



Appendix F Stringybark Solar Farm Bushfire Risk Analysis

Stringybark Solar Farm Pty Ltd

DOCUMENT TRACKING

Project Name	Stringybark Solar Farm Bushfire Risk Analysis
Project Number	19ARM_13082
Project Manager	Robert Cawley
Prepared by	Michael Jordan, Eliza Biggs
Reviewed by	Mick George
Approved by	Mick George
Status	Final
Version Number	1
Last saved on	30 October 2019

This report should be cited as 'Eco Logical Australia, (2019). *Stringybark Solar Farm Bushfire Risk Analysis*. Prepared for Stringybark Solar Farm Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from NSW Rural Fire Service New England Zone Office and Stringybark Solar Farm Pty Ltd.

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Template 2.8.1

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Abbreviations

Abbreviation	Description
APZ	Asset protection zone
BFMC	Bush Fire Management Committee
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DMP	Decommissioning Management Plan
ERP	Emergency Response Plan
FDI	Fire danger index
FDR	Fire danger rating
FRNSW	Fire and Rescue New South Wales
GFDI	Grassland Fire danger index
LGA	Local Government Area
MW	Megawatts
NSWRFS	NSW Rural Fire Service
OEMP	Operations Environmental Management Plan
PBP	Planning for Bushfire Protection
PV	Photovoltaic
SDS	Safety Data Sheet
SEARS	Secretary's Environmental Assessment Requirements

Glossary

Term	Description
Assets	Anything valued by people which includes houses, crops, forests and, in many cases, the environment.
Asset protection zone (APZ)	A fuel-reduced area surrounding a built asset or structure which provides a buffer zone between a bush fire hazard and an asset. The APZ includes a defendable space within which fire fighting operations can be carried out. The size of the required asset protection zone varies with slope, vegetation and Fire Danger Index (NSWRFS 2018).
Bushfire	Unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective.
Fire danger index (FDI)	A relative number denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed.
Fire danger rating (FDR)	A relative class denoting the potential rates of spread, or suppression difficulty for specific combinations of temperature, relative humidity, drought effects and wind speed. Expressed as LOW, MODERATE, HIGH, VERY HIGH, SEVERE, EXTREME or CATASTROPHIC
Fuel hazard	Fine fuels in bushland that burn in the continuous flaming zone at the fire's edge. These fuels contribute the most to the fire's rate of spread, flame height and intensity. Typically, they are dead plant material, such as leaves, grass, bark and twigs thinner than 6 mm thick, and live plant material thinner than 3 mm thick.
Grassland Curing	The proportion of dead material in grasslands – usually increases over summer as tillers die off and dry out, increasing the risk of grassland fire. Note: Grassland curing is measure of grass greenness and expressed as a percentage of the dead grass material based a visual estimate using a guide such as CFA 2014
Intensity	The rate of energy release per unit length of fire front usually expressed in kilowatts per metre (kW/m).
Residence time	The time required for the flaming zone of a fire to pass a stationary point; the width of the flaming zone divided by the rate of spread of the fire.
Spotting	Behaviour of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Note: Definitions sourced from the AFAC Bushfire Glossary (AFAC 2012) unless referenced otherwise.

1. Introduction

1.1 Background

This Bushfire Risk Analysis has been prepared on behalf of Stringybark Solar Farm Pty Ltd (the 'Proponent') to support a Development Application to construct and operate a utility-scale photovoltaic (PV) solar farm of up to 29.9 megawatts (MW) including a substation (the 'Proposal').

The land associated with the Proposal is approximately 14 km east of Armidale, NSW, in the Armidale Regional Council Local Government Area (LGA). It is currently accessible via Gara Road to the south and Waterfall Way/Grafton Road to the north (see **Figure 1**).

The Proposal would comprise land within the landholdings of 597 Gara Road, Metz, NSW, 2350 (Lot 3 DP 1206469 – proposed for the Development Envelope which would contain a solar panel array area and associated infrastructure) and 1060 Waterfall Way, Metz, NSW, 2350 (Lot 3 DP 786950 and Lot 13 DP 822753 – proposed for a new substation, that would connect to an existing 66 kV powerline that runs through the landholding, and associated infrastructure) (referred to as 'the Site'). The Site, approximately 94 hectares (ha), consists of the approximately 91 ha Development Envelope in conjunction with an additional 2.3 ha accounting for the Substation Location Area and its new access, and the underground connection cable within a 2 m easement (0.4 ha). The Site is shown in **Figure 2**.

The Site has largely been cleared for grazing livestock. Ephemeral 1st and 2nd order streams drain the Site towards Commissioners Waters to the south and Gara River to the east. Farm dams have been constructed in the 597 Gara Road landholding to provide water for livestock as there is no permanent water. Two 132 kV high voltage TransGrid transmission lines pass east to west, north of the Development Envelope. There is also an 11 kV distribution power line that crosses the Development Envelope, entering on the western boundary and exiting on the southern boundary.

The land surrounding the Site is primarily used for agricultural activities, with associated rural dwellings comprising two involved residences and three non-involved residences within one kilometre of the Site. The new Armidale Regional Landfill is located north of the Development Envelope, however at the time of this assessment, the landfill had not yet been commissioned. The closest non-involved residence is located approximately 368 m south east of the Site.

The Development Envelope has been intentionally located in the most disturbed southern section of the 597 Gara Road landholding, adjacent to Gara Road, where almost all native vegetation has been removed. Other than a few 1st and 2nd order streams, the Site is relatively featureless and as such, is very suitable for solar development.

The substation would be located adjacent to an Essential Energy 66 kV distribution line, 1.5 km to the north-west of the Development Envelope. The location of the substation has been selected in order to minimise potential visual impacts associated with the Proposal and fine-tuned to minimise impacts to biodiversity and to minimise the risks associated with bushfire (both to and from the Proposal).

The Proposal will generate electricity through the conversion of solar radiation to electricity using PV panels, laid out across the array area of the Development Envelope in a series of modules, mounted on a single axis tracking system with piled steel supports. Solar PV modules will not exceed 4 m in maximum tilt height above natural ground level. Other infrastructure on site would include electrical

invertors, underground electrical cabling, internal access tracks, water tanks, operational buildings, vehicular access, parking areas, security fencing along with landscape screening.

1.2 Purpose of this Report

This Bushfire Risk Analysis has been prepared to provide an assessment of potential hazards associated with bushfire and electrical fire. It first considers relevant guidance within NSW, then presents an overview of the existing environment. Next it considers potential fire hazards associated with the Site throughout the lifecycle of the Proposal. Finally, in line with the appropriate standards, it provides a coordinated response to fire risks.

The Proposal is classified as Integrated Development and is not a subdivision for residential or rural residential purposes, nor is it a development for a special fire protection purpose, hence the issue of a *Bush Fire Safety Authority* from the Commissioner of the NSW Rural Fire Service (NSW RFS) under section 100B of the *Rural Fires Act 1997* is not formally required. Nonetheless, the *Rural Fires Act 1997* places a duty of care on land owners/managers to prevent fire spreading on and from their land, which is a principle that will be adhered to through all phases of the Proposal.

As the Proposal could be exposed to bushfire risk from grasslands or nearby areas of vegetation, and carries the risk of a potential fire starting from within its boundary, this bushfire assessment has been conducted in accordance with *Planning for Bush Fire Protection (PBP), A guide for councils, planners, fire authorities and developers 2006* (RFS, 2006) and with reference to improved measures provided in the pre-release PBP 2018. The PBP 2006 has been revised to account for lessons learnt in major bushfire events, and changes in building codes and construction standards and the revised PBP is now in the pre-release stage (transitional period). The publication and adoption of the new edition of PBP has been delayed until later in 2019. Until the PBP 2019 becomes legislated, the PBP 2006 remains the legally referenced document, and the PBP 2018 can be used on a performance basis in consultation with NSW RFS only under section 4.14(1A) of the *Environmental Planning and Assessment Act 1979*.

In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Proposal. Fire could damage structures and impact the safety of employees and contractors at the Site. Fire leaving the Site poses a threat to human life, safety, and infrastructure and imperils native flora, fauna and ecosystems. Risk can be considered in terms of environmental hazards that increase the likelihood or severity of fire (vegetation, topography and weather patterns), as well as activities and infrastructure that increase combustion or ignition risks.

