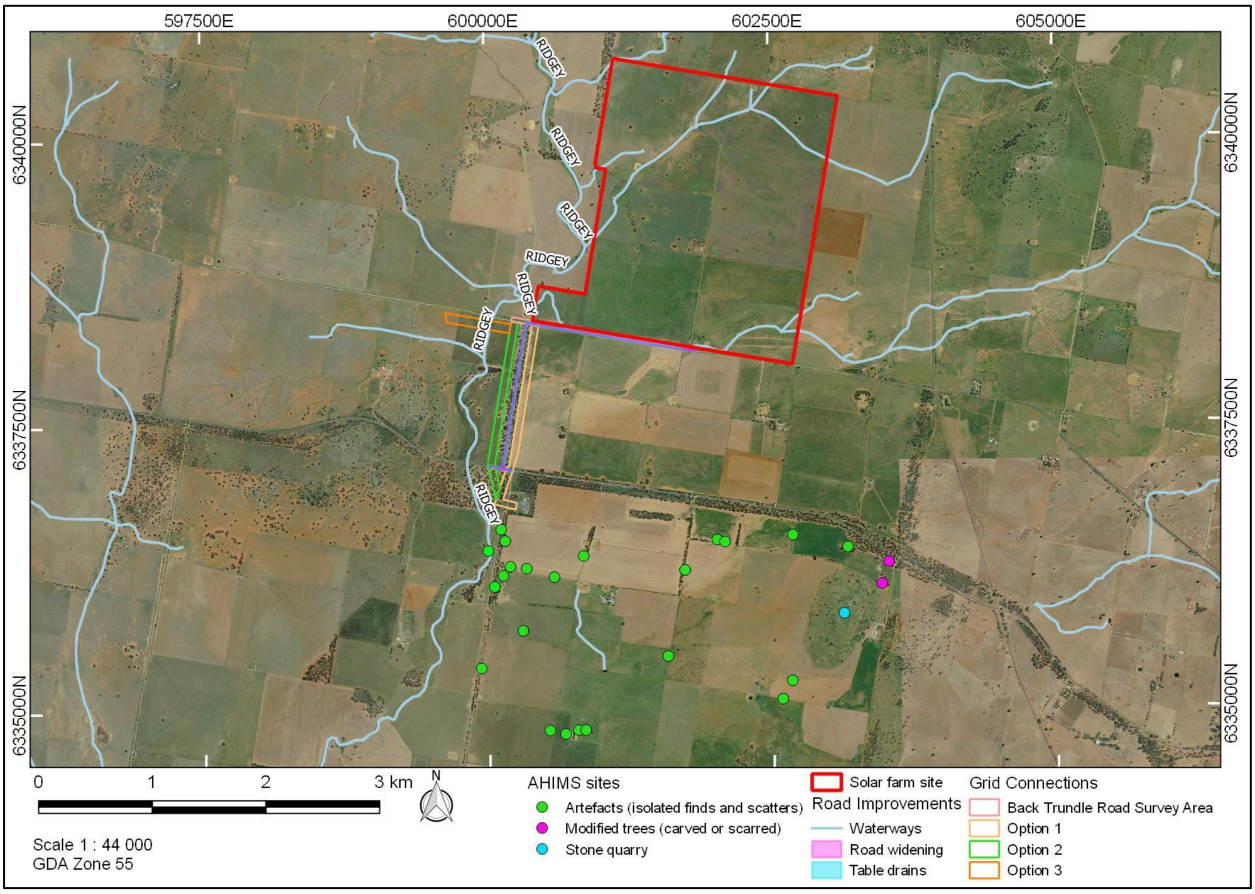
A search of the OEH administered AHIMS database was conducted on 2 August 2018 (**Appendix 2**). The search returned 30 Aboriginal sites within a 10 x 10km search area (see **Table 5-4** for the AHIMS search area; results mapped on **Figure 5-2**). None of the previously recorded sites are located within the Project Site.

Artefact sites (including artefact scatters and isolated artefacts) are the most commonly recorded site type on AHIMS in the search area (90 per cent) followed by modified trees (6.7 per cent) and a stone quarry (3.3 per cent). Artefact scatters are generally located on flat elevated landforms near watercourses, with increasing frequency along named creeks. Isolated artefacts generally increase in frequency closer to watercourses but can occur anywhere in the landscape. Modified trees tend to be located within a few hundred meters of a watercourse but can also occur anywhere in the landscape containing remnant mature native trees, particularly in box woodland. One stone quarry site has been recorded in the area, located on a hill crest where outcropping basalt is present.

Table 5-4: AHIMS site types and frequencies.

Site Type	Number	% Frequency
Isolated finds	22	73.3
Artefact scatters	5	16.7
Scarred trees	2	6.7
Stone quarry	1	3.3
Total	**30**	**100%**

Figure 5-2: Map showing the location and type of AHIMS sites in relation to the Project Site.



5.4 PREVIOUS ARCHAEOLOGICAL ASSESSMENTS

In 2006, Navin Officer completed a heritage assessment for the proposed Parkes Peaking Power Plant and associated corridors. The proposed power plant was to be located (**Figure 5-3**), directly south of the TransGrid substation. Two sites were identified during the survey (#43-3-0081 and #43-3-0083), both isolated finds located in disturbed contexts. Site #43-3-0081 includes a volcanic flake while #43-3-0083 includes a 'red volcanic bogan pick'. The bogan pick was noted as being a rare pick-shaped implement with a rounded butt and body tapering to a point at the distal end.

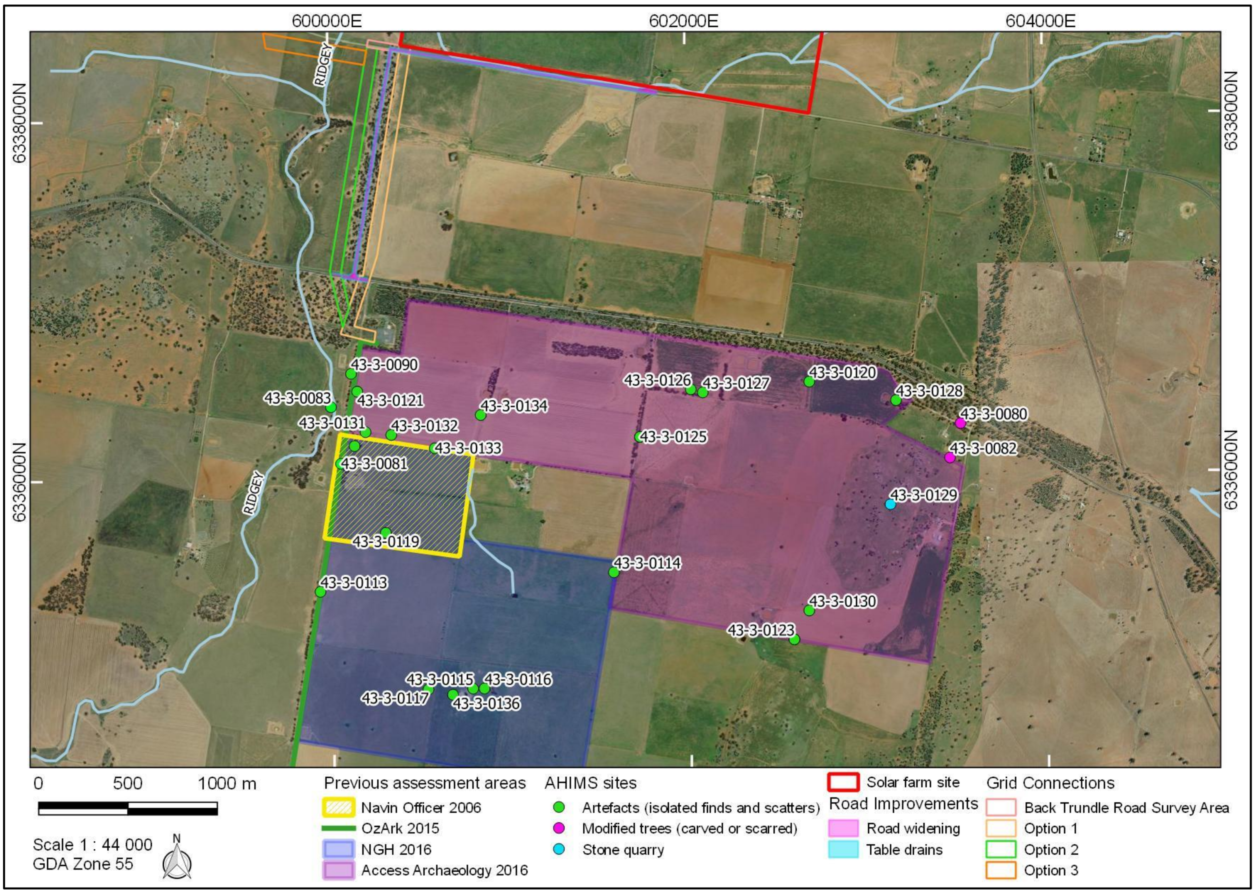
OzArk (2015) completed a Due Diligence assessment of Line 94U extending from the Parkes substation (the southernmost extent of the Project Site; **Figure 5-3**) to Forbes, NSW. No new Aboriginal sites, PADs were recorded within the study area. One previously recorded site, #43-

3-0090, was located during the survey. The site was recorded as an isolated find comprising a silcrete core with over 10 flake scars. The site was identified 200m south of the southernmost extent of the Project Site (south of the TransGrid substation), and 110m east of Ridgey Creek.

In 2016 NGH Environmental completed an archaeological assessment for the Parkes Solar Farm, located approximately 400m south of the southernmost extent of the Project Site (**Figure 5-3**). The assessed area encompassed 240ha of land which is generally flat with little topographic variation. Seven isolated finds were identified during the survey which noted poor GSV. Artefacts included two cores, two retouched flakes, two fragments of grinding stones and a milling slab. All sites were recorded as having low potential for subsurface deposits, largely due to prior levels of disturbance. Artefacts were manufactured from a variety of materials including, sandstone, silcrete, volcanic and fine-grained siliceous materials. The results of the assessment were concluded as being consistent with the predictive model which predicted isolated finds would be a common site type based on the undifferentiated landforms and lack of permanent or semi-permanent water sources. The recorded sites were noted as being a 'back ground' scatter of occupation and no areas of potential intensive occupation related to potential archaeological deposits (PADs) were identified.

Access Archaeology & Heritage (2016) completed the archaeological survey for the Goonumbla Solar Farm, located directly east of the southernmost extent of the Project Site (**Figure 5-3**). The assessed area encompassed 387ha on an undifferentiated, level plain with only one small hill in the east called Millers Lookout. A total of 16 Aboriginal sites were recorded during the field survey including 12 isolated finds, three artefact scatters and one stone hatchet quarry. Silcrete was the most abundant material recorded, making up 36% of the assemblage, with quartz (20%) and volcanics (16%) being the additional materials recorded. Unmodified and retouched flakes as well as cores were the most common artefact types recorded. All artefact sites were recorded on the plain or footslope landforms except for the quarry which was recorded at the crest of Millers Lookout which comprises outcropping Ordovician 'Goonumbla Volcanics'. Evidence of Aboriginal quarrying was noted at several locations on the crest, and a number of large primary flakes were also recorded. It was concluded that the survey recorded a sparse scatter of artefacts across the landscape, consistent with the results of other surveys undertaken in the area, particularly that of NGH Environmental 2016.

Figure 5-3: Map showing the location of the previous assessments in relation to the Project Site.



5.5 PREDICTIVE MODEL FOR SITE LOCATION

Across Australia, numerous archaeological studies in widely varying environmental zones and contexts have demonstrated a high correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural/mythological significance. Consequently sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter.

In formulating a predictive model for Aboriginal archaeological site location within any landscape it is also necessary to consider post-depositional influences on Aboriginal material culture. In all but the best preservation conditions very little of the organic material culture remains of ancestral Aboriginal communities survives to the present. Generally it is the more durable materials such as stone artefacts, stone hearths, shell, and some bones that remain preserved in the current landscape. Even these however may not be found in their original depositional context since these may be subject to either (a) the effects of wind and water erosion/transport—both over short and long time scales—or (b) the historical impacts associated with the introduction of

European farming practices. Scarred trees, by their nature, may survive for up to several hundred years but rarely beyond.

OEH have produced a series of 'pre-1750' predictive models termed the Aboriginal Sites Decision Support Tool (ASDST) which combines data derived from AHIMS with a series of spatial variables that describe the landscape such as elevation, geology and proximity to water. The ASDST outputs GIS raster layers composed of one hectare cells that predict the likelihood of Aboriginal sites (e.g. mounds, artefacts, modified trees, grinding grooves, burials and hearths) occurring in the landscape prior to European settlement (**Appendix 3**). These models do not account for land use disturbance in the intervening period, or local conditions leading to differential preservation of features. However, the ASDST includes an 'accumulated impacts' model that indicates impacts of post-European settlement land-use and its impact upon Aboriginal site features in the landscape (**Appendix 3**; image 7). In combination, these models are used to predict the likelihood of encountering different Aboriginal site types prior to European settlement, and how the distribution of Aboriginal sites are likely to have been affected since this time.

The images shown in **Appendix 3** show the likelihood that a particular site type could have been present in any one hectare cell. In the figure legend, a low (i.e. 1) reading represents a low likelihood of a particular site being present while a higher reading (i.e. 5) represents a higher likelihood. This ranking is for site likelihood, i.e. 'potential', and can be used on a broad scale only. While most of the models in **Appendix 3** show that portions of the Project Site may once have had potential to contain certain Aboriginal sites, **Appendix 3**: image 7; shows a high degree of accumulated impact indicating that many of these sites, had they actually existed in the Project Site, have been removed or disturbed.

According to the pre-1750 models:

- Stone quarries are not likely to occur within the Project Site;
- Modified (scarred) trees are modelled as the most likely site type to be located across the majority of the Project Site, particularly along the drainage lines but historical vegetation clearing for agricultural practices will have reduced this pre-1750 likelihood;
- Burial sites would have had a greater likelihood of being located to the southwest of the Project Site, within 200m of Ridgey Creek. As in the case of scarred trees, however, had this site type once existed, it has probably been impacted by historical land use practices;
- The Project Site models as an area with moderate to high potential to contain stone artefact sites and hearths. These site types have a generally consistent probability of being present across the entirety of the Project Site based on the limited landforms present;
- Grinding groove sites have a low potential of being located within the Project Site; and

- The ASDST accumulated impacts model indicates high levels of disturbance throughout the Project Site reflecting the long-term agricultural use of the area, particularly cropping.

The OzArk (2016) CWLLS predictive model is most relevant to the Project Site in determining its archaeological potential. A small portion of the Project Site includes a Drainage 2 buffer area (see **Section 5.2**), in the vicinity of a minor watercourse, Ridgey Creek, and is composed of slopes (Goonumbla Hills) and plains (Bimbi Plains) landscape units; **Figure 4-1**). The CWLLS predictive model predicts higher numbers of sites within the slopes landscapes than the plains, particularly within Drainage 2 buffers. Artefact sites (including isolated finds and artefact scatters) are the most likely site types to be encountered within the Project Site, and are more likely within the slopes landscapes that occupy most of the Project Site, although they are predicted to occur in lower numbers within the plains landscapes. The likelihood of recording scarred trees is significantly lower within the slopes/plains landscapes (**Table 5-2**).

Knowledge of the environmental contexts of the Project Site and a desktop review of the known local and regional archaeological record, the following predictions are made concerning the probability of those site types being recorded within the Project Site:

- <u>Isolated finds</u> may be indicative of: random loss or deliberate discard of a single artefact, the remnant of a now dispersed and disturbed artefact scatter, or an otherwise obscured or sub-surface artefact scatter. They may occur anywhere within the landscape but are more likely to occur in topographies where open artefact scatters typically occur.
    - As isolated finds can occur anywhere, particularly within disturbed contexts, it is predicted that this site type could be recorded within the Project Site. Previous surveys on similar landforms nearby the Project Site (NGH 2016 and Access Archaeology 2016) recorded high numbers of isolated finds.
- <u>Open artefact scatters</u> are defined as two or more artefacts, not located within a rock shelter, and located no more than 50m away from any other constituent artefact. This site type may occur almost anywhere that Aboriginal people have travelled and may be associated with hunting and gathering activities, short or long term camps, and the manufacture and maintenance of stone tools. Artefact scatters typically consist of surface scatters or sub-surface distributions of flaked stone discarded during the manufacture of tools, but may also include other artefactual rock types such as hearth and anvil stones. Less commonly, artefact scatters may include archaeological stratigraphic features such as hearths and artefact concentrations which relate to activity areas. Artefact density can vary considerably between and across individual sites. Small ground exposures revealing low density scatters may be indicative of background scatter rather than a spatially or temporally distinct artefact assemblage. These sites are classed as 'open', that is, occurring on the land surface unprotected by rock overhangs, and are sometimes referred to as 'open camp sites'.

  Artefact scatters are most likely to occur on level or low gradient contexts, along the crests of ridgelines and spurs, and elevated areas fringing watercourses or wetlands. Larger sites may be expected in association with permanent water sources.

Topographies which afford effective through-access across, and relative to, the surrounding landscape, such as the open basal valley slopes and the valleys of creeks, will tend to contain more and larger sites, mostly camp sites evidenced by open artefact scatters.

  - Artefact scatters, as well as isolated stone artefacts, are the predominant site types occurring in the region. The expected location of artefact scatters is on eroded exposures most commonly adjacent to drainage lines along flat and lower slope landforms. This site type is likely to be in a secondary context from disturbances such as erosion and ploughing. It is likely that any sites associated with such landforms are likely to have a low artefact density and a low complexity of tool types as the sites are either one-off events or only infrequently used due to the lack of a permanent or semi-permanent water source and the undifferentiated landforms present, similar to the results of NGH 2016 and Access Archaeology 2016. Artefacts are most likely to be manufactured from a variety of materials including sandstone, silcrete, volcanic and fine-grained siliceous materials

- <u>Aboriginal scarred trees</u> contain evidence of the removal of bark (and sometimes wood) in the past by Aboriginal people, in the form of a scar. Bark was removed from trees for a wide range of reasons. It was a raw material used in the manufacture of various tools, vessels and commodities such as string, water containers, roofing for shelters, shields and canoes. Bark was also removed as a consequence of gathering food, such as collecting wood boring grubs or creating footholds to climb a tree for possum hunting or bark removal. Due to the multiplicity of uses and the continuous process of occlusion (or healing) following removal, it is difficult to accurately determine the intended purpose for any particular example of bark removal. Scarred trees may occur anywhere old growth trees survive. The identification of scars as Aboriginal cultural heritage items can be problematical because some forms of natural trauma and European bark extraction create similar scars. Many remaining scarred trees probably date to the historic period when bark was removed by Aboriginal people for both their own purposes and for roofing on early European houses. Consequently the distinction between European and Aboriginal scarred trees may not be clear.

  - Vegetation within the Project Site includes remnant native species, particularly box species. These stands of native vegetation include trees of a type, age and size well suited to scar-producing activities. This site type therefore may be encountered and it is also noted that this site type has been recorded locally although high levels of vegetation clearing reduce the likelihood of recording this site type. While the likelihood of recording this site type increases with proximity to water, Kelton (1996) found that modified trees can be found within all landforms.

- <u>Hearths/ovens</u> are often used by Aboriginal people for the preparation of food and would generally be located in the vicinity of available resources, such as water sources to procure fish and shellfish, and on elevated ground to avoid impact from environmental threats.

  - This site type is considered possible in areas where A-Horizon soils are relatively undisturbed. However, given the high levels of disturbance across the Project Site, the likelihood of identifying this site type is significantly reduced.

- Quarry sites and stone procurement sites typically consist of exposures of stone material where evidence for human collection, extraction and/or preliminary processing has survived. Typically, these involve the extraction of siliceous or fine grained igneous and meta-sedimentary rock types for the manufacture of artefacts. The presence of quarry/extraction sites is dependent on the availability of suitable rock formations.
  - This site type is not considered likely to be recorded within the Project Site. One quarry site, #43-3-0129, is located to the southeast of the Project Site, however it should be noted that the site is located on a hill crest with outcropping basalt, and no such landform similar to this are located within the Project Site.
- Burials are generally found in soft sediments such as aeolian sand, alluvial silts and rock shelter deposits. In valley floor and plains contexts, burials may occur in locally elevated topographies rather than poorly drained sedimentary contexts. Burials are also known to have occurred on rocky hilltops in some limited areas. Burials are generally only visible where there has been some disturbance of sub-surface sediments or where some erosional process has exposed them.
  - Generally found in elevated sandy contexts or in association with rivers and major creeks. No such features exist with the Project Site and therefore burials are unlikely to occur.

6 RESULTS OF ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

6.1 SAMPLING STRATEGY AND FIELD METHODS

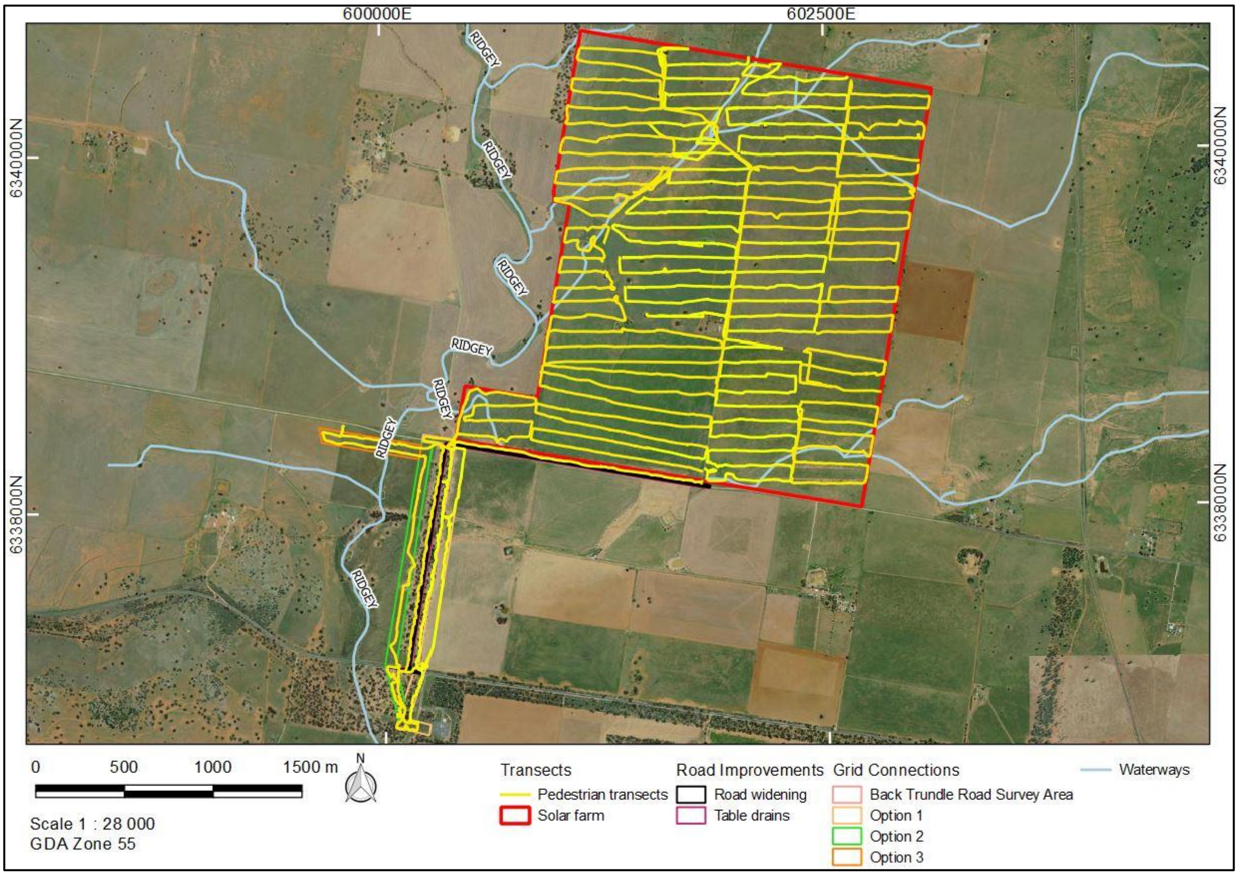
The archaeological methods utilised in the Aboriginal archaeological assessment followed the *Code of Practice* and the proposed methodology (**Appendix 1**). Standard archaeological field survey and recording methods were employed in this survey (Burke & Smith 2004). The entirety of the Project Site was assessed by pedestrian transects. Greater survey effort was expended on landforms deemed to have greater Aboriginal archaeological potential. Areas of greater archaeological potential were largely confined to the areas within 200m of water, particularly Ridgey Creek.

Representatives of the RAPs assisted the archaeologists by placing flags at artefacts and/or alerting the archaeologists that an artefact had been found. A located site was then more closely examined and all artefacts observed on the surface were flagged. For newly recorded sites, all artefacts and features were located with a GPS (global positioning system).

Sites were recorded with digital photography and by GPS units and were described on field recording sheets. General notes pertaining to the survey and ground covered by the archaeologists were kept as well. Representative photos of the Project Site are provided in **Plates 1–10**.

Figure 6-1 illustrates pedestrian coverage of the Project Site. It should be noted that the figure only displays transects of two surveyors although the Project Site was assessed by up to four surveyors each day.

Figure 6-1. The Project Site showing pedestrian transects.



6.2 EFFECTIVE SURVEY COVERAGE

Two of the key factors influencing the effectiveness of archaeological survey are GSV and ground surface exposure (GSE). These factors are quantified in order to ensure that the survey data provides adequate evidence for the evaluation of the archaeological materials across the landscape. For the purposes of the current assessment, these terms are used in accordance with the definitions provided in the *Code of Practice* (DECCW 2010).

GSV is defined as:

> *… the amount of bare ground (or visibility) on the exposures which might reveal artefacts or other archaeological materials. It is important to note that visibility, on its own, is not a reliable indicator of the detectability of buried archaeological material. Things like vegetation, plant or leaf litter, loose sand, stone ground or introduced materials will affect the visibility. Put another way, visibility refers to 'what conceals'* (DECCW 2010: 39).

GSE is defined as:

> *… different to visibility because it estimates the area with a likelihood of revealing buried artefacts or deposits rather than just being an observation of the amount of bare ground. It is the percentage of land for which erosion and exposure was sufficient to reveal*

archaeological evidence on the surface of the ground. Put another way, exposure refers to 'what reveals' (DECCW 2010: 37).

These factors are quantified in order to ensure that the survey data provides adequate evidence for the evaluation of the archaeological materials across the Project Site. For the purposes of the current assessment, these terms are used in accordance with the definitions provided in the Code of Practice (DECCW 2010).

Tables 6-1 and **6-2** present the effective survey coverage within the Project Site in more detail.

The effective survey coverage over the Project Site was very high across the single landform present (**Figure 6-2**). The consistency of the high levels of GSE and GSV were largely afforded by ploughing across approximately 95 per cent of the Project Site. Additional contributors to the high levels of exposure were provided by contouring of drainage lines, farm tracks, animal burrows, ant mounds and erosion. GSV was slighter lower within remnant tree lines due to thick leaf matter and grasses, however the decreased GSV in these areas did not diminish the ability to assess the archaeological potential of the surrounding landform.

Table 6-1: Survey coverage data.

Survey Unit	Landform	Survey Unit Area (sq m)	Visibility %	Exposure %	Effective Coverage Area (sq m) (= Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)
1	Plain	486 000	80	70	272 160	56%

Table 6-2: Landform summary-sampled areas.

Landform	Landform area (sq m)	Area Effectively Surveyed (sq m) (= Effective Coverage Area)	% of Landform Effectively Surveyed (= Area Effectively Surveyed / Landform x 100)	Number of Sites
Plain	486 000	272 160	56%	25

Figure 6-2: Sample view of GSV within the Project Site.

1. View of an exposure within a ploughed paddock containing very high GSV.

2. View of an exposure adjacent to a drainage line also containing very high GSV.

6.3 ABORIGINAL SITES RECORDED

27 Aboriginal sites were identified during the survey (**Figures 6-2** and **6-11**). All sites were artefact sites; either artefact scatters (n=4) or isolated finds (n=23). Further details including the GPS locations, site features and landform have been recorded for each site (**Table 6-3**). The AHIMS ID for each site will be updated once the sites have been approved by AHIMS.

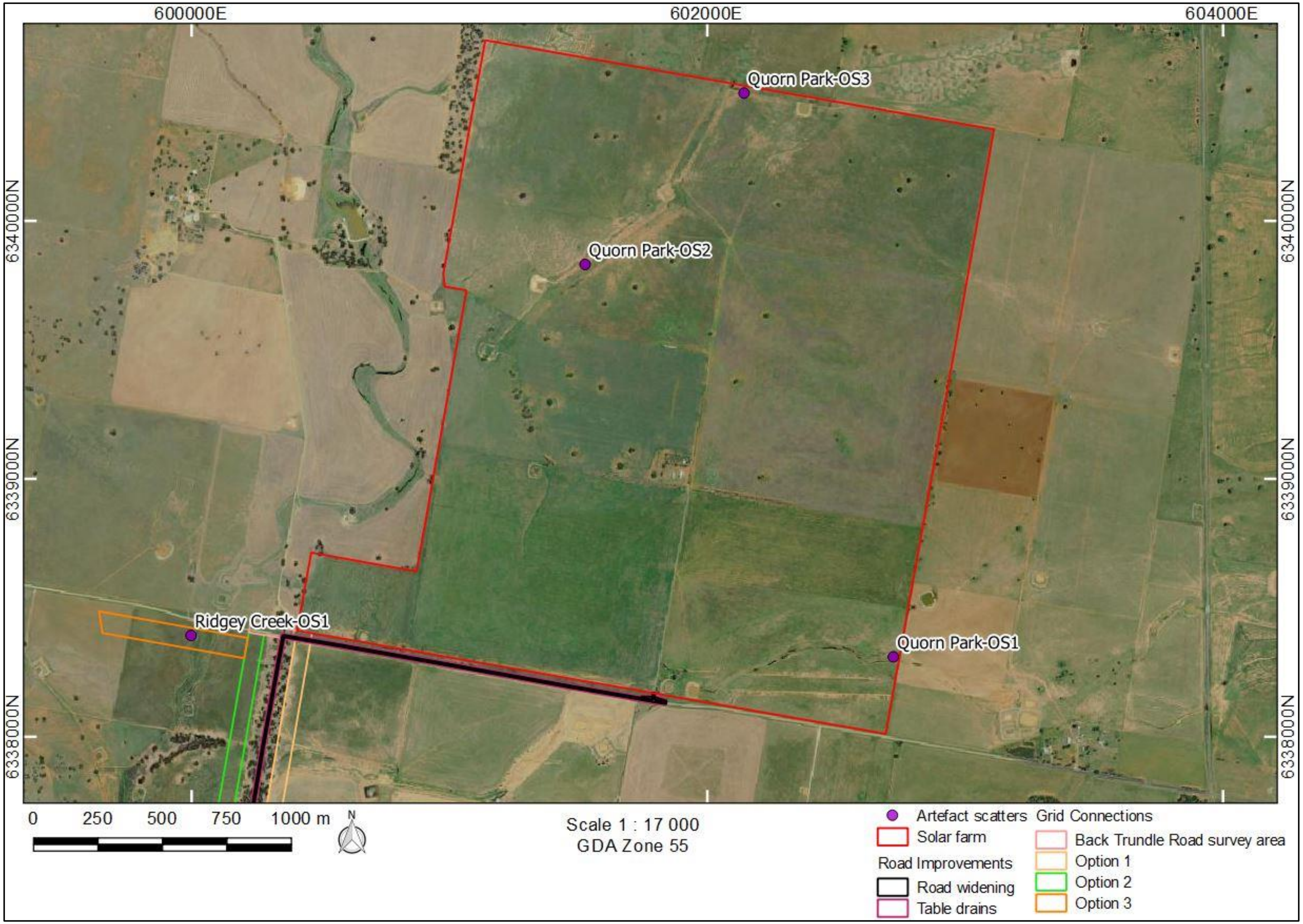
Table 6-3: Survey results.

AHIMS ID	Site Name	Coordinates (GDA Zone 55)	Feature(s)	Landform
Artefact scatters				
43-3-0169	Quorn Park-OS1	602722E, 6338310N	4 artefacts, 54m x 21m	Plain
43-3-0168	Quorn Park-OS2	601525E, 6339832N	9 artefacts, 109m x 23m	Plain
43-3-0167	Quorn Park-OS3	602142E, 6340496N	3 artefacts, 50m x 12m	Plain
43-3-0153	Ridgey Creek-OS1	599997E, 6338393N	5 artefacts, 51m x 16m	Plain
Isolated finds				
43-3-0147	Quorn Park-IF1	601485E, 6338355N	Isolated Find	Plain
43-3-0150	Quorn Park-IF2	601952E, 6338667N	Isolated Find	Plain
43-3-0148	Quorn Park-IF3	602788E, 6338553N	Isolated Find	Plain
43-3-0151	Quorn Park-IF4	602328E, 6338910N	Isolated Find	Plain
43-3-0146	Quorn Park-IF5	601937E, 6339336N	Isolated Find	Plain
43-3-0149	Quorn Park-IF6	601602E, 6339348N	Isolated Find	Plain
43-3-0152	Quorn Park-IF7	601532E, 6339338N	Isolated Find	Plain
43-3-0154	Quorn Park-IF8	601902E, 6339498N	Isolated Find	Plain
43-3-0155	Quorn Park-IF9	601804E, 6339756N	Isolated Find	Plain
43-3-0156	Quorn Park-IF10	602014E, 6339833N	Isolated Find	Plain
43-3-0157	Quorn Park-IF11	602474E, 6339728N	Isolated Find	Plain
43-3-0158	Quorn Park-IF12	602225E, 6340163N	Isolated Find	Plain
43-3-0159	Quorn Park-IF13	602302E, 6340255N	Isolated Find	Plain
43-3-0160	Quorn Park-IF14	602418E, 6340259N	Isolated Find	Plain
43-3-0161	Quorn Park-IF15	602628E, 6340390N	Isolated Find	Plain
43-3-0162	Quorn Park-IF16	602831E, 6340317N	Isolated Find	Plain
43-3-0163	Quorn Park-IF17	603029E, 6340167N	Isolated Find	Plain
43-3-0164	Quorn Park-IF18	603029E, 6340167N	Isolated Find	Plain
43-3-0165	Quorn Park-IF19	602278E, 6340428N	Isolated Find	Plain
43-3-0166	Quorn Park-IF20	602241E, 6340474N	Isolated Find	Plain
43-3-0144	Ridgey Creek-IF1	599898E, 6338425N	Isolated Find	Plain
43-3-0145	Warrawee-IF1	600200E, 6338127N	Isolated Find	Plain
43-3-0143	Ponderosa-IF1	600200E, 6338127N	Isolated Find	Plain

6.3.1 Artefact scatters

Four artefact scatters were recorded during the survey (**Figure 6-3**). Details on each site follow.

Figure 6-3: Aerial showing the location of newly recorded artefact scatters.



Quorn Park-OS1

Site type: Artefact scatter

GPS coordinates: GDA Zone 55 602722E 6338310N

Location of site: Approximately 1.2km west of the Parkes Narromine Railway Line and 280m north of Back Trundle Road, Parkes, on the banks of a highly ephemeral creek (**Figure 6-3**). The site is located approximately 2m east of the property's eastern boundary line on a ploughed field (**Figure 6-4**).

Description of site: Quorn Park-OS1 is a low-density artefact scatter comprising three flakes and a core manufactured from quartz, silcrete and volcanic materials (**Table 6-4**; **Figure 6-5**). These artefacts are located within a generally flat landform on the banks of a highly ephemeral creek line. The 54 x 21m extent of the site was defined by the area of exposed surface containing artefacts. Surrounding vegetation consisted of sparse grass cover due to historical land clearing for farming. The GSE at the time of recording was high (70%) with a GSV of 80% within these exposures. A number of quartz fragments were identified within the area of exposure; however, none contained artefactual characteristics excluding the single quartz flake recorded. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-OS1 was assessed as negligible given the high levels of disturbance and the undifferentiated landform.

Figure 6-4: Aerial showing the location and extent of Quorn Park-OS1.

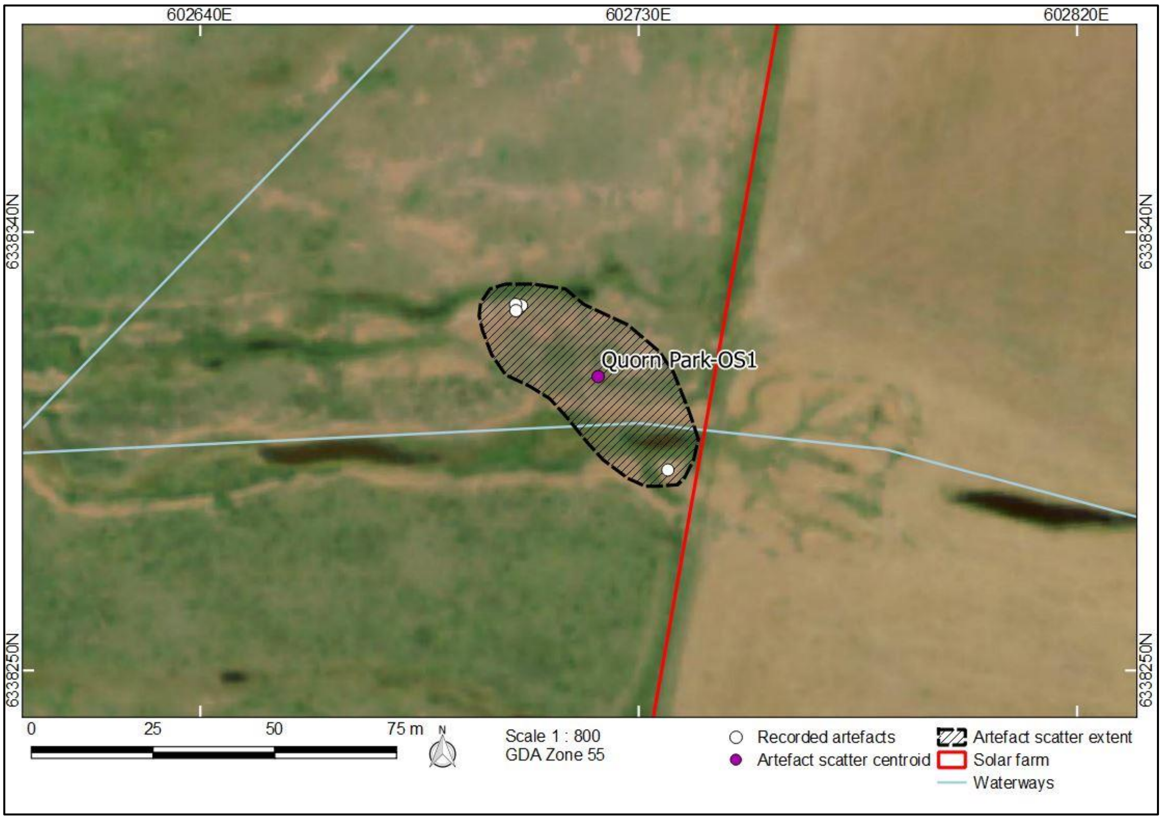


Figure 6-5: Photographs showing an overview and details of Quorn Park-OS1.

1. View east to Quorn Park-OS1 northern site extent.

2. View northeast of the southern section of Quorn Park-OS1.

3. View of Quorn Park-OS1 artefacts: silcrete core (left); quartz flake (centre) and silcrete flake (right).

4. View of Quorn Park-OS1 volcanic flake.

Table 6-4: Quorn Park-OS1. Artefact attributes.

Artefact Type	Material	Integrity	Reduction	Size	Additional detail
Flake	Quartz	Complete	Tertiary	2-4cm	
Flake	Silcrete	Complete	Secondary	2-4cm	
Core	Silcrete	N/A	Secondary	2-4cm	Multidirectional, reduced core with 6 flake scars
Flake	Volcanics	Complete	Tertiary	4-6cm	

Quorn Park-OS2

Site type: Artefact scatter

GPS coordinates: GDA Zone 55 601525E 6339832N

Location of site: Approximately 770m east of Ridgey Creek and 1.5km north of Back Trundle Road, Parkes, on the contour bank of a filled-in drainage line (**Figure 6-3**). The site is located approximately 130m northeast of a property dam within the ploughed field (**Figure 6-6**).

__Description of site__: Quorn Park-OS2 is a low-density artefact scatter comprising eight flakes and a flaked piece manufactured from basalt, silcrete, quartzite, and chert (**Table 6-5**; **Figure 6-7**). These artefacts are located within a flat landform on the surface of a contour bank along a previous drainage line. The 109 x 23m extent of the site was defined by the area of exposed surface containing artefacts. Surrounding vegetation consisted of sparse grass cover due to historical land clearing for farming. The GSE at the time of recording was high (80%) with a GSV of 90% within these exposures. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-OS2 was assessed as negligible as the artefacts are located in a secondary context.

Figure 6-6: Aerial showing the location and extent of Quorn Park-OS2.

Figure 6-7: Photographs showing an overview and details of Quorn Park-OS2.

1. Overview of Quorn Park-OS2.

2. Overview of Quorn Park-OS2.

3. View of Quorn Park-OS2 artefacts: volcanic flakes.

4. View of Quorn Park-OS2 artefacts: quartzite flake (left); silcrete flake (second from left); chert flake (second from right) and basalt flake (right).

5. View of Quorn Park-OS2 artefacts: silcrete flake (left) and basalt flake (right).

Table 6-5: Quorn Park OS2. Artefact attributes.

Artefact Type	Material	Integrity	Reduction	Size
Flake	Basalt	Complete	Secondary	0-2cm
Flake	Basalt	Complete	Tertiary	2-4cm
Flake	Basalt	Longitudinal Break	Secondary	0-2cm
Flake	Silcrete	Proximal Fragment	Tertiary	0-2cm
Flake	Basalt	Distal Fragment	Secondary	2-4cm
Flake	Silcrete	Complete	Secondary	4-6cm
Flake	Quartzite	Complete	Secondary	2-4cm
Flake	Chert	Distal Fragment	Secondary	0-2cm
Flaked Piece	Basalt	Complete	Secondary	2-4cm

Quorn Park-OS3

Site type: Artefact scatter

GPS coordinates: GDA Zone 55 602142E 6340496N

Location of site: Approximately 1.7km west of the Parkes Narromine Railway Line and 2.4km north of Back Trundle Road, Parkes, on the banks of a highly ephemeral creek (**Figure 6-3**). The site is located approximately 20m south of the property's northern boundary line along a contour bank within the ploughed field (**Figure 6-8**).

Description of site: Quorn Park-OS3 is a low-density artefact scatter comprising a silcrete core, a silcrete flaked piece and a basalt flaked piece (**Table 6-6**; **Figure 6-9**). These artefacts are located within a gently undulating plain landform along the southern edge of a contour bank. The 50 x 12m extent of the site was defined by the area of exposed surface containing artefacts. Surrounding vegetation consisted of sparse grass cover due to historical land clearing for farming. The GSE at the time of recording was high (90%) with a GSV of 80% within these exposures. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park OS3 was assessed as negligible as the artefacts are located in a secondary context.

Figure 6-8: Aerial showing the location and extent of Quorn Park-OS3.

