Technical Report – Bush fire risk

Virya Energy

Yanco Delta Wind Farm
7 August 2022

Executive summary

Virya Energy is proposing to construct, operate and maintain the Yanco Delta Wind Farm (the Project). Approval is sought under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) and Part 9, Division 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project would involve the construction, operation and maintenance of a wind farm with up to 208 wind turbine generators (WTGs), a battery energy storage system (BESS) and associated electrical infrastructure. The generating capacity of the wind farm is approximately 1,500 megawatts (MW).

This bush fire risk assessment has been prepared to address the Secretary's Environmental Assessment Requirements relating to bush fire risks and will assist the Minister for Planning to make a determination on whether or not to approve the Project. This assessment provides an overview of bush fire risk factors and outlines bush fire protection measures to be implemented during construction and operation of the Project.

The Project would occur in a flat rural landscape predominantly used for grazing on native grasslands, with isolated blocks of woodland vegetation. The region periodically experiences elevated fire danger conditions (Severe to Catastrophic) and as such bush fire protection is an important consideration in the Project design.

A number of bush fire protection measures are recommended in this report including asset protection zones, firebreaks, vegetation management, requirements for vehicle access and water supply, refuge of last resort, controls on fire ignition, management of risks to firefighting operations and emergency management planning.

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Glossary and terms

Term	Definition
AFAC	Australian and New Zealand National Council for Fire and Emergency Services
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BESS	Battery energy storage system
BFMC	Bush Fire Management Committee
BoM	Bureau of Meteorology
BPL	Bush fire prone land
CASA	Civil Aviation Safety Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FDR	Fire Danger Rating
GFDI	Grass Fire Danger Index
LGA	Local Government Area
MMZ BFMC	Mid-Murray Zone Bush Fire Management Committee
MW	Megawatts
NPWS	National Parks and Wildlife Service
PBP	*Planning for Bush Fire Protection 2019* (NSW RFS, 2019a)
RFS	NSW Rural Fire Service
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
South-West REZ	South-West Renewable Energy Zone
TOBAN	Total fire ban
WTG	Wind turbine generators

1. Introduction

1.1 Background

Virya Energy is proposing to construct the Yanco Delta Wind Farm (the Project). Approval is sought under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) and Part 9, Division 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project would involve the construction, operation and maintenance of a wind farm with up to 208 wind turbine generators (WTGs), a battery energy storage system (BESS) and associated electrical infrastructure. The generating capacity of the wind farm is approximately 1,500 megawatts (MW). The Project would be located within the South-West Renewable Energy Zone (REZ), 10 kilometres north-west of the town of Jerilderie, within the Murrumbidgee Council and Edward River Council Local Government Areas (LGAs) (**Figure 1-1**).

The Project area is defined as the property boundaries of Project landowners (i.e. landowners that have entered into agreements with Virya Energy to have WTGs or associated infrastructure on their properties).

1.2 Project description

The Project would include the following key features:

- Up to 208 WTGs to a maximum tip height of 270 metres (tapered tubular steel towers, 5.8 m wide at the base, on a hardstand of approximately 40 x 50 m)
- Generating capacity of approximately 1500 MW
- BESS, approximately 800 MW/800 megawatt hours (MWh) (type yet to be determined)
- Permanent ancillary infrastructure, including operation and maintenance facility, internal roads, hardstands, underground and overhead cabling, poles for overhead transmission lines, up to eight wind monitoring masts, central primary substation and up to eight collector substations
- Temporary facilities, including site compounds, laydown areas, stockpiles, gravel borrow pit(s) and concrete batch plants.

An indicative Project layout is provided in **Figure 1-2**.

The first WTGs are expected to start power generation in 2025. Individual WTGs have a design life of 30 years. At the end of the design life, the site will be either returned to pre-construction condition or refurbished for ongoing operations.