This Bushfire Risk Analysis represents the first step towards the development of a comprehensive Bushfire Management Plan which will be prepared post-consent, once full detailed design specifications of the Proposal have been determined. Through consultation with the relevant fire authorities, during post-consent preparation of the Bushfire Management Plan, agreement will be reached on the specific details of mitigation and emergency response requirements that will take into account the final layout.

1.3 Consultation

This Bushfire Risk Analysis has been prepared in consultation with the NSW RFS, New England Zone Office (Armidale).

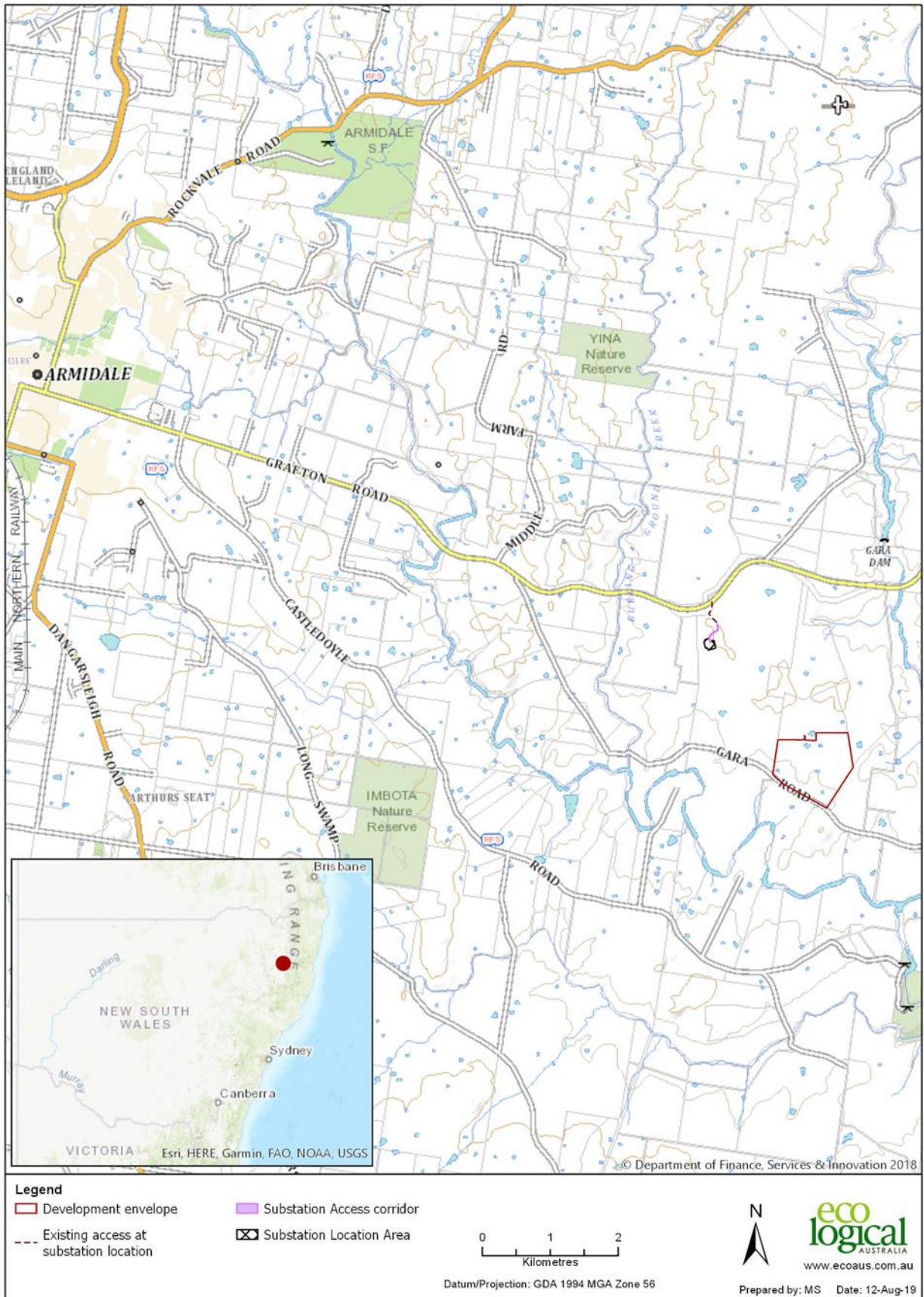


Figure 1: Location Map

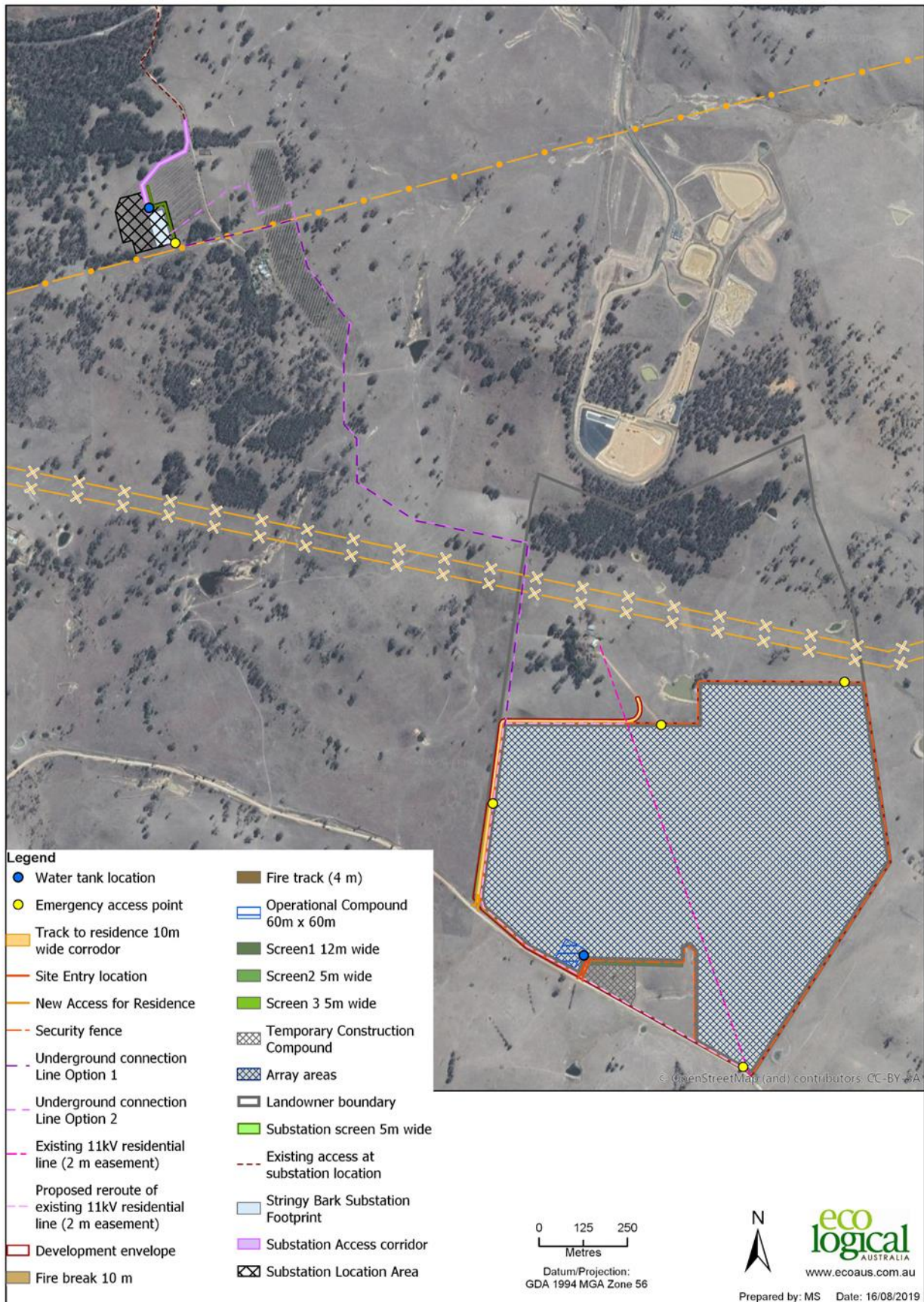


Figure 2: The Site

2. Existing Bushfire risk profile

2.1 Climate

Climate factors are a major influence on the character and potential hazards of any development site, including erosion and plant growth potential (DLWC, 2000). The Site is located within the New England Tablelands bioregion which lies mainly in the temperate to cool temperate climate zone, characterised by warm summers and no dry season (NPWS, 2003).