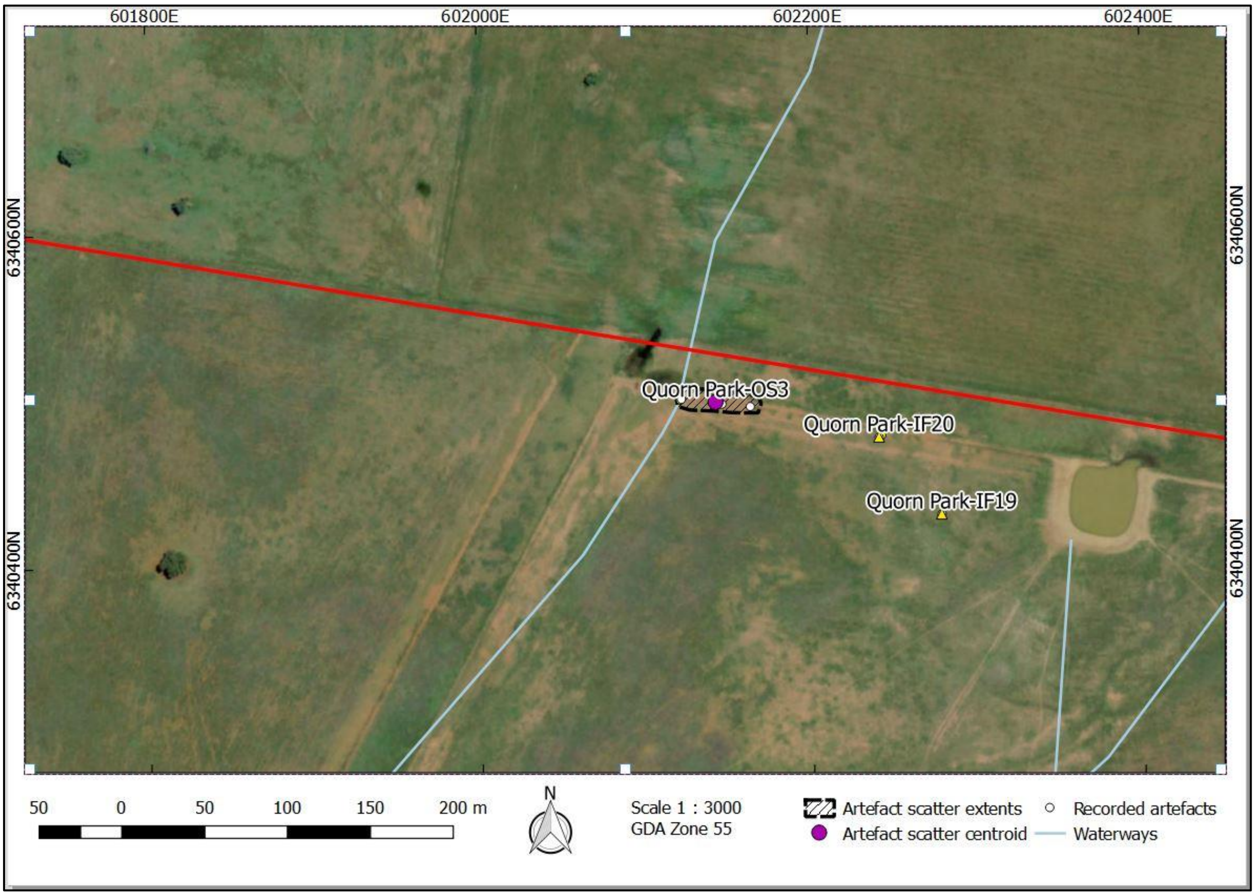


Figure 6-9: Photographs showing an overview and details of Quorn Park-OS3.

	
1. Overview of Quorn Park-OS3 facing west.	2. Overview of Quorn Park-OS3 facing east.

3. View of Quorn Park-OS3: a volcanic core.

4. View of Quorn Park-OS3: a silcrete flake.

5. View of Quorn Park-OS3: a silcrete flake.

Table 6-6: Quorn Park OS3. Artefact attributes.

Artefact Type	Material	Integrity	Reduction	Size
Core	Basalt	Complete	Tertiary	2-4cm
Flake	Silcrete	Proximal Fragment	Secondary	4-6cm
Flake	Silcrete	Distal Fragment	Secondary	2-4cm

Ridgey Creek-OS1

Site type: Artefact scatter

GPS coordinates: GDA Zone 55 599997E 6338393N

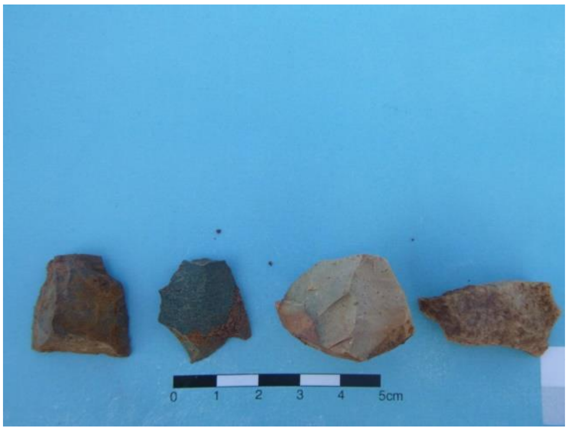
Location of site: Approximately 335m west of McGrath Lane and 28m south of Back Trundle Road, Parkes (**Figure 6-3**). The site is located approximately 20m west of Ridgey Creek (**Figure 6-10**).

Description of site: Ridgey Creek-OS1 is a low-density artefact scatter comprising four flakes and a core with raw materials including basalt, silcrete and quartzite (**Table 6-7; Figure 6-11**). These artefacts are located within a gently undulating plain landform to the west of Ridgey Creek within the ploughed field. The 51 x 16m extent of the site was defined by the area of recognisable artefacts. The GSE at the time of recording was extremely high (100%) with a GSV of 95%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Ridgey Creek-OS1 was assessed as negligible as the artefacts have been displaced by ploughing.

Figure 6-10: Aerial showing the location and extent of Ridgey Creek-OS1.

Figure 6-11: Photographs showing an overview and details of Ridgey Creek-OS1.

	
1. Overview of Ridgey Creek-OS1 facing east towards Ridgey Creek.	2. Overview of Ridgey Creek-OS1 facing south.



3. View of Ridgey Creek-OS1 artefacts: basalt flakes (left and second from left); silcrete core (second from right); and quartzite flake (right).

4. View of Ridgey Creek-OS1 basalt flake.

Table 6-7: Ridgey Creek OS1. Artefact attributes.

Artefact Type	Material	Integrity	Reduction	Size
Flake	Basalt	Proximal Fragment	Tertiary	0-2cm
Flake	Basalt	Complete	Tertiary	0-2cm
Core	Silcrete	N/A	Tertiary	10+cm
Flake	Quartzite	Distal Fragment	Tertiary	2-4cm
Flake	Basalt	Complete	Secondary	6-8cm

6.3.2 Isolated finds

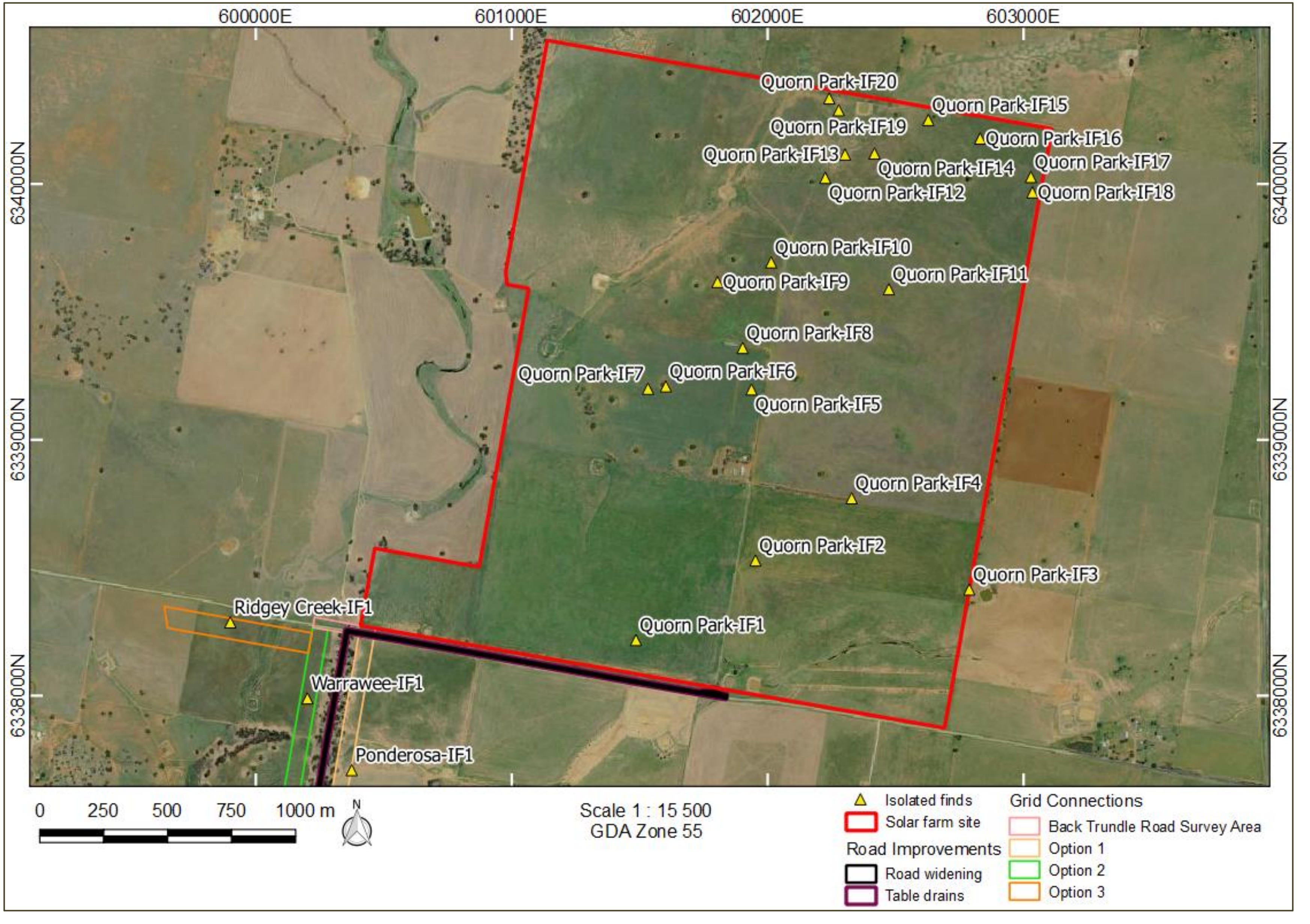
23 isolated finds were recorded during the survey. These are listed in **Table 6-8** and shown on **Figure 6-12**.

Table 6-8: Recorded isolated finds artefact attributes and coordinates.

Site name	GDA Zone 55 Easting	GDA Zone 55 Northing	Artefact type	Material	Size	Additional detail
Quorn Park-IF1	601485	6338355	Flake	Silcrete	2-4cm	Complete; cortex absent
Quorn Park-IF2	601952	6338667	Flake	Quartzite	2-4cm	Longitudinal break; cortex absent
Quorn Park-IF3	602788	6338553	Flake	Silcrete	2-4cm	Longitudinal break; cortex absent
Quorn Park-IF4	602328	6338910	Flake	Coarse-grained mudstone	2-4cm	Complete; cortex absent
Quorn Park-IF5	601937	6339336	Flake	Coarse-grained mudstone	4-6cm	Complete; cortex <50%
Quorn Park-IF6	601602	6339348	Flaked piece	Volcanic	4-6cm	Cortex platform
Quorn Park-IF7	601532	6339338	Core	Coarse-grained mudstone	4-6cm	Unidirectional; 2 scars; 51-75% cortex
Quorn Park-IF8	601902	6339498	Flake	Basalt	6-8cm	Complete; cortex absent

Site name	GDA Zone 55 Easting	GDA Zone 55 Northing	Artefact type	Material	Size	Additional detail
Quorn Park-IF9	601804	6339756	Flake	Coarse-grained mudstone	6-8cm	Complete; cortex <50%
Quorn Park-IF10	602014	6339833	Flake	Quartzite	2-4cm	Complete; cortex absent
Quorn Park-IF11	602474	6339728	Flake	Silcrete	2-4cm	Complete; cortex absent
Quorn Park-IF12	602225	6340163	Flake	Silcrete	2-4cm	Longitudinal break; cortex absent
Quorn Park-IF13	602302	6340255	Flake	Silcrete	6-8cm	Complete; cortex absent
Quorn Park-IF14	602418	6340259	Flake	Silcrete	2-4cm	Proximal fragment; cortex absent
Quorn Park-IF15	602628	6340390	Core	Silcrete	2-4cm	Unidirectional; 3+ scars; ~20% cortex
Quorn Park-IF16	602831	6340317	Flaked Piece	Fine-grained siliceous	4-6cm	Cortex absent
Quorn Park-IF17	603030	6340167	Flake	Quartz	10+cm	Complete; cortex absent
Quorn Park-IF18	603035	6340107	Flake	Basalt	2-4cm	Longitudinal break; cortex <50%
Quorn Park-IF19	602278	6340428	Flake	Fine-grained siliceous	2-4cm	Proximal fragment; cortex absent
Quorn Park-IF20	602241	6340474	Core	Silcrete	2-4cm	Multidirectional; 6 scars; cortex 10%
Ridgey Creek-IF1	599898	6338425	Flake	Basalt	4-6cm	Complete; cortex <50%
Warrawee-IF1	600200	6338127	Core	Silcrete	2-4cm	Multidirectional; 9 scars; bladelet core
Ponderosa-IF1	600374	6337845	Flake	Silcrete	4-6cm	Complete; cortex absent

Figure 6-12: Aerial showing the location of newly recorded isolated finds.



Quorn Park-IF1

Site type: Isolated find

GPS coordinates: GDA Zone 55 601485E 6338355N

Location of site: Approximately 145m north of Back Trundle Road and 2.4km west of the Parkes Narromine Railway Line (**Figure 6-12**).

Description of site: Quorn Park-IF1 is a single silcrete flake located within a flat landform, in a ploughed field (**Table 6-8**; **Figure 6-13** and **6-14**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF1 was assessed as negligible.

Figure 6-13: Aerial showing location of Quorn Park-IF1 and Quorn Park-IF2.

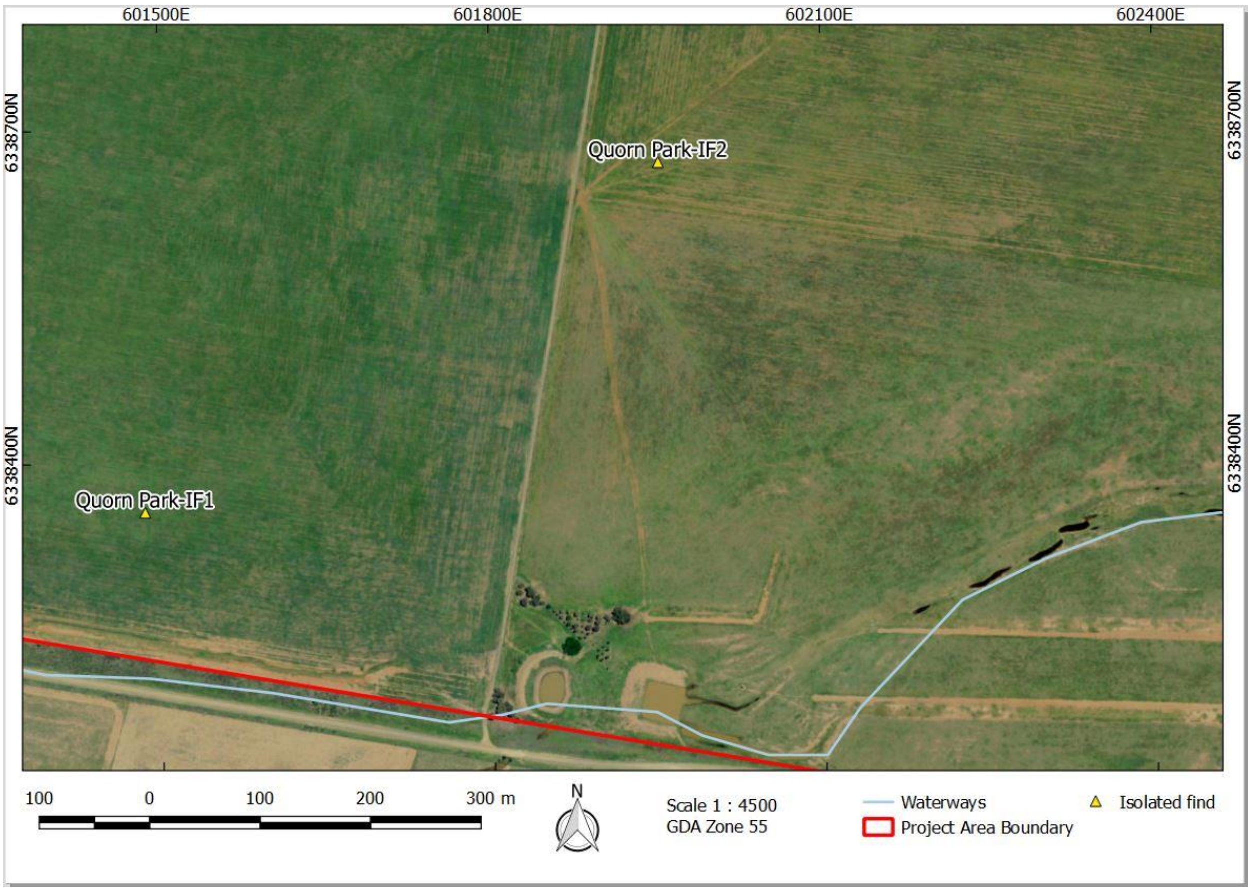


Figure 6-14: Photographs showing an overview and details of Quorn Park-IF1.

1. Overview of Quorn Park-IF1 facing southeast.

2. View of Quorn Park-IF1: a silcrete flake.

Quorn Park-IF2

Site type: Isolated find

GPS coordinates: GDA Zone 55 601952E 6338667N

Location of site: Approximately 530m north of Back Trundle Road; 1.9km west of the Parkes Narromine Railway Line and 73m east of the property's central dirt track (**Figure 6-12**).

Description of site: Quorn Park-IF2 is a single quartzite flake located within a generally flat landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-13** and **6-15**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (60%) with a GSV of 70%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF2 was assessed as negligible.

Figure 6-15: Photographs showing an overview and details of QP IF2.

1. Overview of Quorn Park-IF2 facing west.

2. View of Quorn Park-IF2: a quartzite flake.

Quorn Park-IF3

Site type: Isolated find

GPS coordinates: GDA Zone 55 602788E 6338553N

Location of site: Approximately 560m north of Back Trundle Road; 1.1km west of the Parkes Narromine Railway Line and 30m west of a dam (**Figure 6-12**). The site is located along the eastern fence line of Lot 508 DP750152 (**Figure 6-16**).

Description of site: Quorn Park-IF3 is a single silcrete flake located within a generally flat landform, on the edge of a heavily ploughed field (**Table 6-8**; **Figure 6-17**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (95-100%) with a GSV of 95-100% within this exposure. Identified disturbances include continued ploughing and cultivation as well as disturbances related to construction of the fence line. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF3 was assessed as negligible.

Figure 6-16: Aerial showing location of Quorn Park-IF3.

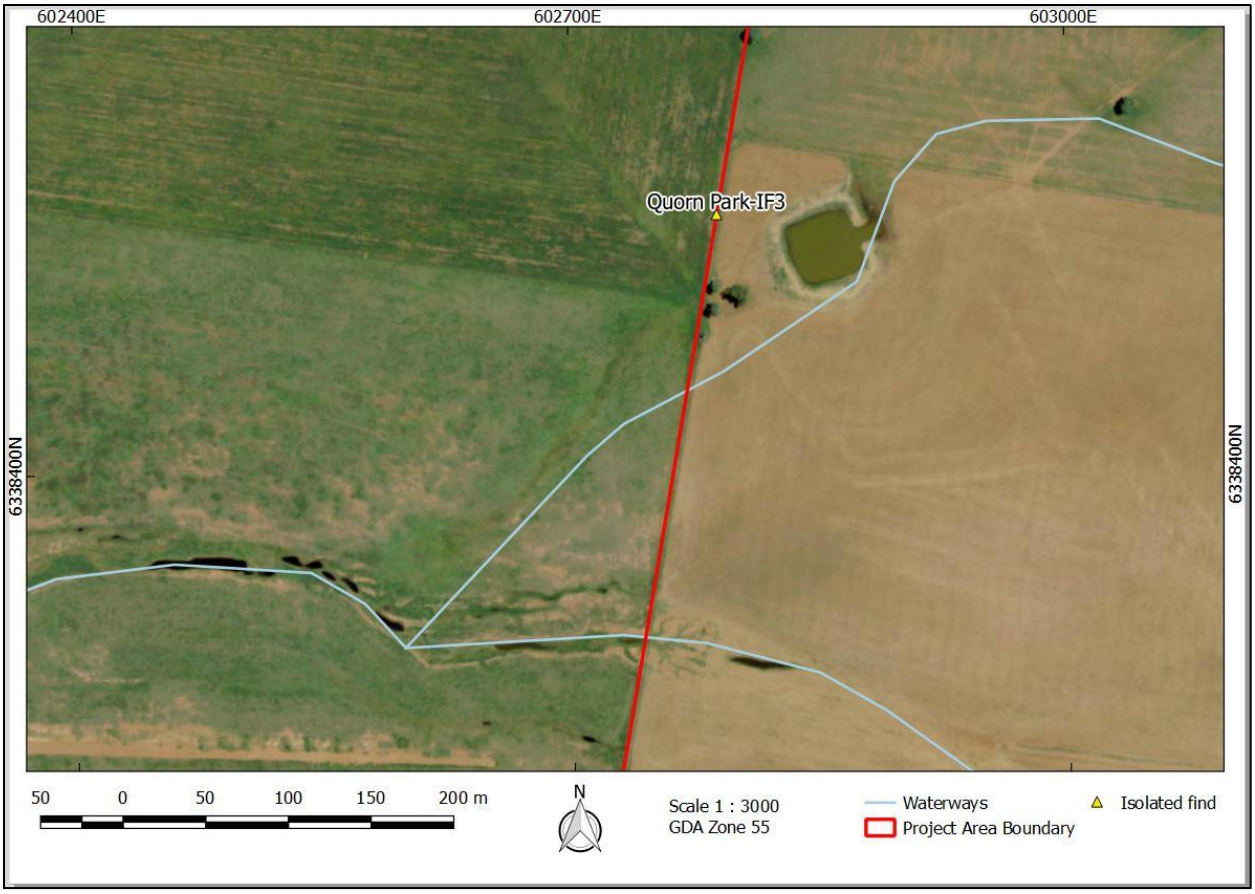


Figure 6-17: Photographs showing an overview and details of Quorn Park-IF3.

	
1. Overview of Quorn Park-IF3 facing north.	2. View of Quorn Park-IF3: a silcrete flake.

Quorn Park-IF4

Site type: Isolated find

GPS coordinates: GDA Zone 55 602328E 6338910N

Location of site: Approximately 825m north of Back Trundle Road; 500m west of the eastern boundary of Lot 508 DP750152; and 402m east of the property's central access (**Figure 6-12**). The site is located on an ant mound at the edge of a stand of regrowth trees (**Figure 6-18**).

Description of site: Quorn Park-IF4 is a single coarse-grained mudstone flake located within a generally flat landform, on an exposure at the edge of a heavily ploughed field, next to a row of regrowth trees (**Table 6-8**; **Figure 6-19**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with an isolated stand of young regrowth trees directly to the west of the site. The GSE at the time of recording was high (95-100%) with a GSV of 95-100% within this exposure. Identified disturbances include continued ploughing and cultivation as well as disturbances related to construction of the fence-line along the area of regrowth trees. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF4 was assessed as negligible.

Figure 6-18: Aerial showing location of Quorn Park-IF4.

Figure 6-19: Photographs showing an overview and details of Quorn Park-IF4.

	
1. Overview of Quorn Park-IF4 facing west.	2. View of Quorn Park-IF4: a coarse-grained mudstone flake.

Quorn Park-IF5

Site type: Isolated find

GPS coordinates: GDA Zone 55 601937E 6339336N

Location of site: Approximately 970m west of the eastern boundary of Lot 508 DP750152; 1.2km north of Back Trundle Road and 48m west of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation (**Figure 6-20**).

Description of site: Quorn Park-IF5 is a single coarse-grained mudstone flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-21**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF5 was assessed as negligible.

Figure 6-20: Aerial showing location of Quorn Park-IF5 and Quorn Park-IF6.

Figure 6-21: Photographs showing an overview and details of Quorn Park-IF5.

<table>
<tr><td></td><td></td></tr>
<tr><td>1. Overview of Quorn Park-IF5 facing northwest.</td><td>2. View of Quorn Park-IF5: a coarse-grained mudstone flake.</td></tr>
</table>

Quorn Park-IF6

Site type: Isolated find

GPS coordinates: GDA Zone 55 601602E 6339348N

Location of site: Approximately 1.3km west of the eastern boundary of Lot 508 DP750152; 1.1km north of Back Trundle Road and 385m west of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation (**Figure 6-20**).

Description of site: Quorn Park-IF6 is a single volcanic flaked piece located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-22**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with one large isolated tree approximately 12m to the northwest of the site. The GSE at the time of recording was high (80%) with a GSV of 90%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF6 was assessed as negligible.

Figure 6-22: Photographs showing an overview and details of Quorn Park-IF6.

	
1. Overview of Quorn Park-IF6 facing west.	2. View of Quorn Park-IF6 artefact: a volcanic flaked piece.

Quorn Park-IF7

Site type: Isolated find

GPS coordinates: GDA Zone 55 601532E 6339338N

Location of site: Approximately 1.1km north of Back Trundle Road and 535m east of the western boundary of Lot 508 DP750152 (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 60m southwest of a large isolated tree (**Figure 6-23**).

Description of site: Quorn Park-IF7 is a single unidirectional core manufactured from a coarse-grained mudstone located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8; Figure 6-24**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with one large isolated tree approximately 60m to the northeast of the site. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park IF7 was assessed as negligible.

Figure 6-23: Aerial showing location of Quorn Park-IF7.

Figure 6-24: Photographs showing an overview and details of Quorn Park-IF7.

	
1. Overview of Quorn Park-IF7 facing west.	2. View of Quorn Park-IF7: a coarse-grained mudstone core.

Quorn Park-IF8

Site type: Isolated find

GPS coordinates: GDA Zone 55 601902E 6339498N

Location of site: Approximately 870m east of the western boundary of Lot 508 DP750152; 1.3km north of Back Trundle Road and 109m west of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 20m southeast of a small stand of regrowth trees (**Figure 6-25**).

Description of site: Quorn Park-IF8 is a single basalt flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-26**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with a small bank of young regrowth trees nearby. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF8 was assessed as negligible.

Figure 6-25: Aerial showing location of Quorn Park-IF8, IF9 and IF10.

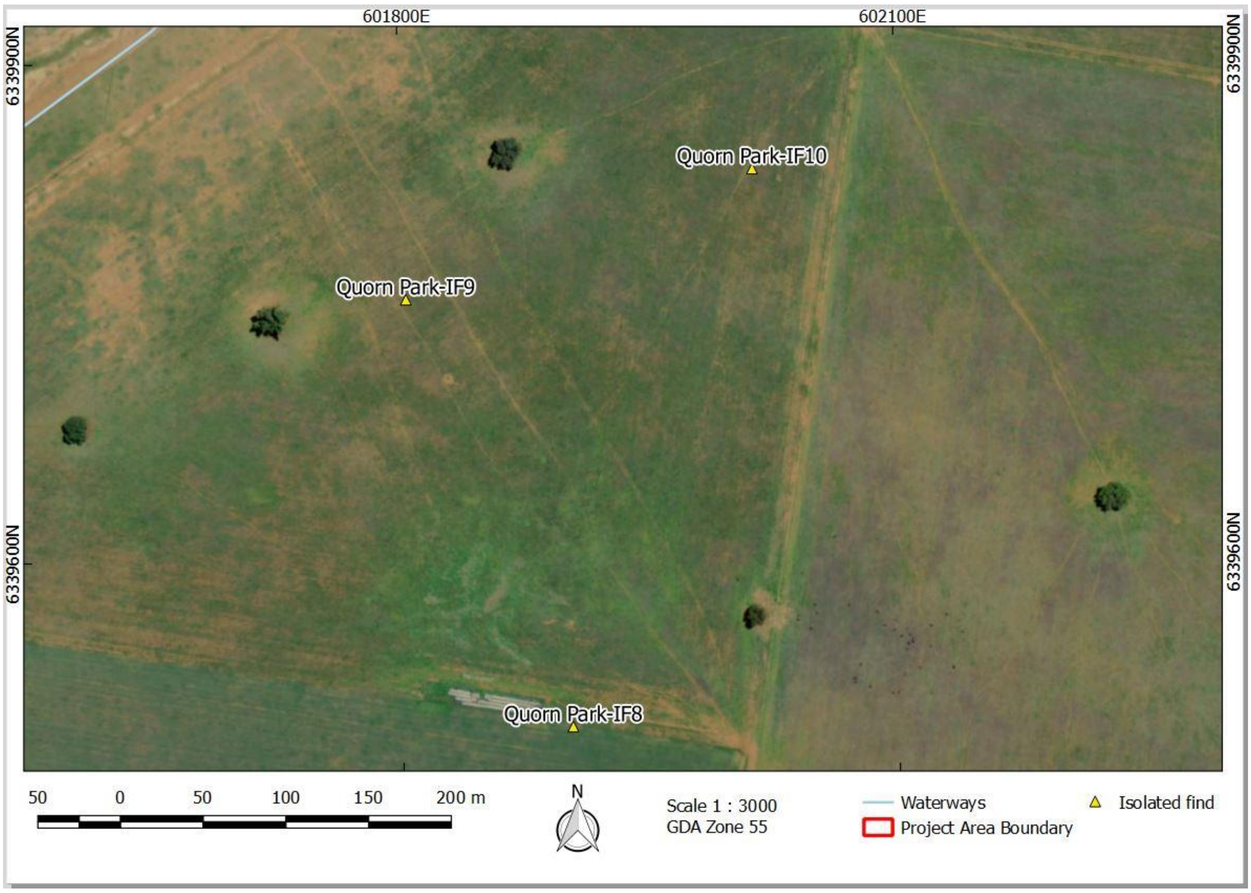


Figure 6-26: Photographs showing an overview and details of Quorn Park-IF8.

	
1. Overview of Quorn Park-IF8 facing west.	2. View of Quorn Park-IF8 basalt flake.

Quorn Park-IF9

Site type: Isolated find

GPS coordinates: GDA Zone 55 601804E 6339756N

Location of site: Approximately 830m east of the western boundary of Lot 508 DP750152, and 1.5km north of Back Trundle Road and 240m west of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 82m east of a large isolated box tree (**Figure 6-25**).

Description of site: Quorn Park-IF9 is a single coarse-grained mudstone flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-27**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with a few isolated large trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF9 was assessed as negligible.

Figure 6-27: Photographs showing an overview and details of Quorn Park-IF9.

	
1. Overview of Quorn Park-IF9 facing west.	2. View of Quorn Park-IF9: a coarse-grained mudstone flake.

Quorn Park-IF10

Site type: Isolated find

GPS coordinates: GDA Zone 55 602014E 6339833N

Location of site: Approximately 710m south of the northern boundary of Lot 508 DP750152; 1.6km south of Back Trundle Road and 45m west of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 145m east of a large isolated tree (**Figure 6-25**).

Description of site: Quorn Park-IF10 is a single quartzite flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-28**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with a few isolated large trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF10 was assessed as negligible.

Figure 6-28: Photographs showing an overview and details of Quorn Park-IF10.

	
1. Overview of Quorn Park-IF10 facing west.	2. View of Quorn Park-IF10: a quartzite flake.

Quorn Park-IF11

Site type: Isolated find

GPS coordinates: GDA Zone 55 602474E 6339728N

Location of site: Approximately 510m west of the eastern boundary of Lot 508 DP750152; 1.6km north of Back Trundle Road and 411m east of the property's central access track (**Figure 6-12**). The site is located within a field used for agricultural cultivation (**Figure 6-29**).

Description of site: Quorn Park-IF11 is a single silcrete flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-30**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF11 was assessed as negligible.

Figure 6-29: Aerial showing location of Quorn Park-IF11.

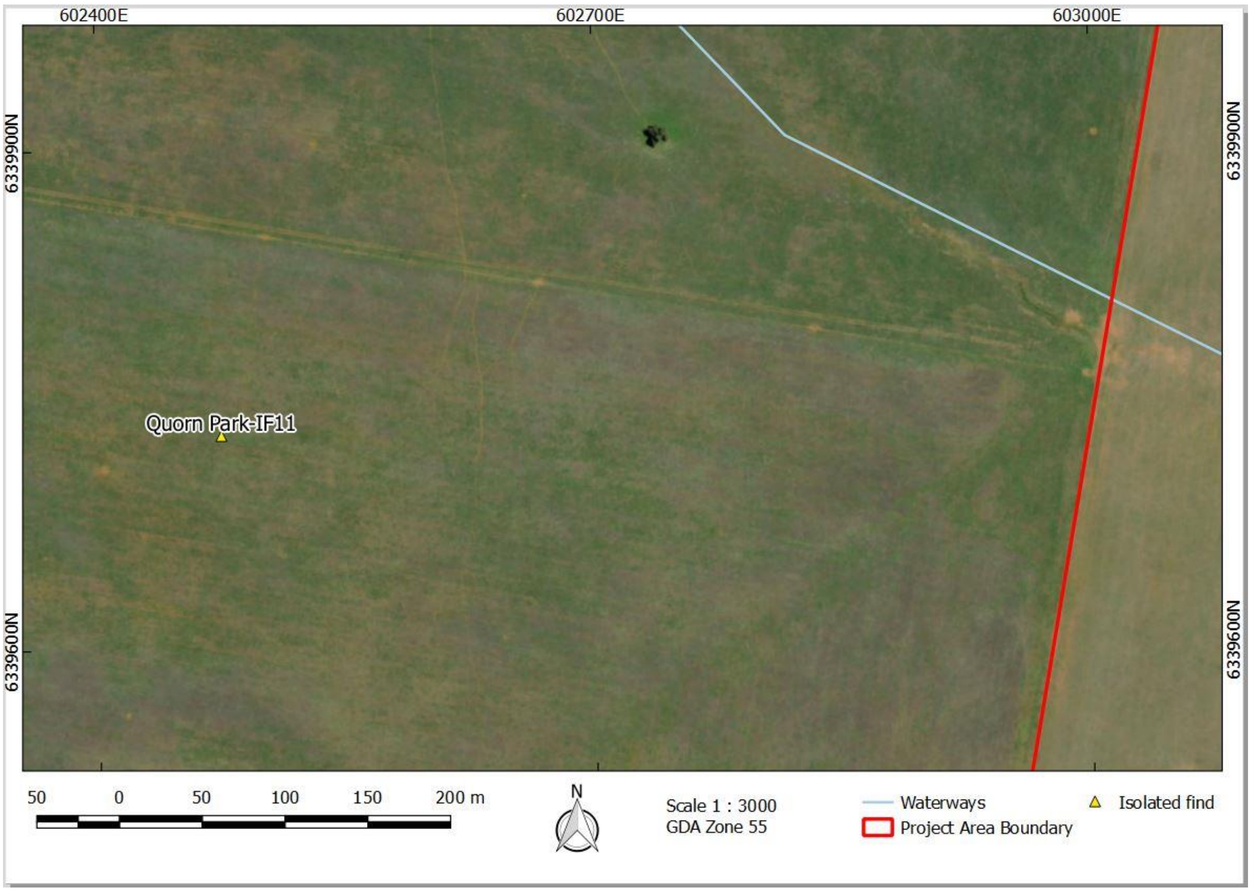


Figure 6-30: Photographs showing an overview and details of Quorn Park-IF11.

	
1. Overview of Quorn Park-IF11 facing west.	2. View of Quorn Park-IF11: a silcrete flake.

Quorn Park-IF12

Site type: Isolated find

GPS coordinates: GDA Zone 55 602225E 6340163N

Location of site: Approximately 335m south of the northern boundary of Lot 508 DP750152; 2km north of Back Trundle Road (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 43m southeast of a drainage line (**Figure 6-31**).

<u>Description of site</u>: Quorn Park-IF12 is a single silcrete flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8; Figure 6-32**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF12 was assessed as negligible.

Figure 6-31: Aerial showing location of Quorn Park-IF12, IF13 and IF14.

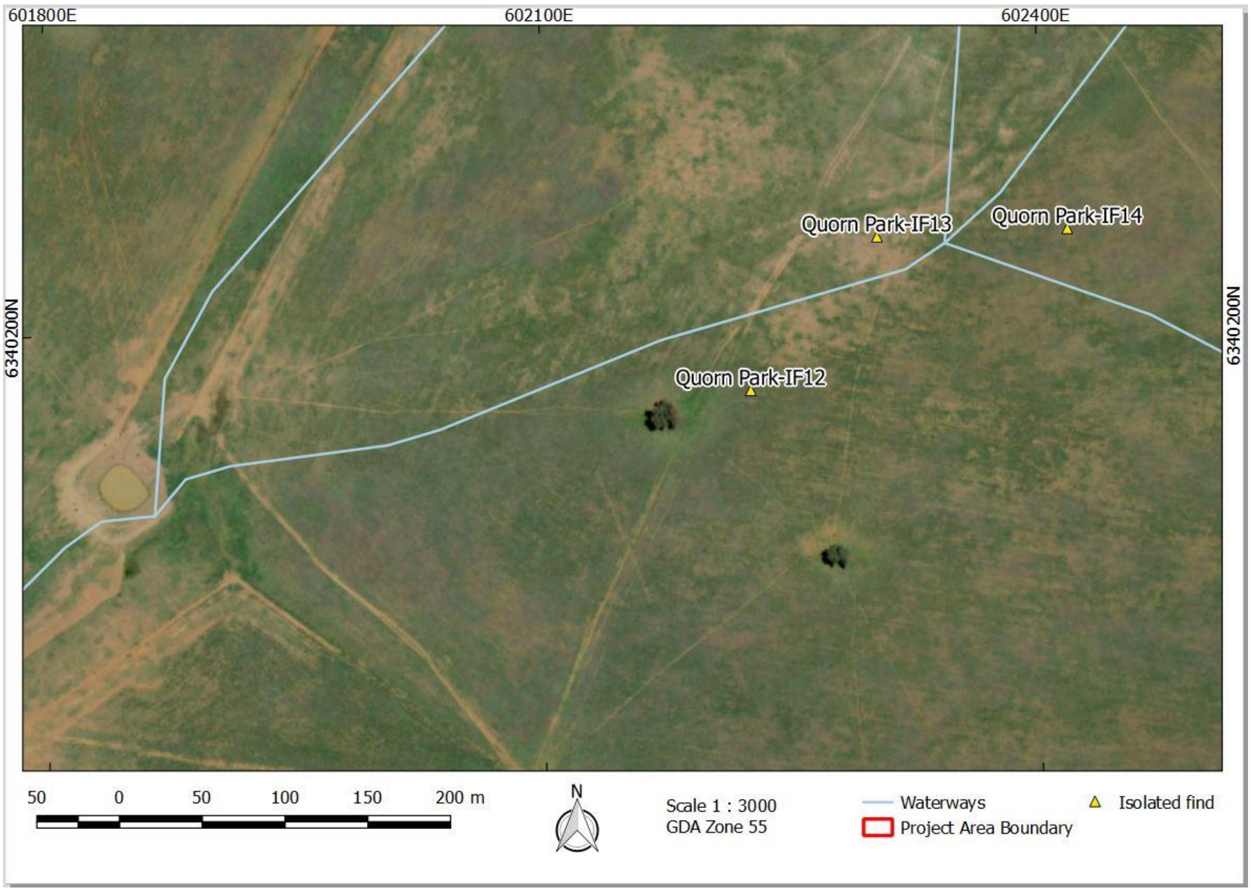


Figure 6-32: Photographs showing an overview and details of Quorn Park-IF12.

	
1. Overview of Quorn Park-IF12 facing west.	2. View of Quorn Park-IF12: a silcrete flake.

Quorn Park-IF13

Site type: Isolated find

GPS coordinates: GDA Zone 55 602302E 6340255N

Location of site: Approximately 235m south of the northern boundary of Lot 508 DP750152; 2.1km north of Back Trundle Road (**Figure 6-12**). The site is located within a field used for agricultural cultivation, approximately 23m north of a drainage line (**Figure 6-31**).

Description of site: Quorn Park-IF13 is a single silcrete flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-33**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF13 was assessed as negligible.

Figure 6-33: Photographs showing an overview and details of Quorn Park-IF13.

	
1. Overview of Quorn Park-IF13 facing west.	2. View of Quorn Park-IF13: a silcrete flake.

Quorn Park-IF14

Site type: Isolated find

GPS coordinates: GDA Zone 55 602418E 6340259N

Location of site: Approximately 210m south of the northern boundary of Lot 508 DP750152; and 2.1km north of Back Trundle Road (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 70m east of the confluence of two drainage lines (**Figure 6-31**).

Description of site: Quorn Park-IF14 is a single silcrete flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-34**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF14 was assessed as negligible.

Figure 6-34: Photographs showing an overview and details of Quorn Park-IF14.

1. Overview of Quorn Park-IF14 facing west.

2. View of Quorn Park-IF14: a silcrete flake.

Quorn Park-IF15

Site type: Isolated find

GPS coordinates: GDA Zone 55 602628E 6340390N

Location of site: Approximately 45m south of the northern boundary of Lot 508 DP750152; 2.3km north of Back Trundle Road and 240m east of the most northern property dam (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 193m east of a drainage line (**Figure 6-35**).

Description of site: Quorn Park-IF15 is a single silcrete unidirectional core located within a generally flat landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-36**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF15 was assessed as negligible.

Figure 6-35: Aerial showing location of Quorn Park-IF15, IF16, IF17 and IF18.