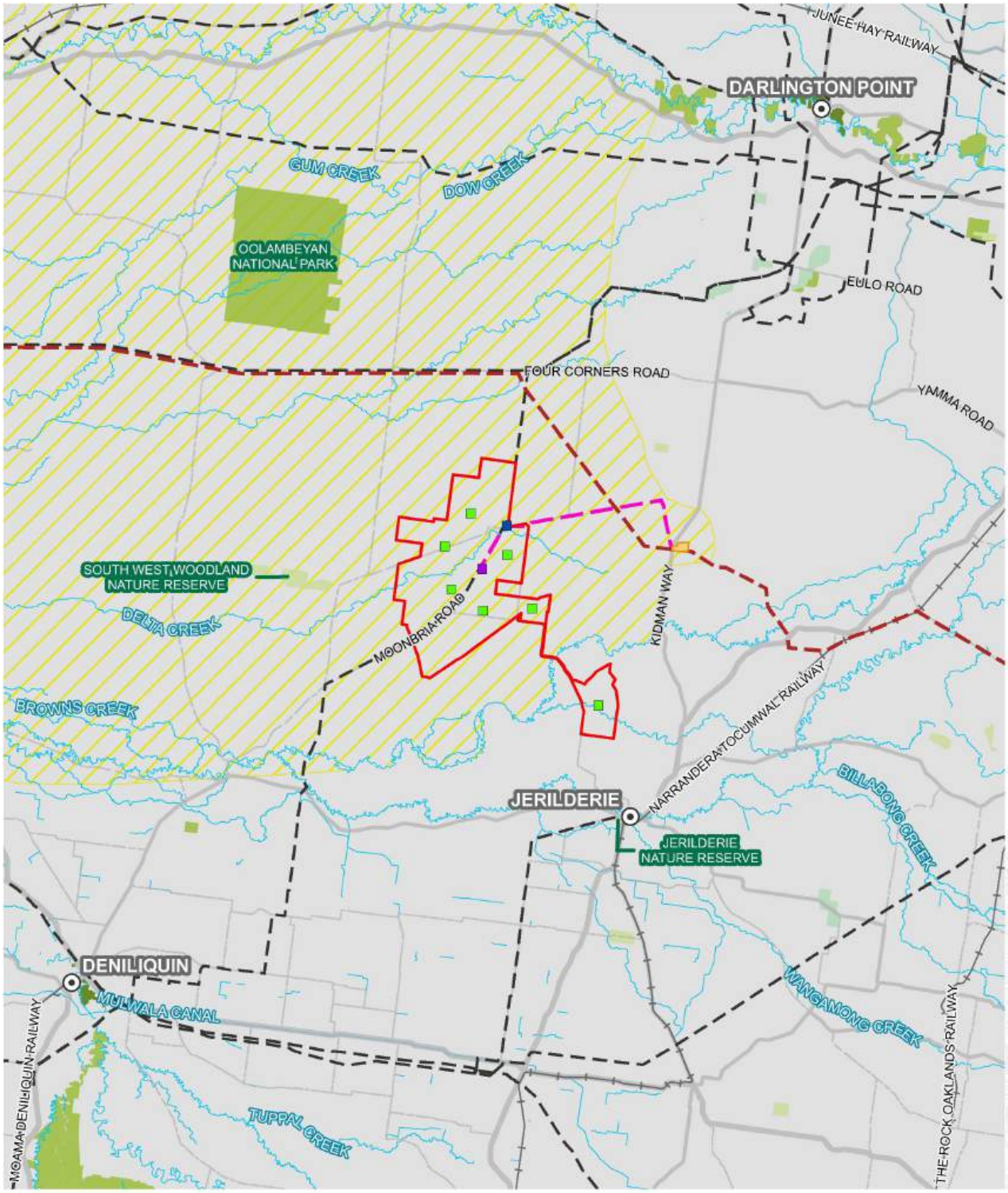


Figure 1-1 Regional context of the Project

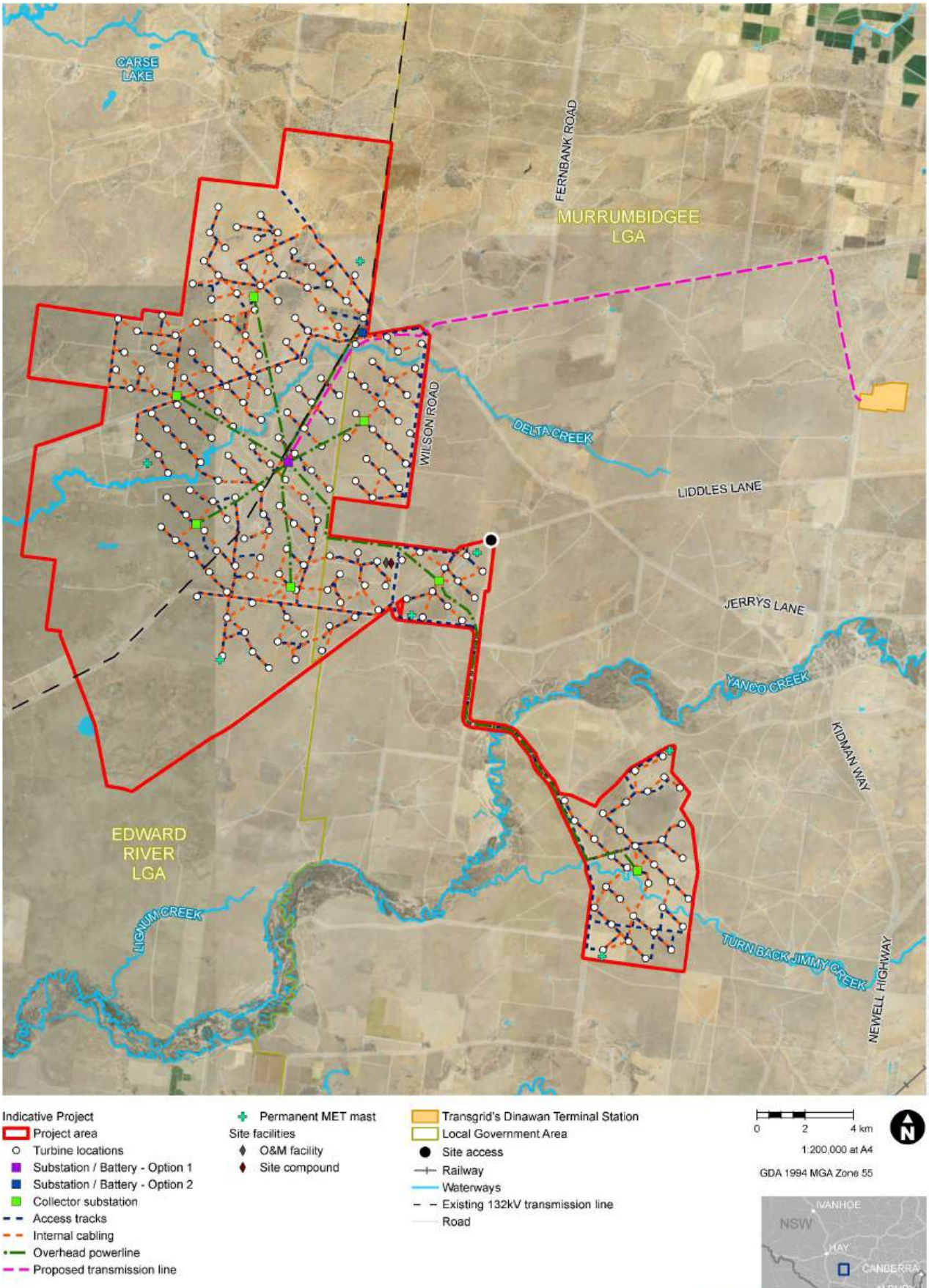


Figure 1-2 Indicative Project layout

1.3 Secretary's Environmental Assessment Requirements

This assessment forms part of the environmental impact statement (EIS) for the Project. The EIS has been prepared under Division 4.7 of the EP&A Act. This assessment has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) (SSD-41743746) relating to bush fire impacts and will assist the Minister for Planning to make a determination on whether or not to approve the Project.

Table 1-1 outlines the SEARs relevant to this assessment along with a reference to where these are addressed.

Table 1-1 SEARs relevant to bush fire risk assessment

Secretary's requirement	Where addressed in this report
Hazards and Risks – including:	
▪ Bushfire - identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bushfires and demonstrate compliance with *Planning for Bush Fire Protection* 2019	This report has been developed following guidance from the NSW Rural Fire Service (RFS), particularly *Planning for Bush Fire Protection* (PBP; RFS, 2019a). To the extent that they are applicable to the Project, the report also follows bush fire safety guidance developed by and for NSW electricity network operators. Impact on aerial firefighting is discussed in **Section 6.3** (operations) and **Section 6.1.8** (construction).