The closest Bureau of Meteorology (BoM) weather station is at Armidale Tree Group Nursery (Station 056037), located approximately 10 km west of the Site. The mean annual maximum temperature is 20.4°C and the mean annual minimum temperature is 6.2°C (BoM, 2019). Mean annual rainfall is 745.2 mm and records indicate monthly mean rainfall received at the Site is highest in November and February, however summer rainfall is not strongly dominant (BoM, 2019). The mean number of rainfall days >1 mm is higher in summer, and range between 4.9 days (May) to 9.2 days (December) (BoM, 2019).

Wind speeds are generally higher in the afternoon (3 pm conditions). Winds are predominantly westerlies from May/June through to December and are generally strongest and more frequent in winter and spring, with mean wind speeds ranging between 11.1 and 13.1 km/h (BoM, 2019). Gentle easterly winds dominate from January through to May, with mean wind speeds ranging between 10.9 to 11.8 km/h, however wind direction is more variable and stronger winds are caused by westerlies (BoM, 2019).

Prevailing weather conditions associated with the bush fire season in the New England Bush Fire Management Committee (BFMC) area are west to north-westerly winds, moderate to high daytime temperatures and low relative humidity (New England BFMC, 2015). Frosts in winter create low fuel moisture contents and dry lightning storms occur in the bush fire season. The greatest potential for bushfire events at the Site occurs between October and February when drier westerly winds contribute to significant grass curing, making the landscape more susceptible to ignitions starting and spreading.

The statutory Bush Fire Danger Period occurs from 1 October to 31 March annually reflecting seasonal fire hazards; however, a permanent variation exists within the New England Zone to commence the Bush Fire Danger Period from August due to prevailing winds in the zone. The declared bushfire season will vary from year to year depending on the prevailing conditions in the region and it can be extended when the usually wetter summers remain dry. The bushfire season can also be brought forward when a drier than average winter results in the landscape being more susceptible to fires starting and spreading in late spring and early summer. The bushfire danger period for the 2018/2019 bushfire season was extended until the end of April 2019 due to prevailing dry conditions.

It is acknowledged that the bushfire season in the New England is frequently commencing earlier and ending later than the statutory Bush Fire Danger Period. These trends and the increased severity of bushfires are predicted to increase as the Earth's climate continues to change in response to both natural and anthropogenic substances and processes (IPCC, 2018). Transitioning to low carbon emission electricity generation technologies, including renewable energy technologies such as solar, is one of the sector transformations required to address climate change (IPCC, 2018).

The historical weather data indicates that over the life of the development, the Site will experience a number of days annually in which adverse fire weather may occur (FDI of Severe and above). Where such days coincide with periods when the fuel hazard is also conducive to fire spread (see **Section 2.2**) bush and/or grassfires may result.

2.2 Fuel Hazard

2.2.1 Fire spread potential within the surrounding landscape

The Site covers approximately 94 ha of rural land, all of which has been cleared for grazing and sown with improved pastures. The Development Envelope slopes gently toward the south. In the wider area, due to historic clearing for agriculture, vegetation cover is generally low except along ridgetops, within road reserves, along the banks of the Commissioners Waters, in isolated patches in paddocks and gullies and within gardens surrounding the homesteads which are scattered across the landscape. To the Development Envelope's north, there is a small area of vegetation surrounding the southern side of an onsite residence, as well as a larger patch of vegetation further north that runs along the ridge line that forms the northern boundary of the landholding.

None of the Development Envelope or Substation Location Area is mapped as Bushfire Prone Land on the Planning Portal, ePlanning Spatial Viewer Bushfire Prone Land Map, although part of the connection line easement, sections of the wider landholding to the north of the Proposal, as well as land near to the Substation Location Area are classed as mapped as Vegetation Category 1 (NSW Department of Planning and Environment, 2019). Category 1, represented as red on the Bushfire Prone Land Map and given a 100 m buffer, is considered to be the highest risk for bush fire. This vegetation category has the highest combustibility and likelihood of forming fully developed fires including heavy ember production.

Figure 3 shows the Site relative to mapped Bushfire Prone Land.

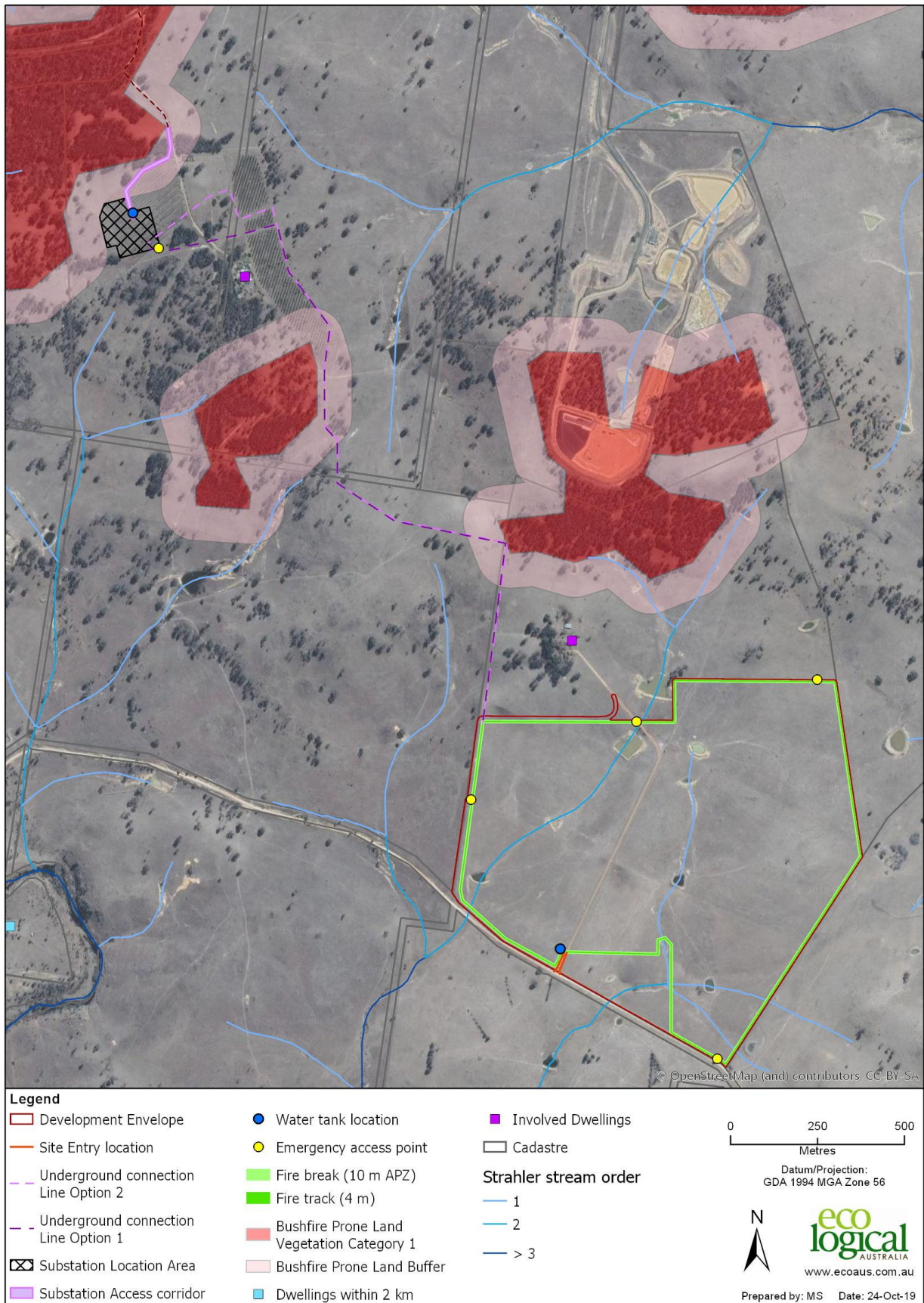


Figure 3: Bushfire Prone Land, Asset Protection Zones and potential emergency exit locations

Ground cover adjacent to the Site is dominated by grazed pastures and while managed, it could be susceptible to grass fires in hot, dry and windy conditions. These areas not classified as bush fire prone, may still carry a grass fire if:

- Grasses are cured (generally more than 50% for continuous fire spread (Cheney & Sullivan, 2008), although discontinuous spread can be propagated in instances as low as 25-30% curing (Cruz *et al*, 2017);
- Grass loads are heavier which provides a greater chance of ignition and fire spread (although grassfires may still start and burn through grazed, eaten out areas and stubble); and
- Pasture grass fuels are continuously linked across the landscape.