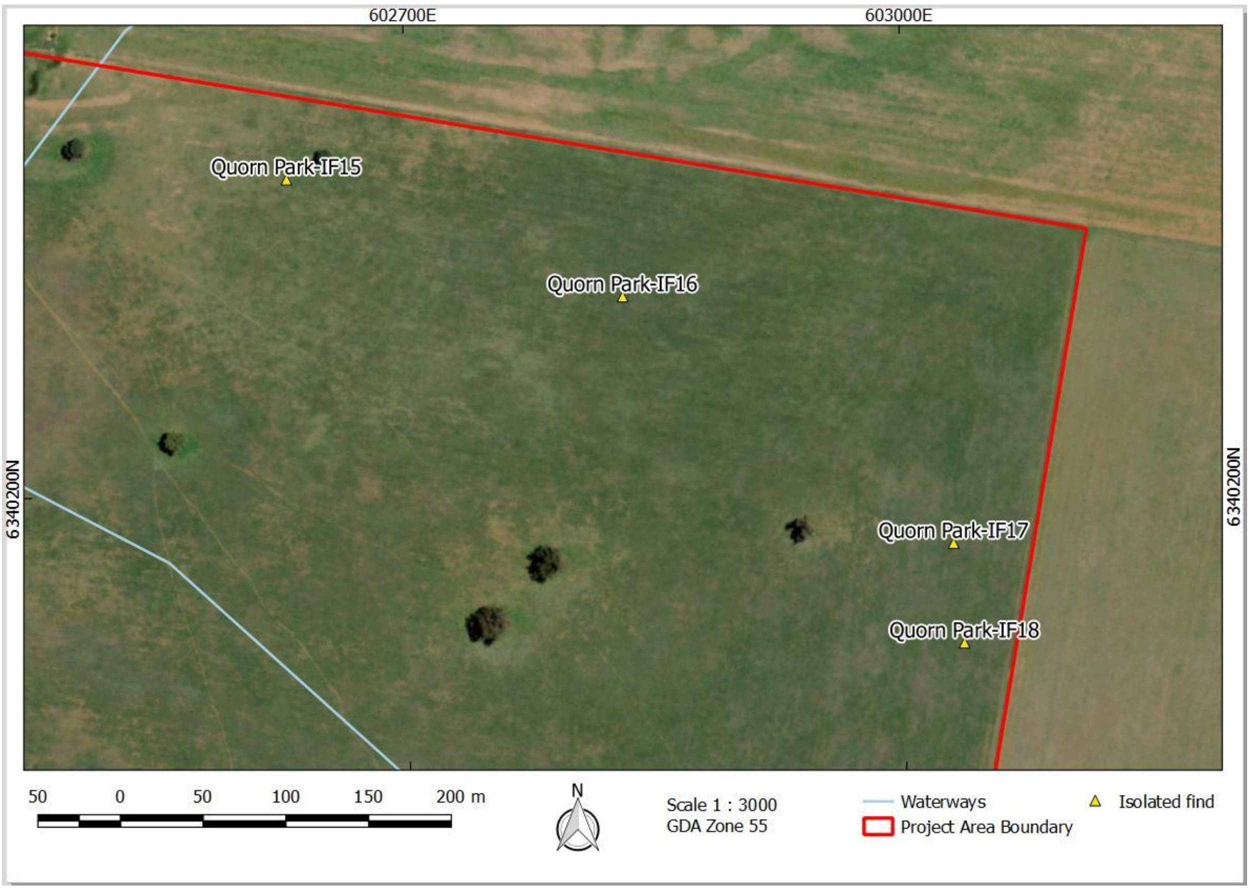


Figure 6-36: Photographs showing an overview and details of Quorn Park-IF15.

	
1. Overview of Quorn Park-IF15 facing west.	2. View of Quorn Park-IF15: a silcrete core.

Quorn Park-IF16

Site type: Isolated find

GPS coordinates: GDA Zone 55 602831E 6340317N

Location of site: Approximately 85m south of the northern boundary of Lot 508 DP750152; 2.2km north of Back Trundle Road and 430m east of the most northern property dam (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 300m northeast of a drainage line (**Figure 6-35**).

Description of site: Quorn Park-IF16 is a single fine-grained siliceous flaked piece located within a flat landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-37**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF16 was assessed as negligible.

Figure 6-37: Photographs showing an overview and details of Quorn Park-IF16.

	
1. Overview of Quorn Park-IF16 facing south.	2. View of Quorn Park-IF16 fine-grained siliceous flaked piece.

Quorn Park-IF17

Site type: Isolated find

GPS coordinates: GDA Zone 55 603030E 6340167N

Location of site: Approximately 45m west of the eastern boundary of Lot 508 DP750152; 2.1km north of Back Trundle Road and 890m west of the Parkes Narromine Railway Line (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 350m northeast of a drainage line (**Figure 6-35**).

Description of site: Quorn Park-IF17 is a single quartz flake located within a flat landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-38**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF17 was assessed as negligible.

Figure 6-38: Photographs showing an overview and details of Quorn Park-IF17.

	
1. Overview of Quorn Park-IF17 facing west.	2. View of Quorn Park-IF17 quartz flake.

Quorn Park-IF18

Site type: Isolated find

GPS coordinates: GDA Zone 55 603035E 6340107N

Location of site: Approximately 25m west of the eastern boundary of Lot 508 DP750152; 2km north of Back Trundle Road and 885m west of the Parkes Narromine Railway Line (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 350m northeast of a drainage line (**Figure 6-35**).

Description of site: Quorn Park-IF18 is a single basalt flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8; Figure 6-39**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation with some large isolated trees. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF18 was assessed as negligible.

Figure 6-39: Photographs showing an overview and details of Quorn Park-IF18.

	
1. Overview of Quorn Park-IF18 facing west.	2. View of Quorn Park-IF18: a basalt flake.

Quorn Park-IF19

Site type: Isolated find

GPS coordinates: GDA Zone 55 602278E 6340428N

Location of site: Approximately 70m south of the northern boundary of Lot 508 DP750152; 2.3km north of Back Trundle Road and 1.6km west of the Parkes Narromine Railway Line (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 75m west of the most northern property dam (**Figure 6-40**).

Description of site: Quorn Park-IF19 is a single fine-grained siliceous flake located within a flat landform, in a heavily ploughed field (**Table 6-8; Figure 6-41**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (80%) with a GSV of 85%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF19 was assessed as negligible.

Figure 6-40: Aerial showing location of Quorn Park-IF19 and IF20.

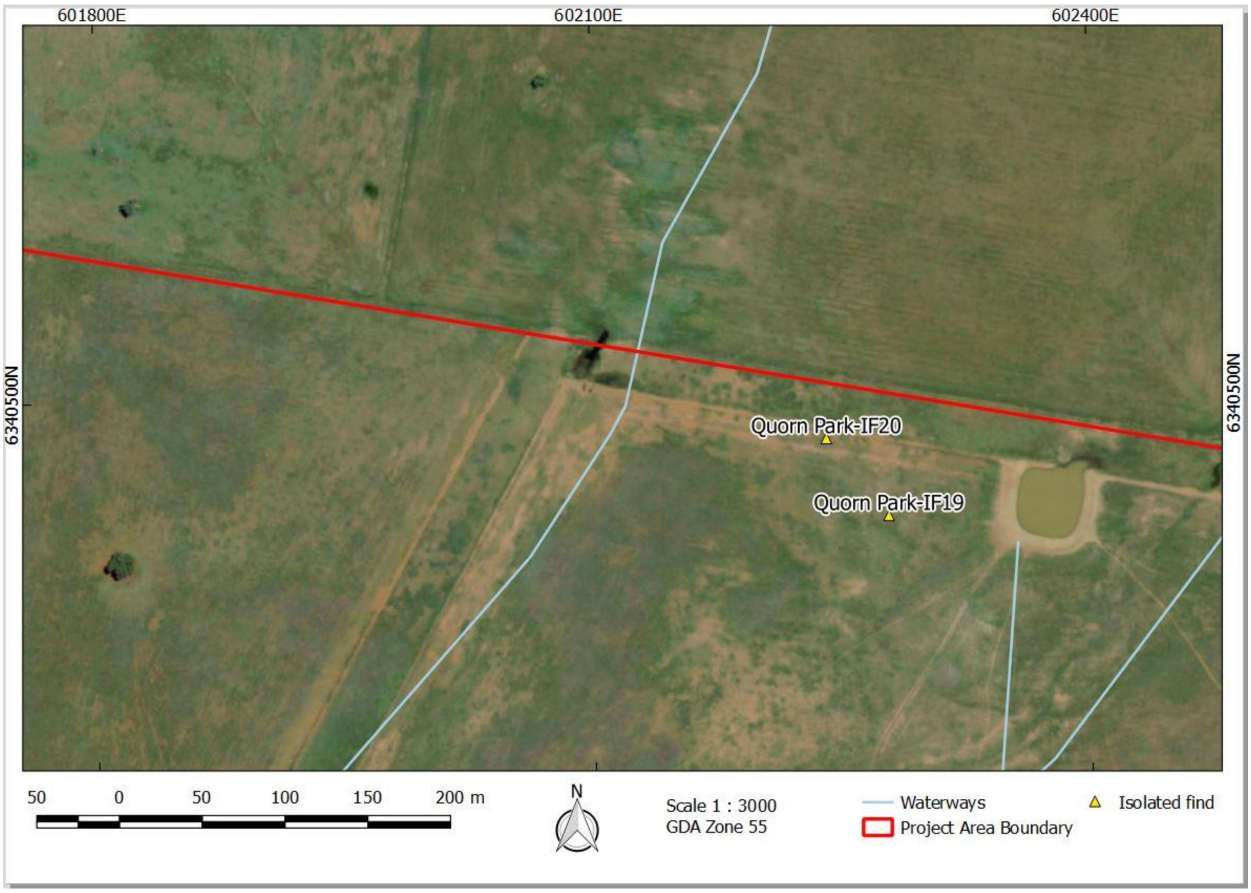


Figure 6-41: Photographs showing an overview and details of Quorn Park-IF19.

	
1. Overview of Quorn Park-IF19 facing west.	2. View of Quorn Park-IF19: a fine-grained siliceous flake.

Quorn Park-IF20

Site type: Isolated find

GPS coordinates: GDA Zone 55 602241E 6340474N

Location of site: Approximately 30m south of the northern boundary of Lot 508 DP750152; 2.35km north of Back Trundle Road and 1.62km west of the Parkes Narromine

Railway Line (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 115m west of the most northern property dam (**Figure 6-40**).

Description of site: Quorn Park-IF20 is a single silcrete, multidirectional core located within a flat landform, in a heavily ploughed field, immediately south of a contour bank (**Table 6-8**; **Figure 6-42**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (80%) with a GSV of 85%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Quorn Park-IF20 was assessed as negligible.

Figure 6-42: Photographs showing an overview and details of Quorn Park-IF20.

	
1. Overview of Quorn Park-IF20 facing west.	2. View of Quorn Park-IF20: a silcrete core.

Ridgey Creek-IF1

Site type: Isolated find

GPS coordinates: GDA Zone 55 599898E 6338425N

Location of site: Within Lot 1 DP1090411; approximately 60m south of Back Trundle Road; 145m west of Ridgey Creek; and 450m of McGrath Lane (**Figure 6-11**). The site is located within a field used for agricultural cultivation (**Figure 6-43**).

Description of site: Ridgey Creek-IF1 is a single basalt flake located within a gently undulating plain landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-44**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Ridgey Creek-IF1 was assessed as negligible.

Figure 6-43: Aerial showing location of Ridgey Creek-IF1.

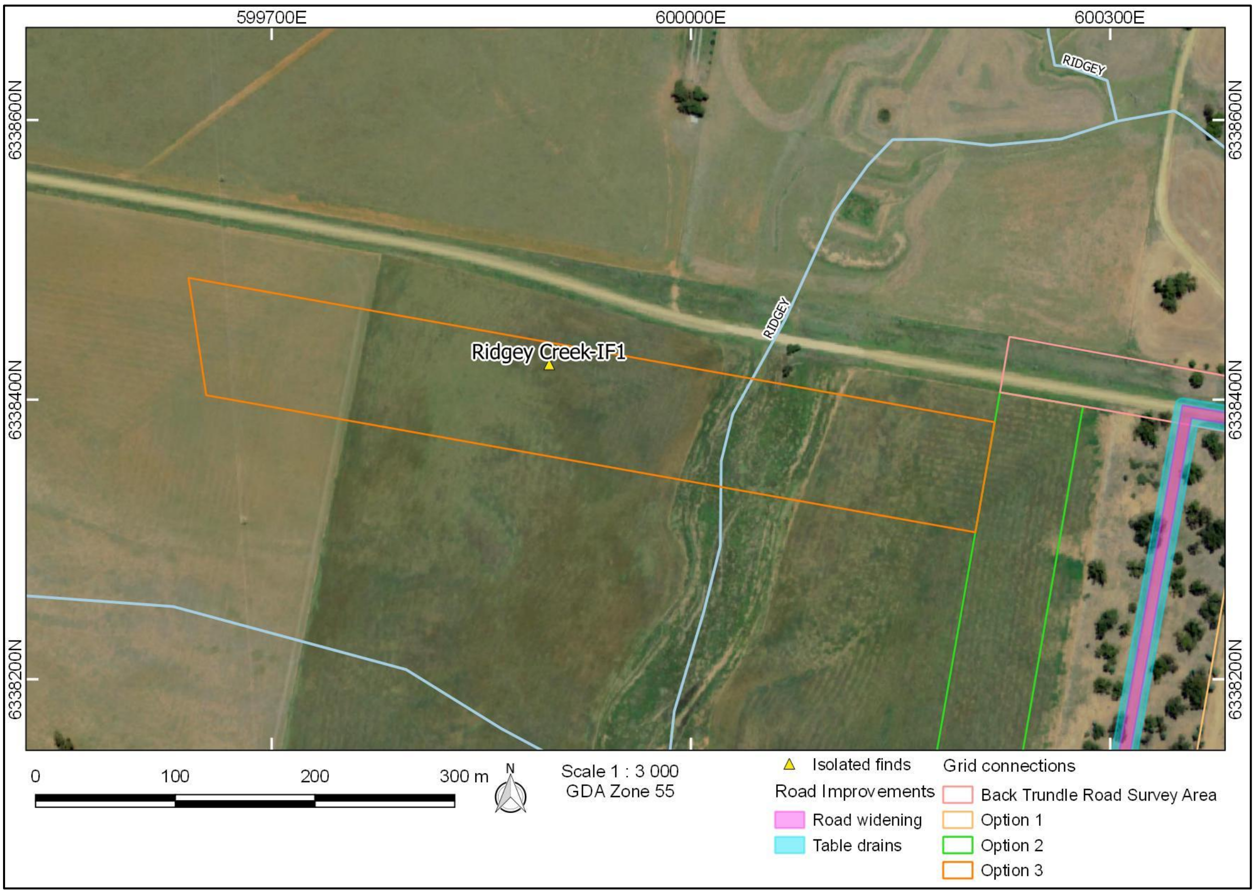


Figure 6-44: Photographs showing an overview and details of Ridgey Creek-IF1.

	
1. Overview of Ridgey Creek-IF1 facing west towards Ridgey Creek.	2. View of Ridgey Creek-IF1: a basalt flake.

Warrawee-IF1

Site type: Isolated find

GPS coordinates: GDA Zone 55 600200E 6338127N

Location of site: Within Lot 8 DP750152, approximately 290m south of Back Trundle Rd and 105m west of McGrath Lane (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 210m east of Ridgey Creek (**Figure 6-45**).

Description of site: Warrawee-IF1 is a single silcrete, multidirectional core located within a flat landform, in a heavily ploughed field (**Table 6-8**; **Figure 6-46**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with a bank of large remnant trees approximately 70m to the east. The GSE at the time of recording was high (70%) with a GSV of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Warrawee-IF1 was assessed as negligible.

Figure 6-45: Aerial showing location of Warrawee-IF1 and Ponderosa-IF1.

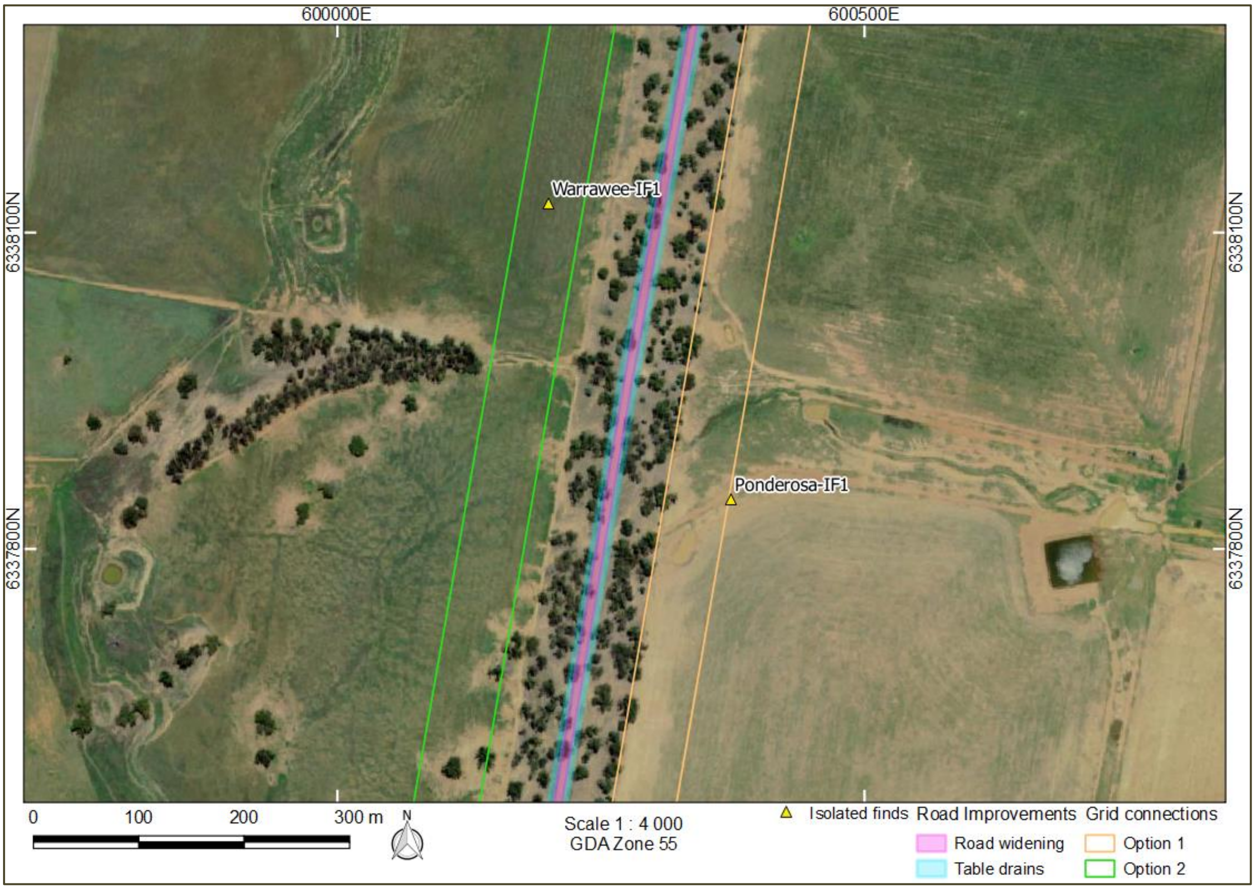


Figure 6-46: Photographs showing an overview and details of Warrawee-IF1.

	
1. Overview of Warrawee-IF1 facing east towards McGrath Lane.	2. View of Warrawee-IF1: a silcrete core.

Ponderosa-IF1

Site type: Isolated find

GPS coordinates: GDA Zone 55 600374E 6337845N

Location of site: Within Lot 504 DP750152, approximately 540m south of Back Trundle Road and 110m east of McGrath Lane (**Figure 6-11**). The site is located within a field used for agricultural cultivation, approximately 60m east of the remnant woodland lining the eastern side of McGrath Lane, and 40m northeast of a small property dam (**Figure 6-45**).

Description of site: Ponderosa-IF1 is a single silcrete flake located within a gently undulating plain landform, in a heavily ploughed field on a large sediment exposure (**Table 6-8; Figure 6-47**). Surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation, with a bank of large remnant trees approximately 60m to the west. The GSE at the time of recording was high (90-95%) with a GSV of 95-100% within this exposure. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Ponderosa-IF1 was assessed as negligible.

Figure 6-47: Photographs showing an overview and details of Ponderosa-IF1.

	
1. Overview of Ponderosa-IF1 facing west towards McGrath Lane.	2. View of Ponderosa-IF1: a silcrete flake.

6.4 ABORIGINAL COMMUNITY INPUT

Discussion was held with the representative from the PHLALC (Anthony Wilson) and Rob Clegg regarding the cultural heritage values, including the significance of the Aboriginal objects and any declared Aboriginal places that exist across the whole area that will be affected by the activity. The significance of these values for the Aboriginal people that have cultural association with the land was also discussed. During the discussion Anthony and Rob knew of no areas within the Project Site that have any known cultural significance.

6.5 DISCUSSION

The predictions based on landform modelling for the Project Site concluded that isolated finds and artefact scatters were the most likely site types to be identified. The results of the current study conform closely to the predictive model with four artefact scatters and 23 isolated finds being identified (**Section 6.3**).

The high number of isolated finds identified is unsurprising given the high levels of GSE and GSV across the Project Site that would generally otherwise obscure such artefacts. These isolated artefacts in conjunction with the low-density artefact scatters recorded highlight that the limited resources of the Project Site would likely have supported only sporadic visits in the past. As described in the regional and local archaeological contexts and the predictive model for site location, watercourses formed an important focus for traditional Aboriginal activities. The use of the Project Site on a sporadic basis is thought likely to be the result of a combination of the following factors:

- The Project Site is situated on flat terrain significantly distant from permanent water, with only ephemeral waterways in close proximity; and

- Homogeneity of the vegetation, landforms and geological resources i.e. there are no distinctive or 'special' resources as compared with much of the wider landscape.

Similar to the results of NGH (2016) and Access Archaeology (2016), none of the identified sites were recorded in association with a PAD. This determination was based on the premise that all recorded sites are located in secondary contexts having been moved either by the repeated, long-term ploughing completed across the Project Site or by the construction of contour banks. Further, the Project Site holds little potential for the existence of further undetected Aboriginal sites due to the nature of the landforms present, the distance from permanent or semi-permanent water courses and the high levels of disturbance.

The absence of scarred trees accords with the results of the 2016 study completed by OzArk (OzArk 2016). This study concluded that scarred trees are most likely to be recorded predominately within channels and floodplains landscapes as opposed to the plains landscapes (OzArk 2016). Hearths were identified through the OEH ASDST tool as having a high probability of being recorded (**Section 5.5** and **Appendix 3**), however no hearths were recorded. This result is unsurprising given the high levels of disturbance which would impact the integrity of the site thereby making them difficult to identify; and the lack of landforms adjacent to permanent or semi-permanent water courses which were occupied for extended periods of time for camping.

6.6 Representativeness, Rarity and Integrity

All values of the *Burra Charter* are considered when evaluating the significance of sites in the study area. Significance assessment of open sites is extremely variable and dependent upon several factors relating to:

- <u>Preservation</u>: Whether the site has the potential for the presence of intact, subsurface deposit, or whether disturbance (human: land surface impacts, or environmental: erosion, deflation) has reduced its integrity and thus its potential
- <u>Representativeness</u>: Is this the type of site one may expect in this landscape? (Relates back to the predictive model), i.e. do many such sites occur nearby?
- <u>Artefacts</u>: Are there artefacts present (material, types or combinations thereof) that are rare in the area or unusual for that type of site?
- <u>PADs</u>: It is impossible to determine the scientific significance of PADs that do not have visible surface artefacts, as there is no site material or soil data to assess. Consequently, test excavation is required for such areas to investigate the presence, extent, nature and integrity of any possible site material such that their significance can be assessed.

The features of representativeness, rarity and integrity of archaeological sites within the study area are discussed below.

<u>Representativeness</u>: As seen above, sites recorded during the survey such as isolated finds and low density artefact scatters are very representative of sites in the region that are located

in similar landforms. In terms of site size, artefact density, raw materials and artefact types, the results of the survey are consistent with the archaeological context highlighted in **Section 5.2** and **5.3**.

Rarity: In the past sites such as isolated finds and artefact scatters would not have been rare and on a state-wide scale, low density artefact scatters and isolated finds would remain the most common site type recorded. Although the sites recorded during this assessment are in no way remarkable, their presence alone, in albeit a heavily modified landscape, remains a memory of the past in a landscape that is fast changing (or has changed).

Integrity: The results of the survey conclude that the general site integrity is low. As noted, the Project Site has been subject to consistent ploughing in the past. All of the recorded sites were assessed to have no associated archaeological deposits and are therefore surface manifestations and possibly, on an individual artefact level, displaced. As highlighted in **Section 4.6.1**, research into the impacts upon archaeological sites as a result of agricultural practices, termed plough zone archaeology, demonstrated that artefacts can move in excess of eight metres per season of cultivation (Frink 1984; Gaynor 2001).

6.7 ASSESSMENT OF SIGNIFICANCE

6.7.1 Introduction

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Social or Cultural Value

This area of assessment concerns the importance of a site or features to the relevant cultural group: in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

Archaeological/Scientific Value

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of value relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

Aesthetic Value

This refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (Australia ICOMOS 2013).

Historic Value

Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have 'shared' historic values with other (non-Aboriginal) communities.

Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage. Consequently the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives. This means it is often necessary to collect oral histories along with archival or documentary research to gain a sufficient understanding of historic values.

6.7.2 Assessed significance of the recorded sites

Social or cultural value

The assessment of cultural or social value concerns the importance of a site or features to the relevant cultural group – in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

A copy of this ACHAR was sent to the RAPs on 9 October 2018 (**Appendix 1**). No feedback was received relating to the social or cultural value of the newly recorded sites. As such, for the purposes of assessing the potential impact to Aboriginal cultural heritage (**Section 6.9**), all recorded sites have been accorded high social and cultural values.

Archaeological/scientific value

The scientific significance of all recorded sites is assessed as low as all sites represent artefacts in secondary contexts. These sites are described as having low scientific / archaeological significance based on the following factors:

- Low density of artefacts;
- Few formal tool types;
- Widespread past and current erosion creating landform modification; and
- Not possible to determine the original or primary context of the recorded artefacts.

Aesthetic value

All recorded sites have been assessed as having low aesthetic value. None of the Aboriginal sites recorded have significant aesthetic value as the integrity of the sensory landscape has been altered in historic and modern times. Additionally, the artefacts themselves are generally not remarkable.

Historic value

None of the Aboriginal sites recorded have an apparent direct relationship to known historical Aboriginal sites (such as missions or massacre sites). It is possible that the area saw some of the earliest contact between Aboriginals and non-Aboriginal settlers, however, none of the recorded Aboriginal sites display evidence that they constitute 'contact' or 'post-contact' Aboriginal sites. To that end, all recorded sites are assessed as having no historic value.

Table 6-9 summarises the significance assessment of sites recorded during this assessment.

Table 6-9: Significance assessment.

Site name	Social or cultural value	Historic value	Aesthetic value	Archaeological / scientific value
Ponderosa-IF1	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Warrawee-IF1	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Ridgey Creek-IF1	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Ridgey Creek-OS1	High	Low	Nil	**Low**: site is sparse and is situated on a landform with disturbed soils, making the likelihood of subsurface deposits unlikely.
Quorn Park-IF1	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF2	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF3	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF4	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.

Quorn Park-IF5	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF6	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF7	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF8	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF9	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF10	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IF11	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF12	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF13	High	Low	Nil	**Low**: the artefact is not in situ and no associated archaeological deposits were identified.
Quorn Park-IF14	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IF15	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IF16	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IF17	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IFI8	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-IF19	High	Low	Nil	**Low**: No associated subsurface deposits as the site is within a cropped paddock.
Quorn Park-OS1	High	Low	Nil	**Low**: does not present any unique characteristic, material or feature which would advance archaeological research in the region.
Quorn Park-OS2	High	Low	Nil	**Low**: site is sparse and is situated on a landform with disturbed soils, making the likelihood of subsurface deposits unlikely. Nearby exposures did not contain artefacts.
Quorn Park-OS3	High	Low	Nil	**Low**: site is sparse and is situated on a landform with disturbed soils, making the likelihood of subsurface deposits unlikely.

6.8 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE PROJECT

The proposed solar farm will impact the entirety of Lot 508 DP750152 encompassing 475.7ha. All grid connections options will be utilised for the Project. The exact location of poles is not yet known, and while every effort will be made to avoid these sites, for the purpose of this assessment it will be assumed that sites associated with the grid connection options will be impacted.

As a result, all 27 Aboriginal sites are located within the impact footprint for the Project (**Table 6-10**).

Table 6-10: Impact assessment.

Site Name	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)
Warrawee-IF1	Direct	Total	Total loss of value
Ponderosa-IF1	Direct	Total	Total loss of value
Ridgey Creek-IF1	Direct	Total	Total loss of value
Ridgey Creek-OS1	Direct	Total	Total loss of value
Quorn Park-IF1	Direct	Total	Total loss of value
Quorn Park-IF2	Direct	Total	Total loss of value
Quorn Park-IF3	Direct	Total	Total loss of value
Quorn Park-IF4	Direct	Total	Total loss of value
Quorn Park-IF5	Direct	Total	Total loss of value
Quorn Park-IF6	Direct	Total	Total loss of value
Quorn Park-IF7	Direct	Total	Total loss of value
Quorn Park-IF8	Direct	Total	Total loss of value
Quorn Park-IF9	Direct	Total	Total loss of value
Quorn Park-IF10	Direct	Total	Total loss of value
Quorn Park-IF11	Direct	Total	Total loss of value
Quorn Park-IF12	Direct	Total	Total loss of value
Quorn Park-IF13	Direct	Total	Total loss of value
Quorn Park-IF14	Direct	Total	Total loss of value
Quorn Park-IF15	Direct	Total	Total loss of value
Quorn Park-IF16	Direct	Total	Total loss of value
Quorn Park-IF17	Direct	Total	Total loss of value
Quorn Park-IFI8	Direct	Total	Total loss of value
Quorn Park-IF19	Direct	Total	Total loss of value
Quorn Park-IF20	Direct	Total	Total loss of value
Quorn Park-OS1	Direct	Total	Total loss of value
Quorn Park-OS2	Direct	Total	Total loss of value
Quorn Park-OS3	Direct	Total	Total loss of value

6.8.1 Ecological sustainable development principles

Australia's *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee 1992) defines ecologically sustainable development (ESD) as:

> *…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

The management and mitigation of Aboriginal sites involves consideration of ESD principles including cumulative impacts, the precautionary principle and the principle of intergenerational equity (OEH 2011: 12–13).

With regards to cultural heritage, the most important aspect of ESD is inter-generational equity whereby the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. Similarly inter-generational equity maintains that places and items of cultural heritage value should be preserved for the education, enjoyment and use of future generations.

The Project adds to the cumulative impact on the region's Aboriginal cultural heritage as all 27 sites will be harmed. However, the heritage impact value of this loss is very low as the sites primarily consist of isolated finds or low density artefact scatters in disturbed contexts. Therefore, the loss has a negligible cumulative impact on the region's Aboriginal cultural heritage resource.

6.9 OVERALL VALUE OF POTENTIAL IMPACT ON HERITAGE ITEMS

A series of guidelines have been developed by the Department of Planning and Environment to quantify and standardise impact assessments (DP&E 2016). The rubric outlined in DP&E 2016 leads to all impacts being graded within the matrix shown in **Figure 6-48**. **Table 6-11** assesses each heritage item to arrive at a standardised 'value of impact'. In **Table 6-11** all objects have been given the highest cultural value (2), and low scientific, aesthetic and historic values (0). It is recognised that even isolated, displaced artefacts can have value to the Aboriginal community. The intention of **Table 6-11** is not to dismiss the cultural attachment the local community may have to the artefacts recorded here, but to try to quantify the overall value of the heritage impact should the project be approved in its current form. This value tries to establish the heritage impact in a regional context and so a value of 'low' should be read as meaning that the impact, at a broader level, will have a low value impact on the area's Aboriginal cultural heritage values.

Figure 6-48: Potential impact to heritage items reference matrix.

	Significance of heritage object or place				
Degree of potential impact on heritage item		Very high	High	Medium	Low
	Total impact	Very high value	High value	Medium value	Low value
	High partial impact	High value	High value	Medium value	Low value
	Medium partial impact	Medium value	Medium value	Low value	Minimal value
	Minimal partial impact	Low value	Low value	Minimal value	Minimal value

Table 6-11: Overall value of potential impact on heritage item.

	Heritage item Isolated finds	Heritage item Artefact scatters
Name or location of the heritage object or place	Quorn Park-IF1 to Quorn Park-IF20; Warrawee-IF1; Ridgey Creek-IF1 and Ponderosa-IF1	Quorn Park-OS1 to Quorn Park-OS3;Ridgey Creek-OS1
Social or cultural value	2	2
Historical	0	0
Scientific	0	0
Aesthetic	0	0
Significance of heritage item	Low importance	Low importance
Degree of impact (partial or full)	Full impact	Full impact
Overall value of potential impact on heritage item	Low value	Low value
Reasoning behind scores	General disturbance at site; Iisolated finds.	General disturbance at site; low artefact density.

As can be seen in **Table 6–11**, the proposed impact to the 27 recorded sites that will be impacted by the Project has been evaluated as having a low value. The management measures set out in **Section 7** will be required to mitigate the loss of this heritage value.

7 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

7.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the Project. **Section 6.7.2** and **Section 6-8** describe, respectively, the significance / potential of the recorded sites and the likely impacts of the Project. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- <u>Avoid impact</u> by altering the Project, or in this case, by avoiding impact to a recorded Aboriginal site. If this can be done, then a suitable curtilage (i.e. 5m) around the site must be provided to ensure its protection both during the short-term construction phase of the Project and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.
- An AHIP which is normally required for impacts to Aboriginal sites under the NPW Act is not necessary as the Project is being assessed under Part 4 Division 4.7 of the EP&A Act (SSD) and impacts to Aboriginal heritage would normally be managed under an ACHMP. Notwithstanding this, the spirit of site protection and management in the face of impacts remains the same. In place of an AHIP under the NPW Act, a Statement of Commitments (SoC) in terms of heritage management is prepared (**Section 7.4**). This SoC forms the basis for the Minister's approval which would usually contain one or more conditions, including a requirement for the preparation of an ACHMP, with which the proponent would be required to operate in accordance with.

The ACHMP should include measures for site conservation, as well as detailing methods for the management of sites to be impacted. The management will depend on many factors including the assessed significance of the sites (**Section 6.7.2**). In certain instances, a site may have low archaeological, aesthetic, and historic values but moderate or high cultural value. In these cases, management is aimed to mitigate the loss of the cultural heritage values, rather than the loss of the scientific values. Sites of low scientific significance, such as an isolated find, could, from an archaeological perspective, be removed/destroyed with no further archaeological management being required. However, given the site's cultural value, further management in respect to these sites will be recommended here. For example, due to a site's cultural values, the local Aboriginal community may wish to collect or relocate artefacts, whether temporarily or permanently, and such management will form part of the ACHMP. The ACHMP will be developed in consultation between the proponent, RAPs, OEH and DP&E.

7.2 MANAGEMENT AND MITIGATION OF RECORDED ABORIGINAL SITES

As a result of the current assessment, 27 sites have been newly recorded within or adjacent to the impact footprint of the Project. Of these 27 sites, all sites will be directly impacted by the Project and the remaining one site will be avoided. However, as the Project design advances and the location of the poles within the grid connections is defined, some sites may be able to be avoided.

It is recommended that these sites be salvaged through the recording and collection of surface artefacts. This recommendation is made due to:

- The cultural value of these sites and their importance to the Aboriginal community;
- The nature of the potentially impacted sites (all are isolated finds or a low density artefact scatters consisting of less than 10 artefacts per site);
- Being generally located in landforms of lower archaeological potential (i.e. in areas distant to reliable water);
- Being generally located in landforms with high previous disturbance from a range of factors including erosion and land use practices;
- The low archaeological values assigned to the sites preclude more intensive archaeological investigations; and
- Sites such as these have a very limited ability to further inform the community about the history and culture of the area. While any potential research questions are limited, some information can nevertheless be gained.

Table 7-1 sets out the recommended archaeological management of all sites within or adjacent to the impact footprint of the Project.

Table 7-1: Management recommendations for sites within or adjacent to the impact footprint of the Project.

Site name	Assessed scientific significance	Degree of harm	Management strategy
Warrawee-IF1	Low	Total	Site is located within the Option 2 grid connection. If Option 3 grid connection is used, every effort should be made to avoid this site. If this is possible, a five-metre buffer should be demarcated around GDA Zone 55 600200E 6338127N during the construction of the electricity line. The demarcation should be clearly visible, and the location of the site should be known to all people working in the area. If avoidance is not possible, description and collection of surface artefacts as per **Section 7.3.1** should be undertaken.
Ponderosa-IF1	Low	Total	Site is located within the Option 1 grid connection. If this option is not used, no further management of this site is required. If Option 1 grid connection is used, every effort should be made to avoid this site. If this is possible a five metre buffer should be demarcated around GDA Zone 55 600374E 6337845N during the construction of the electricity line. The demarcation should be clearly visible and the location of the site should be known to all people working in the area. If avoidance is not possible, description and collection of surface artefacts as per **Section 7.3.1** should be undertaken.
Ridgey Creek-IF1	Low	Total	Site is located within the Option 3 grid connection. If this option is not used, no further management of this site is required.

Site name	Assessed scientific significance	Degree of harm	Management strategy
			If Option 3 grid connection is used, every effort should be made to avoid this site. If this is possible, a five metre buffer should be demarcated around GDA Zone 55 599898E 6338425N during the construction of the electricity line. The demarcation should be clearly visible and the location of the site should be known to all people working in the area. If avoidance is not possible, description and collection of surface artefacts as per **Section 7.3.1** should be undertaken.
Ridgey Creek-OS1	Low	Total	Site is located within the Option 3 grid connection. If this option is not used, no further management of this site is required. If Option 3 grid connection is used, every effort should be made to avoid this site. If this is possible, a five metre buffer should be demarcated around the site extent during the construction of the electricity line. The demarcation should be clearly visible and the location of the site should be known to all people working in the area. The no-go zone should extend to the following locations: • GDA Zone 55 600004E 6338422N in the north • GDA Zone 55 599996E 6338361N in the south • GDA Zone 55 600007E 6338372N in the east • GDA Zone 55 599983E 6338408N in the west. If avoidance is not possible, description and collection of surface artefacts as per **Section 7.3.1** should be undertaken.
Quorn Park-IF1	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF2	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF3	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF4	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF5	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF6	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF7	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF8	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF9	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF10	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF11	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF12	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF13	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF14	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF15	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF16	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.

Site name	Assessed scientific significance	Degree of harm	Management strategy
Quorn Park-IF17	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IFI8	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-IF19	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-OS1	Low	Total	Efforts should be made to preserve this site in the landscape. If avoidance is not possible, description and collection of surface artefacts as per **Section 7.3.1** should be undertaken.
Quorn Park-OS2	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.
Quorn Park-OS3	Low	Total	Description and collection of surface artefact as per **Section 7.3.1**.

7.3 MANAGEMENT PROCESS

7.3.1 Archaeological salvage: surface artefact collection

Stone artefact sites managed under this archaeological salvage will have surface artefacts mapped, catalogued, selectively photographed, collected and moved to safe-keeping.

The surface artefact collection will include the following methodology.

- All visible artefacts at a site should be flagged in the field;
- The site should be photographed after flagging and before recording;
- All artefacts should have the following artefact information recorded:
    - Location;
    - Artefact class;
    - Artefact type;
    - Size;
    - Reduction level;
    - Raw material; and
    - Notes.
- A selection of indicative and / or unusual artefacts from each site will be photographed;
- Once all recording is complete, the artefacts will be collected according to site with artefacts from each site being kept separate;
- Should the collection team encounter a human burial, all work should cease in the area and advice from authorities and RAPs (should the remains be Aboriginal) sought;
- The recording of the artefacts recovered will largely be completed in the field and this data would be incorporated into a report; and

- The salvaged artefacts should be reburied at an agreed upon location. This will take place in accordance with Requirement 26 "Stone artefact deposition and storage" in the Code of Practice. The location chosen for reburial will be an area where future developments will not occur and as close as possible to their original location. A site card will be submitted to AHIMS to record the relocation area.

7.4 STATEMENT OF COMMITMENTS

The proponent will undertake the following SoC.

1. Should the Project be approved, the proponent will develop an ACHMP in consultation with the RAPs. The ACHMP will include the recommendations contained in this report and this SoC.
2. As Project design is finalised all efforts will be made to conserve Aboriginal sites in the landscape.
3. The location of Quorn Park-OS1 will be noted and efforts made to avoid this site as it is located near the perimeter of the solar farm in a landform displaying less disturbance than adjacent landforms.
4. Depending on which grid connection option is chosen, sites in the discarded option will be preserved in the landscape. There is no management required for sites within discarded grid connection options.
5. The isolated finds (Quorn Park-IF1 to Quorn Park-IF20), Quorn Park-OS2 and Quorn Park-OS3 that have been recorded within the solar farm area will be salvaged under the methodology set out in **Section 7.3.1**. All sites are in highly disturbed landforms and likely to be in secondary contexts. As such, it is better that the artefacts are removed to a safe location away from impacts arising from the Project.
6. The recovered artefacts should be reburied at a location within the Project Site where no future developments are planned. The manner of reburial will be detailed in the ACHMP following RAP consultation. As one option, Requirement 26 "Stone artefact deposition and storage" in the Code of Practice will be considered. A site card will be submitted to AHIMS to register the location of any reburied artefacts.
7. An Aboriginal Site Impact Recording Form will be submitted to AHIMS recording the results of the salvage of any sites associated with the Project.
8. The design of the preferred grid connection will consider the location of recorded Aboriginal sites and endeavour to avoid the sites during activities associated with the construction and/or maintenance of the connection. For example, the proponent has some flexibility with the pole spacing associated with the grid connections and this will be utilised wherever possible to avoid impact to known Aboriginal sites.
9. Should any sites within the solar farm (i.e. Quorn Park-OS1) be able to be avoided, those sites will be clearly and permanently demarcated to avoid inadvertent impacts. The

demarcation will include permanent signage. The proponent will consider permanently fencing these sites to avoid inadvertent impacts.

10. Should any sites in the preferred grid connection be able to be avoided, those sites will be clearly shown on Project plans and avoided during maintenance activities.
11. If human skeletal material is noted during works associated with the Project, all works shall cease in that area and the police will be informed. Should the remains prove to be Aboriginal, work shall not re-commence in the area until approval from OEH has been sought.
12. If further Aboriginal objects are noted during works associated with the Project, the *Unanticipated Finds Protocol* presented in **Appendix 4** will be followed. The *Unanticipated Finds Protocol* will form the basis of the procedure for new discoveries set out in the ACHMP when it is developed.

HISTORIC HERITAGE ASSESSMENT REPORT

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8 HISTORIC HERITAGE ASSESSMENT: INTRODUCTION

8.1 BRIEF DESCRIPTION OF THE PROJECT

Please refer to **Sections 1.1** to **1.5** for a description of the Project and the Project Site.

8.2 LANDSCAPE CONTEXT

Please refer to **Sections 4.1** to **4.5** for a description of the landscape context of the Project Site.

8.3 HISTORIC HERITAGE ASSESSMENT OBJECTIVES

The current assessment will apply the Heritage Council *Historical Archaeology Code of Practice* (Heritage Council 2006) in the completion of a historical heritage assessment, including field investigations, in order to meet the following objectives:

Objective one: To identify whether or not historical heritage items or areas are, or are likely to be, present within the Project Site;

Objective two: To assess the significance of any recorded historical heritage items or areas; and

Objective three: Determine whether the activities of the proponent are likely to cause harm to recorded historical heritage items or areas; and

Objective four: Provide management recommendations and options for mitigating impacts.

8.4 DATE OF ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk from Monday 10 September to Wednesday 12 September 2018.

8.5 OZARK INVOLVEMENT

The field work and reporting of the historic heritage of the Project Site was undertaken by the same individuals set out in **Section 2.3**.

9 HISTORIC HERITAGE ASSESSMENT: BACKGROUND

This section provides an analysis of primary and secondary sources relating to the previous occupation of the site. This supports the physical analysis of the site to provide clarity on the potential for archaeological relics to be located in the area of the proposed works.