1.4 Structure of this report

The structure and content of this report are outlined in **Table 1-2**.

Table 1-2 Structure and content

Chapter	Description
Chapter 1 Introduction	Outlines key elements of the Project, SEARs and the structure of this report (this Chapter)
Chapter 2 Legislative and policy context	Provides an outline of the statutory context, including applicable legislation and planning policies
Chapter 3 Assessment methodology	Provides a description of the assessment methodology
Chapter 4 Bush fire risk context	Provides a description of the factors influencing bush fire risk to the Project
Chapter 5 Impact assessment	Describes the potential impacts of bush fire in the Project area, or ignited by Project activities
Chapter 6 Bush fire protection measures	Presents the suite of measures to prepare for bush fire during construction and operation
Chapter 7 Environmental management measures	Presents the bush fire risk environmental management measures applicable for the Project
Chapter 8 Conclusions and recommendations	Summarises the findings of this report
References	Reference list

2. Legislative and policy context

2.1 Commonwealth legislation

2.1.1 Work Health and Safety Act 2011

The Commonwealth *Work Health and Safety Act 2011* (and state-based legislation, the NSW *Work Health and Safety Act 2011*) provides a national framework for protection of the health and safety of people at work, and those who may be affected by such work. Under the Act, persons conducting or undertaking a business have the primary responsibility to ensure (so far as reasonably practicable) the safety of workers and the general public at a workplace. This includes ensuring, so far as reasonably practicable, safety from bush fire-related risks during construction and operation of the Project.

2.2 State legislation

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act restricts the granting of development consent on bush fire prone land (BPL) unless the proposed development conforms with the requirements of *Planning for Bush Fire Protection* (PBP; NSW RFS, 2019a; see **Section 2.3**).

Part 4 of the EP&A Act establishes the framework for assessing development that is permissible with consent. The Project is State Significant Development (SSD) under Section 2.6(1) in conjunction with Section 20 of Schedule 1 of the State Environmental Planning Policy (Planning Systems) 2021.

The Project is defined as electricity generating work and has a capital investment value (CIV) estimated to exceed one billion Australian dollars. Therefore, the Project is proceeding with an application for planning approval as an SSD. Under Section 4.12(8) of the EP&A Act, the application is to be accompanied by an EIS prepared by or on behalf of the applicant in the form prescribed by the Regulations.

The SEARs issued for this Project require an assessment of bush fire risk in accordance with PBP.

The Project area is at least partially classified as BPL (**Section 4.1**). This assessment has been completed and bush fire protection measures recommended in line with the specifications and intent of PBP.

2.2.2 Electricity Supply Act 1995

The *NSW Electricity Supply Act 1995* requires network operators to take appropriate action to ensure public safety. This includes infrastructure considered to be a potential cause of bush fire. 'Appropriate action' can include modifying the infrastructure, removing risky structures/items in proximity to the infrastructure, and trimming/removing vegetation. Bush fire prevention works on aerial consumer mains required under Section 53 of this Act supersede environmental planning instruments including approval or consent requirements under other Acts (including EP&A Act, *Biodiversity Conservation Act 2016, Local Land Services Act 2013 [Part 5A]*).

2.2.3 Electricity Supply (Safety and Network Management) Regulation 2014

The *Electricity Supply (Safety and Network Management) Regulation 2014* requires all network operators to take all reasonable steps to ensure that the design, construction, commissioning, operation and decommissioning of any part of its network is safe. This specifically includes the prevention of bush fires that may be ignited by network assets. The network operator's safety management system must comply with *AS 5577 Electricity Network Safety Management Systems 2013*.

2.2.4 Rural Fires Act 1997

The objectives of the *Rural Fires Act 1997* are to prevent bush fires and protect people, built assets and natural assets from fire damage. The Act provides for the designation of Neighbourhood Safer Places, where people may find shelter from a bush fire. It also provides for the designation and maintenance of fire trails.

The Act states that it is the duty of public authorities, landowners, and occupiers to take all notified and practical steps to prevent bush fire ignition and minimise spread on their land. Trees that are reasonably necessary for protection of threatened species may be retained in fire breaks. Permits are required to light fires for bush fire fuel hazard reduction or to clear fire breaks. The Act reiterates that certain instruments under the EP&A Act, *National Parks and Wildlife Act 1974*, *Local Government Act 1993*, *Biodiversity Conservation Act 2016* and the *Local Land Services Act 2013* do not apply when responding to fire emergencies.