At the Site it is unlikely, as neighbouring properties are agricultural enterprises, that adjoining pastures will be carrying heavy pasture loads which are also fully cured. A more likely scenario is that by mid to late summer (when pastures are either partially to fully cured), the pasture condition is likely to be either slashed or well grazed. Grass fires burning in lighter pasture fuels will burn at a *quicker* rate of spread, *lower* flame height and *shorter residence time* than heavier pastures (Cruz *et al*, 2017¹).

Grass fire spread can be held up or stopped where continuous cured grass cover is broken up by local roads, green creek lines, arterial public roads, firebreaks, fully eaten-out areas and farm breaks/tracks. Such features occur in the landscape surrounding the Site, and include:

- Drainage lines and rivers;
- Screening, ornamental or wind break plantings of non-native tree species;
- Residential houses, shed and other infrastructure required for agricultural activity;
- 132kV powerline easement which passes between the Substation Location Area and the Development Envelope of the Site;
- The Armidale Regional Landfill and its access road;
- Waterfall Way which runs along the northern boundary and Gara Road along the south; and
- Farm access tracks in all adjoining properties.

These features make it very unlikely that large areas of the surrounding landscape can easily support a continuous (fully linked) cured grass cover, which will then allow development of a large-scale grass fire.

2.2.2 Fire spread potential within the Site

There are no woodland fragments across the Development Envelope, which is covered in a combination of native and introduced pastures. Exotic trees that occur within the Substation Location Area will be removed prior to the construction of the Substation. However, the Proposal will alter the land management practices within the Development Envelope and the Substation Location Area, potentially resulting in an increase in fuel load as a consequence of removing livestock from these areas. As a result, grass fires within the Site are considered a potential risk, however, it is considered

¹ Cruz MG, Sullivan AL, Hurley RJ, Plucinski MP, Gould JS (2017) *The effect of fuel load and structure on grassland fire behaviour and fire danger*. CSIRO Land and Water, Client Report No EP178976, Canberra, Australia

that this risk can be effectively managed through mitigation measures to reduce the fuel load within the Site.

Under and between the PV panel infrastructure it is intended that pasture fuels are maintained in a low fuel state (<100 mm) by land management activities such as mechanical methods (e.g. slashing and mowing) and potential sheep grazing. While a fire could still spread in these fuels under adverse fire weather conditions, there is less potential for damage to infrastructure than if heavier pasture fuels are present. Heavier pasture fuels are more difficult to extinguish, have a longer flame length, travel slower with a longer residence time than lighter pasture fuels (Cruz *et al*, 2017), and therefore have a higher potential to damage elevated infrastructure.

In the case that panels were able to be initially ignited, the likelihood of a fire spreading within the solar farm, by propagating from panel to panel, is difficult to fully assess at this stage. This is because of a lack of previous fire records from fire agencies and solar farm sites, or available research results for similar environments, climates, and solar farm components relevant to Australia. Although no relevant information is available from within Australia, the risk of a fire spreading widely from panel to panel is considered likely to be very low because of the panel construction materials (they are predominantly constructed of glass, silicon, steel and aluminium) and its fire resistance rating, and the time of flame exposure which is required to initially ignite these materials.

While the connection cable easement will pass through Bushfire Prone Land, the connection cable itself will be buried, therefore risks only apply during the construction phase.

2.3 Fire History and Ignition Sources

There is no fire history documented for the Site, however the broader New England BFMC area (inclusive of Armidale Regional LGA) experiences on average 95 bushfires per annum, with up to 12 which are considered major fires (New England BFMC, 2015). Across New England BFMC area the main sources of fire ignition are identified as:

- Escaped private burns;
- Lightning Strikes; and
- Arson/fire setting.

Any of these potential ignition sources are possible in the vicinity of the Site.

2.3.1 Ignition sources during Construction and Decommissioning

During the construction and decommissioning phases of the Proposal, the following are potential ignition sources:

- Machinery movement in long grass, including vehicles, earth moving equipment, mowers and slashers;
- Hot work activities, including welders and grinders;
- The storage of waste and combustible materials onsite;
- Storage of flammable liquids;
- Electrical faults;
- Lightning strikes; and
- Cigarette butts disposed of carelessly on-site and from cars travelling along Waterfall Way.

Considering the sparse vegetation cover over the Site and other factors discussed above, it is considered unlikely that the Proposal would pose a significant bush fire risk during construction. The bush fire hazard associated with the activities listed above is considered highly manageable through electrical equipment selection and appropriate maintenance programs, access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an Emergency Response Plan (ERP).

Potential fire risk during decommissioning activities would be similar to those for construction. The Site will be fully decommissioned and returned to a state suitable for agricultural use at the end of its life. The commitment to decommission the project is explicit throughout the SEE. The Proponent has specifically requested in their development application for a lease of only 30 years. Prior to the expiry of that 30 years, all infrastructure associated is required to be removed and the Site returned to agricultural use as part of a decommissioning process. All the physical infrastructure would be removed from Site during decommissioning including:

- The substation;
- Buildings;
- Removal of the solar panels, tracking systems, inverters and cables
- Removal of onsite tracks and fences unless otherwise agreed with the landowner; and
- reinstatement of all disturbed ground.

It is expected that a requirement to decommission and restore the Site to its original state would be included as a condition of consent. Stringybark Solar Farm Pty Ltd would be responsible for decommissioning the Proposal and whoever owns it would be bound to this obligation under the EP&A Act. At the lease expiry, the management of the land would return to the landholder.

2.3.2 Ignition sources during Operation

In addition to the potential ignition sources identified above, the operational phase would include fire risks associated with damaged or faulty electrical equipment.

The solar panels are non-reflective and present no risk of ignitions from concentrated solar energy. Ignitions from other PV equipment is theoretically possible from electrical faults such as arc faults, short circuits, ground faults and reverse currents (Allianz Risk Consulting, 2012). The Proponent advised that arcing issues could be created from the following:

- Use of low quality components leading to fault;
- Mismatch of PV cells; or
- Incorrect / faulty wiring (particularly inter-cell, combiner boxes and isolators).

It is conceivable that arcs or melted components resulting from a fault could, if conditions were suitable, ignite grass fuels under or surrounding installations and potentially start a fire. The level of fire risk from faults cannot be assessed at this stage because there is no case history available (see also **Section 2.2**), however, the risk of faults is considered to be low.

2.4 Life and Asset Risk

2.4.1 Fire-fighter and public safety

The usage of the general area surrounding the Site would mostly be limited to residents and employees who are involved in agricultural enterprises, persons living in rural residential premises within proximity of the proposed solar farm, people using Gara Road or Waterfall Way and the operators of the solar farm site.

All NSW Fire and Rescue stations are equipped with the resources and trained personnel required to deal with fire (and hazmat incidents). The fire-fighters likely to respond to a bushfire in this area would be FRNSW fire fighters (located in Armidale, 12 km from the Site) and/or volunteers from the NSW RFS – although it is noted that NSW RFS volunteers in the region are not trained in or equipped with breathing apparatus at this time. Dumaresq RFS Brigade is 9 km from the Site, on the eastern edge of Armidale, and Commissioners Waters RFS Brigade is 17 km from the Site by road (4.4 km as the crow flies). A multi-agency Pre-Incident Plan for the Site would be developed as part of Emergency Response Planning for the Proposal.

Potential risks to fire-fighter safety associated with a fire burning the solar panels and associated equipment include:

- Electrocution – as solar panels would be energised under any natural or artificial light conditions; therefore, isolation of DC current can only occur external to any solar array, at an inverter (Backstrom & Dinni, 2011);
- Safe use of water spray or foam application is only possible from the perimeter of the solar panelled portion of the farm and could not reach the 250 to 500 m required to reach the furthest internal distance (without an aerial ladder platform appliance); and
- Inhalation of potentially toxic fumes and smoke from any plastic components such as cables (although the main structure of the panels will be glass and aluminium) or other decomposed products of the panels (Allianz Risk Consulting, 2012).