9.1 BRIEF HISTORY OF PARKES

The Parkes district lies within the traditional country of the Wiradjuri, who occupied all the land from the Murrumbidgee to north of the Lachlan and into the upper reaches of the Macquarie Rivers. The Wiradjuri language extended across the whole area and united a number of smaller clans, distinguishing them from the neighbouring Barkindji to the west and Kamilaroi to the north. The rivers provided a rich source of food and resources, with a majority of meeting places and ceremonial grounds being located along their banks.

It was into this country that Europeans first appeared in 1817. In that year, explorer John Oxley travelled through the Lachlan district between the Bogan and Lachlan Rivers. Oxley was followed in 1829 by Charles Sturt along the Bogan River, with further exploration by Surveyor Robert Dixon in 1833 and then Thomas Mitchell in 1835. By the time Mitchell arrived in the Lachlan he discovered that squatters had already arrived, having followed the path of Oxley in the mid-1820s (Unger 1977: 8).

Although these settlers ran their sheep and cattle across the Lachlan Plains, it was not until the mid-1830s that any permanent settlement or homesteads began to appear. Early settlers opened up large pastoral runs near Bland in the southwest around 1835, with Benjamin Boyd's large 60,000 hectare run at Condobolin established by 1840. In response to the influx, the Lachlan Pastoral District was declared in 1839 in an attempt to control the spread of settlement, with the Wellington Pastoral District also established for land north of the Lachlan, including the future site of Parkes (Heritage Office 1996: 99).

By 1836, the squatter Thomas Kite had taken up land at Burrawang which became known as Coobang Station. The presence of Kite, and then the declaration of the Wellington Pastoral District, encouraged others to travel to the area and in 1853 the small settlement of Currajong was formed, just north of the present site of Parkes (Kass 2003: 10). The area remained a sparsely settled rural district until the discovery of gold in 1862 encouraged a rush of new settlers to the district, some who had already tried their luck at the diggings at nearby Forbes.

After a brief rush, many of the goldfields were replaced by orchards and vineyards, with only small gold diggings still in operation by 1867. This changed in 1871 when a rich alluvial lead was found on one of the old sites known as Bushmills. A few large alluvial nuggets reignited the fever and a town sprang up. In 1873, after then Premier Henry Parkes visited, Bushmills was renamed Parkes (Unger 1977: 23).

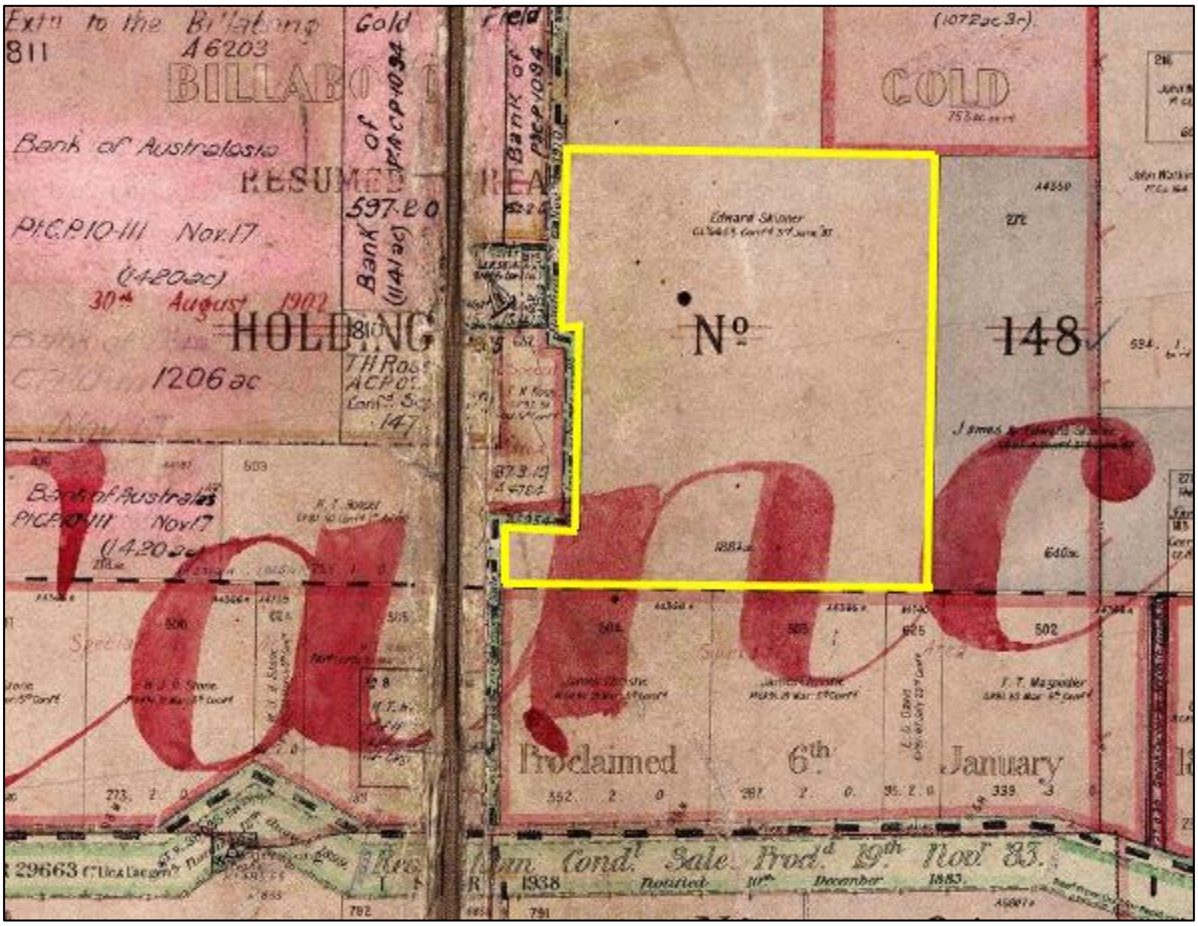
New discoveries and better mining techniques in the 1870s ensured that mining continued around Parkes up until 1907 as a major concern. By the turn of the twentieth century, however, the district was dominated by agricultural holdings growing wheat on a large scale and sheep. Both of these industries had been guaranteed in the area after the arrival in 1893 of the railway, lining Parkes to the markets and wharves in Sydney.

In 1882, the growing town of Parkes elected its first Municipal Council. With a population of 3000 people, the town was developing as a major regional service centre with Government land sales encouraging further development in the late 1880s and the town large enough to support a district agricultural show. By the turn of the twentieth century the town had at least three hotels, a public school, a Catholic convent school, hospital and a creamery serving a growing dairy industry, with a picture theatre opening in 1907. Parkes continued to grow slowly through the first half of the twentieth century reaching a population of almost 4,000 by 1921 and rising to 5,800 by 1931. In 1927, when the railway was extended to Broken Hill, Parkes became an important regional transport centre, with a large railway workshop and yard being established to service the Central West line.

9.2 HISTORY OF THE PROJECT SITE

Research in the history of Lot 508 DP750152 has drawn very little information. The earliest available parish maps of Lot 508 indicate the site was owned by Edward Skinner by 1901 (**Figure 9-1**). By 1912, the property was under the ownership of the Australian Mutual Provident Society and ownership changed again by 1933 with the land then being owned by the Rural Bank of NSW and continued to be owned by the organisation until after 1957.

Figure 9-1: 1901 Currajong Parish Map, County of Ashburnham, showing the portion of Lot 508 within the Project Site (source: NSW Land Registry Service 2018).



9.3 LOCAL CONTEXT

9.3.1 Desktop database searches conducted

A desktop search was conducted on the following databases to identify any potential previously-recorded heritage within the Project Site. The results of this search are summarised in **Table 9-1**.

Table 9-1: Historic heritage: desktop-database search results.

Name of Database Searched	Date of Search	Type of Search	Comment
National and Commonwealth Heritage Listings	28/8/2018	Parkes LGA	No places listed on either the National or Commonwealth heritage lists are located within the Project Site.
State Heritage Register (SHR)	28/8/2018	Parkes LGA	None of the items listed occur within the Project Site.
State Heritage Inventory (SHI)	28/8/2018	Parkes LGA	None of the items listed occur within the Project Site.
LEP	2/8/2018	Parkes LEP of 2012	None of the items listed occur within the Project Site.

A search of the Heritage Council of NSW administered heritage databases and the Parkes LEP returned no records for historical heritage sites within the designated search areas.

9.4 SURVEY METHODOLOGY

Standard archaeological field survey and recording methods were employed in this study (Burke & Smith 2004). The historic heritage field survey was completed concurrently with the Aboriginal heritage field assessment (**Section 6-1**). GPS coordinates and photographs were taken of all heritage items.

10 RESULTS OF HISTORIC HERITAGE ASSESSMENT

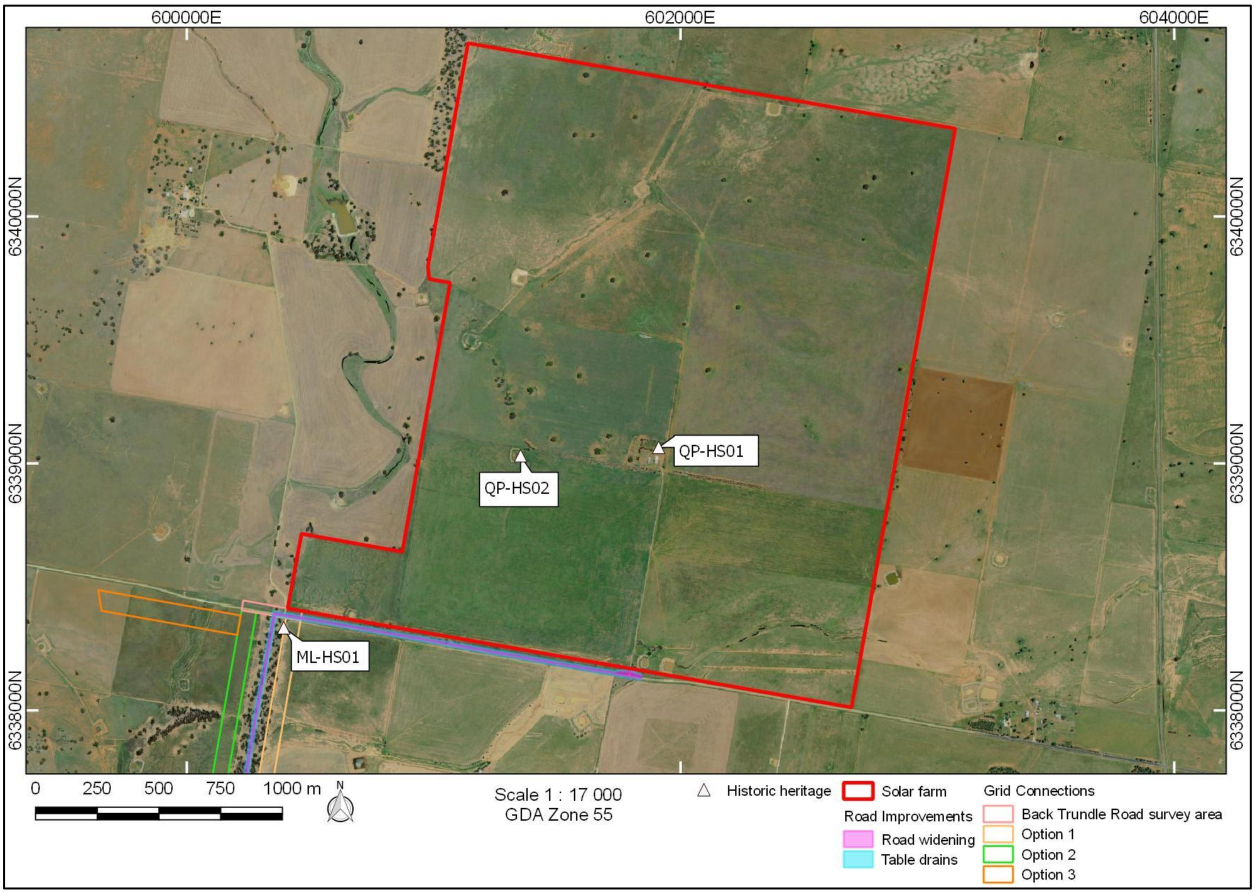
10.1 HISTORIC HERITAGE SITES

A total of three historic heritage sites were identified during the survey (**Table 10-1** and **Figure 10-1**). No areas were identified across the Project Site were assessed as having archaeological potential.

Table 10-1: Historic sites recorded.

Site number	Description	Easting (GDA Zone 55)	Northing (GDA Zone 55)
QP-HS1	Weatherboard house	601908	6339066
QP-HS2	Cars	601351	6339023
ML-HS1	Glass bottle	600391	6338330

Figure 10-1: Location of recorded historic heritage items.



QP-HS01

Site type: Weatherboard house

GPS coordinates: GDA Zone 55 601908E 6339066N

Location of site: Approximately 925m north of Back Trundle Road and 2.1km west of the Parkes Narromine Railway Line (**Figure 10-1**).

Description of site: Rectangular, weatherboard house with a concrete verandah (**Figure 10-2**). The house has a gable roof with clay tiles. Four timber posts line the edge of the verandah. These posts are simple rectangular timber posts with no decorative arches or brackets. The windows present along the front and rear of the house are all slider windows.

Figure 10-2: Photographs showing an overview and details of QP-HS01.

	
1. View west to the front façade of QP-HS01.	2. View west to the rear of QP-HS01.

QP-HS02

Site type: Vehicles

GPS coordinates: GDA Zone 55 601351E 6339023N

Location of site: Approximately 770m north of Back Trundle Road and 2.5km west of the Parkes Narromine Railway Line (**Figure 10-1**).

Description of site: QP-HS02 contains two old vehicles, both Chevrolet utility vehicles (**Figure 10-3**). Ute 1 is a 1967 Chevrolet C/K10 series model and Ute 2 is a 1955 Chevrolet 3124 series Cameo Carrier. Today, the vehicles are heavily rusted and in poor condition.

Figure 10-3: Photographs showing an overview and details of QP-HS02.

1. View west towards ute 1 within QP-HS02.

2. View west towards ute 2 within QP-HS02.

ML-HS01

Site type: Glass bottle

GPS coordinates: GDA Zone 55 601908E 6339066N

Location of site: Approximately 40m east of McGrath Lane and three metres west of the boundary of Lot 504 DP750152 (**Figure 10-1**).

Description of site: Clear glass bottle, embossed with “THIS BOTTLE ALWAYS REMAINS THE PROPERTY OF THE VINEGAR CO OF AUSTRALIA” (**Figure 10-4**). The tall, narrow bottle is moulded in two halves and faceted around the body.

Figure 10-4: Photographs showing an overview and details of ML-HS01.

1. View of ML-HS01.

2. View of ML-HS01 labelling detail.

10.2 ASSESSMENT OF HISTORIC HERITAGE SIGNIFICANCE

10.2.1 Assessment of significance-general principles

The current assessment will evaluate the heritage significance of the historic heritage sites identified within the Project Site in accordance with the NSW Heritage Office guidelines for *Assessing Heritage Significance* (Heritage Office 2001). A historic heritage site must satisfy at minimum one of the following criterion to be assessed as having heritage significance:

Criterion (a): *An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (b): *An item has a 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 (or the cultural or natural history of the local area).*

Criterion (c): *An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).*

Criterion (d): *An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons.*

Criterion (e): *An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (f): *An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).*

Criterion (g): *An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).*

Significance assessments are carried out on the basis that decisions about the future of heritage items must be informed by an understanding of these items' heritage values. The *Australia ICOMOS Burra Charter* (Australia ICOMOS 2013) recognises four categories of heritage value: historic, aesthetic, scientific, and social significance

Items are categorised as having local or state level, or no significance. The level of significance is assessed in accordance with the geographical extent of the item's value. An item of state significance is one that is important to the people of NSW whilst an item of local significance is one that is principally important to the people of a specific LGA.

10.2.2 Assessment of significance of historic items

Table 10-2 to **10-4** details the assessed significance of recorded historic heritage items in accordance with the NSW Heritage Office guidelines and the *Burra Charter* (Australia ICOMOS 2013).

Table 10-2: Assessment of heritage significance – QP-HS01.

Criteria	Comments	Significance
a	The site is not an important item in the cultural history of the Parkes region.	Nil
b	The site cannot be tied to an individual or group of persons.	Nil
c	The site does not contain any remarkable architectural features.	Nil
d	The site has no strong associations with a group for social, cultural, or spiritual reasons.	Nil
e	The site is unlikely to yield further data.	Nil
f	The style of the site is representative of the material and methods used in NSW from the early nineteenth century onwards. This type of site is well represented within Parkes where the public can appreciate it.	Nil
g	The site comprises unremarkable examples of its type and demonstrates little new information about rural properties in NSW.	Nil

Table 10-3: Assessment of heritage significance – QP-HS02.

Criteria	Comments	Significance
a	The site is not an important item in the cultural history of the Parkes region.	Nil
b	The site cannot be tied to an individual or group of persons.	Nil
c	The items within the site are in poor condition and do not provide a good example of creativity or craftsmanship.	Nil
d	The site has no strong associations with a group for social, cultural, or spiritual reasons.	Nil
e	The site is unlikely to yield further data.	Nil
f	The site displays vehicles and materials used in the region from the early nineteenth century. Vehicles in better condition are still exist throughout the country and in museums where the public can appreciate them.	Nil
g	The site comprises unremarkable examples of its type and demonstrates little new information about vehicle production in NSW.	Nil

Table 10-4: Assessment of heritage significance – ML-HS01.

Criteria	Comments	Significance
a	The site is not an important item in the cultural history of the Parkes region.	Nil
b	The site cannot be tied to an individual or group of persons.	Nil
c	The site is not intact and as such do not demonstrate significant creativity or craftsmanship. Neither are they a complete representation of local design styles.	Nil
d	The site has no strong associations with a group for social, cultural, or spiritual reasons.	Nil
e	As integrity of the site is low, they are not likely to yield further data.	Nil
f	The site is not rare.	Nil
g	As integrity of the site is poor, it is not a complete or important representation of a cultural or natural place.	Nil

10.3 DISCUSSION

The sites and items recorded during the current assessment are representative of the farming heritage in the district. The overall low level of heritage significance attached to the new recordings can be attributed to the following factors:

1. Prior community heritage studies. Previous historic heritage assessment completed on behalf of Parkes Shire Council have captured the majority of prominent, historically significant places in the district. The likelihood that previously unidentified and unrecorded, yet highly significant, places would be documented during the current study was thus low.

2. The nature of settlement in the district. As an agricultural/pastoral region, the Project Site exhibits very a low housing density. The likelihood that previously unknown structures would be documented away from the known and existing buildings is thus low. In the event that other historic heritage places do exist within the Project Site, it is likely that only relatively unobtrusive foundation remnants would have been extant.

3. The nature of agricultural and pastoral activities. Aside from modifications to the environment (most visibly, vegetation clearing and ploughing), enclosure of land, and the establishment of farm infrastructure, farming leaves few traces in the form of artefacts dispersed throughout the area. Artefacts, when located, are more likely to consist of dropped/discarded equipment rather than extensive conurbations of artefacts. Such items are relatively unobtrusive and their identification is subject to factors such as GSV. GSV was very high across the Project Site and would have allowed for the identification of artefacts however only one artefact was identified.

10.4 LIKELY IMPACTS TO HISTORIC HERITAGE FROM THE PROJECT

No historic heritage items, which may hold constraints for undertaking the project, were identified in the Project Site. As such, there are no likely impacts to historic heritage from the activities of the Project.

11 MANAGEMENT AND MITIGATION: HISTORIC HERITAGE

11.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF HISTORIC SITES

Appropriate management of heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the Project.

In terms of best practice and desired outcomes, avoiding impact to any historical item is a preferred outcome, however, where a historical site has been assessed as having no heritage value, impacts to these items does not require any legislated mitigation.

11.2 MANAGEMENT AND MITIGATION OF RECORDED HISTORIC SITES

No items or sites of historic heritage significance were identified in the Project Site. Should any items of historic heritage significance be uncovered then the *Historic Heritage Unanticipated Finds Protocol* (**Appendix 5**), will need to be enacted. This protocol stipulates the processes to follow should likely historic objects become uncovered through the activities of the Project.

12 RECOMMENDATIONS

12.1 ABORIGINAL HERITAGE

Under Section 89A of the NPW Act it is mandatory that all newly-recorded Aboriginal sites be registered with OEH AHIMS. As a professional in the field of cultural heritage management it is the responsibility of OzArk to ensure this process is undertaken.

To this end it is noted that **27 Aboriginal sites** were recorded during the assessment.

The following recommendations are made on the basis of these impacts and with regard to:

- Legal requirements under the terms of the NPW Act whereby it is illegal to damage, deface or destroy an Aboriginal place or object without the prior written consent of OEH;
- The findings of the current investigations undertaken within the Project Site; and
- The interests of the Aboriginal community.

Table 7-1 lists the 27 sites that are likely to be impacted by the Project and tabulates the associated scientific values assessment and recommended archaeological management strategies.

As a consequence of the proposed impacts to Aboriginal cultural heritage sites within the Project Site, the following archaeological recommendations are made in an effort to responsibly manage Aboriginal cultural heritage sites *in situ*, or where appropriate, mitigate the loss of cultural heritage at those sites within the impact footprint.

1) Should development consent for the Project be granted, the Statement of Commitments set out in **Section 7.4** will be followed.
2) All land-disturbing activities must be confined to within the assessed Project Site. Should the parameters of the proposed work extend beyond the assessed area, then further archaeological assessment may be required.
3) Inductions for staff undertaking the proposed activity shall include the legislative protection requirements for Aboriginal sites and items in NSW and the relevant fines for non-compliance.

12.2 HISTORIC HERITAGE

The following recommendations are made on the basis of these impacts and with regard to:

- Legal requirements under the terms of the Heritage Act;
- Guidelines presented in the *Burra Charter* (Australia ICOMOS 2013);
- The findings of the current assessment; and

- The interests of the local community.

Recommendations concerning the Project Site are as follows.

4) The activities of the project can proceed without further historic heritage investigation provided that all ground disturbance activities are confined to within the Project Site. If the parameters of the proposed activity extend beyond the study area, then further archaeological assessment may be required.
5) This assessment has concluded that there is a low likelihood that the proposed activity would harm historic items. If objects are encountered that are suspected to be historic heritage items, all work must stop and the *Unanticipated Finds Protocol* (**Appendix 5**) should be followed.
6) Inductions for staff undertaking the proposed activity shall include the legislative protection requirements for historic sites and items in NSW and the relevant fines for non-compliance.

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Kass 2003	Kass, T. 2003. *Parkes Shire Thematic History*, A report prepared for Parkes Shire Council.
Kelton 1996	Kelton, J. 1996. *Aboriginal Archaeological Sites in the Lachlan Valley*. Report to NPWS.
Mitchell 2002	Mitchell, P. 2002. *NSW Ecosystems Database Mapping Unit Descriptions*, Groundtruth Consulting.
Navin Officer 2006	Navin Officer. 2006. *Peaking Power Plant and associated Gas Pipeline: Parkes, NSW. Cultural Heritage Assessment Report*. Report prepared for URS.
NGH Environmental 2016	NGH Environmental. 2016. *Cultural Heritage Assessment Report: Parkes Solar Farm.* Report to Neoen Australia Pty Ltd.
NPWS 2003	National Parks and Wildlife Services. 2003. *The Bioregions of New South Wales – Their Biodiversity, Conservation and History*. NSW National Parks and Wildlife Service, Hurstville.
OEH 2011	Office of Environment and Heritage 2011. *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.*
OzArk 2015	OzArk Environmental and Heritage Management Pty Ltd. 2015. *Archaeological Due Diligence Assessment: Line 94U Optical Ground Wire Installation, Parkes to Forbes NSW*. Reportto TransGrid.
OzArk 2016	OzArk Environmental and Heritage Management Pty Ltd. 2016. *Central West Local Land Services Travelling Stock Reserves Study*. Report to Central West Local Land Services.
Tindale 1974	Tindale, N.B. 1974. *Aboriginal tribes of Australia: their terrain, environmental controls, distribution, limits, and proper names*. University of California Press; Canberra: Australian National University Press, Berkeley.
Unger 1977	Unger, L.A. 1977. *Panorama of Parkes 1817-1977*, Parkes and District Historical Society Publication.

Unger (ND)	Unger, L.A. No Date. Aboriginal activity in the Parkes district. Parkes & District Historical Society.
White 1986	White, I. 1986. Dimensions of Wiradjuri. Unpublished Thesis. Department of Prehistory and Anthropology. Australian National University.

PLATES

Plate 1: View across the ploughed paddock in the south of the proposed solar farm site.

Plate 2: View north along Ridgey Creek within grid connection Option 3.

Plate 3: View of isolated, remnant box trees in the north of the proposed solar farm site.

Plate 4: View south along grid connection Option 1.

Plate 5: View south from the central portion of grid connection Option 2.

Plate 6: View southeast from the southern portion of grid connection Option 2.

Plate 7: View west along grid connection Option 3.

Plate 8: View north along the western road corridor of McGrath Lane.

Plate 9: View east along the northern road corridor of Henry Parkes Way.

Plate 10: View east along the northern road corridor of Back Trundle Way.

APPENDIX 1: ACHCRS DOCUMENTATION

Log of Aboriginal community consultation

Aboriginal Consultation Log - Quorn Park Solar			
Date	**Organisation**	**Comment**	**Method**
4.7.18	Parkes Champion Post	Rebecca Hardman (RH) rang newspaper is printed on a Tuesday and Friday The cut off is by 10:30am Thursday for Friday ad and Monday 10:30am for Tuesday	phone
4.7.18	Parkes Champion Post	RH sent ad to newspaper for proof	email
4.7.18	Office of Environment & Heritage (OEH)	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	Peak Hill Local Aboriginal Land Council	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	Office of The Registrar, ALRA	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	National Native Title Tribunal	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	NTSCORP	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	Parkes Shire Council	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	Central West Local Land Services	RH sent stage1 agency letter requesting potential stakeholders. Closing date. 19.7.18	email
4.7.18	Office of The Registrar, ALRA	RH received response from Megan, she has forwarded to Jodie for response	email
5.7.18	Parkes Champion Post	RH rang to check on proof and quote, Katherine to get back to RH this morning	phone
5.7.18	Parkes Champion Post	Rh received ad proof and quote	email
5.7.18	Parkes Champion Post	RH sent ad back with edits	email
5.7.18	Parkes Champion Post	RH received ad proof	email
5.7.18	Parkes Champion Post	RH sent ad back with edits	email
5.7.18	Parkes Champion Post	RH received ad proof	email
5.7.18	Parkes Champion Post	RH sent ad back with edits	email
5.7.18	Parkes Champion Post	RH received ad proof	email
5.7.18	Parkes Champion Post	RH sent ad back with edits	email
5.7.18	Parkes Champion Post	RH received ad proof	email

5.7.18	Parkes Champion Post	RH sent ad back confirming correct. Will be published Friday 6th July. RSVP 20th July	email
5.7.18	Parkes Champion Post	RH phoned to make payment for ad	phone
5.7.18	National Native Title Tribunal	RH received notification *Records held by the National Native Title Tribunal as at 4th July 2018 indicate that there are no Native Title Determination Applications, Determinations of Native Title, or Indigenous Land Use Agreements over the identified area of the* Shire of Parkes.	email
5.7.18	Local Lands Services Central West	RH received letter response advising to contact OEH	Post
11.7.18	Peak Hill Local Aboriginal Land Council	RH received phone call from Cherie, wanting to become a RAP	phone
11.7.18	Office of The Registrar, ALRA	Sheridan Baker (SB) received email suggesting to contact Peak Hill LALC for stakeholders	email
13.7.18	Rob Clegg	Daughter phoned to advise he wants to be a RAP for the project	phone
13.7.19	Rob Clegg	Phoned to advised wants to be a RAP for the project. Gave email address for future correspondence	phone
18.7.18	OEH	RH sent follow up email requesting Stakeholders	email
18.7.18	OEH	RH received list of stakeholders to contact	email
19.7.18	Binjang Wellington Wiradjuri Heritage Survey	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Bogan River Peak Hill Wiradjuri Aboriginal Corporation	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Bulgandramine Youth Development Aboriginal Corporation	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Condobolin Local Aboriginal Land Council	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	email
19.7.18	Cowra Local Aboriginal Land Council	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	email
19.7.18	Eva Coe	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Little Burning Mountain Aboriginal Corporation	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Mooka	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Peak Hill Local Aboriginal Land Council	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	email

19.7.18	Peter Peckham	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Trevor Robinson	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Warramunga Community Advancement Co-operative Society LTD	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
19.7.18	Wiradjuri Council of Elders	RH sent letter for expression of interest to become a RAP for the project. Stage 1 closes 6th August 2018	Post
26.7.18	Bogan River Peak Hill Wiragjuri Aboriginal Corporation	Letter returned to sender	RTS
3.8.18	Binjang Wellington Wiradjuri Aboriginal Corporation	Sheridan Baker (S)B received a call from Jamie confirming registration	phone
3.8.18	Little Burning Mountain Aboriginal Corporation	Letter returned to sender	RTS
3.8.18	Trevor Robinson	Letter returned to sender	RTS
3.8.18	Bulgandramine Youth Development Aboriginal Corporation	Letter returned to sender	RTS
7.8.18	Peak Hill Local Aboriginal Land Council	SB sent stage 2 methodology. Closing date for feedback is the 5th September 2018	email
7.8.18	Rob Clegg	SB sent stage 2 methodology. Closing date for feedback is the 5th September 2018	email
7.8.18	Binjang Wellington Wiradjuri Aboriginal Corporation	SB sent stage 2 methodology. Closing date for feedback is the 5th September 2018	email
7.8.18	Rob Clegg	SB received response from Rob saying he will look at on Thursday	email
14.8.18	Peak Hill Local Aboriginal Land Council	SB received an email from Cherie confirming registration	email
14.8.18	Peak Hill Local Aboriginal Land Council	SB received a call from Cherie making sure email received	email
23.8.18	Peak Hill Local Aboriginal Land Council	SB called Cherie on the landline re bringing fieldwork forward - line did not answer	email
23.8.08	Peak Hill Local Aboriginal Land Council	SB called Cherie on the her mobile re bringing fieldwork forward - line did not answer, could not take call at this time	email
29.8.18	Peak Hill Local Aboriginal Land Council	RH sent invitation to fieldwork	email
29.8.18	Rob Clegg	RH sent invitation to fieldwork	email
30.8.18	OEH	RH sent notification of RAPs	email
30.8.18	Peak Hill Local Aboriginal Land Council	RH sent notification of RAPs	email

31.8.18	Rob Clegg	RH received phone call from Rob, he does not have workers comp but wants to do fieldwork. Offred to pass on a 3rd party employers' details, Rob accepted	email
31.8.18	Rob Clegg	RH phoned Rob back with Frank from Get set's details	email
5.9.18	Peak Hill Local Aboriginal Land Council	SB rang PHLALC but did not receive an answer	phone
5.9.18	Peak Hill Local Aboriginal Land Council	SB rang called Cherie Keed on her mobile- Message said "your call can not be completed at this time, please call again later"	phone
5.9.18	Peak Hill Local Aboriginal Land Council	SB emailed Cherie asking for contact urgently re fieldwork offer	email
5.9.18	Get Set Training	SB rang landline and left a message for Frank to call back regarding if he had contact with Rob Clegg	phone
5.9.18	Get Set Training	SB rang Franks mobile. Frank has been away and has not heard from him. Frank is now back and will check with the office tomorrow and give SB a call.	phone
5.9.18	Rob Clegg	SB spoke to Rob Clegg - he can do Monday and Tuesday (unavailable Wednesday and Thursday. Happy to go through Getset for insurance. SB to get Frank to call on Robs mobile tomorrow	phone
6.9.18	Peak Hill Local Aboriginal Land Council	SB rang and spoke to Laikan, Laikan said Cherie was sick, but would get her to to look at tomorrow, Cherie's daughter also works with Laikan and will take the message home. Laikan is aware that the fieldwork is on Monday and will also require an additional person for 1.5 days. SB to resend the letter of offer and Laikan will send through the PH LALC Workers Comp cert of currency	email
6.9.18	Peak Hill Local Aboriginal Land Council	SB rang and spoke to Laikan, Laikan said Cherie was sick, but would get her to to look at tomorrow, Cheries daughter also works with Laikan and will take the message home. Laikan is aware that the fieldwork is on Monday and will also require an additional person for 1.5 days. SB to resend the letter of offer and Laikan will send through the PH LALC Workers Comp cert of currency	email
5.9.18	Get Set Training	SB received a call from Frank saying he had not heard from Rob Clegg. SB supplied Robs mobile number and Frank will sort out paper work for the 2 days engagement - Mon Tues	phone
6.9.18	Peak Hill Local Aboriginal Land Council	SB redsent letter of fieldwork offer	email
6.9.18	Peak Hill Local Aboriginal Land Council	SB rang called Cherie Keed on her mobile- Message said "your call can not be completed at this time, please call again later"	phone
6.9.18	Get Set Training	SB rang and spoke to Frank and confirmed he had been in contact with and sent through paperwork to Rob	phone
6.9.18	Rob Clegg	SB rang and confirmed with Rob that he had heard from Frank. Rob is about to fill out the paperwork now.	phone
6.9.18	Peak Hill Local Aboriginal Land Council	SB rang Anthony Wilson to see if he was still the site officer for the peak Hill LALC. Mobile went to a message bank	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB rang PH LALC - Phone rang out	phone

7.9.18	Peak Hill Local Aboriginal Land Council	SB rang Cherie mobile and left a message	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB rang Anthony Wilson and explained - Anthony said he was available and had a other person who could do the additional days. He will go see Cherie now and get her to call SB. Anthony will also chase up W/comp insurance for SB	phone
7.9.18	Peak Hill Local Aboriginal Land Council	Cherie called and left a message for SB to call back, supplied a new phone number	phone
7.9.18	Peak Hill Local Aboriginal Land Council	Cherie called and left a message for SB to call back, supplied a new phone number	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB rang and left a message for Cherie to call back	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB received a call from Cherie confirming that Anthony Wilson will be available, and that Lyn Bell will do the additional 1.5 days. Request to start later on 4th day as site officers have to attend a 10:30 meeting at the LALC on the Thursday. SB said she would see what can be done	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB rang for Anthony and got given his new number	phone
7.9.18	Rob Clegg	SB rang and confirmed that Rob had the address of where to go on Monday	phone
7.9.18	Rob Clegg	SB texted through Stephanie’s mobile number in case of issues	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB received a call from Anthony confirming email address for meeting location to be sent through to	phone
7.9.18	Peak Hill Local Aboriginal Land Council	SB sent through map and time etc to Anthony	email
7.9.18	Rob Clegg	SB received call from Rob saying that he has an appointment between 11:30 and 12:30 on Monday, SB said she would let SR know and that she would get back to him if any issues	phone
9.10.18	Peak Hill Local Aboriginal Land Council	SB sent draft ACHAR and cover letter - closing date 7.11.18	email
9.10.18	Rob Clegg	SB sent draft ACHAR and cover letter - closing date 7.11.18	email
9.10.18	Binjang Wellington Wiradjuri Aboriginal Corporation	SB sent draft ACHAR and cover letter - closing date 7.11.18	email
9.10.18	Rob Clegg	Rob send he would send through feedback.	email
7.11.18	Peak Hill Local Aboriginal Land Council	RH left message requesting feedback on the ACHAR on landline.	Phone
7.11.18	Rob Clegg	Rob advised that the project should proceed ASAP and only artefacts that would be disturbed should be collected.	Phone
7.11.18	Binjang Wellington Wiradjuri Aboriginal Corporation	RH left message requesting feedback on the ACHAR.	Phone
7.11.18	Peak Hill Local Aboriginal Land Council	RH left message requesting feedback on the ACHAR on mobile.	phone

13.11.18	Binjang Wellington Wiradjuri Aboriginal Corporation	Updated ACHAR sent to RAPs with an additional 10 days review closing 23 November 2018	email
13.11.18	Rob Clegg	Updated ACHAR sent to RAPs with an additional 10 days review closing 23 November 2018	email
13.11.18	Peak Hill Local Aboriginal Land Council	Updated ACHAR sent to RAPs with an additional 10 days review closing 23 November 2018	email
14.11.18	Rob Clegg	Jodie Benton (JB) spoke to Rob. He is happy with the revised report and acknowledges that an additional site will be impacted. He also noted that he would like someone to be present if grading is to occur.	in person
20.11.18	Rob Clegg	SR sent Rob the following email: *Thanks for providing feedback earlier last week to Jodie. There is no recommendation currently in the report to have a monitor present of site when during the ground disturbance work because based on the landforms present there is a low chance that additional artefacts will be found. However, I will include your recommendation in the report for the Office of Environment and Heritage and the Department of Planning to consider.*	email
20.11.18	Peak Hill Local Aboriginal Land Council	RH phoned landline - N/A	phone
20.11.18	Peak Hill Local Aboriginal Land Council	RH phoned mobile - N/A	phone

Stage 1 advertisement placed in the Parkes Champion-Post newspaper, Friday 6 July 2018

parkeschampionpost.com.au — Friday, July 6, 2018 PARKES CHAMPION POST 17

Public Notices

PARKES SHIRE COUNCIL

NOTICE OF DEVELOPMENT PROPOSAL

Notice is hereby given that Parkes Shire Council has received Development Application No: DA2018/0063 from TFL Trust for the proposed demolition of an existing dwelling-house and construction of kiosk (drive-through coffee outlet) on land known as Lot 1 DP 609174, 5 Cecile Street, Parkes.

Plans and supporting documentation relating to this development proposal may be inspected at the Parkes Shire Administration Centre, 2 Cecile Street, Parkes between the hours of 8.30am and 5.00pm, Monday to Friday, for the period 3 July 2018 to 24 July 2018. Alternatively, plans and supporting documentation may be viewed at Council's website: www.parkes.nsw.gov.au.

Any interested person may, within the aforementioned period, make written submission to the Parkes Shire Council with respect to such proposed development. If your comments are an objection, then the grounds of the objection must be specified.

Public Notices

Expression of Interest
Cultural Heritage Management

OzArk Environmental & Heritage Management P/L has been engaged by Geolyse Pty Ltd on behalf of the proponent Quorn Park Solar Farm Pty Ltd, and is seeking registrations of interest from Aboriginal groups or individuals of the Parkes area, who wish to be consulted over the proposed Quorn Park Solar Farm including associated grid connections and road upgrades. The proposed development site is approximately 10km North West of Parkes on the Back Trundle road, Parkes NSW. The proposed Quorn Park Solar Farm will encompass approximately 475 hectares of rural land within the Parkes Shire LGA.

The purpose of this consultation is to identify stakeholders to assist in the Aboriginal cultural heritage assessment of the proposed development site. If you hold cultural knowledge relevant to determining the impacts to the cultural significance of the above mentioned area, please register your interest by post: OzArk EHM, PO Box 2069, Dubbo NSW 2830; email: rebecca@ozarkehm.com.au, or by phoning OzArk between 9.00am and 5.00pm weekdays on 02 6882 0118.

All submissions should be received no later than **Friday 20th July 2018.**

PARKES CHAMPION POST CLASSIFIED DEADLINES: Are as follows;

All coloured display notices such as In memory, Thank you and Council notices, etc need to be submitted by **1pm Friday before for the Tuesday publication. All black & white lineage ads needs to be submitted by 12.00pm Monday, for Tuedays paper.** For Fridays paper all coloured display notices will need to be submitted by **Wednesday 4.30pm to make deadline for Fridays paper, all black and white lineage ads will need to be submitted by 12.00pm the Thursday before.**

Exceptions maybe carried out please call the office on 6862 2322 for further information.

Wanted to Buy

ANTIQUE BUYER
In area, Wednesday 11th July, Cash Paid! Old shop and Garage signs, Displays, Tins, Oil bottles, workshop manuals, Comics, Toys, Pedal cars, old watches, Traps, Tools, Camp ovens, Cow bells, Military and railway items, Sone bottles and jars, Shed contents.
Phone Rob 0418 391 084

Positions Vacant

QUALIFIED MOTOR MECHANIC
Trade qualified Light Vehicle Mechanic required for permanent full-time position in busy workshop in Parkes. Must have current MVRL licence & drivers licence.
Hourly rate $25 to $30 depending on experience, plus overtime available.
All enquiries are strictly confidential.
To apply please email resume to: ***mappersonmechanical@bigpond.com***, or call us on 68823928 for more info.

Home Maintenance

A-ALLEN'S TREE Lopping, Felling, Stump grinding Quotes. 6852-1439, 0427-253-837

Accommodation

WANTED PERSON TO SHARE two bedroom unit. Prefer middle age person with drivers licence. Phone 026863-4648.

Personal Notices

Why Stay Single and Alone...
...when at New Beginnings Network we have many members seeking companionship/love! Meet through personal phone calls not an impersonal computer match up whilst receiving expert dating advice with real relationship experts with 25+yrs experience.
Servicing all areas: City/Rural/Outback with members of all ages from the young to the young at heart (seniors welcome)
1800 315 311 for a free compatibility match to see who is waiting to meet you, or text **0455 133 314** and we'll call you!
(Privacy assured)
Taking calls 7 days til late
www.newbeginningsnetwork.com.au

Adult Services

AUSSIE LADY
Gorgeous Slim Figure
Your Country Lover
Fri 6th & Sat 7th
Ph: 0439 263 764.

Stage 1 letter to agencies and Aboriginal community organisations

OzArk Environmental & Heritage Management Pty Ltd

ABN: 59 104 582 354

Environmental & Heritage Management P/L

4th July 2018

Members
Peak Hill Local Aboriginal Land Council
C/- Cherie Keed
PO Box 63
PEAK HILL NSW 2869
phlala@yahoo.com.au
6869 1726

Dear Members,

Re: Aboriginal and historic heritage assessment for the proposed Quorn Park Solar Farm near Parkes, NSW.

OzArk Environmental & Heritage Management P/L is currently seeking Expressions of Interest from relevant Aboriginal groups and individuals in the Parkes area, to form a consultation group to assist Geolyse Pty Ltd (on behalf of the Proponent - Quorn Park Solar Farm Pty Ltd), in the Aboriginal cultural heritage evaluation for the above mentioned project.

Quorn Park Solar Farm Pty Ltd intends to seek development consent under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) to develop a new solar farm including associated grid connections and road upgrades near Parkes, NSW. The proposed development site is approximately 10km North West of Parkes on the Back Trundle road and proposes to encompass approximately 475 hectares of rural land within the Parkes Shire LGA.

Therefore, we are currently undertaking Aboriginal community consultation as per the Office of Environment and Heritage (OEH) *Aboriginal cultural heritage consultation requirements for proponents 2010*.

If the your organisation can recommend and provide contact details for any known Aboriginal groups or individuals with cultural knowledge relevant to determining the impacts to the cultural significance of the proposed Quorn Park Solar Farm, please advise our office. The closing date for Stage 1 round 1 expressions of interest is **Thursday 19th July 2018**.

Once relevant groups and individuals have been identified, they will form part of the formal consultation process for the project.

Kind regards,

Sheridan Baker
Community Liaison

Dubbo | Queanbeyan
HEAD OFFICE: 145 Wingewarra St/PO Box 2069 DUBBO NSW 2830
ph 02 6882 0118 | enquiry@ozarkehm.com.au | www.ozarkehm.com.au

OzArk Environmental & Heritage Management Pty Ltd

ABN: 59 104 582 354

Figure 1: Site Location of proposed Quorn Park Solar Farm.