The Act declares the bush fire danger period to run from October to March (inclusive), which can be modified by the NSW Rural Fire Service (RFS). Total fire bans (TOBANs) may be issued by the Minister in the interests of public safety.

This Act provides the framework through which bush fire risk is managed on the Project.

2.3 Regulatory policies/relevant guidelines

2.3.1 Planning for Bush Fire Protection

The SEARs (as per **Table 1-1**) mandate that this bush fire assessment follows *Planning for Bush Fire Protection 2019* (NSW Rural Fire Service, 2019a) (PBP). PBP seeks to provide for human safety (including of fire responders) during bush fire events and to minimise the effects of bush fires on property; while considering development potential, site characteristics and environmental protection. Achievement of these objectives is underpinned by several principles:

- Control the types of development permissible in bush fire prone areas
- Minimise the impact of radiant heat and direct flame contact by separating development from bush fire hazards
- Minimise the vulnerability of buildings to ignition and fire spread from flames, radiation and embers
- Enable appropriate access and egress for the public and firefighters
- Provide adequate water supplies for bush fire suppression operations
- Focus on property preparedness, including emergency planning and property maintenance requirements
- Facilitate the maintenance of Asset Protection Zones (APZs), fire trails, access for firefighting and on-site equipment for fire suppression.

2.3.2 Guide for Bush Fire Prone Land Mapping

The identification of bush fire prone land (BPL) in NSW is required under the EP&A Act, including a requirement for and guidance for the preparation of a BPL map identifying vegetation within LGAs that has the potential to support a bush fire. The BPL map is the trigger for the consideration of bush fire protection measures for new development (PBP [RFS, 2019] and Australian Standard 3959-2009 – *Construction of buildings in bush fire prone areas*). Guidance for identification and mapping of BPL is provided in the Guide for Bush Fire Prone Land Mapping (NSW Rural Fire Service, 2015).

The Guide for Bush Fire Prone Land Mapping (NSW Rural Fire Service, 2015), in conjunction with PBP (RFS, 2019a), is designed to identify if an area can support a bush fire or is subject to bush fire attack based on the presence and type of vegetation fuel sources. It is the responsibility of local government area/rural fire district-based Bush Fire Management Committees. BPL mapping is typically published by the respective Bush Fire Management Committees and the maps and metadata are developed according to guidance provided by

NSW RFS (2015). BPL mapping for the state is available from the NSW Government data portal, www.data.nsw.gov.au.

BPL assessments are based on allocation of the vegetation present into one of four categories, as follows:

- Category 1– includes areas of forest, woodland, heath, forested wetland and timber plantation; highest risk category
- Category 2 – rainforests and "lower risk vegetation parcels"; these parcels contain remnant vegetation that is limited in its connectivity to larger areas and land parcels with land management practices that actively reduce bush fire risk (and are subject to a bush fire plan or similar). Category 2 vegetation has lower bush fire risk than category 1 and 3 vegetation
- Category 3 – includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands. Moderate risk category
- Exclusion – Areas of vegetation less than one ha and greater than 100 m separation from category 1, 2 or 3 vegetation; small patches or strips of remnant vegetation; managed grasslands; agricultural cropland; gardens; and mangroves are not mapped as bush fire prone.

BPL is defined as land with category 1, 2 or 3 vegetation and land within 100 m of category 1 or within 30 m of category 2 or 3 vegetation. BPL mapping for the Project is discussed further in **Section 4.1**.

2.3.3 ISSC 20 – Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure

ISSC 20 - Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure (ISSC, 2012) was written to protect public safety and electricity assets and by offering guidance on the management of activities in electricity easements. Consideration of activities to occur in electricity easements must include impact on safety clearances (accounting for conductor sag and sway) and safety issues including bushfire. Clearances are calculated for typical spans to accommodate error margins for blowouts, so longer spans may require a greater distance.