The materials for individual components within the solar farm infrastructure have not yet been finalised, therefore, the flammability and toxicity of burning components cannot be determined in detail at this time. The burning of materials such as backing sheets and ethylene vinyl acetate (EVA) will produce hazardous gasses and therefore may require breathing apparatus if those materials are adopted. Thus, the level of risk from burning solar panel components is difficult to quantify, exacerbated by the limited experience in Australia with bushfires in similar installations. Any fire-fighters attending a fire at the solar farm should be equipped with breathing apparatus and trained in structural and electrical fire-fighting – specific safety requirements for firefighters will be determined prior to construction, following the agreement of final design specifications and materials, as discussed in Section 3.10.

2.4.2 Assets

Assets are potentially at risk from a bushfire that may propagate within the solar farm and spread from the Site, or from an external fire threat. The following assets are proposed on site or located within two kilometres of the Proposal:

ASSETS LOCATED ON-SITE

The proposed solar farm consists of the following:

- Approximately 90 ha of solar PV modules on piled supports;
- Inverters;
- Underground cabling;
- One substation and connection to existing 66 kV distribution lines;
- Temporary Construction compound/ Operations compound;
- Security fencing;
- Maintenance and access tracks; and
- Landscaping and tree planting.

ASSETS LOCATED OFF-SITE

The closest assets described by the New England BFMC (2015) are listed in the table below and illustrated in Figure 4.

Map Ref	Asset name	Asset type	Subtype	Risk level	Priority	Treatment	Distance from Site
142	Gara Dam Pump Station	Economic	Infrastructure	High	3A	-	~ 2.7 km NE
369	Aboriginal Site	Cultural	Aboriginal Significance	Very High	2A	-	~ 2.8 km SE
62	Gara River Hydro-Electric Scheme	Cultural	Non Indigenous	Very High	2A	T45	~ 2.8 km SE
61	Gara Gorge Visitor Facilities	Economic	Tourist and Recreational	Very High	2A	T45	~ 2.8 km SE

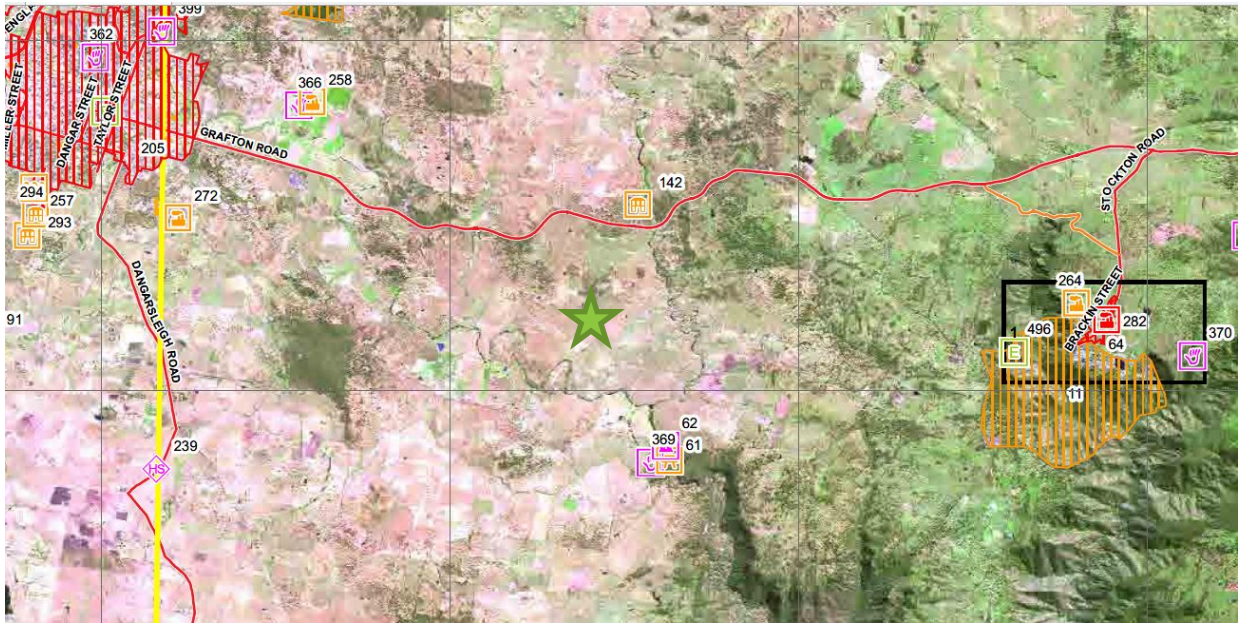


Figure 4: Snapshot of the Central East bushfire planning map (New England BFMC, 2015); green star indicates Site location.

Existing receivers and assets located within 2 km of the Site (see Figure 5) include:

- Two involved residences;
- Three neighbouring properties: 686 Gara Road (dwelling 368 m south), 914 Gara Road (dwelling 2.2 km, south east) and 229 Gara Road (dwelling 896 m, west);
- Agricultural enterprises including livestock (and associated infrastructure);
- Gara Road and Waterfall Way;
- The Armidale Regional Landfill (600 m from the Proposal);
- A residence on the other side of Commissioners Waters (132 Milne Road, 716 m south);
- 17 further rural residences;
- 132 kV high voltage powerlines, 66kV Essential Energy line; and
- Fences.

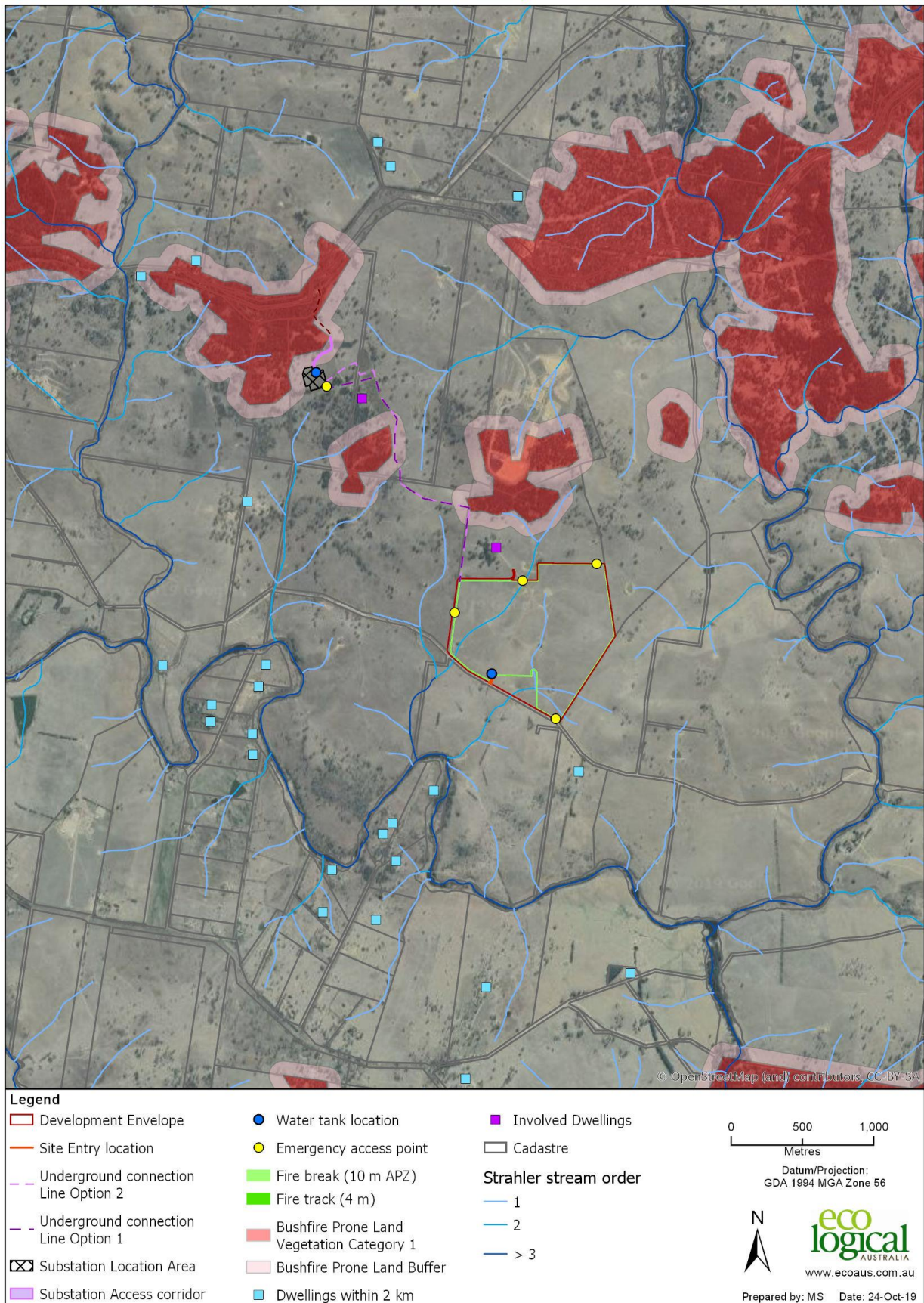


Figure 5: Nearby assets and Bushfire Prone Land

3. Mitigation strategies

3.1 Overview

Mitigation strategies presented are guided by the Aims and Objectives of the draft *Planning for Bush Fire Protection* (NSWRFS, 2018) in the context of the bush fire risk factors present at the Site. They include requirements for asset protection zones (APZ) and defensible space, site landscaping, access, water and utilities, and fire preparedness and response. These management actions will be included in the Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP) and Decommissioning Management Plan (DMP) prepared, in consultation with fire authorities and the Council, prior to each respective phase of the Proposal.