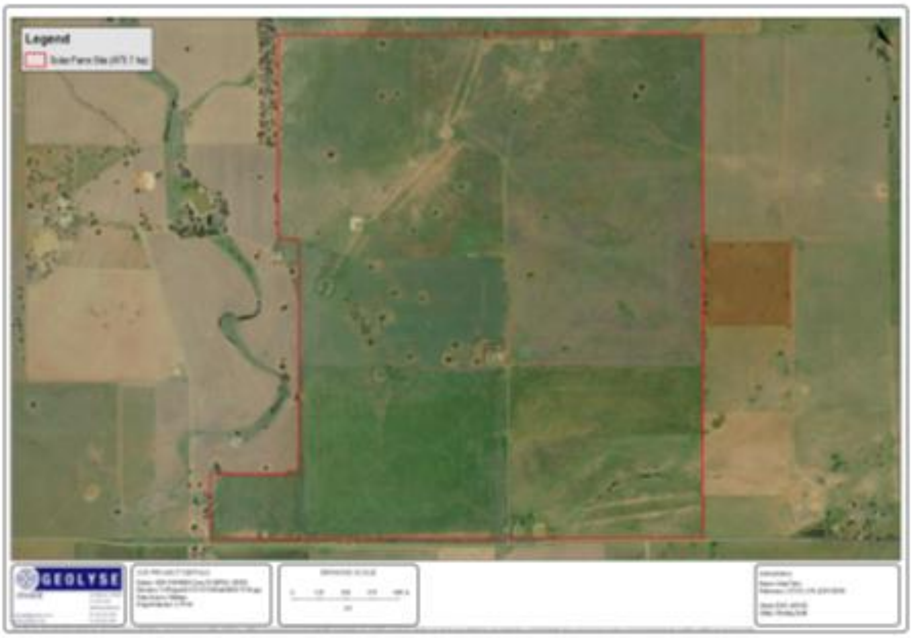
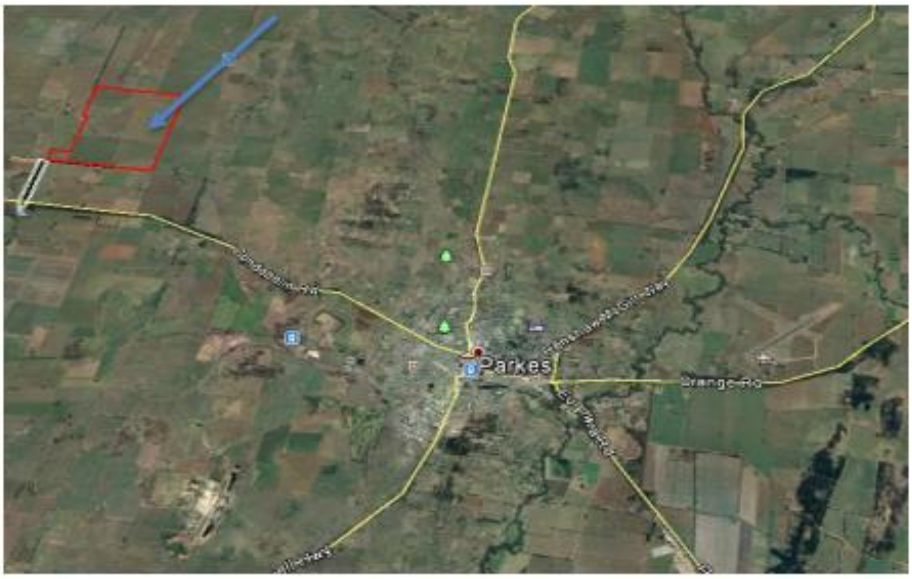


Figure 2: Location of proposed Quorn Park Solar Farm



Quorn Park Solar Farm near Parkes, NSW

Page 2

Stage 2/3 consultation letter and survey methodology (sent to: all RAPs)

OzArk Environmental & Heritage Management Pty Ltd
ABN: 59 104 582 354

7 August 2018

Members
Peak Hill Local Aboriginal Land Council
C/- Cherie Keed
PO Box 63
Peak Hill NSW 2869
phlalc@yahoo.com.au

Re: Aboriginal Cultural Heritage Assessment for the proposed Quorn Park Solar Farm, near Parkes, Parkes Local government Area.

Dear Members,

Thank-you for your registration of interest to become a Registered Aboriginal Party (hereafter 'RAP') to be consulted over the proposed Quorn Park Solar Farm, near Parkes, NSW, in the Parkes Local Government Area.

The purpose of this letter is to present information to RAPs about the proposed project and to gather information from RAPs about the cultural significance of the Study Area. RAPs are also invited to comment on the Aboriginal archaeological assessment methodology outlined below. Your input is important and will be used, wherever possible, to improve the assessment of the Study Area.

OzArk Environmental & Heritage Management (OzArk) acknowledges that land was traditionally occupied by Aboriginal people, and we pay respect to Aboriginal beliefs, cultural heritage and the past and continued connection of Aboriginal people to the land. We also pay respect to post-contact experiences of Aboriginal people with attachment to the area.

Information about the Project

OzArk Environmental & Heritage Management (OzArk) have been engaged by Geolyse on behalf of Renewable Energy Developments (the Proponent) to complete an Aboriginal archaeological assessment of the Study Area, which is located approximately 8.2 kilometres northwest of Parkes, NSW (**Figure 1**).

The Proponent is seeking development consent to develop a solar farm (the Project). The Project is classified as State Significant Development (SSD) under the provisions of Part 4 Division 4.7 of the *Environmental Planning and Assessment Act 1979* in accordance with the *State Environmental Planning Policy (State and Regional Development) 2011*.

The proposed development includes the construction of the solar farm, grid connection and potential road improvements.

Solar farm

The solar farm footprint covers an area of 475.7 hectares (**Figure 2**).

Grid connections

Three grid connection options are being considered to connect the solar farm to an existing substation in Lot 1 DP717289 (**Figure 3**). Areas which will be surveyed include:

- Option 1: North of Condobolin Road, this option is within Lot 504 DP750152, immediately adjacent to the western fence line, approximately 60 metres wide. The option crosses Condobolin Road, remaining west of Pat Meredith Drive (in Lot 7002 DP94814) until crossing to the east to the existing substation.

Dubbo | Queanbeyan | Sydney | Armidale
HEAD OFFICE: 145 Wingewarra St/PO Box 2069 DUBBO NSW 2830
ph 02 6882 0118 | enquiry@ozarkehm.com.au | www.ozarkehm.com.au

- Option 2: North of Condobolin Road, this option is within Lot 8 DP750152, offset from the eastern fence line by 20 metres and approximately 60 metres wide. This option crosses Condobolin Road and crosses Lot 7002 DP94814 where it joins the Option 1 alignment.
- Option 3: Within Lot 8 DP750152, offset from the northern fence line by a minimum of 20 metres, extending west from Option 2, approximately 80 metres wide and extends for a distance of approximately 560 metres.
- Back Trundle Road Survey Area: This area is common to all options as the grind connection will need to cross Back Trundle Road.

It should be noted that the impact area would be contained within the chosen grid connection option but would not impact the entire area.

Potential road improvements

Potential road and intersection improvements may be required (**Figure 4**). Based on recent solar farm developments to the south, the following improvements may be required:

- Upgrade the intersection of Henry Parkes Way and McGrath Lane.
- Upgrade access to the solar farm site off Back Trundle Road.
- Upgrade McGrath Lane to provide all weather two-way traffic i.e. 8 metres wide gravel pavement and associated table drains.
- Widening of tapers of McGrath Lane and Back Trundle Road intersection.
- Upgrade Back Trundle Road to the solar farm access point to provide all weather two-way traffic i.e. 8 metres wide gravel pavement and associated table drains.

Environmental context

The topography of the Study Area is largely undifferentiated with only a gentle slope to the west and contains limited hydrological features, in the form of ephemeral drainage lines (**Figure 5**). Few remnant trees are present throughout the proposed solar farm, while the southernmost extent of the Study Area along Back Trundle Road is densely vegetated with mature, box species.

The solar farm portion of the study area has been subject to repeated, long-term ploughing and vegetation clearance, as has the three options for the grid connection. A number of dams have also been constructed along the drainage lines.

While there are minor variations in the topography of the Study Area, these are not pronounced enough to be mapped in a way that is meaningful for the archaeological understanding of the Study Area.

Local archaeological context

Aboriginal Heritage Information Management System search

A search of the Aboriginal Heritage Information Management System (AHIMS) database was conducted on 2 August 2018. The search returned 30 Aboriginal sites within a 10 x 10 kilometres search over. None of the previously recorded sites are located within the Study Area (**Figure 6**).

Recorded AHIMS sites include 22 isolated finds, five artefact scatters, two modified trees (scarred or carved) and one stone quarry site.

Previous archaeological assessments

In 2016 NGH Environmental completed an archaeological assessment for the Parkes Solar Farm, located approximately 400 metres south of the southern most extent of the current Study Area. The assessed area encompassed 240 hectares of land which is generally flat with little topographic variation. Seven isolated finds were identified during the survey which noted poor ground surface visibility (GSV). Artefacts included two cores, two retouched flakes, two fragments of grinding stones and a milling slab. All sites were recorded as having low potential for subsurface deposits, largely due to prior levels of disturbance. Artefacts were manufactured from a variety of materials including, sandstone, silcrete, volcanic and fine grained siliceous materials. The results of the assessment were concluded as being consistent with the predictive model which predicted isolated finds would be a common site type based on the undifferentiated landforms and lack of permanent or semi-permanent water sources. The recorded sites were noted as being a 'back ground' scatter of occupation and no areas of potential intensive occupation related to potential archaeological deposits (PADs) were identified.

Access Archaeology & Heritage (2016) completed the archaeological survey for the Goonumbla Solar Farm, located directly east of the southernmost extent of the current Study Area. The assessed area encompassed 387 hectares on an undifferentiated, level plain with only one small hill in the east called Millers Lookout. A total of 16 Aboriginal sites were recorded during the field survey including 12 isolated finds, three artefact scatters and one stone hatchet quarry. Silcrete was the most abundant material recorded, making up 36% of the assemblage, with quartz (20%) and volcanics (16%) being the materials recorded. Unmodified and retouched flakes as well as cores were the most common artefact types recorded. All artefact sites were recorded on the plain or footslope landforms except for the quarry which was recorded at the crest of Millers Lookout which comprises outcropping Ordovician 'Goonumbla Volcanics'. Evidence of Aboriginal quarrying was noted at several locations on the crest, and a number of large primary flakes were also recorded. It was concluded that the survey recorded a sparse scatter of artefacts across the landscape, consistent with the results of other surveys undertaken in the area, particularly that of NGH Environmental 2016.

Predictive model

Preliminary predictive modelling, based upon numerous archaeological studies in various environmental zones and contexts throughout Australia, indicates a high correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural significance. Consequently, sites tend to be found along permanent and ephemeral water sources, along access or trade routes, and in areas that have good flora/fauna resources and appropriate topography (i.e. flat or gently sloping landforms) or shelter.

Generally, more durable materials such as stone artefacts, stone hearths, shell, and some bones remain preserved in the present-day landscape. However, these may not be found in their original depositional context due to: (a) the effects of wind and water erosion/transport over short and long time scales; and (b) the historical impacts of European farming practices including (e.g. grazing and cropping; land degradation associated with exotic pests such as goats and rabbits; and the installation of farm related infrastructure including water-storage, irrigation, utilities, roads, fences, stockyards and residential quarters).

As such, greater Aboriginal archaeological potential tends to exist on landforms within 200 metres of permanent and ephemeral water sources, along access or trade routes, and areas with suitable flora/fauna and shelter. Archaeological potential is reduced on landforms disturbed by erosion and historical impacts (e.g. farming and infrastructure installation).

Knowledge of the environmental contexts of the Study Area and a desktop review of the known local archaeological record, the following predictions are made concerning the probability of those site types being recorded within the Study Area:

- Isolated finds - may occur anywhere, particularly within disturbed contexts, as such it predicted that this site type could be recorded within the Study Area.

- Artefact scatters - Artefact scatters, as well as isolated stone artefacts, are the predominant site types occurring in the region. The expected location of artefact scatters is on eroded exposures most commonly adjacent to drainage lines along flat and lower slope landforms. This site type is likely to be in a secondary context from disturbances such as erosion, and ploughing. It is likely that any sites associated with such landforms are likely to have a low artefact density and a low complexity of tool types as the sites are either one-off events or only infrequently used due to the lack of a permanent or semi-permanent water source and the undifferentiated landforms present.

- Scarred trees - Vegetation within the Study Area includes remnant native species. These stands of native vegetation include trees of a type, age and size well suited to scar-producing activities. This site type therefore may be encountered and it is also noted that this site type has been recorded locally

- Quarry sites - this site type could be recorded within the Study Area should suitable rock outcroppings be available. One quarry site, #43-3-0129, is located to the southeast of the however it should be noted that the site is located on a hill crest, and no such landform is located within the current Study Area.

- Hearths/ovens - This site type is considered possible in areas where A-Horizon soils are relatively undisturbed and could be found in association with larger artefact scatters. As the majority of the Study Area has been subject to ploughing, this site type, is likely to have been impacted and no longer discernible.

- Burials - are generally found in elevated sandy contexts or in association with rivers and major creeks. No such features exist with the proposal area and therefore such sites are unlikely to occur.

The proposed Aboriginal archaeological assessment methodology

The Aboriginal archaeological assessment of the Study Area will follow the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010). The field inspection will follow the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011).

<u>Survey methodology</u>

Standard archaeological field survey and recording methods will be employed in this assessment (Burke & Smith 2004).

It should be noted that the aim of any archaeological survey is not to locate each and every artefact in a landscape but to undertake investigations so that the archaeological potential and archaeological characteristics of all landforms within a Study Area are known. Therefore, the aims of the survey will be to:

a) Conduct pedestrian transects to sample the landforms within the Study Area so that their archaeological potential can be determined;

b) Evaluate whether the predictive model set out in is valid;

c) Determine if any portions of the Study Area require test excavation in order to understand the archaeological potential at a particular location;

d) Undertake sufficient assessment in order to satisfy Sections 2.2, 2.4 (as it pertains to scientific values), 2.5, 2.6, and 2.7 in the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011);

e) Collecting sufficient data so that the results can be presented in an Aboriginal Cultural Heritage Assessment Report (ACHAR) as set out in Section 3 in the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011); and

f) Undertaking survey and record keeping in order to satisfy Requirements 1–13 of the Code of Practice.

In the field, OzArk staff will identify, record and evaluate physical (i.e. archaeological) evidence. Site recording will capture all of the information required to complete current AHIMS site recording forms (e.g. site location, site boundary, site plan, representative photographs, artefact recording and feature recording). RAPs will participate in the survey, identifying Aboriginal objects, determining the cultural significance of Aboriginal objects and identifying cultural places or non-physical site types within the Study Area. OzArk staff understand that cultural knowledge may not be provided in some instances due to cultural sensitivities (e.g. men's and/or women's places). Under these circumstances, in order to assess the potential impacts, OzArk staff will need to be told, only in general terms, why a particular place is important, and what the significance of the impact will be. OzArk staff will liaise with RAPs on a case-by-case basis to determine how to record the location in a culturally sensitive manner. OzArk staff will ensure that field assessments are completed in the time budgeted, and emphasise that only the Study Area is to be assessed at all times.

<u>Survey areas</u>

The field assessment will include the following in the proposed impact areas:

- Solar farm: survey will aim to sample all landforms present using systematic transects. In areas deemed to have lower archaeological potential, i.e. areas more than 200 metres from watercourses; areas with poor GSV; and areas with significant prior disturbance, the survey effort will not be as intensive as it will be in areas deemed to have increased archaeological potential where full systematic survey will be completed.
- Grid connections: all three options will be subject to full pedestrian survey due to their width, averaging 20 metres.
- Road improvements: the entire corridors will also be subject to full pedestrian survey due to its width. Survey will be intensive along Back Trundle Road due to the presence of dense vegetation.

<u>Test excavation</u>

It is possible that the survey may identify landforms where test excavation under the Code of Practice (Requirements 14–17) is required. Should such landforms be identified during the survey, the test excavation methodology will be prepared as a separate document that will be circulated to all RAPs for review and comment.

Feedback on the proposed methodology and on the cultural significance of the Study Area

OzArk is required to give you 28 days to review and provide feedback on the proposed Aboriginal archaeological assessment methodology. This period closes on **5th September 2018 at 5pm**. In addition, OzArk invites you to comment on the Aboriginal cultural heritage significance of the proposed Study Area, including:

- Any protocols that RAPs wish to be incorporated into the information gathering process and assessment methodology
- Any other matters, including issues or areas of cultural significance that might affect, inform or refine the assessment methodology.
- Any Aboriginal objects of cultural value to Aboriginal people in the Study Area.
- Any places of cultural value to Aboriginal people in the Study Area, including: places with social, spiritual and cultural value; historic places with cultural significance; and potential places/areas of historic, social, spiritual and/or cultural significance.
- Any protocols that RAPs wish to be implemented in the sourcing and holding of cultural information, including sensitive information, and information with restricting public access.
- Any management options, including how to avoid or mitigate harm and/or conserve Aboriginal objects or places.

We welcome this input to ensure Aboriginal cultural values are considered prior to the field assessment to ensure adequate preparation. Input is invited from representatives at any stage of the project.

Should you need any help supplying feedback or have any queries, please do not hesitate to contact our office (phone: 02 6882 0118; or email: stephanie@ozarkehm.com.au).

Kind regards,

Stephanie Rusden
Archaeologist

OzArk Environmental & Heritage Management Pty Ltd
PO Box 2069 DUBBO 2830
P: 02 6882 0118; F: 02 6882 0630
stephanie@ozarkehm.com.au; www.ozarkehm.com.au

OzArk and staff respectfully acknowledge the Traditional Owners and Custodians of the country on which we work.

Quorn Park Solar Farm, near Parkes, NSW. Page 6

Stage 4 ACHAR review letter (sent to: all RAPs)

OzArk Environmental & Heritage Management Pty Ltd

ABN: 59 104 582 354

Environmental & Heritage Management P/L

9 October 2018

Members
Peak Hill Local Aboriginal Land Council
C/- Cherie Keed
PO Box 63
PEAK HILL NSW 2869
phlalc@yahoo.com.au

Dear Members,

RE: DRAFT Aboriginal Cultural Heritage Assessment - Quorn Park Solar Farm.

Thank-you for your continued participation as a Registered Aboriginal Party (RAP) and involvement in the above mentioned project.

Renewable Energy Developments (the Proponent) would like to offer you the opportunity to provide feedback on the draft report that has been undertaken in accordance with stage four (4) of the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (ACHCR).

We wish to draw your attention to section 7.3 Management Process, page 89 (last dot point) regarding the fate of the salvaged artefacts. Please let us know if you disagree with this recommendation, which is for reburial of the salvaged artefacts in a safe part of the project area.

As per the ACHCRs we are required to give you twenty eight (28) days to supply feedback on the attached documents. This period closes on the **Wednesday 7th November 2018.** Should our office not be contacted within this time frame, we will presume that you are satisfied with the contents of the report as it stands.

Should you need any help supplying feedback or have any queries, please do not hesitate to contact our office.

Kind regards,

Sheridan Baker
Consultation Officer

Dubbo | Queanbeyan
HEAD OFFICE: 145 Wingewarra St/PO Box 2069 DUBBO NSW 2830
ph 02 6882 0118 | enquiry@ozarkehm.com.au | www.ozarkehm.com.au

Stage 4 additional ACHAR review letter (sent to: all RAPs)

OzArk Environmental & Heritage Management Pty Ltd

ABN: 59 104 582 354

13 November 2018

Members
Peak Hill Local Aboriginal Land Council
C/- Cherie Keed
PO Box 63
PEAK HILL NSW 2869
phlalc@yahoo.com.au

Dear Members,

RE: DRAFT Aboriginal Cultural Heritage Assessment - Quorn Park Solar Farm.

Thank-you for your continued participation as a Registered Aboriginal Party (RAP) and involvement in the above-mentioned project.

Following the closure of stage four (4) of the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010, the impact footprint of the project was modified. The modification includes the inclusion of grid connection alignment 2 which will result in impact to an additional Aboriginal site, Warrawee IF-1.

The Proponent would like to allow an additional 10 days for the updated Aboriginal Cultural Heritage Assessment Report to be reviewed and provide any feedback. This period closes on the **Friday 23rd November 2018.** Should our office not be contacted within this time frame, we will presume that you are satisfied with the contents of the report as it stands.

Should you need any help supplying feedback or have any queries, please do not hesitate to contact our office.

Kind regards,

Sheridan Baker
Consultation Officer

Dubbo | Queanbeyan
HEAD OFFICE: 145 Wingewarra St/PO Box 2069 DUBBO NSW 2830

APPENDIX 2: AHIMS EXTENSIVE SEARCH RESULT

Office of Environment & Heritage
NSW GOVERNMENT

AHIMS Web Services (AWS)
Extensive search - Site list report

Your Ref/PO Number : 1910 Quorn Solar
Client Service ID : 361674

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
43-3-0118	Parkes Solar IF6	GDA	55	600300	6335697	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,NGH Heritage - Fyshwick					Permits		
43-3-0080	Parkes P1	GDA	55	603525	6336275	Open site	Valid	Modified Tree (Carved or Scarred) : -		102769
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
43-3-0081	PIF2	GDA	55	600053	6336084	Open site	Valid	Artefact : 1		102769
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
43-3-0082	P2.	GDA	55	603464	6336084	Open site	Valid	Modified Tree (Carved or Scarred) : 1		102769
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
43-3-0083	PIF1	GDA	55	600000	6336400	Open site	Valid	Artefact : 1		102769
	Contact	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
43-3-0090	Ridgey Creek - Parkes	GDA	55	600114	6336585	Open site	Valid	Artefact : -		102769
	Contact Mr.Trevor Robinson	Recorders	Mr.Trevor Robinson					Permits		
43-3-0135	GSF-5 Isolated Artefact	GDA	55	600148	6336485	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0136	Parkes Solar Relocated Artefacts	GDA	55	600667	6334791	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,NGH Heritage - Fyshwick					Permits		
43-3-0112	Parkes Solar IF7	GDA	55	600130	6336182	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,NGH Heritage - Fyshwick					Permits		
43-3-0113	Parkes Solar IF5	GDA	55	599931	6335372	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,NGH Heritage - Fyshwick					Permits		
43-3-0114	Parkes Solar IF4	GDA	55	601575	6335464	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,Mr.Matthew Barber,NGH Heritage - Fyshwick,NGH Heritage - F					Permits		
43-3-0115	Parkes Solar IF3	GDA	55	600780	6334824	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,Mr.Matthew Barber,NGH Heritage - Fyshwick,NGH Heritage - F					Permits		
43-3-0116	Parkes Solar IF2	GDA	55	600844	6334824	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,Mr.Matthew Barber,NGH Heritage - Fyshwick,NGH Heritage - F					Permits		
43-3-0117	Parkes Solar IF1	GDA	55	600530	6334822	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,Mr.Matthew Barber,NGH Heritage - Fyshwick,NGH Heritage - F					Permits		
43-3-0120	GSF-7 Isolated Artefact	GDA	55	602680	6336515	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0121	GSF-6 Isolated Artefact	GDA	55	600148	6336485	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		

Report generated by AHIMS Web Service on 02/08/2018 for Stephanie Rusden for the following area at Datum :GDA, Zone : 55, Eastings : 595853 - 605853, Northings : 6332926 - 6342926 with a Buffer of 0 meters. Additional Info : Survey. Number of Aboriginal sites and Aboriginal objects found is 30

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Office of Environment & Heritage
NSW GOVERNMENT

AHIMS Web Services (AWS)
Extensive search - Site list report

Your Ref/PO Number : 1910 Quorn Solar
Client Service ID : 361674

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
43-3-0122	GSF-14 Artefact Cluster	GDA	55	602582	6335080	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0123	GSF-13 Isolated Artefact	GDA	55	602582	6335080	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0124	GSF-12 Isolated Artefact	GDA	55	601729	6336217	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0125	GSF-11 Isolated Artefact	GDA	55	601729	6336217	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0126	GSF-10 Isolated Artefact	GDA	55	602016	6336479	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0127	GSF-9 Isolated Artefact	GDA	55	602083	6336461	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0119	Parkes Solar IF6a	GDA	55	600300	6335697	Open site	Destroyed	Artefact : -		
	Contact	Recorders	Mr.Matthew Barber,Mr.Matthew Barber,NGH Heritage - Fyshwick,NGH Heritage - F					Permits		
43-3-0128	GSF-8 Artefact Cluster	GDA	55	603165	6336407	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0129	Millers Lookout Quarry	GDA	55	603128	6335827	Open site	Valid	Stone Quarry : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0130	GSF-15 Isolated Artefact	GDA	55	602667	6335240	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd					Permits		
43-3-0131	GSF-4 Isolated Artefact	GDA	55	600192	6336259	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd,Acce					Permits		
43-3-0132	GSF-3 Artefact Cluster	GDA	55	600336	6336242	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd,Acce					Permits		
43-3-0133	GSF-2 Isolated Artefact	GDA	55	600579	6336165	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd,Acce					Permits		
43-3-0134	GSF-1 Isolated Artefact	GDA	55	600838	6336348	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Doug Williams,Mr.Doug Williams,Access Archaeology and Heritage Pty Ltd,Acce					Permits		

Report generated by AHIMS Web Service on 02/08/2018 for Stephanie Rusden for the following area at Datum :GDA, Zone : 55, Eastings : 595853 - 605853, Northings : 6332926 - 6342926 with a Buffer of 0 meters. Additional Info : Survey. Number of Aboriginal sites and Aboriginal objects found is 30

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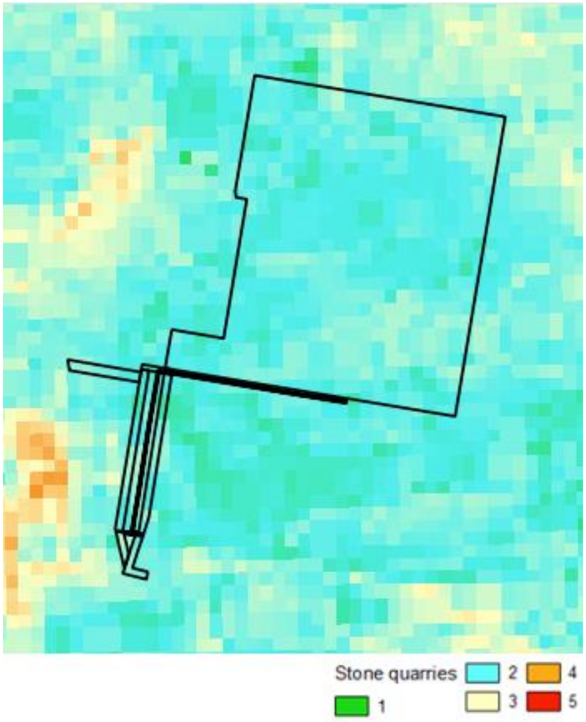
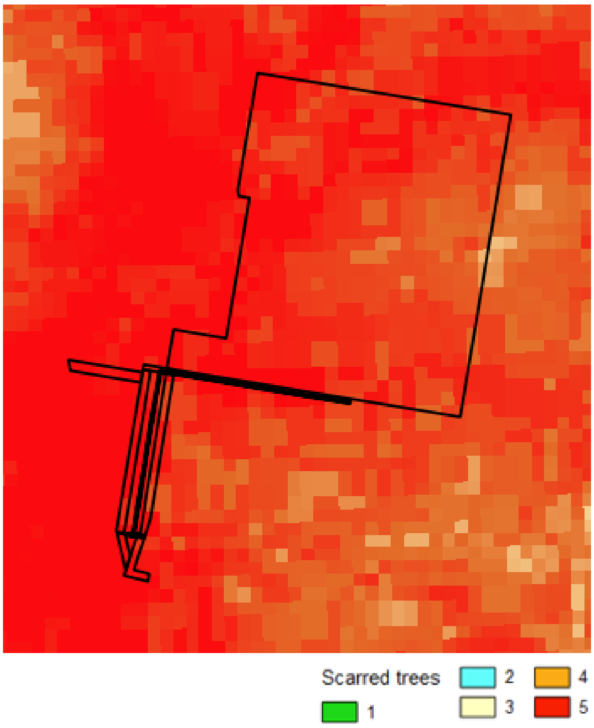
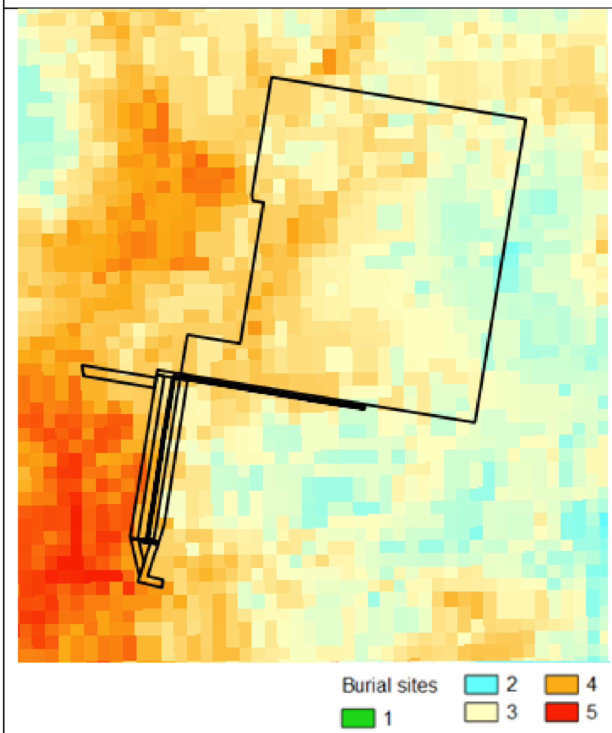
APPENDIX 3: ASDST PREDICTIVE DATA OF THE PROJECT SITE



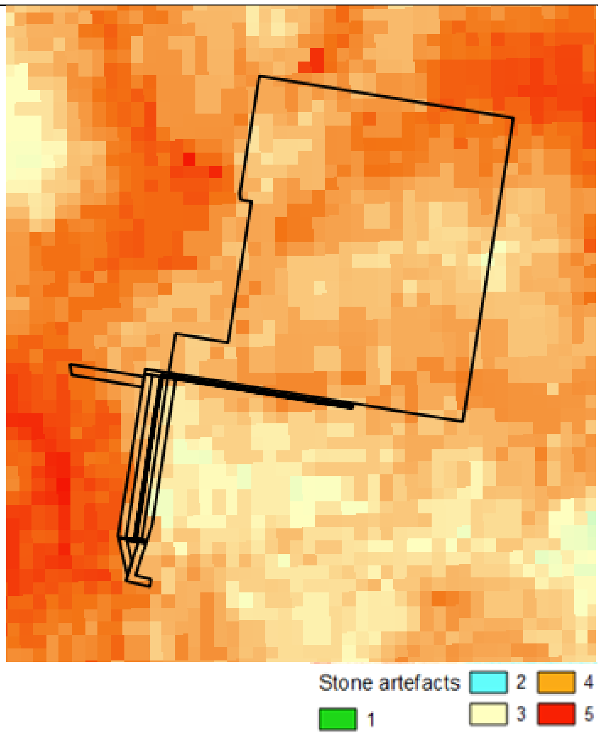
1. View of the Project Site with the likelihood of quarries being present.



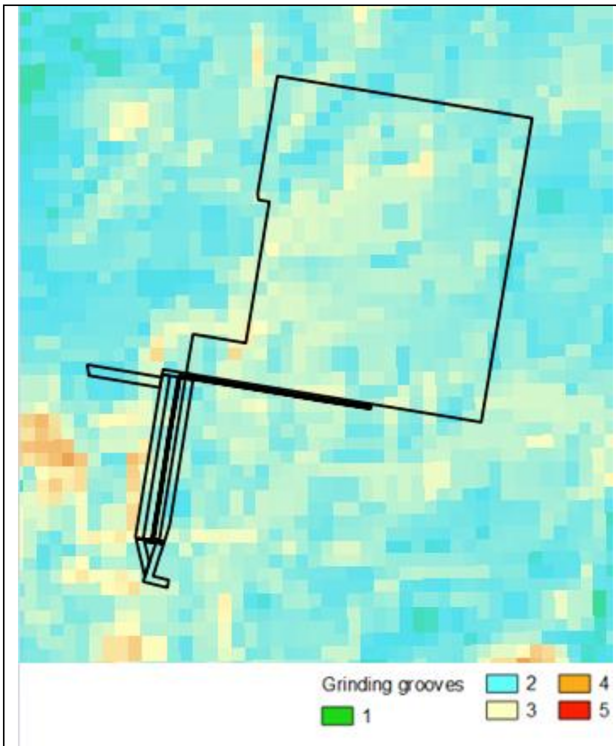
2. View of the Project Site with the likelihood of scarred trees being present.



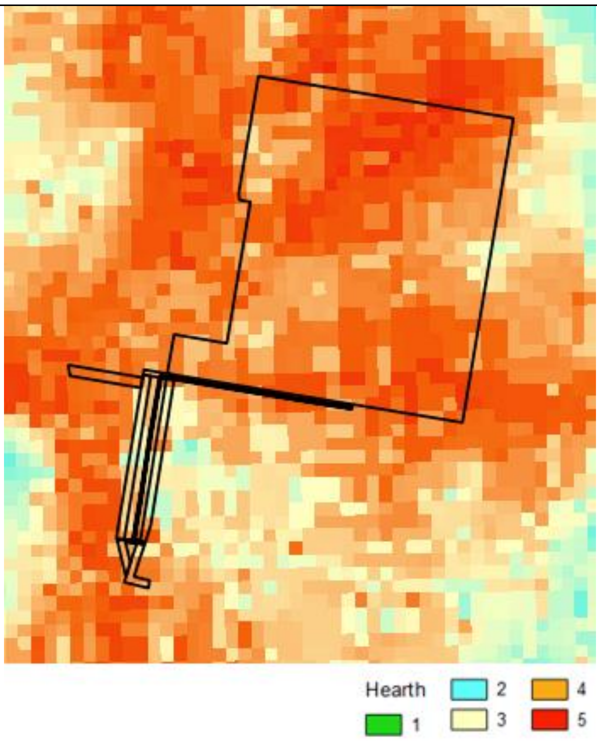
3. View of the Project Site with the likelihood of burial sites being present.



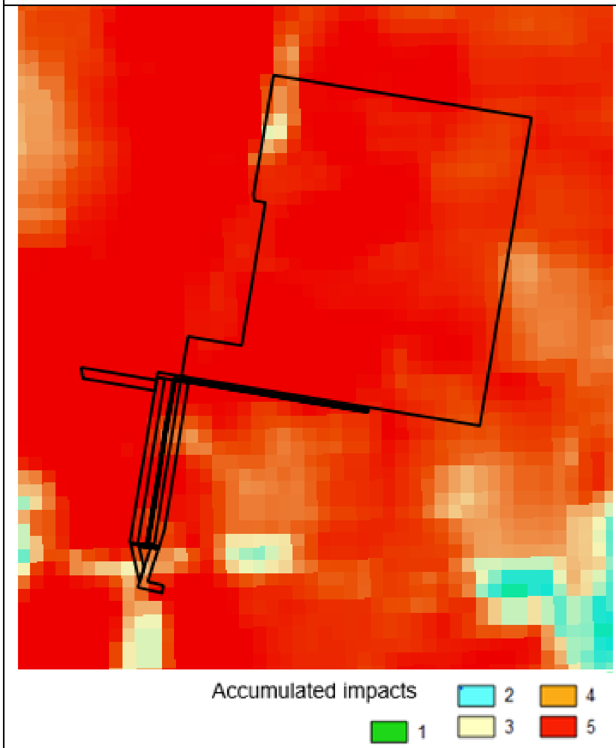
4. View of the Project Site with the likelihood of stone artefact sites being present.



5. View of the Project Site with the likelihood of grinding grooves being present.



6. View of the Project Site with the likelihood of hearths being present.



7. View of the Project Site showing accumulated impacts.

APPENDIX 4: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

An Aboriginal artefact is anything which is the result of past Aboriginal activity. This includes stone (artefacts, rock engravings etc.), plant (culturally scarred trees) and animal (if showing signs of modification; i.e. smoothing, use). Human bone (skeletal) remains may also be uncovered while onsite.

Cultural heritage significance is assessed by the Aboriginal community and is typically based on traditional and contemporary lore, spiritual values, and oral history, and may also take into account scientific and educational value.

Protocol to be followed in the event that previously unrecorded or unanticipated Aboriginal object(s) are encountered:

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:
    a. Not further harm the object;
    b. Immediately cease all work at the particular location;
    c. Secure the area so as to avoid further harm to the Aboriginal object;
    d. Notify OEH as soon as practical on 131 555, providing any details of the Aboriginal object and its location; and
    e. Not recommence any work at the particular location unless authorised in writing by OEH.
2. In the event that Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and OEH contacted.
3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:
    a. The recording and assessment of the find(s);
    b. The fulfilment of any legal constraints arising from the find(s), including complying with OEH directions; and
    c. The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).
    d. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from OEH (normally an Aboriginal Heritage Impact Permit).

APPENDIX 5: HISTORIC HERITAGE: UNANTICIPATED FINDS PROTOCOL

A historic artefact is anything which is the result of past activity not related to the Aboriginal occupation of the area. This includes pottery, wood, glass and metal objects as well as the built remains of structures, sometimes heavily ruined.

Heritage significance is assessed by suitably qualified archaeologists who place the item or site in context and determine its role in aiding the community's understanding of the local area, or their wider role in being an exemplar of state or even national historic themes.

Protocol to be followed in the event that previously unrecorded or unanticipated historic object(s) are encountered:

1. All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.
   a) The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted; and
   b) The site supervisor will be informed of the find(s).
2. If finds are suspected to be human skeletal remains, then NSW Police must be contacted as a matter of priority.
3. If there is substantial doubt regarding the historic significance for the finds, then gain a qualified opinion from an archaeologist as soon as possible. This can circumvent proceeding further along the protocol for items which turn out not to be significant. If a quick opinion cannot be gained, or the identification is that the item is likely to be significant, then proceed to the next step.
4. Immediately notify OEH (Heritage Division) at 131 555 of the discovery:
5. Facilitate, in co-operation with the appropriate authorities:
   a) The recording and assessment of the finds;
   b) Fulfilling any legal constraints arising from the find(s). This will include complying with OEH directions; and
   c) The development and conduct of appropriate management strategies. Strategies will depend on consultation with stakeholders and the assessment of the significance of the find(s).
6. Where the find(s) are determined to be significant historic items, any re-commencement of construction related ground surface disturbance may only resume in the area of the find(s) following compliance with any consequential legal requirements and gaining written approval from OEH.

Appendix E

SOILS ASSESSMENT

September 2018

Soil Report: Quorn Park Solar Farm, Parkes

Prepared for:
Quorn Park Solar Farm Pty Ltd

Dr. David McKenzie
Soil Management Designs
Orange NSW

Contents

List of Figures

List of Attachments

EXECUTIVE SUMMARY

A soil survey was carried out in August 2018 at the site of a proposed solar farm approximately 10 km north-west of Parkes NSW. The area of interest at 'Quorn Park' covers about 475 ha.

The majority of the site is gently sloping with a westerly aspect. It is underlain by colluvium/alluvium derived from ancient dark-coloured volcanic parent material. Windblown dust also is likely to have been involved as a soil-forming material.

The five soil pits that were assessed indicated that approximately 40% of the study area is Red Chromosol (light textured topsoil overlying clay-rich subsoil) and 60% Red Dermosol (soil with a lack of strong texture contrast between topsoil and well structured subsoil).

Key soil issues at the site were as follows:

- Water erosion is unlikely to be a serious issue provided that a protective organic groundcover is maintained, preferably via the use of sown perennial pasture. The stable subsoil conditions (as indicated by favourable dispersion and exchangeable sodium data) mean that tunnel erosion is highly unlikely. Coverage of the soil surface by pasture also will minimize the risk of soil loss via wind erosion.
- The main soil-related limitation to crop and pasture production is soil acidity. Lime (calcium carbonate) application across the entire area at 'Quorn Park' prior to solar panel installation will be beneficial.
- The only nutrient requiring attention is sulphur – it can be added via gypsum (calcium sulphate) application at a rate of 0.2 t/ha.
- There was no obvious need for broad-scale deep ripping to improve plant root growth across the study area.
- Salinity was not evident at any of the five sampling sites.

Based on the 5-pit assessment, 60% of the study area (represented by sampling sites 1, 3 and 5) is 'biophysical strategic agricultural land' (BSAL).

Site 2 was non-BSAL because of a combination of soil acidity (pH_{CaCl2} =4.4 at a depth of 5-15 cm) and evidence of waterlogging below a depth of 62cm. Site 4 was non-BSAL because of soil acidity (pH_{CaCl2} =4.4 at a depth of 5-15 cm).

The subsoil waterlogging at Site 2 appeared to be caused by bedrock close to the surface and proximity to a watercourse. At the other four sampling sites, the 'rusty red' soil profile colour indicated that subsoil drainage was unimpeded.

In summary, the suggested soil management inputs associated with the solar farm proposal are:

1. Add lime to overcome agriculturally-induced soil acidity. Extra 0-15 cm soil testing prior to construction is recommended to provide a detailed map showing lime application rates.
2. Establish pasture as soon as possible to minimize the risk of soil erosion.
3. Add gypsum to overcome sulphur deficiency problems.
4. Control vehicle traffic during construction to minimize compaction problems, particularly when the soil is wet and prone to being damaged.
5. Position the solar panels on an incline, at night-time, in a way that encourages deep penetration of water from the panel drip lines that can be utilized efficiently by deep rooted pasture plants.
6. On-going soil testing (triennially to a depth of 30 cm at the 5 sampling sites) is recommended to allow possible fine-tuning of the management of soil pH, nutrition and structure under the pasture, and to demonstrate progress with soil health over time.
7. After solar farm decommissioning, assess compaction damage in the topsoil and consider non-inversion chisel ploughing to loosen the soil.

1 INTRODUCTION

A soil survey was carried out on 14 August 2018 at the site of a proposed Solar Farm about 10 km north-west of Parkes NSW (Figure 1). The study was requested by Quorn Park Solar Farm Pty Ltd via Geolyse Pty Ltd. The area of interest covers approximately 475 ha.

The aims of the assessment of topsoil and subsoil to a depth of one metre were to:

1. Find out how sodic the soil is and assess the risk of water erosion, particularly tunnel erosion, during and after installation of the solar panels and associated infrastructure.
2. If the soil is sodic, give recommendations about gypsum (calcium sulphate) and lime (calcium carbonate) application to improve soil drainage when wet and reduce excessive hardness when dry.
3. If the soil is acidic, provide recommended rates of application of lime.
4. Identify any soil nutrient problems that exist so that suitable fertiliser can be added to improve pasture growth. Vigorous pasture production is likely to make the soil better at the end of the solar farm project than at the start through increases in soil carbon content and improved soil structure.
5. Provide an overview of soil constraints relevant to construction of the solar farm, eg. shrink-swell potential and subsoil salinity.
6. Any soil limitations will be discussed in relation to the agricultural value of the site, with reference to 'biophysical strategic agricultural land' (BSAL) definitions from NSW Government.