2.3.4 ISSC3 – Guide for the Management of Vegetation in the Vicinity of Electricity Assets

ISSC3 – Guide for the Management of Vegetation in the Vicinity of Electricity Assets (ISSC, 2016) provides specific actions to fulfil the requirements of the *Electricity Supply (Safety and Network Management) Regulation 2014* and AS 5577. It provides vegetation clearance and other hazard management requirements around a range of electrical infrastructure components, including overhead line conductors, poles, towers, and substations.

3. Assessment methodology

A desktop assessment was completed for the Project area, drawing on the following data:

- Vegetation type
- Topography
- Climate
- Bush fire prone land mapping (local councils)
- Fire history (NPWS).

Climate data was sourced from the Bureau of Meteorology (BoM) for stations 74129 Deniliquin (data for 1970-1997, up to 3 hourly) and 74258 Deniliquin Airport (data for 1997-2022, up to hourly) or as otherwise indicated in text.

Temperature, wind speed, humidity and rainfall data were used to calculate the Grass Fire Danger Index (GFDI) from 1970 to 2021 to describe historic bush fire conditions. Sub-daily (3-hourly or hourly, depending on data availability) records were used to find the highest GDFI for any given day.

Climate change projections for these climate variables were sourced from SimCLIM[1] to describe potential bush fire conditions by 2055 (the planned end of the Project lifetime) and 2090 (for ongoing operations). Median results for the model suite describing the high-emissions scenario (RCP8.5) for the Intergovernmental Panel on Climate Change's (IPCC's) *Fifth Assessment Report* (2013) were used.[2] Climate change projections were based on the Deniliquin data, using an expanded 40 year baseline from 1976 to 2015.

These data were used to characterise plausible bush fire risk to the Project over its intended and potential operating life. Based on this risk and applicable guidance (e.g. PBP, AS3959), appropriate bush fire protection measures were identified for application to the Project.

The assessment and protection measures will be reviewed by the RFS prior to finalisation of this report.

[1] https://www.climsystems.com/simclim/

[2] At the time of writing, the IPCC's *Sixth Assessment Report* is in the process of being released. However, the underpinning models have not yet been incorporated into industry tools. Therefore, this assessment draws on the older model suite.

4. Bush fire risk context

4.1 Regional context

The Project would be located in a highly modified rural landscape with isolated patches of remnant woody vegetation, and a strip of riparian vegetation along the Yanco Creek (**Figure 1-2**). Landowners in the area plough mineral earth firebreaks at their property boundaries prior to the commencement of each fire season.

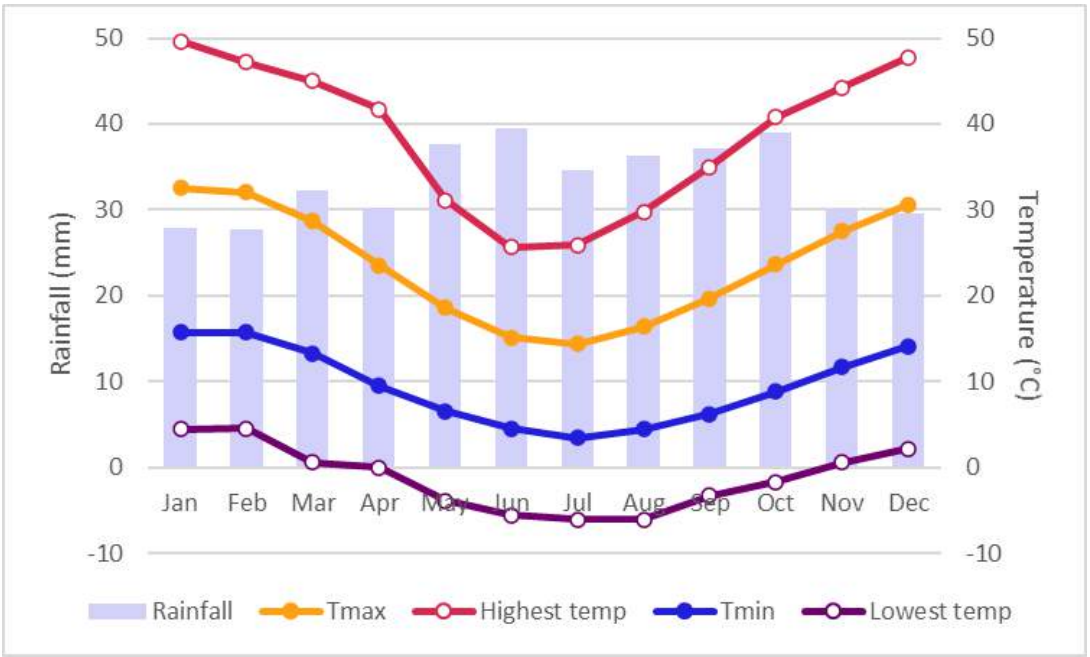
The Project area is in the Southern Riverina Fire Area for the purposes of fire danger ratings, and falls within the region covered by the Mid Murray Zone Bush Fire Management Committee (MMZ BFMC).