3.2 Asset Protection Zones

3.2.1 Description

An APZ is defined (NSWRFS, 2018) as:

A fuel reduced area surrounding a build asset or structure which provides a buffer zone between the bushfire hazard and an asset. The APZ includes a defensible space within which fire fighting operations can be carried out. The size of the required APZ varies with slope, vegetation and fire danger index.

An APZ can be maintained as a lower fuel hazard area through mowing/slashing or grazing grass, creating a fire break of ploughed/ fallow ground or mineral earth break (such as fire trail). APZs do not eliminate the fire risk and under adverse conditions fire may spot over, or embers may travel through, APZs. However, they may lower fire risk it to an extent where fire control is more feasible under most conditions or damage to the asset is reduced or eliminated. They can assist in reducing the potential for a fire to impact the Site, as well as spread from the Site.

3.2.2 Specifications

APZs would also be designed in accordance with RFS guidance including *Standards for Asset Protection Zones*, and maintained to reduce the risk of fuel loads building up. The specifications recommended for the perimeter APZ/fire break are shown in the table below.

Table 1: APZ and fire break requirements

APZ/fire break	Width	Specification
Perimeter fire break	10 m width from PV Panels	Setback 10 m from PV panels Break maintained from the commencement of construction in perpetuity as an Inner Protection Area (PBP 2018 – Appendix 4) as follows: Trees - Canopy is less than 15% at maturity - Canopy at maturity must not touch or overhang any buildings on site including infrastructure - Lower limbs are removed to 2m above ground - Canopies should be separated by 2m – 5m - Preference should be given to smooth barked or evergreen trees

APZ/fire break	Width	Specification
		Shrubs - Should not form a continuous canopy and not more than 20% of groundcover Grass - where present should be kept as mown <100mm in height - leaf and other debris including woodchip should be removed Perimeter break also incorporates a mineral earth perimeter Category 1 fire trail (trafficable 4 m width with passing bays every 250 metres) within the 10 m APZ, maintained in accordance with NSWRFs fire trail standards (NSWRFs 2017)
Substation APZ	10 m width from any substation infrastructure	The APZ is maintained from the commencement of construction in perpetuity as an Inner Protection Area (PBP 2018 – Appendix 4) as above. If established as a gravel surface it may reduce future ongoing vegetation management requirements
Temporary fire break	10 m width from construction footprint	Maintained for the duration of the fire season around the perimeter of construction works according to the perimeter fire break specifications above.

Despite the limitations of any APZ it is recommended that a perimeter APZ/fire break be established around the solar farm. An APZ/fire break will significantly reduce the likelihood of a bushfire spreading into the solar farm or from the solar farm into surrounding farmland.

These specifications will ensure the risk of a fire propagating across the APZ is minimised and that burning embers will not spot across the APZ, except under very high winds.

3.3 Site landscaping

3.3.1 Screen plantings

The vegetation screens are proposed to reduce the visibility of the solar array from nearby residences. Trees and shrubs abutting the APZ on the side of an approaching fire may increase the risk of embers carrying across a fire break and creating the potential for a spot fire to spread on the other side (Cheney & Sullivan, 2008). The planting of trees and shrubs for visual screening on the external side of the APZ may increase the risk of embers from an external fire entering the solar farm, and therefore the following mitigation measures are recommended for screen plantings:

- Use species suitable for the environment that have low fire spotting characteristics (such as smooth bark or evergreen species) and avoid high flammability species in consultation with the RFS and local nurseries;
- Plant as a continuous windbreak with no breaks of sufficient size to allow winds to funnel through;
- The final chosen supplier will need to ensure that they can supply the agreed composition of species and meet performance standards;
- Plantings are placed on the outer side of the APZ (away from the asset); and
- Routine maintenance occurs prior each fire season to remove dead materials, dead plant growth and leaf litter from within the vegetation screen.

3.3.2 Fuel management within the Site

The fuel load across the Proposal will be monitored and will be actively managed through mechanical slashing and/or mowing or grazing as required to reduce the risk of grass fires starting within the Site and ensuring that fires originating from outside the Site do not intensify as a consequence of entering the Site.

During the bushfire season, pastures within the Site (including under panels) are to be maintained with minimal fuel load (<100 mm grass height). Fuel management requirements would be achieved through mechanical methods such as slashing and mowing, herbicide, and/or potential grazing. If grazing is utilised, overgrazing will be avoided to maintain the groundcover and reduce the potential for erosion.

3.4 The Substation

The substation should have a 10 m APZ around all potentially critical components e.g. anything rubber or plastic or with a lower ignition point. There is to be no combustible vegetation within the substation APZ, e.g. a gravel surface.

3.5 Construction and design

Electrical equipment selected for the 30 year life span of the Proposal would be designed to minimise the potential for ignition and certified to comply with relevant Australian Standards. The Proposal will ensure that all equipment at the Site is installed correctly and maintained in good order to prevent sources of ignition from faulty equipment. All installed equipment would be earthed appropriately following comprehensive testing of soil conductivity to ensure lightning effects are not harmful to the operation of the Proposal.

Chemical storage will be in accordance with Safety Data Sheet (SDS) requirements and would consider potential fire hazards (e.g. the use of fire cupboards for the storage of chemicals). An inventory of the quantities, storage location and copies of SDSs will be held at both access points to the solar farm and will be made available to the emergency services on arrival to the Site.

Solar panels and other components (such as cables) may be exposed to flame contact if a fire were to spread within the solar farm footprint. Therefore, it is recommended that components that are vulnerable to damage from temperatures associated with flame contact are shielded as far as possible. Design should consider the following features:

- Burial of cables underground; and
- Shielding of above ground cables and circuitry.

All electrical equipment must comply with relevant construction standards and design; installation of electrical equipment such as junction boxes, inverters, transformer and electrical cabling is to be in accordance with AS 3000:2007 Wiring Rules.

3.6 Solar Farm Construction

Should construction of the solar farm take place between 1 August and 31 March (see **Section 2** for data on seasonal occurrence of fire weather), the following measures are recommended to control the risk of grass fire ignitions:

- The APZ/fire break is constructed as one of the first stages of development;
- All plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g. soil and vegetation);
- A suitable fire appliance is present on site with at least two personnel trained in bushfire fighting;
- On days when Very High Fire Danger Rating or higher is forecast for Armidale, the “fires near me” app is to be checked hourly for the occurrence of any fires likely to threaten the site; and
- A hot works permitting system is in place and all operations involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) cease during Total Fire Bans, while the Grassland Fire Danger Index (GFDI) is or is forecast to be 35 or greater, or high winds are forecast.

3.7 Solar Farm Ongoing Operations

Fuel management within solar farm

It is assumed that a grass fire may start and spread within the footprint of the solar farm (see **Sections 2.3 and 2.4**); ignitions could include lightning fires, human error or electrical faults. For this reason, it is recommended that vegetation fuels internal to the APZ and throughout the solar farm are maintained in a minimal condition by slashing, mowing or grazing. This will minimise the radiant heat exposure to solar farm components and reduce the risk of a fire spreading beyond the solar farm.