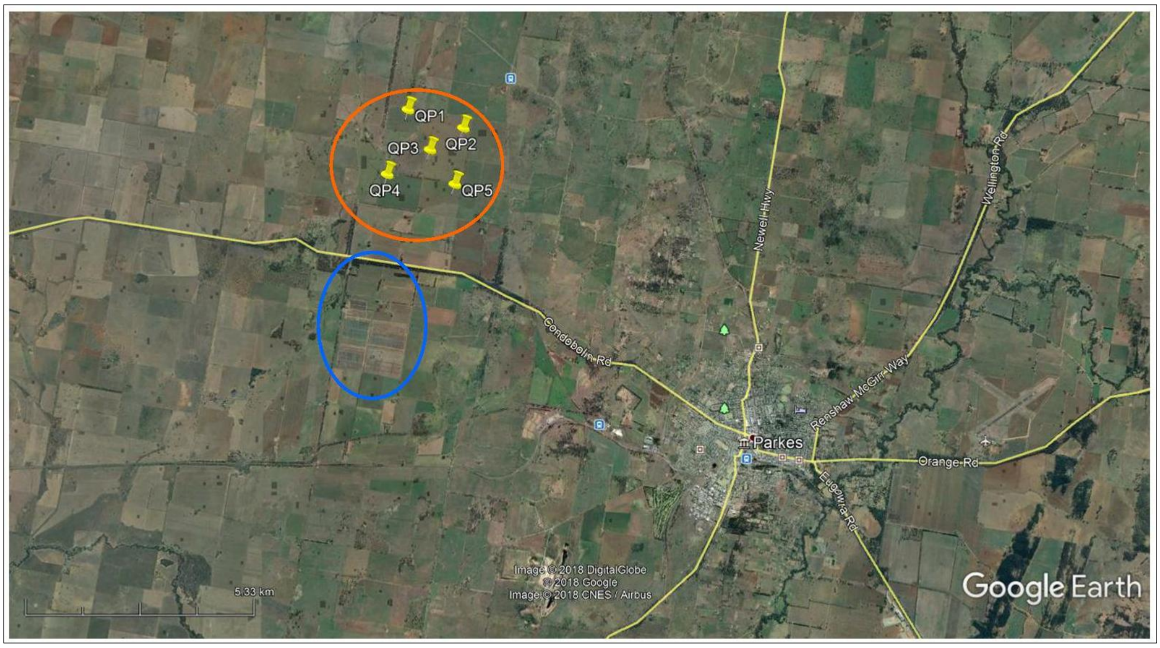


Figure 1. Location of the study area (orange circle), 10 km north-west of Parkes. The blue circle shows the location of an existing solar farm and electricity sub-station.

2 SITE DESCRIPTION AND EXISTING INFORMATION

2.1 Site Description

The majority of the site is gently sloping with a westerly aspect (slope <1.5%; see Figure 2). It is underlain by colluvium/alluvium derived from mafic Ordovician parent material (Yarrimbah Formation; Raymond *et al.* 2000). Windblown dust also is likely to have been involved as a soil-forming material. The south-flowing creeks are tributaries of Goobang Creek, which joins the Lachlan River near Condobolin.

Land use at the study site in August 2018 was dryland cropping (barley and canola).

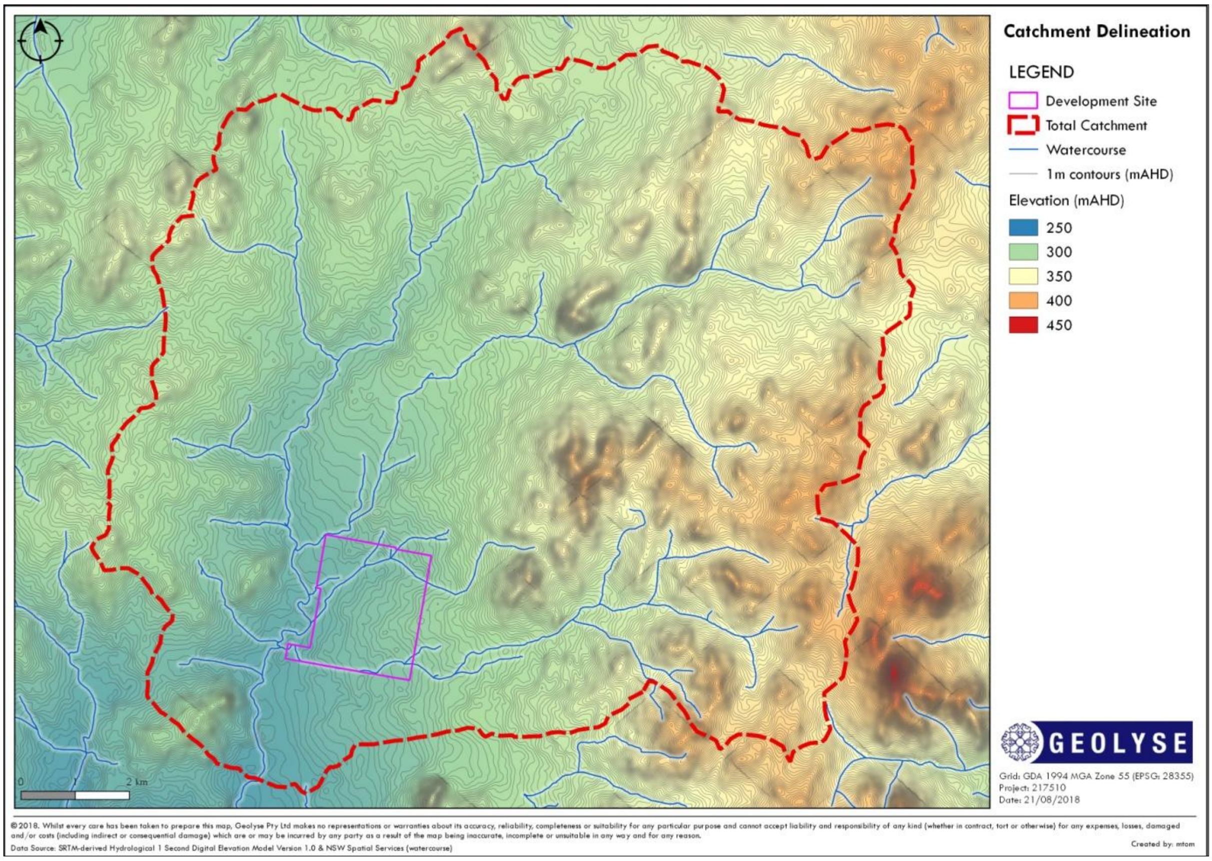


Figure 2. 'Quorn Park' boundaries (purple lines) in relation to elevation contours.

2.2 Existing Soil Information

A search of the NSW Government's 'eSPADE' website (part of the NSW Natural Resource Atlas) was conducted to identify any existing soil profile information. There are no eSPADE soil profiles located in the area of interest.

According to King (1998), the 'soil landscape unit' at 'Quorn Park' is 'Brolgan Plain', derived from 'Quaternary alluvium'.

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) includes mapping of lands identified as BSAL. NSW Government BSAL mapping indicates that none of the study site is BSAL (NSW Planning & Infrastructure, 2013).

3 SOIL SURVEY METHODOLOGY

3.1 Field Work

The soil survey included an assessment of 5 detailed soil pit profiles dug with a backhoe (approximately 1.2 m deep). The soil pit locations are shown in Figure 3.

Figure 3. Soil pit positions in relation to 'Quorn Park' boundaries.

The field description methods were as described in the '*Australian Soil and Land Survey Field Handbook*' (National Committee on Soil and Terrain, 2009) and the '*Guidelines for Surveying Soil and Land Resources, Chapter 29*' (McKenzie *et al*., 2008). The soil profiles have been classified according to the Australian Soil Classification (Isbell, 2002).

The soil survey was carried out by Dr David McKenzie, who has Certified Professional Soil Scientist accreditation from Soil Science Australia (including 'Recognised Competencies for Australian Soil Survey') and a PhD in soil science. Dr. McKenzie also has 'Chartered Scientist' accreditation with British Society of Soil Science.

The 1.2 m deep pit profiles were trimmed with a geological pick to allow high-resolution photography (4MB SLR images) and description of the undisturbed structure and root growth.

The following characteristics were assessed for the layers identified in each of the soil profiles:

- thickness of each layer (horizon);
- soil moisture status at the time of sampling;
- pH (using Raupach test kit);
- colour of moistened soil (using Munsell reference colours) and mottle characteristics;
- pedality of the soil aggregates;
- amount and type of coarse fragments (gravel, rock, manganese oxide nodules);
- texture (proportions of sand, silt and clay), estimated by hand;
- presence/absence of free lime and gypsum;
- root frequency; and
- dispersibility and the degree of slaking in deionised water (after 10 minutes).

Field observations for each pit are presented in Attachments A, B and C.

The soil structure information (Attachment C) has been summarised to give SOILpak 'compaction severity' scores (McKenzie, 2001). This allows deep tillage recommendations to be made from the structure observations. The score is on a scale of 0.0 to 2.0, with a score of 0.0 indicating very poor structure for crop root growth and water entry/storage. Ideally, the SOILpak score of the root zone should be in the range 1.5 to 2.0.

Hand texturing (National Committee on Soil and Terrain, 2009) provides an approximation of the clay content of a soil. In conjunction with the estimation of coarse fragment (gravel) content, it provides a low-cost alternative to particle size analysis.

3.2 Laboratory Testing of Soil Samples

All of the soil pits were sampled for laboratory analysis. The sampling intervals for laboratory analysis were as per the BSAL 'Interim Protocol' (NSW Government, 2013); ie. 0 to 5 cm, 5 to 15 cm, 15 to 30 cm, 30 to 60 cm, and 60 to 100 cm.

The soil was analysed by Incitec-Pivot Laboratory, Werribee Victoria for exchangeable cations, pH, electrical conductivity, chlorides, topsoil nutrient status (nitrate-nitrogen, phosphorus, sulphur, zinc, copper, boron) and organic carbon content (Attachment D). An ammonium acetate method was used for the extraction of exchangeable cations. The CEC values are the sum of exchangeable sodium, potassium, calcium, magnesium and aluminium; exchangeable sodium data are presented as exchangeable sodium percentage (ESP). The electrochemical stability index (ESI) = $EC_{1:5} \div$ ESP. Phosphorus was determined using the Colwell method, sulphur by the CPC method, boron by a calcium chloride ($CaCl_2$ extraction) and zinc/copper by a DTPA extraction (see Rayment and Lyons [2011] for further details).

Soil dispersibility, as measured by the Aggregate Stability in Water (ASWAT) test (Field *et al.*, 1997), was assessed by Soil Management Designs in Orange, NSW. The results are presented in Attachment D. The ASWAT test has been related to the well-known Emerson aggregate stability test by Hazelton and Murphy (2007) – see Table 1. An advantage of the ASWAT test is that the results can be linked with management issues such as the need for gypsum application and avoidance of wet working (McKenzie, 2013) (Figure 4). The conversion factors of Slavich and Petterson (1993) allowed the ECe to be calculated from the EC of 1:5 soil:water suspensions ($EC_{1:5}$) and texture.

Table 1. The relationship between the Emerson Aggregate Stability Test and the ASWAT test.

Dispersibility	Emerson Aggregate Classes	Probable score for the ASWAT test (Field *et al.*, 1997)
Very high	1 and 2(3)	12-16
High	2(2)	10-12
High to moderate	2(1)	9-10
Moderate	3(4) and 3(3)	5-8
Slight	3(2), 3(1) and 5	0-4
Negligible/aggregated	4, 6, 7, 8	0

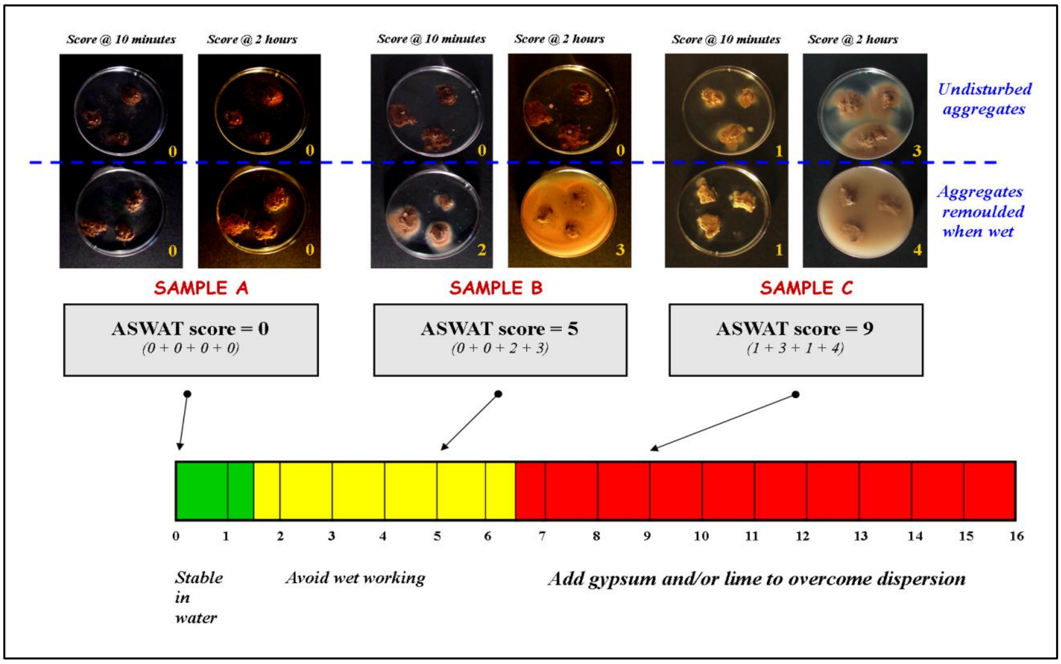


Figure 3. The link between ASWAT results and soil management options.

4 SOIL SURVEY RESULTS

4.1 Soil Types

The Australian Soil Classification (ASC) (Isbell, 2002) has been used to determine soil types at each of the 5 sampling sites. Photographs of the soil profiles (and associated landscapes) at each site are presented in Figure 5.

A single 'soil landscape unit' covers the entire study area. It consists of a mosaic of the following soil types (Isbell, 2002):

- Chromosols, which have a strong texture contrast between the A and B horizons; the B horizon is non-sodic with a neutral to alkaline pH.
- Dermosols, which have a lack of strong texture contrast between topsoil and well structured subsoil.

Site	Soil profile and ASC description	Landscape View
Pit 1	Red Chromosol 	
Pit 2	Red Chromosol 	
Pit 3	Red Dermosol 	 ***Cont.***

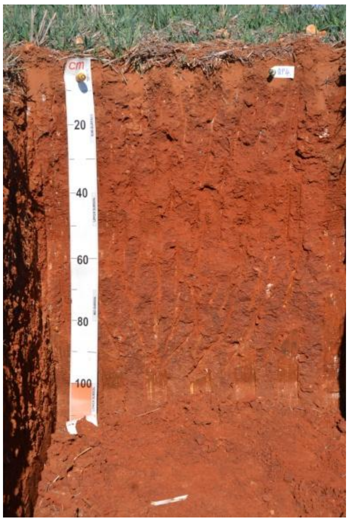
Site	Soil profile and ASC description	Landscape View
Pit 4	Red Dermosol 	
Pit 5	Red Dermosol 	

Figure 5. Photographs of soil profiles and landscapes at each of the five sampling sites.

4.2 Soil factors relevant to establishment and management of the proposed solar farm

Water and Wind Erosion

Water erosion is unlikely to be a serious issue provided that a protective organic groundcover is maintained. It is recommended that perennial pasture be used (see Section 5). The stable subsoil conditions (as indicated by favourable dispersion and exchangeable sodium data; Attachment D) mean that tunnel erosion is very unlikely to occur.

pH and Nutrients

The main soil-related limitation to crop and pasture production is soil acidity (Attachment D). Lime (calcium carbonate) application will overcome the constraint. This is not an essential pre-requisite for management of the solar farm. However, there is an opportunity to do something as part of the solar farm development that would provide a net soil health benefit. Because soil ameliorants will be difficult to apply once the solar farm infrastructure has been built, it is recommended that lime be applied across the entire area at 'Quorn Park', prior to solar panel installation, to provide both short-term and long-term soil health benefits beneath perennial pasture.

Fortunately, subsoil pH is close to ideal for growth of a broad range of pasture and crop species.

The only nutrient requiring attention for soil health improvement is sulphur – it can be added via gypsum (calcium sulphate) application at a rate of 0.2 t/ha.

Compaction

There was no obvious need for deep ripping to improve plant root growth across the study area. The only layer with obvious compaction damage was the B21 horizon (8-40 cm) at Pit 3.

Site Drainage and Trafficability

The favourable soil profile drainage characteristics in the upper half-meter of soil at the sites inspected in this study indicates that the soil is unlikely to become badly boggy and impassable in wet weather.

Shrink-swell Capacity

There was no evidence of extreme shrink-swell characteristics in any of the subsoils. However, the low topsoil CEC values (a measure of shrink-swell potential as the soil is dried and rewet) indicate a slow natural repair process following soil compaction damage.

Salinity

Salinity was not evident at any of the five sampling sites.

4.3 BSAL Status within the Study Area

Based on a 5-pit assessment 60% of the study area (represented by sampling sites 1, 3 and 5) is BSAL.

Site 2 was non-BSAL because of a combination of soil acidity (pH_{CaCl2} =4.4 at a depth of 5-15cm) and evidence of waterlogging below a depth of 62cm. Site 4 was non-BSAL because of soil acidity (pH_{CaCl2} =4.4 at a depth of 5-15cm).

The subsoil waterlogging at Site 2 appeared to be caused by bedrock close to the surface and proximity to a water course. At the other four sampling sites, the 'rusty red' soil profile colour indicated that subsoil drainage was unimpeded.

4.4 Land and Soil Capability; Agricultural Land Classification

It is evident from the Land and Soil Capability (LSC) (NSW OEH 2012), Agricultural Land Classification (Hulme *et al.* 2002) and BSAL (NSW Government 2013) assessments (Attachment E) that the area of interest at 'Quorn Park' is high quality agricultural land. Subsoil conditions for plant growth are particularly favourable because of unimpeded drainage (except at Pit 2), excellent capacity to store water and a near-ideal pH.

However, the upper 15 cm of soil is strongly acidic and limiting to plant growth. Overcoming this problem through the application of agricultural lime will make the 'Quorn Park' site significantly better for plant growth than in August 2018.

5 LAND MANAGEMENT RECOMMENDATIONS

5.1 Soil inputs prior to solar panel installation

Soil management requirements for the 'Quorn Park' Solar Farm site, prior to solar panel installation, are as follows:

- Application of lime (calcium carbonate; $CaCO_3$) across the entire area will overcome acidity constraints. This will provide an enhanced capacity to establish and maintain groundcover. If possible, use non-inversion cultivation at a depth of 15 cm (around the contours if possible) to thoroughly mix the lime with acidic topsoil. Additional 0-15 cm soil testing is recommended prior to construction to provide a detailed map showing lime application rates across 'Quorn Park'.
- Establish and maintain perennial pasture that provides 100% groundcover, even under very dry conditions. Aim for a pasture that includes a balanced mix of grasses, legumes and herbs. The presence of impressive concentrations of plant available phosphorus in the topsoil (Attachment D) means that improved pasture with introduced pasture species will be preferable to less productive native pasture species.
- The soil is well supplied with phosphorus and nitrogen, but gypsum (calcium sulphate; $CaSO_4$) application is recommended (coarse grade mined product; 0.2 t/ha) to overcome sulphur deficiency.

It is best to spread soil ameliorants, perhaps spray for weeds, then sow a pasture while the site is free of obstacles to farm machinery, ie. prior to installation of the solar farm infrastructure.

The anticipated improvement in soil assessment and management following conversion to solar power generation almost certainly will lead to an improvement in soil conditions for plant growth. The roots and fungi associated with diverse and vigorous pasture assist with soil aggregation and carbon sequestration.

The creation of baseline soil data will allow improvements in soil fertility to be demonstrated in later years. Regular on-going soil testing will allow the soil management programs for the solar farm to be fine-tuned. Soil testing in the upper 30 cm of soil is recommended in the vicinity of the five existing soil sampling sites on a triennial basis, with emphasis on organic carbon, nutrients, pH and soil structure.

5.2 Minimisation of construction impacts

The key soil-related issues that need to be considered during construction are:

- If possible, incorporate lime and establish the pasture prior to installation of the solar panels so that risk of soil erosion associated with construction soil surface disturbance is minimized.
- Where possible, restrict traffic to clearly defined tracks, rather than having random unguided traffic creating compaction over a large proportion of the site.
- Minimise serious compaction by restricting construction activities during wet weather.
- Where deep trenching occurs for cable installation, aim to refill the trenches with subsoil first then topsoil.

5.3 Management of operational impacts

Shading of the land surface by solar panels

Single axis tracking allows light beneath solar panels to be distributed across the surface of the ground. As the tracking technology rotates from east in the morning to west in the evening, it moves a band of sunlight from west to east across the entire surface area of the site. It is evident that on a cloudless day, all of the pasture would receive at least some direct sunlight for photosynthesis. At other times of the day, there would also be a significant amount of reflected sunlight at ground level.

There are benefits, to the soil and pasture, from the shading of the solar panels. Near-surface soil daytime temperatures will be reduced in summer, which is likely to create the following benefits:

- Less water loss via evaporation.
- A reduction in soil carbon loss; the rate at which soil organic matter decomposes and releases CO_2 declines as soil temperature is lowered.

In years with favourable soil moisture conditions in Spring, the shading from panels may slow down plant growth, relative to unshaded pasture. However, the stored soil water not used at that time would allow pasture to continue to grow strongly in early summer when the soil usually is too dry for optimal plant growth.

Localised changes in rainfall infiltration associated with solar panels

Night time rainfall on tilted ‘parked’ panels would produce runoff from the panels that will create plumes of water that penetrate quickly and deeply into the soil; this is analogous to soil water entry via drip irrigation lines. It is also noted that panels can be stowed in a safe position either east or west, usually at 30 degrees and this creates two settings for night rain.

The end result would be more efficient water entry, and better rainfall storage efficiency, than with rain falling onto paddocks without solar panels. Near-surface soil moisture often is lost via evaporation. Deeply penetrating plumes of rain water from the panel drip lines would be utilized efficiently by pasture plant roots, and there would be stimulation of earthworms and other beneficial soil organisms.

Deep water movement and the creation of vertical worm channels will promote root growth into the deep subsoil, where the potential for carbon sequestration is greater than near the surface because of lower soil temperatures and slower decomposition rates for deposited organic matter.

Grazing management of the pasture by sheep

Although fire hazards need to be minimised, it is desirable that 100% groundcover be maintained through conservative sheep grazing practices (or slashing) so that erosion risk is minimised. The use of pasture species that create plenty of food/seed for burrow-creating soil fauna (eg. ants) will provide extra vertical biopores that will assist with water entry and subsoil aeration.

The pasture beneath and near solar panels should only be grazed when the soil is dry and firm enough to avoid compaction via sheep trampling. With the principal land use and economic return being generation of solar power, there is more flexibility to achieve a grazing regime that protects groundcover and the soil resource.

Consider using Oldman Saltbush in any landscape plantings

Oldman Saltbush (*Atriplex nummularia*) is a native shrub with fire retarding foliage that can be used to reduce the rate of spread of grass fires that may enter via neighbouring farms.

Deep water extraction by saltbush will minimise the risk of secondary salinisation from neighbouring land.

Oldman Saltbush provides valuable fodder for sheep. It will persist for many decades provided that the grazing pressure is not too heavy.

5.4 Decommissioning issues

If the proposed solar farm is decommissioned after say 30-35 years, the possible 0-15 cm compaction from vehicles associated with solar panel dismantling and removal (and from traffic associated with the operational phase) would have to be removed via non-inversion chisel ploughing.

Soil testing (0-15 cm assessment with a focus on organic carbon, nutrients, pH and soil structure) almost certainly will demonstrate an improvement in soil condition under the solar farm, relative to soil testing described in this report for the dryland crop production system that preceded this new land use.

5.5 Overview of proposed soil-related mitigation measures

The suggested soil management inputs associated with the 'Quorn Park' solar farm proposal are:

1. Add lime to overcome agriculturally-induced soil acidity; additional 0-15 cm soil testing is recommended to provide a detailed map showing lime application rates.
2. Establish pasture as soon as possible to minimize the risk of soil erosion.
3. Add gypsum to overcome sulphur deficiency problems.
4. Control vehicle traffic during construction to minimize compaction problems, particularly when the soil is wet and prone to being damaged.
5. Position the solar panels on an incline, at night-time, in a way that drips rainfall from the panels and creates deeply penetrating plumes of soil water that maximizes the depth of water entry for efficient utilization by deep rooted pasture plants.
6. Triennial topsoil testing is recommended to fine-tune the management of soil pH, nutrition and structure under the pasture, and to demonstrate progress with soil health over time.
7. After solar farm decommissioning, assess compaction damage in the topsoil and consider non-inversion chisel ploughing to loosen the soil.

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Attachment A. Overview Data.

Site	Easting, m WGS84	Northing, m WGS84	Slope %	Australian Soil Classification (ASC) Subgroup	Great Group	Suborder	Order	BSAL	Aspect	Depth to rock >90%,cm	Depth to waterlogged layer, cm	TAW (0-100 cm), mm	Surface conditions Surface Rock %	Diam, mm	Ground Cover, %
1	601520	6340315	2	Haplic	Mesotrophic	**Red**	**Chromosol**	No	S			196	30	15	50
2	602790	6339820	1	Mottled	Mesotrophic	**Red**	**Chromosol**	No	NW		62	138	10	8	50
3	602010	6339383	1	Haplic	Dystrophic	**Red**	**Dermosol**	0	N		78	158	10	10	40
4	601012	6338801	1	Haplic	Dystrophic	**Red**	**Dermosol**	No	W		80	193	30	15	70
5	602583	6338558	1	Haplic	Dystrophic	**Red**	**Dermosol**	0	S			203	<1		80

Attachment B. Layer Data.

Site	Horizon	Lower depth cm	Texture	pH water	Moist soil colour (Munsell)	Colour from Munsell sheet	Mottles	Mn %	SOILpak compaction score	Coarse fragments %	Coarse fragments Size	Dispersion 10 minutes	Moisture	Lime %	Root score
1	A1	8	SL	4.5	5YR3/4	Dark reddish brown			1.4	20	15	0	D		1
1	A3	16	FSCL	5	2.5YR4/8	Red			1.5	15	15	1	S		1
1	B21	45	LC	6	2.5YR3/6	Dark red			1.5	5	15	0	M		1
1	B22	110+	LC	8	10R3/6	Dark red			1.7	5	15	0	M		1(55)
2	A1	13	ZCL	5	5YR4/4	Reddish brown			1.3	5	7	1	D		1
2	B21	30	LMC	5.5	2.5YR3/4	Dark reddish brown			1.1			0	S		1
2	B22	62	MC	7	2.5YR3/6	Dark red			1.6			0	M		1
2	BC	120+	MC	7	2.5YR3/6	Dark red	prom. grey 20%		1.2	60	10	0	M		0
3	A1	8	FSCL	5.5	5YR3/4	Dark reddish brown			1.0	3	7	0	D		2
3	B21	40	LC	6	2.5YR3/6	Dark red			0.8			0	S		1
3	B22	78	LC	7	2.5YR3/6	Dark red			1.5			0	S		1
3	B23	110+	LC	7.5	2.5YR3/6	Dark red	distinct grey 20%	25	1.3	5	5	0	S		0
4	A1	10	FSCL	4.5	5YR3/4	Dark reddish brown			1.3	20	15	0	D		1
4	B21	30	LC	5.5	2.5YR3/6	Dark red			1.1	20	15	1	S		1
4	B22	55	LC	6	2.5YR3/6	Dark red			1.5			0	M		1
4	B23	80	LC	5.5	10R3/4	Dusky red			1.4			0	M		1(70)
4	B24	110+	LC	5.5	10R3/4	Dusky red	distinct grey 15%	5	1.4	5	7	0	M		
5	A1	14	FSCL	4	5YR3/4	Dark reddish brown			1.1			1	D		1
5	B21	73	LC	5.5	2.5YR4/6	Red			1.7			0	S		1(45)
5	B22	110+	LC	6.5	5YR4/6	Yellowish red	faint grey 15%		1.6			0	M		0

Attachment C. Soil Structure Details.

Site	Lower depth cm	Grade	Type	Size	Fabric	Consistence	SOILpak compaction score
1	8	W	PO	10	E	2	1.4
1	16	M	PO	8	E	2	1.5
1	45	S	PO/LE	10	E	2	1.5
1	110+	S	SB	5	RP/SP	2	1.7
2	13	W	PO/LE	10	E	2	1.3
2	30	M	BL/PO	15	E	3	1.1
2	62	S	LE/PO	10	E	2	1.6
2	120+	S	LE/PO	10	E	2	1.2
3	8	W	BL/PO	15	E	3	1.0
3	40	W	BL/LE	15	E	3	0.8
3	78	S	PO	8	E	2	1.5
3	110+	M	LE/PO	10	E	2	1.3
4	10	W	PO	7	E	2	1.3
4	30	M	BL/PO	10	E	2	1.1
4	55	S	PO	5	E	1	1.5
4	80	S	PO	6	E	1	1.4
4	110+	S	PO	6	E	1	1.4
5	14	W	LE/PO	12	E	2	1.1
5	73	S	SB	5	E	1	1.7
5	110+	M	PO/LE	7	E	1	1.6

Attachment D. Laboratory Data.

Site	Depth,	pH	pH	EC 1:5	ECe	Chloride	Exchangeable cations, meq/100g						ESP	ESI	Ca/Mg	ASWAT	NO3-N	Colwell-P	PBI	SO4-S	DTPA-Zn	DTPA-Cu	Boron	Org. C
	cm	water	CaCl2	dS/m	dS/m	mg/kg	Ca	Mg	K	Na	Al	CEC				score	mg/kg	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	%
1	0-5	5.7	4.9	0.13	1.8	12	5.4	1.4	2.0	0.1	0.0	8.9	0.6	0.2	3.9	4	42	46	68	6.4	2.2	1.9	0.94	2.6
1	5-15	5.6	4.7	0.08	0.7	<10.0	4.3	1.0	1.3	0.0	0.1	6.7	0.1	0.5	4.3	4	32	13	75	3.9	0.39	2.4	0.89	1
1	15-30	7.5	6.4	0.04	0.3	<10.0	6.4	2.3	1.6	0.1	0.0	10.4	0.5	0.1	2.8	9	4.1							0.37
1	30-60	8.2	7.2	0.07	0.6	<10.0	8.3	5.3	1.9	0.1	0.0	15.6	0.4	0.2	1.6	3	2.1							0.24
1	60-100	8.6	7.8	0.13	1.1	<10.0	9.0	8.6	2.3	0.1	0.0	20.0	0.6	0.2	1.0	3	<0.5							0.16
2	0-5	6.1	5.2	0.14	1.2	<10.0	5.2	1.2	2.3	0.01	0	8.71	0.1	1.22	4.33	6	42	43	46	5.9	1.1	1.2	1	1.9
2	5-15	5.2	4.4	0.12	1	10	3.5	1.1	1.3	0.01	0.3	6.2	0.2	0.74	3.18	4	38	27	64	10	0.22	1.2	0.65	0.92
2	15-30	6.8	5.9	0.05	0.4	<10.0	8.6	3.9	1.1	0.05	0	13.65	0.4	0.14	2.21	4	5.3							0.49
2	30-60	7.9	6.9	0.05	0.4	<10.0	13	7.3	0.83	0.09	0	21.22	0.4	0.12	1.78	3	2.1							0.4
2	60-100	8.8	8	0.15	1.1	<10.0	23	9.2	0.77	0.06	0	33.03	0.2	0.83	2.5	0	1.7							0.2
3	0-5	6.7	6	0.13	1.1	<10.0	9.2	1.9	2	0.01	0	13.11	0.1	1.7	4.84	4	21	55	70	5.1	1.1	1.3	1.1	2.1
3	5-15	5.7	4.8	0.1	0.9	<10.0	5.8	1.7	1.2	0.01	0	8.71	0.1	0.87	3.41	2	36	41	91	6.1	0.2	1.4	0.83	1.1
3	15-30	7.3	6.7	0.1	0.9	<10.0	6.9	2.2	0.76	0.01	0	9.87	0.1	0.99	3.14	3	4.3							0.44
3	30-60	7.5	6.6	0.04	0.3	<10.0	7.1	3.3	0.75	0.05	0	11.2	0.4	0.09	2.15	3	1.6							0.33
3	60-100	8.1	7.2	0.06	0.5	<10.0	9.2	4.9	1.1	0.09	0	15.29	0.6	0.1	1.88	0	0.7							0.23
4	0-5	5.5	4.7	0.19	1.6	13	4	1.7	2.1	0.01	0	7.81	0.1	1.48	2.35	6	63	31	72	9	1.2	2	0.9	2.6
4	5-15	5.3	4.4	0.09	0.8	<10.0	4	1	1.4	0.01	0.5	6.87	0.1	0.62	4	4	30	20	98	4.1	0.3	2.3	0.93	1.2
4	15-30	6.8	5.8	0.03	0.3	<10.0	5.2	1.2	1	0.01	0	7.41	0.1	0.22	4.33	8	3.9							0.41
4	30-60	7.7	6.7	0.04	0.3	<10.0	6.6	3.1	0.96	0.04	0	10.7	0.4	0.11	2.13	6	2.5							0.23
4	60-100	7.2	6.3	0.05	0.4	<10.0	4.8	5.2	0.99	0.19	0	11.18	1.7	0.03	0.92	3	<0.5							0.1
5	0-5	6.8	6.1	0.12	1	<10.0	8	1	1.6	0.01	0	10.61	0.1	1.27	8	4	23	47	65	5.2	0.82	1.2	0.72	1.6
5	5-15	5.3	4.5	0.11	0.9	<10.0	3.7	0.9	0.91	0.07	0.3	5.8	1.2	0.09	4.3	2	36	61	74	7	0.45	1.6	0.64	1.1
5	15-30	6	4.9	0.03	0.3	<10.0	4.7	1.6	0.41	0.01	0	6.72	0.1	0.2	2.94	2	6.4							0.44
5	30-60	6.8	5.8	0.03	0.3	<10.0	6.5	3.1	0.28	0.07	0	9.95	0.7	0.04	2.1	2	2.4							0.24
5	60-100	7.3	6.1	0.03	0.3	<10.0	9.1	4.9	0.48	0.11	0	14.59	0.8	0.04	1.86	1	2.3							0.1

Attachment E. Land and Soil Capability (LSC), BSAL and Agricultural Land Classification conclusions.

Map ID	Land and Soil Capability Factors								LSC Class	LSC Description	BSAL Status	Agricultural Land Classification
	Water erosion slope class	*Wind erosion class*	*Structural decline class*	*Soil acidification class*	*Salinity class*	*Waterlogging class*	*Shallow soil class*	*Mass movement class*				
1	2	3	3	4	1	2	2	1	**4**	Moderate capability land	YES	2
2	2	2	3	3	1	4	2	1	**4**	Moderate capability land	NO	3
3	2	2	3	3	1	3	2	1	**3**	High capability land	YES	2
4	2	2	3	3	1	3	2	1	**3**	High capability land	NO	2
5	2	2	3	3	1	2	2	1	**3**	High capability land	YES	2

Appendix F

NOISE IMPACT ASSESSMENT

Assured Environmental

QUORN PARK SOLAR FARM – NOISE & VIBRATION IMPACT ASSESSMENT

GEOLYSE PTY LTD

Project ID. 11047

R_5

DATE OF RELEASE: 18/12/2018

ABN: 87 604 851 078

Unit 7, 142Tennyson Memorial Avenue – Tennyson – Queensland - 4105

Table 1: Document Approval

	Name	Position Title	Signature	Date
Author	Michelle Clifton	Senior Consultant		18/12/2018
Reviewer	Craig Beyers	Consulting Services Manager		18/12/2018
Approver	Craig Beyers	Consulting Services Manager		18/12/2018

Table 2: Revision Register

Revision	Date	Name	Issued to	Comment
R_0	20/11/2018	C. Beyers	A. Brownlow	Formal report release
R_1	21/11/2018	C. Beyers	A. Brownlow	Comments
R_2	29/11/2018	C. Beyers	A. Brownlow	Comments
R_3	29/11/2018	C. Beyers	A. Brownlow	Comments
R_4	18/12/2018	C. Beyers	A. Brownlow	Comments
R_5	18/12/2018	C. Beyers	A. Brownlow	Comments

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1 INTRODUCTION

1.1 Scope of Assessment

Assured Environmental (AE) was appointed by Geolyse Pty Ltd to undertake a noise and vibration impact assessment for the proposed Quorn Park Solar Farm (QPSF). The project involves construction and operation of a solar farm and grid connection.

The noise and vibration study has been undertaken to assess the potential impacts of the construction and operation of the proposed solar farm on nearby sensitive receptors in accordance with the following NSW policies and guidelines:

- NSW Noise Policy for Industry (NPfI) (EPA, 2017)
- NSW Assessing Vibration: a technical guideline (DEC, 2006);
- NSW Road Noise Policy (DECCW, 2011); and
- Interim Construction Noise Guideline (DECCW, 2009).

In accordance with the requirements of the above guidelines, computational modelling and first principle calculations have been undertaken to support the assessment of the potential for adverse amenity impacts as a result of the development.

1.2 This Report

This report summarises the methodology, results and conclusions of the noise and vibration impact assessment. A glossary of terms is presented in Appendix A to assist the reader.

2 PROPOSED DEVELOPMENT SITE

2.1 Development Site

The proposed development site is located approximately 8.5 km north west of Parkes, New South Wales. Specifically, the proposed solar farm is to be constructed within the boundary of Lot 508 on DP750152.

2.2 Nearby Sensitive Receptors

The closest surrounding receptors and the distance to the development boundary are shown in Figure 1. Where compliance is able to be demonstrated for these receptors, compliance would be achieved for all nearby sensitive receptors.

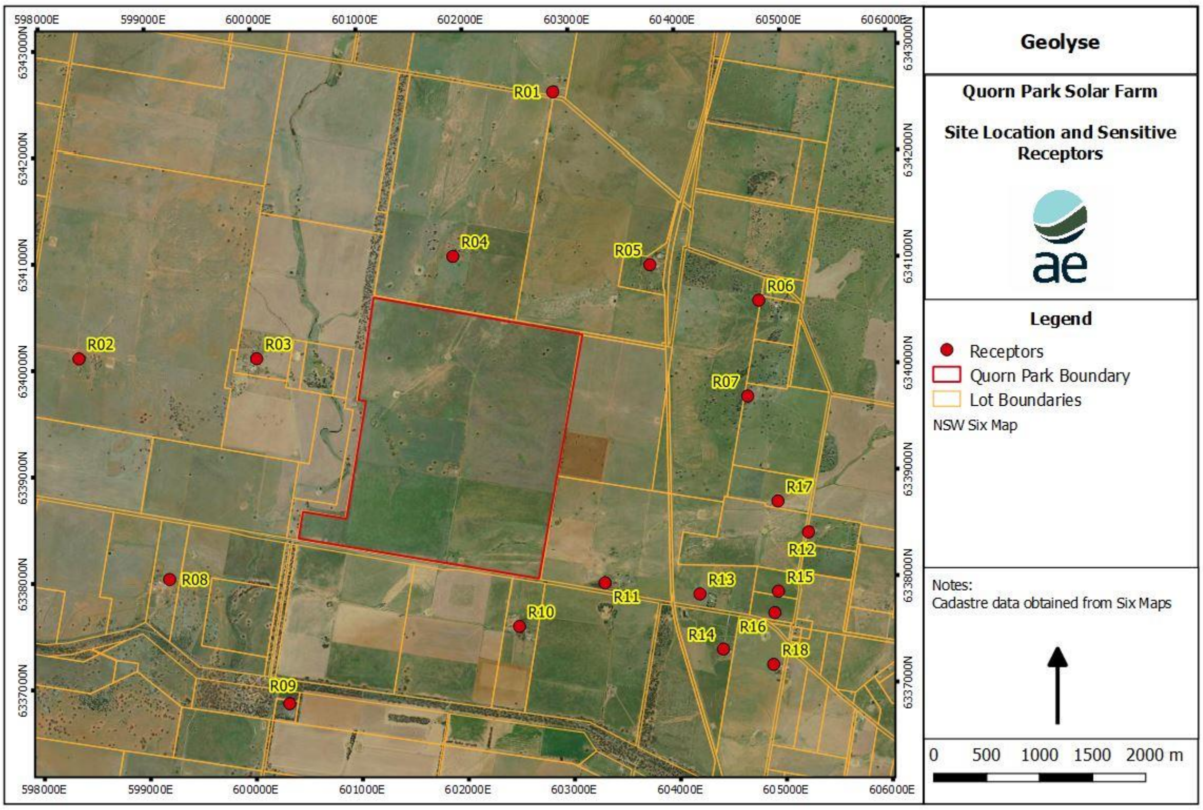

Figure 1: Surrounding Area and Sensitive Receptors

3 CONSTRUCTION NOISE ASSESSMENT

3.1 Duration of Construction Works

The construction of the QPSF is expected to take approximately 36 weeks with a number of different activities undertaken over that time.

Table 3 below presents an overview of each of the construction tasks along with their expected duration. It is noted that some of these tasks are likely to occur concurrently (e.g. site preparation and construction of the substation is likely to be undertaken at the same time as installation of the solar PV modules and cabling).

Table 3: Construction Phases and Expected Duration

Construction Phase	Duration
Site preparation and substation construction	18 – 26 weeks
Installation of solar panels and cabling	12 – 26 weeks
Commissioning	6 – 8 weeks

Given the separation distance from the subject site the to the nearest existing sensitive receptors there is potential for the duration of construction to be minimised through construction works outside standard hours (as described in Table 4 below).

The assessment has therefore considered the potential for adverse amenity impacts associated with construction outside recommended standard hours.

3.2 Interim Construction Noise Guideline

Guidance on the assessment and management of construction noise in NSW is provided in the Interim Construction Noise Guideline 2009 (ICNG) published by the NSW EPA.

The main objectives of the Guideline are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours, unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage;
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts; and
- Provide guidelines for assessing noise generated during the construction phase of developments.

In achieving these objectives, the guideline provides a framework for the qualitative and quantitative assessment of potential construction noise impacts noting that, for major projects, a quantitative assessment is the preferred approach.

Table 4 presents construction noise criteria outlined in the guideline. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Table 4: NSW EPA Construction Noise Criteria – Residential Receivers

Time of Day	Management Level (Free-field)	How to Apply
Recommended standard hours: Monday to Friday, 7 am to 6 pm Saturday, 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Where nearby sensitive uses are predicted to be noise affected, the proponent of the project is required to apply reasonable and feasible noise mitigation measures noting that a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

For construction outside standard hours, the assessment criteria has been determined based on the minimum allowable RBL as provided in the NPfI. That is, for the purposes of the assessment it is assumed that the RBL is 30 dB(A) for night periods thereby resulting in a noise affected limit of 35 dB(A) for construction outside standard hours.

3.3 Construction Noise Sources

In terms of noise emissions, the site preparation activities and installation of the solar PV modules (specifically driving the support posts into the ground) are expected to represent those with the most significant potential for adverse impacts. The indicative project schedule has determined these two activities may occur concurrently. Therefore, for the purposes of the assessment, the impacts associated with these two elements have been assessed cumulatively.