4.2 Bush fire weather

4.2.1 Historical bush fire weather

The Project area experiences a warm and persistently dry climate (**Figure 4-1**). Average daily maximums range between 32.5°C in January and 14.4°C in July. Temperatures exceeding 40°C have occurred in all months between October and April. The highest temperature on record is 49.6°C, occurring in January 1878. The highest temperature in recent decades (i.e. since 1970) is 47.6°C, which has occurred in January 1990 and 2019.

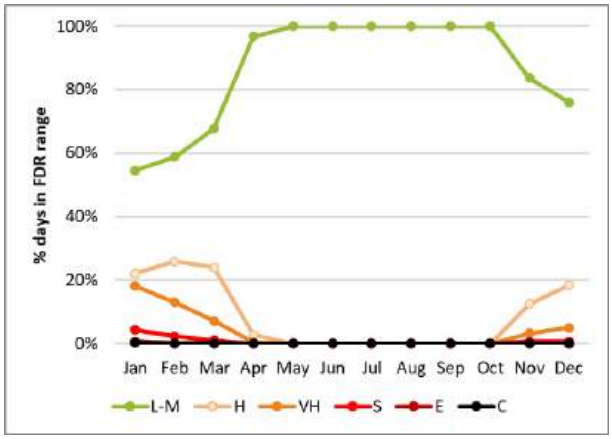
Average annual rainfall in the region is 407 mm. Annual rainfall (1858-2021) has ranged between 141 mm (1914) and 804 mm (1974). Although winter and spring tend to be wetter than summer and autumn, rainfall is relatively evenly distributed throughout the year, with 55% of annual rain falling during May-October (**Figure 4-1**).



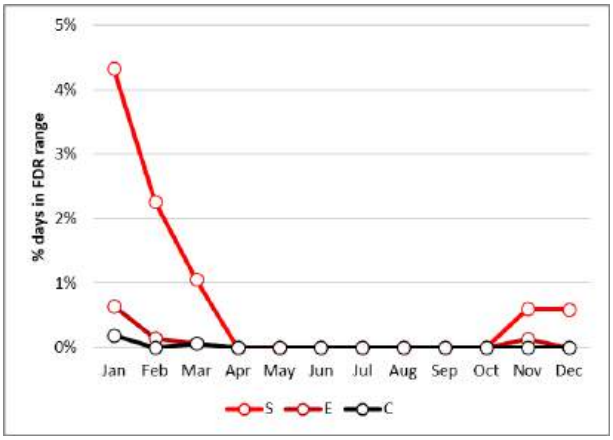
Data for BoM station 74128 Deniliquin (Visitor Information Centre), temperature data for 1858-2003, rainfall data for 1858-2003 (temperature) and 1858-2021 (rainfall) (BoM, 2022)

Figure 4-1 Average monthly rainfall, average daily maximum (Tmax) and minimum (Tmin) temperatures, highest and lowest temperatures on record by month

Average monthly fire danger ratings (FDR)[3] are in the low to moderate range between March and December (Grass Fire Danger Index [GFDI] <12), and are high in January and February (GFDI 12-<25; **Figure 4-2**). Days of very high FDR or greater (GFDI ≥25) have occurred in all months between November and April. Days with catastrophic fire danger (GFDI>150) have been recorded in January and March.



a) Percentage of days with maximum daily GFDI in each fire danger rating scale



b) Percentage of days with maximum daily GFDI in the severe and above fire danger rating scale