Days of Very High or worse fire danger

To minimise the risk of grass fire ignitions, all operations on the site involving earth moving equipment, vehicles, slashers and hot works (e.g. grinders, welders) should cease while the GFDI is or forecast to be 35 or greater, or high winds are forecast. This will require establishing an operational procedure for onsite recording of temperature, relative humidity and wind speed, as well as associated training.

Fire-fighter safety

The safety hazards for fire-fighters from PV panels (**Section 2.4.1**) and local fire-fighting capability are such that fire suppression within the Array areas of the solar farm cannot be expected or relied upon. Therefore, fire suppression is most likely to be staged from the perimeter fire trail (APZ) or beyond, and not the internal access tracks (although the internal management tracks may be utilised if approved by the fire agency incident controller). An exception to this would be aerial water bombing that is compliant with air operations safety procedures; however, these resources may not be available at short notice for a fire that could spread several kilometres within an hour.

Given the possible toxicity of smoke from burning solar farm components, fire-fighters, farm workers and neighbours should avoid working down wind of any fire burning within the solar farm.

An Emergency Response Plan (ERP) should be prepared for the solar farm that provides the following:

- Addresses foreseeable on-site and off-site fire events;
- Clearly states work health safety risks and procedures to be followed by fire-fighters, including:
 - Personal protective clothing;

- Minimum level of respiratory protection;
- Minimum evacuation zone distances;
- A safe method of shutting down and isolating the PV system;
- Any other risk control measures required to be followed by fire-fighters;
- Evacuation triggers and protocols; and
- Suppression response strategies and tactics, including aerial suppression options/management.

Two copies of the ERP should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at the main entrance point to the solar farm (Gara Road), external to any security fence or locked gate, and a copy provided to local emergency responders (see **Figure 2**). The RFS New England Zone Office and Fire and Rescue NSW will also be supplied with details including the Site Manager name and 24hr contact number, along with an alternate contact; proposed construction start date and duration; and Site access details should the emergency services need to gain quick entry to the site in the event of an emergency.

Once constructed and prior to operation, contact should be made by the site operator with the Local Emergency Management Committee to establish emergency management procedures with relevant authorities for the safety hazards presented by the Site. The operator of the solar farm should brief the local volunteer fire brigades and neighbouring farmers at appropriate intervals, for example, at annual pre-season fire meetings, on safety issues and procedures.

3.8 Access

The Site is well serviced by council roads which afford direct access to the Site. The main access to the Development Envelope is proposed via Gara Road while access to the Substation Location Area is proposed via Waterfall Way (**Figure 2**).

Appropriate emergency vehicle access will be provided across the entire Site. There will be five (5) gated emergency entrance and exit points (including the main entrance) along the perimeter security fence of the Development Envelope and two (2) gated emergency entrance and exit points at the Substation Location Area (including the main substation entrance) ensuring that the Proposal can be accessed or evacuated at a number of locations (see **Figure 3**).

A perimeter Category 1 fire trail is to be constructed around the solar farm footprint (Array areas), from the commencement of construction and maintained for the life of the Proposal on the Site perimeter, in accordance with NSWRFs standards for fire trails (NSWRFs, 2017). A number of internal management tracks will provide internal access within the solar farm. The Site access track network will be designed and constructed in compliance with RFS standards. As identified in Section 3.7 fire suppression is most likely to be staged from the perimeter fire trail, and not the internal access tracks. As such internal trails dedicated specifically for fire-fighting are not proposed (although the internal management tracks may be utilised if approved by the fire agency incident controller).

3.9 Water and Utilities

Whilst the likelihood of a damaging fire impacting the solar farm is considered low, the consequence could be significant (such as the potential loss of panels and/or related electrical systems are

damaged). The risk of a fire starting from the solar farm and spreading to surrounding areas is also considered low.

FIREFIGHTING WATER:

Although it is a lower risk site, the availability of water supplies to assist with initial fire attack and fire suppression operations will further reduce the risk of a fire spreading into or from the site by reducing the time fire crews will spend away from an active fire to refill water supplies. Therefore, a dedicated fire emergency water supply of 20,000 litres fitted with NSW RFS compatible Storz couplings (also NSW Fire and Rescue compatible) is recommended to be provided as a filling point for fire tankers. Two dedicated fire emergency water tanks are proposed at the Site for the sole use of fire protection in line with the RFS standards (NSW RFS, 2018); one located adjacent to the Gara Road access point in the operational compound near the solar array, and another at the Substation Location Area (see Figure 2). There is also a large farm dam situated immediately to the north of the Development Envelope which provides a ready supply of water for fire management if required.

GENERAL WATER:

Non-potable water required for the Proposal would be sourced offsite under agreement with existing water access licences. Accordingly, a water access licence from DPI Water would not be required for construction activities. Potable water required for the construction, maintenance and decommissioning phases of the Proposal will be sourced from local water cartage services in the surrounding area, along with ensuring appropriate licences are held.

ELECTRICITY:

No new transmission lines will be installed as part of the development except to connect the substation to the adjacent 66 kV Essential Energy transmission line. An existing 11 kV distribution line servicing a single involved residence that crosses the Development Envelope is proposed to be rerouted and installed underground. The development will not impact the existing transmission easement of management in accordance with National electrical transmission line standards including the specification in *ISSC3 Guideline for Managing Vegetation Near Power Lines* (Resources and Energy NSW, 2016).

3.10 Fire Preparedness and Response

The CEMP, OEMP and DMP will provide safety protocols to ensure all staff and contractors are aware of the bushfire risk on site and the mitigation measures required to reduce this risk. It is recommended that a **Bushfire Management Plan** is prepared for the Site in further consultation with relevant fire authorities post-consent and prior to commencing construction activities as a Condition of Consent, acknowledging specific risks associated with the Site, Proposal and surrounding influences. The Plan will identify:

- Potential ignition reduction strategies, including management procedures for hot works permitting, smoking, vehicle use off formal access tracks, and Total Fire Ban requirements.
- Preparedness procedures in response to increasing fire danger such standard equipment required during the fire season and the suspension of activities as the FDI rises.
- Daily monitoring of the Fire Danger Rating, and communication of any further mitigation measures required to all staff and contractors.

- Protocols for basic training of all staff on the appropriate response to a fire emergency and in the use of firefighting equipment on site.
- Fire suppression equipment both onsite and offsite during construction and operation. Firefighting equipment lists will also be detailed in the Work Method Statements.
- Finalised water tank locations and details.
- Finalised and agreed details of the APZ.
- Management procedures for the use, storage and maintenance of flammable materials.
- Due to the unique electrical hazards associated with solar farms it is recommended that procedures for responding to and reporting a bushfire are documented in a discrete ERP (as a sub-plan of the Bushfire Management Plan).

The ERP should include consideration of personnel working on site during construction and operations, as well as responding fire authorities.

Other requirements to include in an ERP are procedures which:

- Address foreseeable on-site and off-site fire events;
- Clearly state work health safety risks and procedures to be followed by fire-fighters, including:
 - Identify personal protective clothing and minimum level of respiratory protection;
 - Provide details/procedures for ensuring access to the Site;
 - Specify a procedure to determine minimum evacuation zone distances;
 - Document a safe method of shutting down and/or isolating the PV system and other necessary components of the solar farm; and
 - Any other risk control measures required to be followed by fire-fighters.
- Aerial water bombing that is compliant with air operations safety procedures should also be addressed noting the high voltage transmission lines nearby which may pose a risk to aerial operations.
- Two copies of the ERP should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at the main entrance point to the solar farm, external to any security fence or locked gate, and a copy provided to local emergency responders. It is recommended the Plan is prepared for the duration of the operation phase and updated at least every five years detailing:
 - Responses to an emergency alert being issued by fire authorities.
 - Incident management and control arrangements.

Once constructed and prior to operation, contact should be made by the site operator with the Local Emergency Management Committee to establish emergency management procedures with relevant authorities for the safety hazards presented by the Site. The operator of the solar farm should brief the local volunteer fire brigades and neighbouring farmers at appropriate intervals, for example, at annual pre-season fire meetings, on safety issues and procedures.

3.11 Summary of Mitigation Actions

A summary of the bushfire mitigation strategies and recommendations made in this document are provided in **Table 2** below.