It is noted that construction works are expected to progress across the site such that plant and equipment would only be in a single area for a short period of time. For example, each post takes approximately 25-30 seconds to drive into the ground thereby providing the ability to install a new pile approximately every 2.5 minutes. Given this, the potential for adverse impacts at any one receptor is expected to only occur for a short period of time. Table 5 below presents a summary of the plant and equipment likely to be required to complete the on-site construction works. The sound power levels presented have been sourced from published noise emission datasets and the library of source noise levels maintained by Assured Environmental.

Table 5: Construction Phases and Expected Duration

Construction Phase	Plant Item	Number Required	Sound Power Level, dB(A)	Acoustical Usage Factor, % d)
Site preparation and construction of site substation a)	Truck & Dog b)	1	108	40
	Excavator	3	106	40
	Wheeled Loader	2	107	40
Installation of solar PV modules & inverter assemblies and grid connection	Piling Rig e)	3	112 - 124	20
	Franna Crane	2	107	16
	Trencher	2	97	40
	Generator	1	73	50
	Trucks c)	1	107	40
	Powered Hand Tools e)	3	110	10

a) Construction plant used intermittently as required. Continuous use not expected.

b) Truck movements associated with deliveries assumed to move through site at 10 km per hour as a moving point source.

c) Deliveries to site only to occur during standard construction hours.

d) The 'Acoustical Usage Factor' represents the percentage of time that a particular item of equipment is assumed to be running at full power while working on site.

e) Includes a correction for tonality.

It should be noted that the piling sound power level used in the model is 107 dB(A) (excluding tonality correction) as presented in Table 6.

Where the solar farm is to be decommissioned, it is reasonable to assume that these activities would generate comparable noise to construction (excepting no piling activities would be required). Hence, receptor noise levels during decommissioning would be expected to be equal to or lower than those predicted for the construction of the QPSF. Where compliance is predicted to be achieved during construction, it is expected that it would also be achieved for decommissioning of the solar farm.

It is noted that a Decommissioning Management Plan (DMP) would be prepared and approved by DPE prior to decommissioning. This DMP would incorporate a noise impact assessment which would enable the assessment to be based on criteria applicable at this future time, and to be based on a known decommissioning schedule and methodology.

3.4 Assessment of Impacts

For the purposes of predicting impacts associated with noise emissions from the Subject Site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (version 2019 build 165.4905) developed by DataKustik. CadnaA incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with ISO Standard 9613 (1996) "*Acoustics - Attenuation of sound during propagation outdoors*".

The model is utilised to assess the potential noise emissions from the Subject Site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

For the construction phase of the proposed project, predictive noise modelling has considered the range of potential impacts likely noting that noise generating activities will progressively move across the site over the duration of construction. As such, the highest noise levels would not be expected to be experienced at a single receptor for more than one day while construction equipment (e.g. piling rig) is at the closest point to the receptor.

Table 6 below presents predicted receptor noise levels during concurrent construction phases of the proposed solar farm.

Table 6: Predicted Receptor Noise Levels –Concurrent Construction Activities, dB(A)

Receptor	Description	Predicted Construction Noise Levels, $L_{Aeq,\ 15min}$	Noise Management Level		Comply (Y/N)
			Standard Hours	Outside Standard Hours	
R01	Existing receptor	<10	40	35	Y
R02	Existing receptor	<10	40	35	Y
R03	Existing receptor	33	40	35	Y

Receptor	Description	Predicted Construction Noise Levels, $L_{Aeq,\ 15min}$	Noise Management Level		Comply (Y/N)
			Standard Hours	Outside Standard Hours	
R04	Existing receptor	33	40	35	Y
R05	Existing receptor	25	40	35	Y
R06	Existing receptor	<10	40	35	Y
R07	Existing receptor	13	40	35	Y
R08	Existing receptor	<10	40	35	Y
R09	Existing receptor	17	40	35	Y
R10	Existing receptor	30	40	35	Y
R11	Existing receptor	27	40	35	Y
R12	Existing receptor	<10	40	35	Y
R13	Existing receptor	<10	40	35	Y
R14	Existing receptor	<10	40	35	Y
R15	Existing receptor	<10	40	35	Y
R16	Existing receptor	<10	40	35	Y
R17	Existing receptor	<10	40	35	Y
R18	Existing receptor	<10	40	35	Y

Review of the predicted noise levels confirms that compliance with the noise management level provided in the ICNG is predicted to be achieved for all receptors during standard hours and outside standard hours.

3.5 Mitigation of Construction Noise Levels

Whilst compliance of the construction criteria is achieved at all receptors, administrative controls are recommended during outside standard hours to minimise the potential for adverse amenity impacts. Potential controls available to the construction contractor to minimise potential impacts for construction works outside standard hours could include:

- Limiting the type and scale of activities undertaken outside normal construction hours;
- Using broad-band reversing alarms on all mobile plant and equipment;
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Select quieter items of plant and equipment where feasible and reasonable.;
- Operating plant in a quiet and efficient manner;
- Reduce throttle setting and turn off equipment when not being used; and
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.

Overall, given the size of the subject site, there is potential for construction works to be undertaken outside standard hours subject to the effective implementation of the above reasonable and feasible mitigation measures. Further, given the tendency for agricultural activities to be undertaken during evening and night periods, construction during these periods, when undertaken concurrently with these agricultural activities is unlikely to represent a significant amenity impact for residences in the area.

4 OPERATIONAL PHASE NOISE ASSESSMENT

4.1 Operational Noise Criteria

4.1.1 Overview

The acoustic assessment has been completed in accordance with the procedure identified in the NPfI. The NPfI recognises that scientific literature has identified that both the increase in noise level above background levels (that is, intrusiveness of a source), as well as the absolute level of noise are important factors in how a community will respond to noise from industrial sources.

In response to this, the NPfI establishes two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These two criteria are then used to determine project trigger levels against which the proposed development will be assessed. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response.

The derivation of the two sets of criteria are presented below. For residential dwellings, the noise criteria are assessed at the most-affected point (i.e. highest noise level) on or within the property boundary. Where the property boundary is more than 30 metres from the house, then the criteria applies at the most-affected point within 30 m of the house.

4.1.2 Intrusiveness Noise Criteria

The project intrusiveness noise level is intended to protect against significant changes in noise levels as a result of industrial development. To achieve this, the NPfI describes intrusive noise as noise that exceeds background noise levels (as defined by the Rating Background Level or RBL) by more than 5 dB.

Given the remote location of the development site and the lack of any significant activity in the area, the impact assessment has assumed baseline noise levels equivalent to the minimum background noise levels provided in the NPfI. Therefore, Table 7 presents the derivation of the intrusiveness criteria based on the minimum background noise level established by the NPfI.

Table 7: Derived Intrusiveness Noise Criteria

Receptor	Intrusiveness $L_{Aeq,15\text{-minute}}$ Criteria		
	Day	Evening	Night
All nearby residential receptors [a)]	40 [b)]	35 [b)]	35 [b)]

a) Receptor noise limit applied at a location 30 m from the dwelling façade.

b) Minimum background noise level established by the NPfI 2017 + 5 dB.

4.1.3 Amenity Criteria

The project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses. Review of the surrounding area has identified that that there are no industrial noise sources in the area with future industrial development in the area considered unlikely. As such, the project amenity noise criteria are equivalent to the indicative noise amenity area noise levels presented in Table 8 below.

Table 8: NPfI Amenity Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dB(A))	
			Total Industrial Noise	Project Specific
Residence	Rural	Day	50	50
		Evening	45	45
		Night	40	40

4.1.4 Project Trigger Levels

The project trigger level (i.e. the noise limit considered by the assessment) is the lower value of the project intrusiveness noise level and the project amenity level, after the conversion to $L_{Aeq, 15\,min}$ dB(A) equivalent level. Table 9 presents the standardised intrusiveness noise level and the project amenity level as derived by adding 3 dB to each period of the day.

Table 9: Determining Project Trigger Level

Time of Day	Standardised $L_{Aeq, 15\,min}$ Noise Level (dB)		
	Intrusiveness Criteria	Project Specific ANL	Project Trigger Level
Day	40	50 + 3 = 53	40
Evening	35	45 + 3 = 48	35
Night	35	40 + 3 = 43	35

4.1.5 Sleep Disturbance

NSW EPA have identified a screening assessment for sleep disturbance based on the night-time noise levels at a residential location. Where noise levels at a residential location exceed:

- $L_{Aeq, 15\,min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 whichever is the greater,

a detailed maximum noise level event assessment should be undertaken.

As discussed in Section 4.5, the predicted noise levels at residential locations do not exceed 40 dB(A) $L_{Aeq, 15\,min}$, therefore a detailed sleep disturbance assessment is not required. Further, given the noise sources associated with the operation of a solar farm are all continuous (inverters) or semi-continuous (tracking motors) during daylight hours, short-term instantaneous noise events are unlikely. As such, consideration of compliance against the L_{AFmax} sleep disturbance limits is unwarranted.

4.2 Noise Sources

The Quorn Park Solar Farm is to consist of solar photovoltaic (PV) plant (80 MW) and associated infrastructure for storing energy and supplying it into the grid. It is expected that, at completion, infrastructure installed on site will incorporate:

- 19x SMA 5MVA inverters (each comprising two 2.5 MVA inverters and transformer);
- 3,300 NEXTracker motors;
- 1x Substation; and
- 10x Battery storage units with each battery storage unit comprising:
    - containerised battery storage with HVAC systems on each end of the containers
    - inverters; and
    - transformers.

Discussions with the proponent have confirmed that the particular battery supplier for the project has not been selected. Selection will depend on engineering and commercial factors and will be made during the procurement stage of the project. For the purposes of this study, the major equipment suppliers have been considered and the worst case for noise emissions adopted as described above. Alternative arrangements do not include containers to house the batteries but use all weather enclosures with the arrangement of HVAC's and inverters providing a lower overall noise impact.

The PV panels will be mounted onto fixed support structures by single axis tracking panels which track the suns movement across the day through the use of small motors which rotate the panel arc of the sun to maximise the solar effect. Noise emissions from the tracking motors are expected to occur for approximately one minute out of each 15-minute period (providing for up to five degrees' rotation per hour) during day periods.

Placement of the required inverters is also expected to be finalised during the detailed design phase of the project. For the purposes of the assessment, the inverters have been located at even spacing across the site with all inverters located outside of the inverter buffer area identified on Figure 2.

A single substation is expected to be required for the proposed solar farm to allow connection to the grid. The final location of the substation has not yet been determined. The final location selected for the development will depend on engineering considerations including optimal sub surface conditions for foundations, layout of the modules and the route of the overhead high voltage lines for grid connection. The battery storage system is likely to be located in close proximity to the substation and control room in order to share common infrastructure. For the purposes of the assessment, it has been assumed that the storage system could be located anywhere outside of the battery storage buffer zones identified in Figure 2.

Table 10 presents a summary of the source noise levels considered in the assessment. The sound power levels for the plant and equipment presented in the table below are as provided by the manufacturer or taken from information held in our library.

Table 10: Source Noise Levels

Source	Sound Power Level (dB(A))
NexTracker	60 (each)
2.5 MVA SMA Inverter a)	92 (each)
Transformer	73 (each)
Battery storage (Fluence):	
Transformer	73 (each)
HVAC	88 (each)
Inverters	92 (each)
Light Vehicle	88

a) Based on previous experience with similar sources there is potential for tonal influences associated with this source. Therefore, in accordance with the NPfI, a +5 dB penalty has been applied to this source.

b) Assessment included source noise levels for the worst-case battery storage system. Given this, where the final equipment selected for the development is sited in accordance with the recommendations of this report, compliance is expected at all nearby sensitive receptors.

c) Assessment assumes the substation could be located anywhere within the site boundary. As such, where compliance is predicted, no limitations on the siting of this equipment are necessary to achieve compliance with the adopted noise limits.

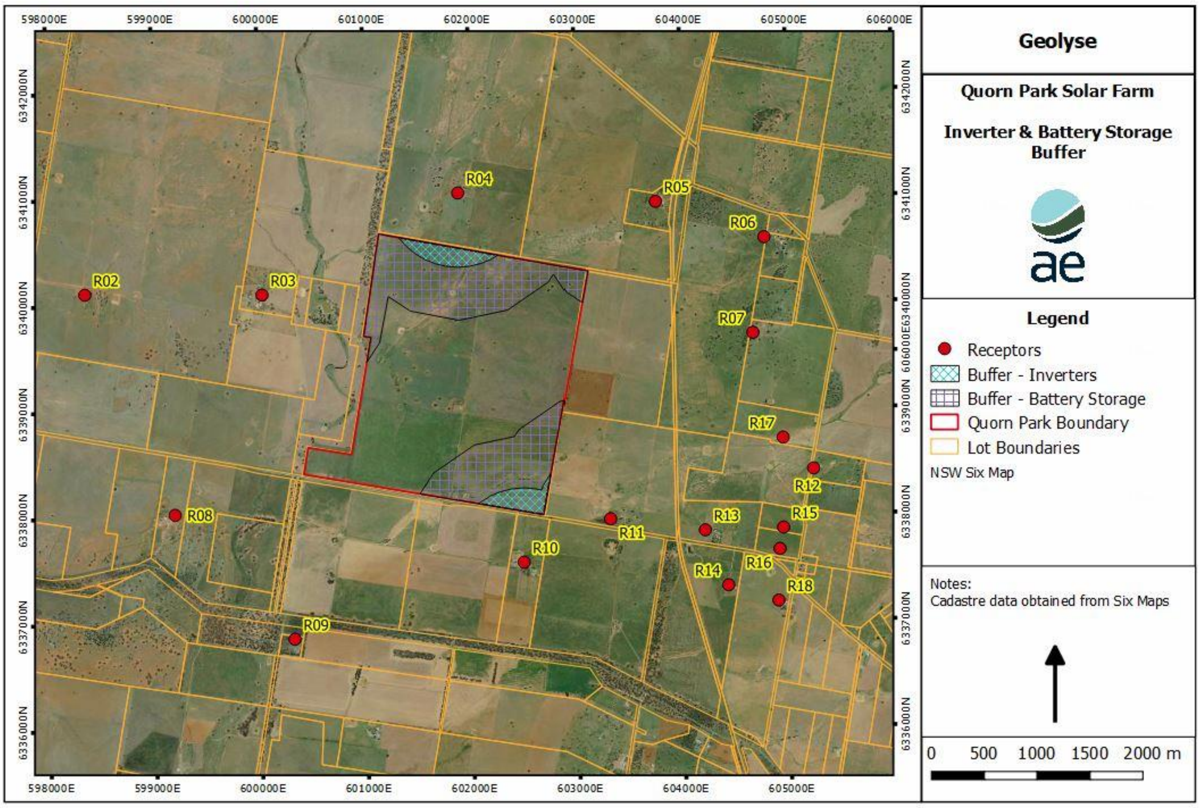

Figure 2: Storage System Placement

4.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with noise emissions from the Subject Site on nearby sensitive receptors, noise modelling of the sources was completed using the proprietary software CadnaA (version 2019 build 165.4905) developed by DataKustik. CadnaA incorporates the influence of meteorology, terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with ISO Standard 9613 (1996) "*Acoustics - Attenuation of sound during propagation outdoors*".

The model is utilised to assess the potential noise emissions from the Subject Site under a range of operating scenarios and meteorological conditions. The noise modelling also allows investigation of possible noise management solutions, in the event that non-compliance with the assessment criterion is predicted.

4.4 Meteorology

The NPfI presents guidelines for the consideration of meteorological effects on noise propagation, specifically, temperature inversions and/or gradient winds. NPfI provides two options for assessing meteorological effects as detailed in Table 11.

Table 11: Standard and Noise Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard conditions	Day/evening/night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL.
Noise enhancing conditions	Day/evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL).
	Night: stability categories A-D with light winds (up to 3 m/s at 10 m AGL). And/or stability category F with light winds (up to 2 m/s at 10 m AGL).

The following conditions have been modelled:

- Day Periods – Stability class D at 3 m/s representing a worst-case assessment of potential impacts for day-periods; and
- Night Periods – Temperature inversion (stability class F) with light (2 m/s) winds a worst-case assessment of potential impacts for night periods.

4.5 Predicted Noise Levels

Table 12 below presents predicted receptor noise levels during the operational phase of the proposed solar farm based on the minimum separation distances identified in Figure 2. Review of the predicted noise levels confirms that compliance with the intrusive noise criteria established in accordance with the NPfI can be achieved for all receptors for both day and night periods under worst-case meteorological conditions.

Table 12: Predicted Receptor Noise Levels - Operational Phase, dB(A)

Receptor	Predicted Operational Noise Levels, $L_{Aeq, 15min}$		Intrusive Noise Criteria [a]	Comply (Y/N)
	Day Periods	Night Periods		
R01	<10	<10	40/35	Y
R02	<10	<10	40/35	Y
R03	28	32	40/35	Y
R04	26	30	40/35	Y
R05	15	17	40/35	Y
R06	<10	12	40/35	Y
R07	18	17	40/35	Y
R08	<10	<10	40/35	Y
R09	<10	<10	40/35	Y
R10	26	25	40/35	Y
R11	25	24	40/35	Y
R12	<10	<10	40/35	Y
R13	16	15	40/35	Y
R14	<10	<10	40/35	Y
R15	<10	<10	40/35	Y
R16	<10	<10	40/35	Y
R17	<10	<10	40/35	Y
R18	<10	<10	40/35	Y

a) Intrusive noise criteria for day and night periods

Given the predicted compliance with the noise limits derived in accordance with the NPfI, no further noise mitigation is considered necessary.

5 ROAD TRAFFIC NOISE ASSESSMENT

5.1 Introduction

Noise impacts associated with vehicle movements during the operational phase of the QPSF project are expected to be negligible as visitation will be limited to periodic maintenance and infrequent plant and equipment replacements. During construction and any future decommissioning of the farm however, traffic movements will be more significant

Estimates of total light and heavy vehicle movements associated with the delivery of farm infrastructure and associated materials and resources to build the solar farm are provided in Table 13. The maximum number of heavy vehicle movements during the peak of the construction period is not expected to exceed 63.

Table 13: Construction Phase Traffic

Type of Vehicle	Peak Daily Vehicle Movements
Heavy vehicle	Peak 63 per day
Light Vehicle	Peak 30 per day
Total	**Peak 93 per day**

a) Where 1 vehicle movement is as defined by DPE to be 1 vehicle entering and leaving the site.

The assessment has considered the potential impacts associated with noise emissions from the maximum peak daily expected 30 light and 63 heavy vehicle movements from the site entry along the local access road (Back Trundle Road) onto McGrath Lane and Henry Parkes Way, as summarised in Table 14 below.

All vehicle movements are expected to occur during standard construction hours however, as a worst-case, it has been assumed that vehicles associated with arrival of construction workers to site could arrive over the one-hour period from 6 am – 7 am (i.e. during night periods).

Table 14: Summary of Road Traffic Data

Road Segment	Vehicle Type	Vehicle Speed	Number Vehicles	
			Day (7 am to 10 pm)	Night (Peak 1-hour)
Back Trundle Road	Light	60 km/hr	60	30
	Heavy	40 km/hr	125	0
McGrath Lane	Light	60 km/hr	60	30
	Heavy	40 km/hr	125	0
Henry Parkes Way	Light	100 km/hr	60	30
	Heavy	100 km/hr	125	0

a) Assumes all truck deliveries to site occur during standard construction hours (7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturday).

5.2 Assessment Criteria

The ICNG does not provide criteria for the assessment of construction road traffic during the project. Given this, reference is made to the noise criteria provided in the NSW Road Noise Policy (RNP). Based on the type of roadway, Table 15 below presents the applicable road traffic noise criteria for existing residences affected by traffic on existing roadways generated by land use developments.

Table 15: Applicable Road Traffic Noise Criteria

Road Category	Type of Project & Land Use	Assessment Criteria
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	Day: $L_{Aeq,1\,hour}$ 55 dB(A) Night: $L_{Aeq,1\,hour}$ 50 dB(A) (external)
Freeways or motorways/ arterial roads (Henry Parkes Way)	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	Day: $L_{Aeq,15\,hour}$ 60 dB(A) Night: $L_{Aeq,9\,hour}$ 55 dB(A) (external)

5.3 Noise Modelling Methodology

For the purposes of predicting impacts associated with road traffic noise emissions was completed using the proprietary software CadnaA (version 2019 build 165.4905) developed by DataKustik. The model incorporates the influence of terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receptor locations. All predictions have been undertaken in accordance with Calculation of Road Traffic Noise (CRTN) methodology developed by the UK Department of Transport. In accordance with the requirements of the RNP, the predictive noise modelling incorporated the following assumptions:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CRTN methodology using the approximation $L_{Aeq,1\,hour} = L_{A10,1\,hour} - 3$.
- Noise source heights were set at 0.5 m above road level for cars, 1.5 m for heavy vehicle engines and 3.6 m for heavily vehicle exhausts.
- Noise from heavy vehicle exhausts is 8 dB lower than the steady continuous engine noise; and
- Corrections established for Australian conditions applied through a negative correction to the CRTN predations of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982).

Review of the predicted noise level presented in Table 16 below confirms that compliance with the RNP is achieved. It is noted that as a worst case, the assessment has considered a minimum separation distance of 30 m from the roadway to the nearest sensitive receptor to Henry Parkes Way and 25 m separation distance to Back Trundle Road. Review of aerial photography for the area suggests that this represents a conservative assumption with lower noise levels expected at all existing sensitive receptors.

Table 16: Predicted $L_{Aeq,15\ hour}$ Noise Levels - Road Traffic Noise

Receptor	Setback from Roadway	Period	Parameter	Criteria	Predicted Noise Level	Comply (Y/N)
Worst-case assumed sensitive receptor (Henry Parks Way)	30 m	Day	$L_{Aeq,15\ hour}$	60 dB(A)	55	Y
		Night	$L_{Aeq,9\ hour}$	55 dB(A)	48	Y
Worst-case assumed sensitive receptor (Back Trundle Road and McGrath Lane)	25 m	Day	$L_{Aeq,1\ hour}$	55 dB(A)	50	Y
		Night	$L_{Aeq,1\ hour}$	50 dB(A)	41	Y

6 VIBRATION ASSESSMENT

6.1 Introduction

A review of the proposal indicates there is potential for impacts as a result of vibration generated by plant and equipment during the construction phase. Given this, an assessment of the potential for vibration impacts has been undertaken. In particular, the assessment has considered the potential for impacts on both human comfort and structural damage for the nearest residence to the construction works.

6.2 Assessment Criteria

The vibration criteria presented in the Environmental Noise Management – *Assessing Vibration: A Technical Guide* (2006) published by the NSW Department of Environment Climate Change and Water (DECCW) have been adopted for the assessment. The technical guide provides vibration criteria associated with amenity impacts (human annoyance) for the three categories of vibration:

- Continuous vibration (e.g. road traffic, continuous construction activity);
- Impulsive vibration includes less than 3 distinct vibration events in an assessment period (e.g. occasional dropping of heavy equipment); and
- Intermittent vibration includes interrupted periods of continuous vibration (e.g. drilling), repeated periods of impulsive vibration (e.g. pile driving) or continuous vibration that varies significantly in amplitude.

Table 17 and Table 18 present the criteria for continuous and impulsive vibration and intermittent vibration, respectively.

Table 17: Continuous & Impulsive Vibration Criteria for Residences – Peak Velocity

Location	Vibration Type	Preferred Limit (mm/s)	Maximum Limit (mm/s)
Residences	Continuous	0.28	0.56
Residences	Impulsive	8.6	17

Table 18: Intermittent Vibration Criteria for Residences

Location	Assessment Period	Preferred Value ($m/s^{1.75}$)	Maximum Value ($m/s^{1.75}$)
Residences	Day-time	0.20	0.40

The above criteria are suitable for assessing human annoyance in response to vibration levels. In order to assess potential damage to buildings, reference has been made to British Standard *BS 7385-2: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration*. Table 19 presents vibration criteria for assessing the potential for building damage.

Table 19: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Particle Velocity (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures – residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

6.3 Potential Vibration Sources

Table 20 identifies the vibration source levels for the equipment and likely to be used for the construction of the solar farm.

Table 20: Vibration Source levels – Peak Particle Velocity

Equipment Item	PPV at 10 metres (mm/s)	Source
Piling	1 – 2	Rockhill, D.J. et. al. [b)]
Roller	5 – 6	DECCW
7 tonne compactor	5 – 7	DECCW
Loaded trucks (rough surface)	5	USA DT [a)]
Loaded trucks (smooth surface)	1 – 2	USA DT [a)]
Excavator	2.5 – 4	DECCW

a) Transit Noise and Vibration Impact Assessment, US Department of Transportation, May 2006.

b) Rockhill, D.J., Bolton, M.D. & White, D.J. (2003) 'Ground-borne vibrations due to press-in piling operations'

6.4 Assessment of Potential Impacts

Based on the vibration source levels at 10 metres (presented in Table 20), peak particle velocities have been predicted at various separation distances. The NSW DECCW indicates that in predicting vibration levels, it can be assumed that the vibration level is inversely proportional to distance (with the relationship varying between $d^{-0.8}$ to $d^{-1.6}$ based on field data).

The US Department of Transportation's Transit Noise and Vibration Impact Assessment (May 2006) presents the following construction vibration propagation formula assuming an inverse relationship:

$$PPV@d_2 = PPV@d_1 \times (d_1/d_2)^{1.5}$$

where: d_1 = distance 1 (reference distance for source data) (m)
d_2 = distance 2 (separation distance for predicted PPV) (m)
PPV = peak particle velocity (mm/s)

The above formula has been considered for predicted PPVs at various distances from construction equipment. Based on the above information, Table 21 presents PPV predictions for the various construction equipment.

Table 21: Predicted Peak Particle Velocity at Sensitive Receptors (mm/s)

Distance from Source (m)	Predicted Peak Particle Velocity (mm/s)					
	Roller	7 tonne compactor	Excavator	Piling	Loaded trucks (rough surfaces)	Loaded trucks (smooth surfaces)
10	6.00	7.00	4.00	0.35 - 0.71	5.00	1 – 2
20	2.12	2.47	1.41	0.19 - 0.38	1.77	0.35 – 0.71
30	1.15	1.35	0.77	0.13 - 0.25	0.96	0.19 – 0.38
40	0.75	0.88	0.50	0.09 - 0.18	0.63	0.13 – 0.25
50	0.54	0.63	0.36	0.07 - 0.14	0.45	0.09 – 0.18
60	0.41	0.48	0.27	0.05 - 0.11	0.34	0.07 – 0.14
70	0.32	0.38	0.22	0.04 - 0.09	0.27	0.06 – 0.11
80	0.27	0.31	0.18	0.04 - 0.07	0.22	0.05 – 0.09
90	0.22	0.26	0.15	0.03 - 0.06	0.19	0.04 – 0.07
100	0.19	0.22	0.13	0.02 - 0.03	0.16	0.03 – 0.06
150	0.1	0.12	0.07	0.35 - 0.71	0.09	0.02 – 0.03
Type	Continuous	Continuous	Continuous	Intermittent	Intermittent	Intermittent
Nuisance Criteria	Residential 0.28 (preferred) / 0.56 (max) School 0.56 (preferred) / 1.1 (max)					
Building Criteria	Residential 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above					

The predicted vibration levels presented in Table 21 indicate compliance with the continuous preferred vibration nuisance criteria for locations at a separation distance of 50-60 metres. Compliance with the building damage criteria is predicted at 10 metres from construction for each source.

For intermittent vibration associated with haul vehicles and piling, it is difficult to provide an appropriate comparison with the relevant criteria (which is presented as a Vibration Dose Value (VDV) in $m/s^{1.75}$). The calculation of a VDV requires both the overall weighted RMS (root mean square) acceleration (m/s^2) typically obtained from on-site measurements and the estimated time period for vibration events.

It is noted, however, that the piling PPV at distances of 470 m (the distance to the nearest sensitive receptor from potential piling) is predicted to be within the maximum continuous criteria of 0.56 mm/s. This comparison with the continuous criteria (as a conservative approach) indicates that vibration levels associated with piling are not considered to be significant (which is expected given the significant separation distances).

7 CONCLUSIONS AND RECOMMENDATIONS

A solar farm (to be known as the Quorn Park Solar Farm) is proposed to be built on one allotment (Lot 508 on DP750152). The area surrounding the proposed development is sparsely populated with dominant activities including a range of agricultural and rural uses.

The impact assessment has considered the potential for adverse impacts resulting from noise (construction, road traffic and operational) and vibration (construction) emissions on nearby residential uses.

The assessment of potential noise impacts has considered both construction during standard hours and outside standard hours. For construction during standard hours, adverse amenity impacts during the construction phase of the project are considered unlikely. For construction works undertaken outside standard hours, significant amenity impacts are considered unlikely where the following management measures are implemented:

- Limiting deliveries to the site to standard construction hours (7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturday);
- Using broad-band reversing alarms on all mobile plant and equipment;
- Examine different types of machines that perform the same function and compare the noise level data to select the least noisy machine;
- Select quieter items of plant and equipment where feasible and reasonable;
- Operating plant in a quiet and efficient manner;
- Reduce throttle setting and turn off equipment when not being used; and
- Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers.

For the operational phase of the project, adverse amenity impacts are considered unlikely and compliance with applicable criterion achieved where the buffer separation distances for inverters and battery storage systems (including the substation) as shown in Figure 2 are adopted for the final project design.

Overall, based on the results of the assessment, the risk of adverse impacts as a result of the proposed Quorn Park Solar Farm is considered to be low with noise and vibration emissions complying with the applicable criteria. Hence, from an acoustic perspective, the proposed development site is considered acceptable for the proposed use.

APPENDIX A: GLOSSARY OF TERMS

A-Weighting	A response provided by an electronic circuit which modifies sound in such a way that the resulting level is similar to that perceived by the human ear.
dB (decibel)	This is the scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and the reference pressure (0.00002 N/m^2).
dB(A) or dBA	This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Free-field	Refers to a sound pressure level determined at a point away from reflective surfaces other than the ground with no significant contribution due to sound from other reflective surfaces; generally, as measured outside and away from buildings.
L_{Aeq}	This is the equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period. Noise levels often fluctuate over a wide range with time. Therefore, when a noise varies over time, the L_{Aeq} is the equivalent continuous sound which would contain the same sound energy as the time varying sound. Many studies show that human reaction to level-varying sounds tends to relate closer to the L_{Aeq} noise level than any other descriptor.

Appendix G

TRAFFIC IMPACT ASSESSMENT

TRAFFIC IMPACT ASSESSMENT
QUORN PARK SOLAR FARM

PREPARED FOR

QUORN PARK SOLAR FARM PTY LTD

October 2018

• Civil, Environmental & Structural Engineering • Surveying • Environmental • Planning • Architecture

TRAFFIC IMPACT ASSESSMENT

QUORN PARK SOLAR FARM

PREPARED FOR:

QUORN PARK SOLAR FARM PTY LTD

OCTOBER 2018

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Executive Summary

1.1 DEVELOPMENT SUMMARY

Location: 950 Back Trundle Road, Parkes, known as Lot 508 DP750152

Use: Solar Farm

Access: Access will be off Back Trundle Road (via McGrath Lane and Henry Parkes Way)

Car Parking: A detailed layout plan including car parking has not been prepared at this stage, however it is assumed that construction staff vehicles will be accommodated on-site within an informal gravel parking area

1.2 TRAFFIC IMPACT ASSESSMENT SUMMARY

1.2.1 TRAFFIC GENERATION

Delivery Trucks: To be conservative the estimated traffic generation has been based on the assumption that the largest delivery vehicle will be a 19 m Semi-trailer. If B-double trucks are used this will reduce the estimated heavy vehicle trips generated. For the purposed of road and intersection geometric assessments it has been assumed that B-doubles are used as a worst case scenario.

Construction: The total estimated traffic trips generated during construction is approximately 13,060 vehicle trips.

The peak daily trips are estimated to be 185 vehicles per day (60 light vehicles and 125 heavy vehicles).

The peak hour traffic will at the beginning and end of the work day as crew arrive/leave the site generating an estimated peak of 30 vehicles per hour

Operation: The estimated traffic generated during operation is up to 4 vehicle trips per day. There will also be isolated infrequent times of substantial maintenance that will generate some additional trips.

Impact: Henry Parkes Way and the main highways to be used to connect to Henry Parkes Way are pre-approved General Mass Limit GML and Concessional Mass limit CML roads and hence are expected to be able to cater for the construction and operation traffic from the development.

If B-Doubles are utilised permits for the use of McGrath Lane and the portion of Back Trundle Road will need to be gained through the National Heavy Vehicle Accreditation Scheme (NHVAS).

Regular inspections and maintenance (if required) will be necessary to ensure the condition of McGrath Lane and Back Trundle Road are maintained.

1.2.2 ACCESS

Access Design: The site access will be designed to cater for the largest vehicle accessing the site.

Turn Warrants: The development triggers the warrant for a Basic Right Turn treatment (BAR) and a Basic Left Turn treatment (BAL) at the intersection of McGrath Lane with Henry Parkes Way. It is proposed to upgrade the existing intersection to meet the Austroads standards for a BAR/BAL intersection.

Sight Distances: A site inspection was carried out to check the existing sight distances at the key intersections in the vicinity of the site. The site inspection revealed that the sight distance at the intersections of Henry Parkes Way/McGrath Lane and McGrath Lane/Back Trundle Road are in excess of the required SISD of 351 m.

The sight distance at the farm access point is expected to exceed the SISD of 351 m but will need to be confirmed once the final access point in selected.

1.2.3 RECOMMENDATIONS

Road Upgrades: It is recommended that the intersection of Henry Parkes Way/McGrath Lane be upgraded to comply with a BAR/BAL intersection treatment.

We expect that Parkes Shire Council will require pre and post construction dilapidation surveys to be carried out for McGrath Lane and Back Trundle Road

TMP: A detailed Traffic Management Plan (TMP) should be prepared by the final EPC contractor in consultation with Parkes Shire Council, RMS and any other relevant stakeholders to confirm the final traffic mitigation and control mechanisms to be adopted during the construction phase.

1.2.4 CONCLUSION

There are no issues in relation to traffic and transport that should preclude the consent to construct and operate the solar farm provided the recommendations of this report are carried out.

Introduction

2.1 BACKGROUND

The purpose of this Traffic Impact Assessment is to examine the potential traffic impacts of the proposed solar farm developments at 950 Back Trundle Road, Parkes, known as Lot 508 DP750152.

This Traffic Impact Assessment has been prepared to accompany the Environmental Impact Statement for the development.

Specifically the Traffic Impact Assessment will address the following Secretary's Environmental Assessment Requirements (SEARs) for the development:

- *A traffic impact study prepared in accordance with the methodology set out in Section 2 of the RTA's Guide to Traffic Generating Developments 2002 and including:*
  - *Hours, days and periods of construction.*
  - *Schedule for phasing/staging of the project.*
  - *Traffic volumes:*
    - *Existing background traffic.*
    - *Project-related for each stage including construction, operation and decommissioning.*
    - *Projected future traffic, including background, Goonumbla Solar Farm project, Inland Rail construction and project-related traffic.*
  - *Traffic volumes are to also include a description of:*
    - *Ratio of light vehicles to heavy vehicles.*
    - *Peak times for existing traffic.*
    - *Peak times for project-related traffic.*
    - *Transportation hours.*
    - *Project related traffic interaction with existing and projected background traffic.*
  - *The origin, destination and routes for:*
    - *Employee and contractor light traffic.*
    - *Heavy traffic.*
    - *Oversize and over mass traffic.*
- *A description of all oversize and over mass vehicles and the materials to be transported.*
- *Details of access requirements to and from Henry Parkes Way and an analysis of affected intersections with Henry Parkes Way, along the haulage route.*
- *The impact of generated traffic and measures employed to ensure efficiency and safety on the public road network during construction, operation and decommissioning of the project.*
- *The need for improvements to the road network, and details of improvements proposed such as road widening and intersection treatments, to cater for and to mitigate the impact of project-related traffic. Proposed road facilities, access and intersection treatments are to be identified and be in accordance with Austroads Guide to Road Design and Roads and Maritime Supplements, including safe intersection sight distance.*
- *Local climate conditions that may affect road safety for vehicles used during construction, operation and decommissioning of the project (e.g. fog, dust, wet weather, etc.)*
- *The layout of the internal road network, parking facilities and infrastructure within the project boundary.*
- *A Traffic Management Plan is to be developed in consultation with the Parkes Shire Council and Roads and Maritime prior the commencement of haulage and/or construction operations. The TMP is to identify and provide management strategies to manage the impacts of projected related traffic including:*
  - *Haulage of materials to site.*
  - *The safe transportation of construction workers from accommodation facilities to site and return. In this regard, Roads and Maritime will require specific details on how the proponent will ensure the identified management measures employed to ensure the safety of staff travelling to and from the site each day will be controlled and enforced.*

2.2 SITE LOCATION

The development site is located off Back Trundle Road, approximately 8.5 km north-west of Parkes, NSW, within the Parkes Local Government Area (LGA). The development site is on Lot 508 DP 750152 (covering 470 ha) and is owned by a single landowner. **Figure 1** below shows the location of the site in relation to the township of Parkes and the surrounding road network.

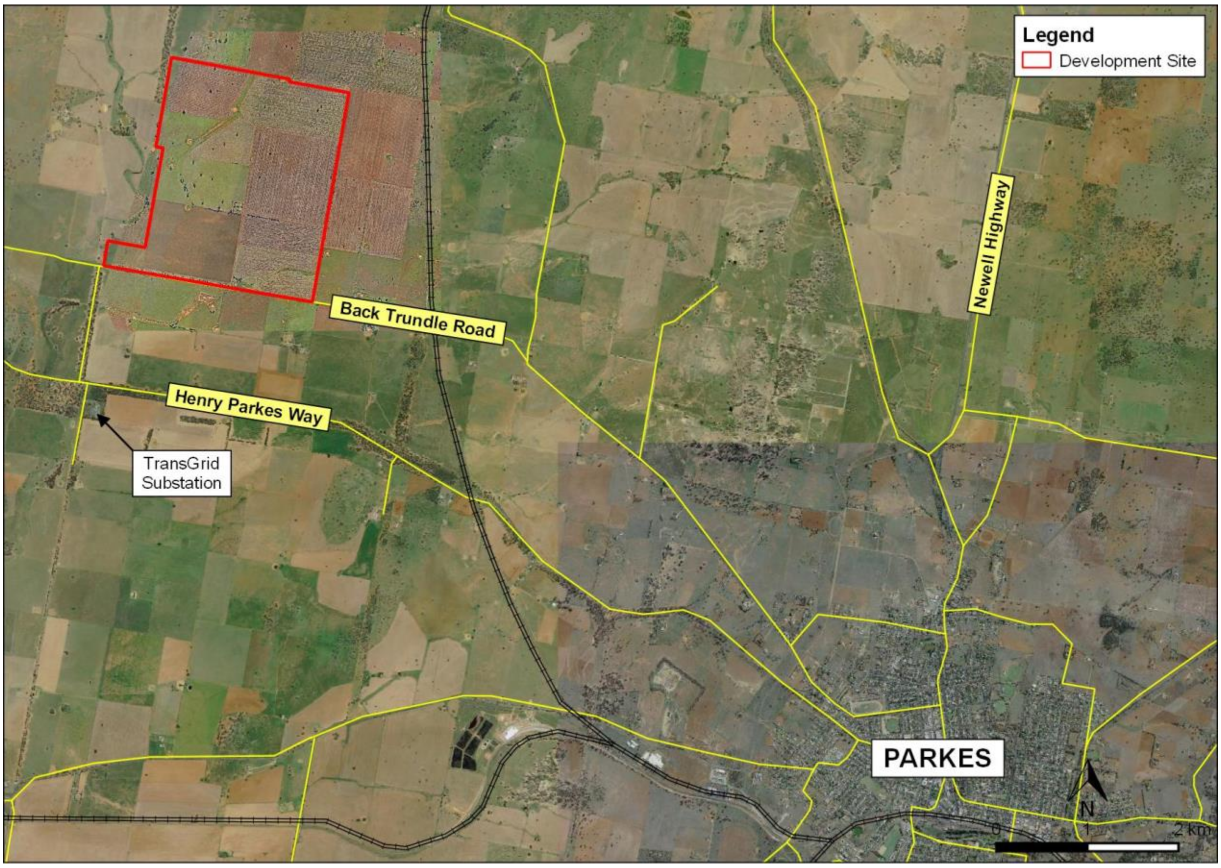


Figure 1: Development Site (Imagery: NSW Spatial Services/NearMap)

2.3 SITE DESCRIPTION

The site is currently used as farmland for crop raising and grazing purposes. The site is predominately flat with some minor natural waterways.

TransGrid's Parkes Zone Substation is located to the south of the site, as is the constructed 65 MW Parkes Solar Farm and the approved (but not built) 70 MW Goonumbla Solar Farm.

The Parkes National Logistics Hub (Hub) is located to the south-east. The Hub is a multi-modal transport facility strategically located at the cross roads of the Newell Highway connecting Brisbane and Melbourne, and the transcontinental railway linking the eastern seaboard to Perth.

2.4 PROPOSED DEVELOPMENT DESCRIPTION

The proposed Quorn Park Solar Farm is a 80 MW electricity generation works that will be comprised of solar photovoltaic modules, steel racking and piled supports, electrical transformers and inverters, electrical cabling, telecommunications equipment, an electrical control room, site substation and perimeter fencing. The farm may also include an electrical storage system which would include batteries housed in electrical enclosures.

Access to the site will be from Back Trundle Road via McGrath Lane and Henry Parkes Way.

Existing Traffic Conditions

3.1 EXISTING ROAD NETWORK

3.1.1 HENRY PARKES WAY

Henry Parkes Way is a bitumen sealed, two lane, two way classified Arterial Road with two 3.5 metre wide lanes in each direction. There are bitumen sealed shoulders approximately 0.5-1 metres wide along both sides in the vicinity of the site.

The road extends east from the Cobar Condo Road north of Condobolin to the Escort Way west of Orange and is aligned generally in an east – west direction.

Figure 2 below represents a typical section of Henry Parkes Way near the subject site with the intersection of McGrath Lane visible in the centre of the plate.

Figure 2: Henry Parkes Way typical section (August 2018)

Figure 3 below shows the intersection of Henry Parkes Way and McGrath Lane intersection.

Figure 3: Henry Parkes Way / McGrath Lane Intersection (August 2018)

3.1.2 MCGRATH LANE

McGrath Lane is an unsealed local Council road connecting Henry Parkes Way to Back Trundle Road.

McGrath Lane has a gravel formation approximately 7 metres wide allowing two vehicles to pass one another as required and is 1.3 kilometres in length.

Figure 4 below represents a typical section of McGrath Lane looking north towards Back Trundle Road.

Figure 4: McGrath Lane typical section (August 2018)

3.1.3 BACK TRUNDLE ROAD

Back Trundle Road is an unsealed local Council road connecting the townships of Trundle and Parkes.

In the vicinity of the development site, Back Trundle Road has a gravel formation approximately 7 metres wide allowing two vehicles to pass one another as required.

Figure 5 below represents a typical section of Back Trundle Road looking east towards the development site.

Figure 5: Back Trundle Road typical section (August 2018)

3.1.4 RMS ROAD NETWORKS

The Roads & Maritime Services (RMS) General Mass Limits (GML) and Concessional Mass Limits (CML) network in the locality of the subject site is shown in **Figure 6** below. The Concessional Mass

Limits (CML) allows an operator to operate at mass limits above the national agreed limits provided the operator is accredited under the National Heavy Vehicle Accreditation Scheme (NHVAS).