Table 2: Summary of recommended mitigation strategies and actions

Mitigation Strategy	Section of Report	Action
Create and maintain a perimeter fire break	3.2	A 10 m fire break is to be established around the PV Panels. The perimeter break is to be maintained in accordance with the NSWRFs (2018) APZ requirements for an Inner Protection Area. The perimeter break is to incorporate a 4 m Category 1 perimeter fire trail (see Access below).
Create and maintain an APZ around the Substation	3.2	A 10 m fire break is to be established extending from substation infrastructure. The APZ is to be maintained in accordance with the NSWRFs (2018) APZ requirements for an Inner Protection Area.
Implement appropriate site landscaping	3.3	Where screen plantings are proposed they are to be: • Located on the external side of the APZ; • Consist of low flammability and spotting species; • Be planted as a continuous break; and • Maintained to remove any dead leaf litter, branches and dead vegetation. Within the solar farm layout maintain minimal fuel load by grazing, slashing, mowing or herbicides.
Construction and design	3.4	Consider shielding heat sensitive components in areas where potential flame contact may occur.
Maintain emergency access/egress for fire fighters and site personnel	3.5	The perimeter APZ is to incorporate a 4 m Category 1 perimeter fire trail, established and maintained in accordance with NSWRFs requirements (NSWRFs 2019) including provisions for passing bays and turn around points. Proposed main access point is from Gara Road and a substation access point is via the existing access point on Waterfall Way.
Water and utilities	3.6	Provide a dedicated water supply of 20,000 litres at the operations compound and substation location area fitted with Storz couplings as filling points for fire tankers.
Fire preparedness and response	3.7	A Bushfire Management Plan is prepared (incorporating a discrete ERP) including: • Ignition reduction strategies; • Fire suppression equipment details; • Flammable materials storage requirements; • Fire preparedness procedures; • Fire reporting and response to formal emergency alerts; • A standalone ERP detailing fire fighting restrictions, potential hazards, specialised Personal Protective Equipment (PPE) requirements, shut-down/isolation procedures, evacuation zone distances, aerial suppression considerations and availability of the ERP.

4. Cumulative Impacts

The proximity of multiple construction and/or operational projects provides opportunity for potential cumulative impacts. Key mitigation strategies for cumulative impacts are the spatial and temporal separation of impacts

A search of the NSW Major Projects websites (both the old and new) and the Armidale Regional LGA website was undertaken on 9 August 2019 to identify major projects and renewable energy projects which may contribute to cumulative impacts. The location and status of projects identified within 10 km of the Proposal during the search are provided in Table 3 and shown in Figure 6.

Table 3: Nearby major and/or renewable energy projects

Project	Approximate Distance and Direction from Site	Development Phase
Oxley Solar Farm (300 MW, with 30 MWh battery storage capacity)	Investigation area adjoins the eastern boundary of the Site*	Secretary's Environmental Assessment Requirements (SEARs) issued for SSD
Armidale Waste Facility	310 m North East	Soon to be commissioned, with fulltime operational activities commencing in 2020
Olive Grove Solar Farm	300 m North East	Pre-DA consultations with Armidale Regional Council
Metz Solar Farm (100 MW)	9 km North East	Under Construction

* The Scoping Report for Oxley Solar Farm claims that the PV panels, battery storage and associated infrastructure for the proposed Oxley Solar Farm will likely only occupy half of its proposed 900 ha site (NGH Environmental, 2019). The actual development footprint of the Oxley Solar Farm is not currently known.

The construction and/or operation of these proposed developments may coincide with construction and/or operation of the Proposal; however, it is not possible to know which proposed developments will progress to completion at this point in the development process. The cumulative impacts related to bushfire mitigation and other developments in the area are as follows:

Volunteer fire-fighter workload – Response call outs should not increase because the ignition risk is very low and possibly lower than the risk from surrounding agricultural activities. There will, however, be an ongoing requirement for briefing on the ERP.

Construction stage transport and road use – The bushfire mitigation infrastructure (i.e. fire breaks, and water storage) will add a small percentage to the total construction traffic and road use.

Ongoing operations – there would not be any cumulative operational impacts.

The proximity of multiple projects actively managing fire risk could assist in management responses and may create a positive cumulative impact, in comparison with existing conditions. The Armidale Landfill is adopting best practice fire sensitive design principles and mitigation measures for inclusion in its yet-to-be-finalised Landfill Environmental Management Plan (Armidale Regional Council, 2019). Adopting a similar best practice approach at Olive Grove Solar Farm and Oxley Solar Farm will help manage impacts. In consultation with Council and RFS, the preparation of the Bush Fire Management Plan will consider, on an ongoing basis, the most current information available regarding fire risk from and to surrounding land uses.

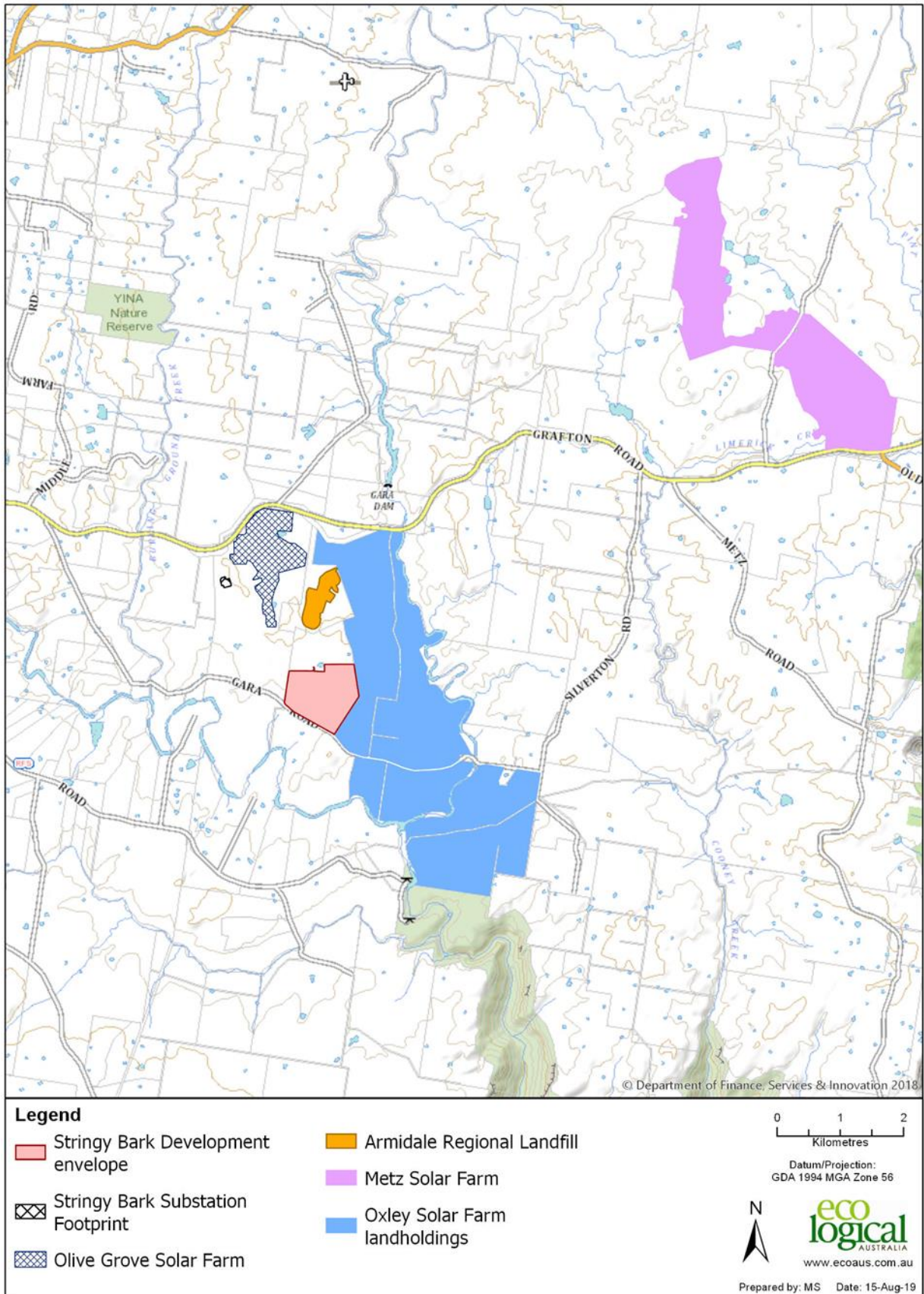


Figure 6: Location of major and renewable energy projects within 20 km of the Proposal

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