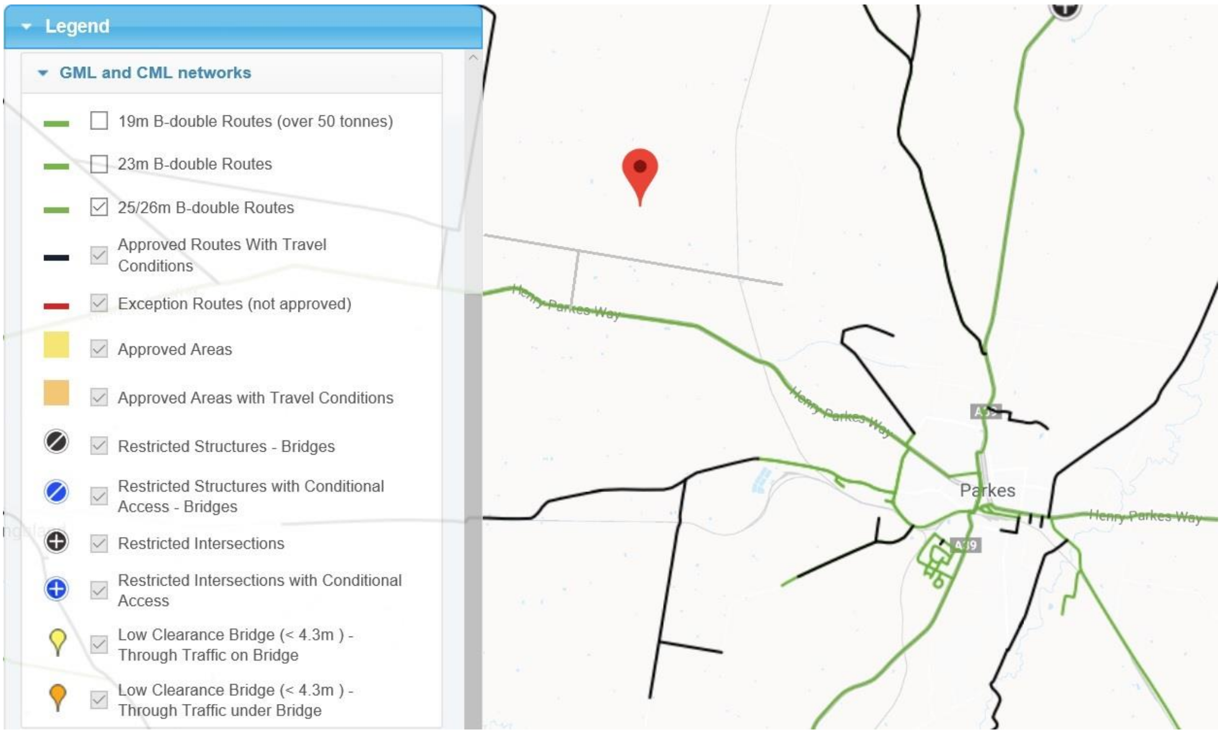


Figure 6: RMS General Mass Limits (GML) and Concessional Mass Limits (CML) Network

The RMS network plan shows Henry Parkes Way is approved for GML and CML heavy vehicles up to and including 26 m long B-doubles.

Back Trundle Road along the site's southern boundary and McGrath Lane are not an approved GML or CML heavy vehicle routes and will require approvals from the NHVAS to permit their use by B-Double trucks as part of the heavy vehicle delivery route.

Vehicle Access to Proposed Development

4.1 ACCESS ROUTES

4.1.1 COARSE AGGREGATE AND FINE CRUSHED GRAVEL

Whilst the source of both coarse and fine gravel to be used in the construction of hardstand areas and access tracks has not been locked in at the time of writing this report it is expected that they will be sourced locally, and that access to the site will be via:

Henry Parkes Way – McGrath Lane – Back Trundle Road

4.1.2 WATER DELIVERIES

Any water required for road dust suppression and construction will ideally be sourced onsite. If there is insufficient water available on site, deliveries will be sourced locally, using the following route;

Henry Parkes Way – McGrath Lane – Back Trundle Road

4.1.3 SOLAR MODULE/SUBSTATION COMPONENTS

The solar farm components will likely be sourced from overseas as a result of their specialised nature.

Imported components will be delivered to either the port of Newcastle, Botany Bay and/or Port Kembla and transported to the site by road. It is anticipated that the following routes will be used by heavy and over-dimensional (OD) vehicles. The anticipated route form Newcastle is as follows:

Hunter Expressway – Golden Highway – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road

The anticipated route from Botany Bay is as follows:

M5 Motorway – Hume Motorway – Lachlan Valley Way – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road

The anticipated route from Port Kembla is as follows:

Princess Motorway – Hume Motorway – Lachlan Valley Way – Newell Highway – Henry Parkes Way – McGrath Lane – Back Trundle Road

4.1.4 CONSTRUCTION STAFF

It is expected that staff working on the project will be travelling from surrounding regional centres with the majority of staff travelling from the nearby township of Parkes (township located approximately 8.5 km south-east of the site)

The anticipated route from Parkes is as follows:

Henry Parkes Way – McGrath Lane – Back Trundle Road

4.2 SITE ACCESS

As shown above, the main access route for both light and heavy vehicles is:

Henry Parkes Way – McGrath Lane – Back Trundle Road

During development, the largest delivery vehicle (excluding oversized vehicles) is expected to be a either a 19 metre Semi-trailer or a 26 metre long B-double. At the time of writing this report it has not been decided if B-double trucks will be utilised to delivery materials to site. The site access will be designed to cater for the swept path of the largest vehicle accessing the site.

The intersections of Henry Parks Way/McGrath Lane and McGrath Lane/Back Trundle Lane are able to accommodate the swept path of a B-double truck.

We also expect that the intersections above will be able to cater for any oversized vehicles required to deliver oversize components however specific traffic control measures for these deliveries will need to be prepared and implemented to suit the specific oversize delivery vehicle.

4.3 INTERSECTION TREATMENT ASSESSMENT

The Austroads Road Design Guidelines Part 4: *Intersections and Crossing - General* contain warrants to determine turn treatments at an intersection based on peak hour through and turning volumes. These warrants are shown in **Figures 7 & 8** below for the left turn in and right turn in to McGrath Lane from Henry Parkes Way.

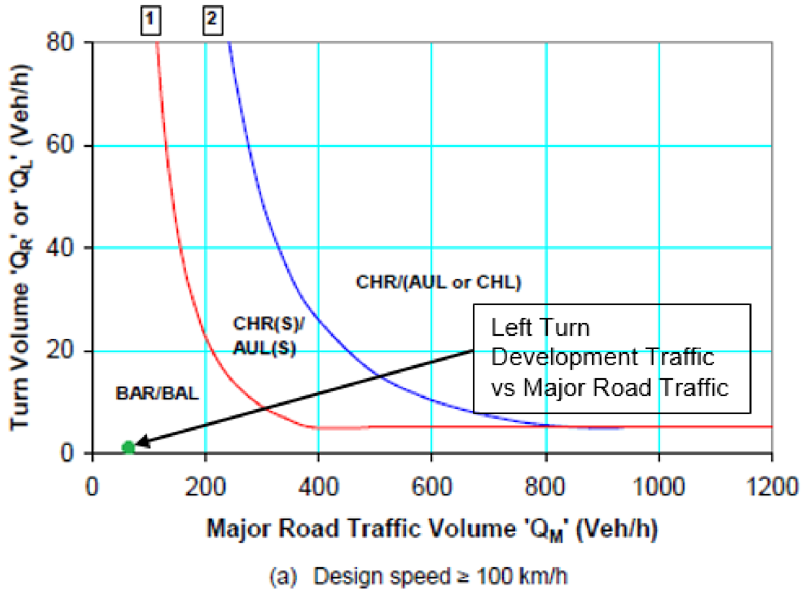


Figure 7: Left Turn Warrant for turn treatment at Henry Parks Way/McGrath Lane

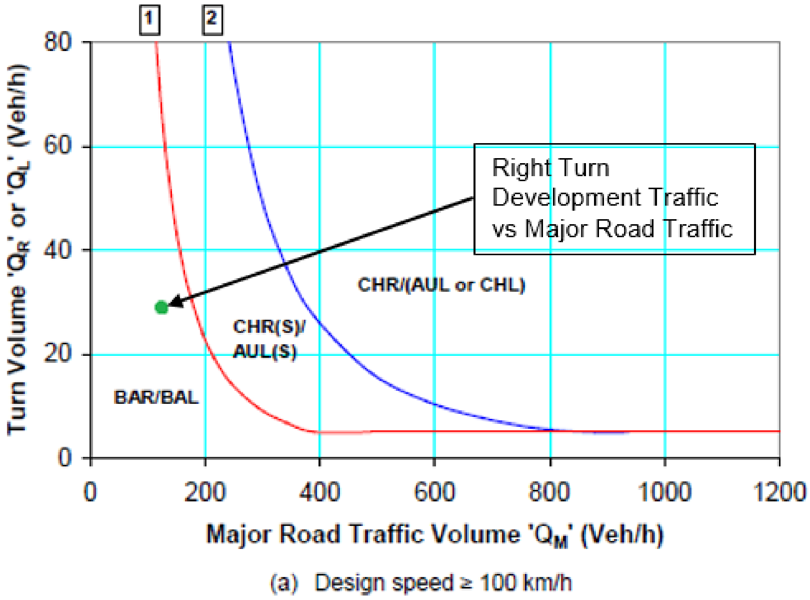


Figure 8: Right Turn Warrant for turn treatment at Henry Parks Way/McGrath Lane

The warrants use peak hour traffic and only apply to the turning movements from the major road. To be conservative, it has been assumed that peak site generated traffic will coincide with the existing peak traffic along Henry Parkes Way.

RMS provided traffic counts taken during May 2017 on Henry Parkes Way west of Moulden Street (approximately 2 km west of the CBD of Parkes and 8 km east of the intersection with McGrath Lane). The data indicated that the average total (both directions combined) daily traffic on Henry Parkes Way is approximately 1400 vehicles per day. The data included hourly counts and indicated a maximum weekday morning peak hour traffic of 137 vehicles per hour (both directions combined). The evening weekday peak hour traffic was 156 vehicles per hour (both directions combined).

Appendix A has a complete detailed table of estimated traffic volumes generated during the construction of the farm. The construction of the farm is estimated to generate a maximum of 185 daily vehicle trips during the peak construction period (See **Section 5.1** below). Of this a maximum of 30 vehicle trips per hour is expected at the beginning and end of the work day as crew arrive/leave the site.

Reference to the warrants reproduced in **Figures 7 & 8** with the respective peak hour turning movements plotted (green dot) indicate that the following turn treatments are warranted:

- Basic left-turn treatment (BAL)
- Basic right-turn treatment (BAR)

The volumes obtained do not include the expected increase in traffic due to peak harvesting seasons, however the warranted turn treatments are expected to be capable of facilitating these increases.

The existing intersection treatment at intersection of Henry Parkes Way and McGrath Lane does not meet the requirements for a BAL/BAR treatment. As such it is recommended that the existing intersection be upgraded to a BAL/BAR type intersection. Two preliminary layout designs for the proposed upgrade to the intersection have been prepared based on a largest delivery vehicle of a 19 m semi (Option A – **Drawing 217510_01**) and a largest delivery vehicle of a 26 m B-double (Option B – **Drawing 217510_02**).

4.4 INTERSECTION SIGHT DISTANCE ASSESSMENT

4.4.1 SIGHT DISTANCE REQUIREMENTS

A site visit was conducted on August 14 2018 to assess the achievable sight distances at key intersections in the vicinity of the site.

Austroads Guide to Road Design - Part 4A: *Unsignalised and Signalised Intersections* outlines the requirements for sight distance for unsignalised intersections.

The guide recommends that the Safe Intersection Sight Distance (SISD) should be the minimum sight distance provided on the Major Road at any intersection.

The method of measuring SISD is shown in **Figure 9** below.

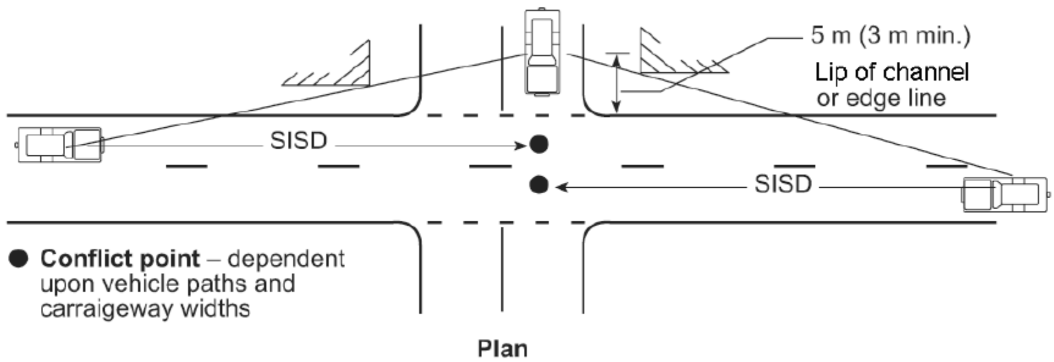


Figure 9: Guide to measuring SISD for unsignalised intersections

The Austroads guide provides a formulae for calculating SISD values for vehicles at varying design speeds and road conditions. The following formula is used to determine the SISD for heavy vehicles:

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)}$$

where

SISD	=	safe intersection sight distance (m)
D_T	=	decision time (sec) = observation time (3 sec) + reaction time (sec) – refer to *AGRD Part 3* (Austroads 2016b) for a guide to values
V	=	operating (85th percentile) speed (km/h)
d	=	coefficient of deceleration – refer to Table 3.3 and *AGRD Part 3* for a guide to values
a	=	longitudinal grade in % (in direction of travel: positive for uphill grade, negative for downhill grade)

Based on the above formula and adoption of an operating 85th percentile speed of 110 km/h, a minimum SISD of 351 meters is required.

4.4.2 ASSESSED INTERSECTION SIGHT DISTANCES

4.4.2.1 Henry Parkes Way / McGrath Lane Intersection

Henry Parkes Way in the vicinity of the its intersection with McGrath Lane is relatively straight and flat, with trees along the verge setback sufficiently to not impede on the safe intersection sight distance available at the site. **Figures 10 & 11** below illustrate the view to the east and west respectively along Henry Parkes Way from the intersection of McGrath Lane.

Figure 10: View East down Henry Parkes Way from McGrath Intersection

Figure 11: View West down Henry Parkes Way from McGrath Intersection

Based on our site inspection the sight distance at the intersection is in excess of the required 351 metres in both directions.

4.4.2.2 McGrath Lane / Back Trundle Road Intersection

Back Trundle Road in the vicinity of the its intersection with McGrath Lane is relatively straight and flat, with trees along the verge setback sufficiently to not impede on the safe intersection sight distance available at the site. **Figures 12 & 13** below illustrate the view to the east and west respectively along Back Trundle Road from the intersection of McGrath Lane.

Figure 12: View East down Back Trundle Road from McGrath Intersection

Figure 13: View West down Back Trundle Road from McGrath Intersection

Based on our site inspection the sight distance at the intersection is in excess of the required 351 metres in both directions.

4.4.2.3 Back Trundle Road / Site Access

Back Trundle Road in the vicinity of the site access is relatively straight and flat, with trees along the verge generally setback sufficiently to not impede on the safe intersection sight distance that would be available at the final site access point.

The location of the site access will be at the existing Quorn Park property access and the sight distance available here is in excess of the required 351 metres in both directions. A typical view of Back Trundle Road looking towards the site access is shown in **Figure 12** above.

4.4.3 SIGHT DISTANCE SUMMARY

Based on the site inspections undertaken at the intersections of Henry Parks Way/McGrath Lane and McGrath Lane/Back Trundle Road, the available sight distances are in exceedance of Austroad's requirements for SISD.

It is recommended to install advance warning "Trucks Turning" signs to alert vehicles travelling along Henry Parkes Way to trucks entering and leaving McGrath Lane. It is recommended that these signs be removed following completion of construction at the solar farm.

Traffic Impact of Proposed Development

5.1 TRAFFIC GENERATION

5.1.1 CONSTRUCTION

An estimated 36 week construction period is expected, with a summary of total vehicle trips and peak daily trips shown in **Table 5.1.** A complete detailed table of estimated traffic volumes generated during construction of the solar farm is included in **Appendix A**.

Whilst B-doubles may be used to transport materials to site for the purposes of estimating truck trips it has been assumed that the largest truck used will be a 19 m Semi-trailer. If B-doubles are used this will reduce the estimated total heavy vehicle trips generated by the construction of the site.

Table 5.1 – Estimated Construction Traffic

Type of Vehicle	Total Vehicle Trips	Peak Daily Trips
Heavy Vehicles	Approximately 4,000 total HV trips	Peak of 125 daily HV trips
Light Vehicles	Approximately 9,060 total LV trips	Peak of 60 daily LV trips
Total	Approximately 13,060 total trips	Peak of 185 daily HV trips

Please note a trip is defined as a one way vehicular movement from one point to another excluding the return journey. Therefore, a return trip to / from a land use is counted as two trips.

Buses will be used to transport the majority of workers to the site each day during the heavy workload period when panels are being installed. Heavy vehicle deliveries would be scheduled to avoid the peak light vehicle movements at the beginning and end of the work day as crew arrive/leave the site to minimise conflict between light and heavy vehicles.

5.1.2 OPERATION AND MAINTENANCE

Once the solar farm construction phase is complete, the site will generate minimal traffic trips and thus be considered as having a minimal impact upon the local road network and traffic volumes post construction. The likely traffic generation post construction is estimated as:

- Assuming daily routine maintenance is carried out by one or two personnel the daily traffic generation for this would be four vehicle trips per day onto the local road network. All other movements are expected to be carried out internally onsite.
- Intermittent maintenance to replace and service parts in irregular time intervals. This is not expected to occur frequently and will have negligible impacts on the road network.
- Limited visitors to site such as office based staff and small courier deliveries.

Traffic generated during the operation and maintenance of the solar farm will produce no noticeable change to Henry Parkes Way in comparison to its current traffic volumes. Due to the very low existing traffic volumes on McGrath Lane and Back Trundle Road the additional traffic generated during operation and maintenance will be noticeable but will have no significant impact to the operation of the roads.

5.2 TRAFFIC IMPACT

During the peak construction period the proposed development will generate up to approximately 185 vehicle trips daily (made up of 125 heavy vehicles and 60 light vehicles) and post construction routine operation and maintenance of the farm will produce around 4 vehicle trips daily.

The pre and post development traffic will be primarily carried by Henry Parkes Way, McGrath Lane and Back Trundle Road. Depending on the final port(s) used to deliver the overseas components delivery trucks will also use Hunter Expressway, Golden Highway, Newell Highway, M5 Motorway, Hume Motorway, Lachlan Valley Way and Princess Motorway. As outlined in **Section 2.1.4** all of the roads above (with the exception of McGrath Lane and Back Trundle Road) are RMS approved routes for GML and CML heavy vehicles up to and including 26 metre B-doubles.

The additional traffic is expected to have minimal impact on the existing road infrastructure as outlined in the following sections.

Henry Parkes Way

The traffic counts provided by RMS indicates that approximately 1,400 vehicles per day currently use Henry Parkes Way in the vicinity of the subject site. During the peak construction period it is estimated that this would increase by up to 185 vehicles per day which equates to an increase of approximately 13%. On average the increase in daily trips during the peak in the construction phase would generate an additional 105 vehicles per day which equates to an increase of approximately 7.5%. It is expected that these minor increases occurring for only limited times will be comfortably absorbed by Henry Parkes Way with no significant decrease in the operating performance of the road.

McGrath Lane and Back Trundle Road

As outlined in **Section 3.1.4** McGrath Lane and Back Trundle Road are not existing RMS approved routes for GML and CML heavy vehicles and therefore will require approval through the National Heavy Vehicle Accreditation Scheme (NHVAS) if B-doubles are to be used to delivery materials to the site.

McGrath Lane and Back Trundle Road's road pavements are expected to be able to accommodate the increased traffic and heavy vehicle usage due to the relatively short construction period.

It is anticipated that Parkes Shire Council will require a pre and post construction dilapidation survey of McGrath Lane and Back Trundle Road to ensure the roads are restored to pre-construction conditions following construction of the farm.

5.3 GOONUMBLA SOLAR FARM AND INLAND RAIL PROJECT

The risk of construction traffic from the Quorn Park Solar Farm (QPSF) coinciding with traffic for the Goonumbla Solar Farm or Inland Rail transport hub developments is very low. The Goonumbla Solar Farm is due to be constructed from the first quarter of 2019 and should be completed within about nine months. It will complete before QPSF moves to construction. The earliest likely date for commencing construction of QPSF would be the first quarter of 2020.

The first stage of the Inland Rail project is underway with track upgrades and construction of new track and a siding. This stage is expected to be completed by February 2019. There is no information on the timing of subsequent stages of the development. Although the scope of work is expected to be extensive, it will be staged and therefore may not coincide with QPSF construction traffic. Regardless of timing, the location of the logistics terminal is between the Henry Parkes Way and Brolgan Road and not near to the QPSF. Access to the logistics terminal is available via Brolgan Road if necessary to avoid conflicts.

Traffic Management Plan

Until a final EPC contractor is appointed and details for the construction of the solar farm are locked in assumptions made in this report in relation to traffic generation and management is subject to review and potential change. Nevertheless the assumed traffic generated by the development contained within this report is considered the worst case scenario and a conservative estimate.

RMS have requested as part of the SEARs for the development:

- *A Traffic Management Plan is to be developed in consultation with the Parkes Shire Council and Roads and Maritime prior the commencement of haulage and/or construction operations. The TMP is to identify and provide management strategies to manage the impacts of projected related traffic including:*
  - *Haulage of materials to site.*
  - *The safe transportation of construction workers from accommodation facilities to site and return. In this regard, Roads and Maritime will require specific details on how the proponent will ensure the identified management measures employed to ensure the safety of staff travelling to and from the site each day will be controlled and enforced.*

Accordingly a detailed Traffic Management Plan (TMP) will need to be prepared prior to construction starting at the site to detail final traffic management measures to be adopted during the construction phase.

The TMP would be prepared and implemented in accordance with the final Development Consent issued for the solar farm and developed in consultation with Parkes Shire Council, RMS and any other relevant stakeholders

In general terms the TMP would include details on the following:

- Construction timeframe and staging of works,
- Confirmation of anticipated additional traffic volumes generated by the farm,
- Confirmation of final HV and OD vehicle haulage routes to be used for all delivery vehicles,
- A process to review haulage route road conditions prior to the commencement of works,
- A process to carry out pre and post construction road dilapidation surveys to ensure roads are reinstated to at least pre-construction conditions,
- Requirements for any additional TMP(s) required for a specific work stage/process (e.g. delivery of oversize components),
- Qualify and identify any relevant mechanisms for OD vehicle permits and traffic management requirements, and

The above list is not intended to be an exhaustive list with the final TMP requirements dictated by the conditions outlined within the final Development Consent.

References

Austroads (2017) Guide to Road Design Part 4: Intersections and Crossing – General
Austroads (2017) Guide to Road Design Part 4A: Unsignalised and Signalised Intersections
Roads and Traffic Authority (2002) Guide to Traffic Generating Developments

Drawings

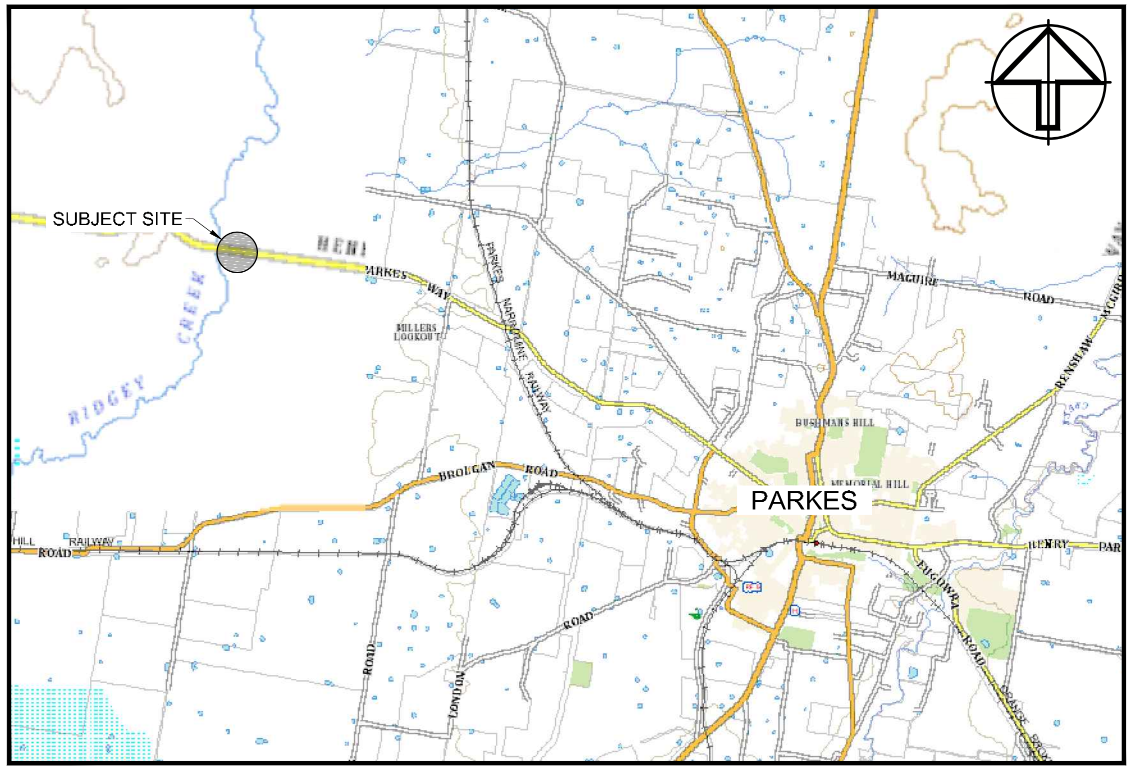
QUORN PARK SOLAR FARM

HENRY PARKS WAY AND MCGRATH LANE INTERSECTION, PARKES NSW 2870

QUORN PARK SOLAR FARM PTY LTD

CONCEPT DESIGN OPTION A (19m SEMI-TRAILER)

SCHEDULE OF DRAWINGS	
DRAWING	TITLE
C001	TITLE SHEET AND SCHEDULE OF DRAWINGS
C002	CONCEPTUAL AUSTROADS BASIC LEFT TURN (BAL) AND BASIC RIGHT (BAR) TURN INTERSECTION LAYOUT
C003	AUSTROADS PRIME MOVER AND SEMI-TRAILER (19m) TURNING PATHS



SITE LOCALITY
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REV.	DATE	DFTD.	APPD.	DETAILS
A	22/08/18	AH	PPO	FOR REVIEW
B	04/09/18	AH	PPO	FOR REVIEW
C	22/10/18	AH	PPO	FOR REVIEW

	FILE	INITIALS	DATE
SURVEY	-	-	-
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE

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PROJECT: QUORN PARK SOLAR FARM

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DRAWING: TITLE SHEET AND SCHEDULE OF DRAWINGS
PROJECT NUMBER 217510 | DRAWING FILE 217510_01C_C001-C003.dwg | ORIGINAL A1
SURVEY MARK - | R.L. - | DATUM A.H.D.
IMAGE SOURCE -
STATUS FOR REVIEW | SHEET C001 OF C003 | SET 01

NOTES:

1. THIS PLAN IS CONCEPTUAL ONLY AND IS SUBJECT TO DETAILED ENGINEERING DESIGN AND THE APPROVAL OF THE NEW SOUTH WALES ROADS AND MARITIME SERVICE.
2. INTERSECTION LAYOUT SHOWN IS A BASIC LEFT TURN (BAL) AND BASIC RIGHT TURN (BAR) INTERSECTION IN ACCORDANCE WITH THE AUSTROADS GUIDE TO ROAD DESIGN PART 4A: UNSIGNALISED AND SIGNALISED INTERSECTIONS.
3. INTERSECTION LAYOUT SHOWN CATERS FOR THE LEFT TURN IN AND LEFT TURN OUT MOVEMENTS OF AN AUSTROADS PRIME MOVER AND SEMI-TRAILER (19m). REFER TO THIS SHEET FOR DETAILS.

LEGEND:

- PROPOSED ROAD PAVEMENT
- EXISTING/PROPOSED EDGE OF BITUMEN
- EXISTING/PROPOSED EDGE OF FORMATION
- EXISTING/PROPOSED TYPE E1 EDGE LINE
- EXISTING/PROPOSED TYPE C1 CONTINUITY LINE
- PROPOSED TYPE BB DOUBLE BARRIER LINES
- PROPOSED TYPE TB HOLD LINE
- PROPOSED SIGN AND POST
- PROPOSED TABLE DRAIN
- APPROXIMATE LIMIT OF WORKS (SUBJECT TO DETAILED DESIGN)

REV.	DATE	DFTD.	APPD.	DETAILS
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SURVEY	-	-	-
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE
SCALE 1:250 (A1)
SCALE 1:500 (A3)
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DRAWING: CONCEPTUAL AUSTROADS BASIC LEFT TURN (BAL) AND BASIC RIGHT TURN (BAR) INTERSECTION LAYOUT

PROJECT NUMBER 217510 | DRAWING FILE 217510_01C_C001-C003.dwg | ORIGINAL A1
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LEGEND:

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- EXISTING/PROPOSED EDGE OF FORMATION
- EXISTING/PROPOSED TYPE E1 EDGE LINE
- EXISTING/PROPOSED TYPE C1 CONTINUITY LINE
- PROPOSED TYPE BB DOUBLE BARRIER LINES
- PROPOSED TYPE TB HOLD LINE
- PROPOSED SIGN AND POST
- TD — PROPOSED TABLE DRAIN
- XX — XX — APPROXIMATE LIMIT OF WORKS (SUBJECT TO DETAILED DESIGN)

Prime mover and semi-trailer (19 m)	
Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m

REV.	DATE	DFTD.	APPD.	DETAILS
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DRAINS/ HEC-RAS MODELLING	-	-	-
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SCALE 1:250 (A1)

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DRAWING: AUSTROADS PRIME MOVER AND SEMI-TRAILER (19m) TURNING PATHS

PROJECT NUMBER 217510 | DRAWING FILE 217510_01C_C001-C003.dwg | ORIGINAL A1

SURVEY MARK - | R.L. - | DATUM A.H.D.

IMAGE SOURCE -

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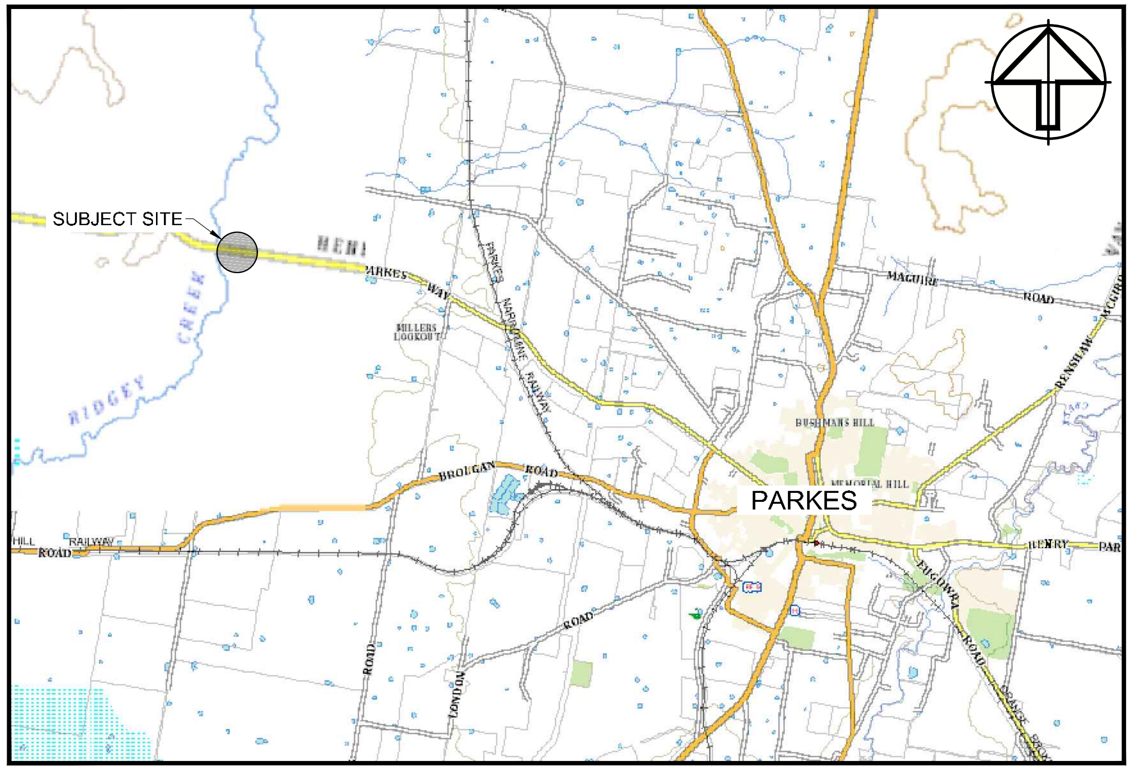
QUORN PARK SOLAR FARM

HENRY PARKS WAY AND MCGRATH LANE INTERSECTION, PARKES NSW 2870

QUORN PARK SOLAR FARM PTY LTD

CONCEPT DESIGN OPTION B (26m B-DOUBLE)

SCHEDULE OF DRAWINGS	
DRAWING	TITLE
C001	TITLE SHEET AND SCHEDULE OF DRAWINGS
C002	CONCEPTUAL AUSTROADS BASIC LEFT TURN (BAL) AND BASIC RIGHT (BAR) TURN INTERSECTION LAYOUT
C003	AUSTROADS PRIME MOVER AND B-DOUBLE TRAILER CONFIGURATION (26m) TURNING PATHS



SITE LOCALITY
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REV.	DATE	DFTD.	APPD.	DETAILS
A	04/09/2018	AH	PPO	FOR REVIEW
B	22/10/2018	AH	PPO	FOR REVIEW

	FILE	INITIALS	DATE
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DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

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NOTES:

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3. INTERSECTION LAYOUT SHOWN CATERS FOR THE LEFT TURN IN AND LEFT TURN OUT MOVEMENTS OF AN AUSTROADS PRIME MOVER AND B-DOUBLE TRAILER CONFIGURATION (26m). REFER TO THIS SHEET FOR DETAILS.

LEGEND:

(grey fill)	PROPOSED ROAD PAVEMENT
(blue line)	EXISTING/PROPOSED EDGE OF BITUMEN
(red line)	EXISTING/PROPOSED EDGE OF FORMATION
(solid line)	EXISTING/PROPOSED TYPE E1 EDGE LINE
(dashed line)	EXISTING/PROPOSED TYPE C1 CONTINUITY LINE
(double line)	PROPOSED TYPE BB DOUBLE BARRIER LINES
(dashed line)	PROPOSED TYPE TB HOLD LINE
(symbol)	PROPOSED SIGN AND POST
— TD —	PROPOSED TABLE DRAIN
— xx — xx —	APPROXIMATE LIMIT OF WORKS (SUBJECT TO DETAILED DESIGN)

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SURVEY	-	-	-
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE

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DRAWING: CONCEPTUAL AUSTROADS BASIC LEFT TURN (BAL) AND BASIC RIGHT TURN (BAR) INTERSECTION LAYOUT

PROJECT NUMBER 217510 | DRAWING FILE 217510_02B_C001-C003.dwg | ORIGINAL A1

SURVEY MARK - | R.L. - | DATUM A.H.D.

IMAGE SOURCE - | SET 02

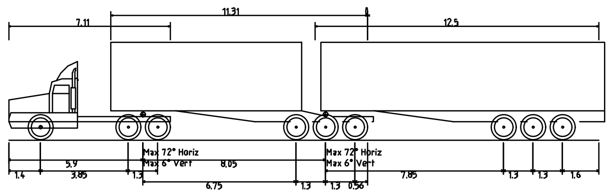
STATUS FOR REVIEW | SHEET C002 OF C003

NOTES:

1. THIS PLAN IS CONCEPTUAL ONLY AND IS SUBJECT TO DETAILED ENGINEERING DESIGN AND THE APPROVAL OF THE NEW SOUTH WALES ROADS AND MARITIME SERVICE.
2. INTERSECTION LAYOUT SHOWN IS A BASIC LEFT TURN (BAL) AND BASIC RIGHT TURN (BAR) INTERSECTION IN ACCORDANCE WITH THE AUSTROADS GUIDE TO ROAD DESIGN PART 4A: UNSIGNALISED AND SIGNALISED INTERSECTIONS.
3. INTERSECTION LAYOUT SHOWN CATERS FOR THE LEFT TURN IN AND LEFT TURN OUT MOVEMENTS OF AN AUSTROADS PRIME MOVER AND B-DOUBLE TRAILER CONFIGURATION (26m). REFER TO THIS SHEET FOR DETAILS.

LEGEND:

- PROPOSED ROAD PAVEMENT
- EXISTING/PROPOSED EDGE OF BITUMEN
- EXISTING/PROPOSED EDGE OF FORMATION
- EXISTING/PROPOSED TYPE E1 EDGE LINE
- EXISTING/PROPOSED TYPE C1 CONTINUITY LINE
- PROPOSED TYPE BB DOUBLE BARRIER LINES
- PROPOSED TYPE TB HOLD LINE
- PROPOSED SIGN AND POST
- TD — PROPOSED TABLE DRAIN
- XX — XX — APPROXIMATE LIMIT OF WORKS (SUBJECT TO DETAILED DESIGN)



B-Double (26.0m)	
Overall Length	26.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	15.000m

REV.	DATE	DFTD.	APPD.	DETAILS
A	04/09/2018	AH	PPO	FOR REVIEW
B	22/10/2018	AH	PPO	FOR REVIEW

	FILE	INITIALS	DATE
SURVEY	-	-	-
DESIGN	-	-	-
DRAINS/ HEC-RAS MODELLING	-	-	-
ENGINEERING/ SURVEYING APPROVAL		-	-

DRAWING SCALE

SCALE 1:250 (A1)

0 5 10 15 20

SCALE 1:500 (A3)

DO NOT SCALE FROM THESE DRAWINGS. ALL MEASUREMENTS SHALL BE CONFIRMED ON SITE AND WITH GEOLYSE PTY. LTD. PRIOR TO CONSTRUCTION

APPROVAL AUTHORITY: PARKES SHIRE COUNCIL

CLIENT: QUORN PARK SOLAR FARM PTY LTD

PROJECT: QUORN PARK SOLAR FARM

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DRAWING: AUSTROADS PRIME MOVER AND B-DOUBLE TRAILER CONFIGURATION (26m) TURNING PATHS

PROJECT NUMBER 217510	DRAWING FILE 217510_02B_C001-C003.dwg		ORIGINAL A1
SURVEY MARK -	R.L. -	DATUM A.H.D.	
IMAGE SOURCE -			SET 02
STATUS FOR REVIEW	SHEET C003 OF C003		

Appendix A

ESTIMATED TRAFFIC TRIPS

Quorn Park Solar Farm - Estimated Construction Traffic Trips

Peak Daily Trips

Stage	Trips/day		Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Site supervision/engineers	LV/Other	8		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Site preparation and substation construction	HGV	20		20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20												
	LV/Other	8		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8												
Solar panel delivery	HGV	50						50	50	50	50	50	50	50	50																								
	LV/Other							0	0	0	0	0	0	0	0																								
Installation solar panels	HGV	25									25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25					
	LV/Other	34									34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34					
Installation cabling	HGV	30											30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30											
	LV/Other	10											10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10											
Commissioning	HGV	6																													6	6	6	6	6	6	6		
	LV/Other	8																													8	8	8	8	8	8	8		
Construction restoration and completion	HGV	33																																				33	33
	LV/Other	8																																				8	8
	All			36	36	36	36	86	86	86	145	145	185	185	185	135	135	135	135	135	135	135	135	135	135	135	135	107	67	67	81	81	81	81	22	22	22	49	49
Peak Total Trips per day	HGV			20	20	20	20	70	70	70	95	95	125	125	125	75	75	75	75	75	75	75	75	75	75	75	75	55	25	25	31	31	31	31	6	6	6	33	33
	LV/Other			16	16	16	16	16	16	16	50	50	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	52	42	42	50	50	50	50	16	16	16	16	16
	HGV			3	3	3	3	9	9	9	12	12	16	16	16	9	9	9	9	9	9	9	9	9	9	9	9	7	3	3	4	4	4	4	1	1	1	4	4
Trips per hour	LV/Other			8	8	8	8	8	8	8	25	25	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	26	21	21	25	25	25	25	8	8	8	8	8
	Max			**8**	**8**	**8**	**8**	**9**	**9**	**9**	**25**	**25**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**30**	**26**	**21**	**21**	**25**	**25**	**25**	**25**	**8**	**8**	**8**	**8**	**8**

LV/Other Assumptions	People	Trips
Panel installation (15% use private vehicles) remainder come in 2 buses	100	34
Cabling installation (electricians) average 2 per veh	10	10
Site supervision/engineers	4	8
Site Preparation and substation construction (2 per veh)	8	8
Commissioning	4	8
Construction restoration and completion	4	8
LV/other Trips occur during 2 one hour periods		
Deliveries spread over 8 hour day		

Stage	Trips/day		Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Total Trips
Site supervision/engineers	LV/Other	8		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	1,728
Site preparation and substation construction	HGV	6		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6													864
	LV/Other	8		8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8													1,152
Solar panel delivery	HGV	28						28	28	28	28	28	28	28	28																									1,344
	LV/Other							0	0	0	0	0	0	0	0																									-
Installation solar panels	HGV	9									9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9						1,296
	LV/Other	34									34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34						4,896
Installation cabling	HGV	2											2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2												192
	LV/Other	10											10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10												960
Commissioning	HGV	1.5																													1.5	1.5	1.5	1.5	1.5	1.5	1.5			63
	LV/Other	6																													6	6	6	6	6	6	6			252
Construction restoration and completion	HGV	20																																				20	20	240
	LV/Other	6																																				6	6	72
	All			22	22	22	22	50	50	50	93	93	105	105	105	77	77	77	77	77	77	77	77	77	77	77	77	63	51	51	58.5	58.5	58.5	58.5	15.5	15.5	15.5	34	34	13,059
Average Total Trips per day	HGV			6	6	6	6	34	34	34	43	43	45	45	45	17	17	17	17	17	17	17	17	17	17	17	17	11	9	9	10.5	10.5	10.5	10.5	1.5	1.5	1.5	20	20	3,999
	LV/Other			16	16	16	16	16	16	16	50	50	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	52	42	42	48	48	48	48	14	14	14	14	14	9,060

LV/Other Assumptions	People	Trips
Panel installation (15% use private vehicles) remainder come in 2 buses	100	34
Cabling installation (electricians) average 2 per veh	10	10
Site supervision/engineers	4	8
Site Preparation and substation construction (2 per veh)	8	8
Commissioning	3	6
Construction restoration and completion	3	6

Note:

A trip is defined as a one way vehicular movement from one point to another excluding the return journey. Therefore, a return trip to / from a land use is counted as two trips