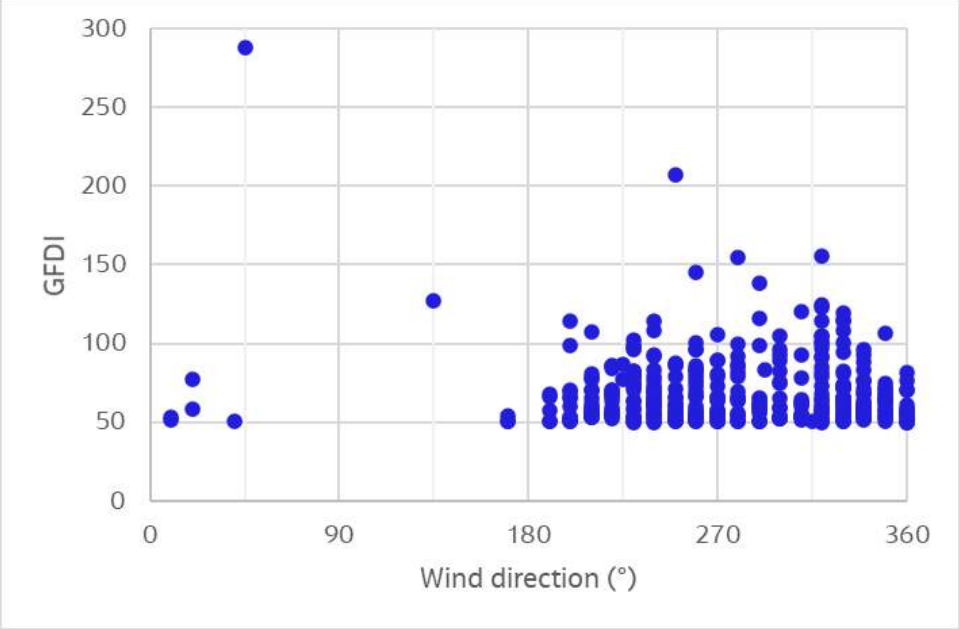
Low-moderate: L-M; high: H; very high: VH; severe: S; extreme: E; catastrophic: C. Figure b is provided to show the occurrence of rare days of particularly elevated fire danger at a visible scale. Data compiled from BoM stations 74128 Deniliquin and 74258 Deniliquin Airport, data for 1975-2021.

Figure 4-2 Estimated fire danger rating (FDR) values for the region

Total fire bans (TOBANs) are declared by the NSW RFS. During TOBANs, potential human sources of ignition are prohibited or restricted to reduce the risk of bush fires igniting during or (rarely) immediately preceding a period of dangerous fire weather. FDR on TOBAN days is typically very high or greater.

Days with elevated FDR usually coincide with winds from a westerly direction, but this ranged from south-easterly through to north-easterly over the period of record (**Figure 4-3**).

[3] Note: Australia's FDR system is set to change from September 2022 (https://www.afac.com.au/initiative/afdrs). At the time of writing, the calculations feeding into the new system are unclear. This report therefore uses the current system to characterise fire weather at the site.



Data compiled from BoM stations 74128 Deniliquin and 74258 Deniliquin Airport, data for 1975-2021.

Figure 4-3 Wind direction at times when daily maximum GFDI is 50 or above (severe, extreme, catastrophic FDR)

The bush fire season generally runs between October/November and March/April, varying with local conditions (MMZ BFMC, 2009). Days with westerly to northerly winds, high daytime temperatures and low humidity are most commonly associated with dangerous fire weather conditions in this region. Two days in the period of record, however, have experienced relatively mild temperatures and relative humidity, but strong (92.5 km/h) north-easterly to south-easterly winds that drove the FDR to catastrophic and extreme respectively. These were in March 1979 and in January 1983.

Dry storms can occur during the bush fire season, and are known to start fires (MMZ BFMC, 2009).

A fire burning in the region is unlikely to generate its own weather.

4.2.2 Climate change projections for bush fire weather

The WTGs for the Project have a design life of 30 years, so should therefore be resilient to fire danger and other climate conditions in the 2050s. At the end of design life, the Project may be closed or refurbished for continued operation. Climate projections indicate bush fire weather in the region is very likely to become harsher over the coming decades (Timbal *et al.*, 2015).

Climate projections for 2055 (end of WTG design life) and 2090 (longer term horizon for ongoing operation) were generated for the Project area. Change factors to 2055 and 2090 for each of these weather parameters were applied to 1975-2015 of the compiled Deniliquin data.

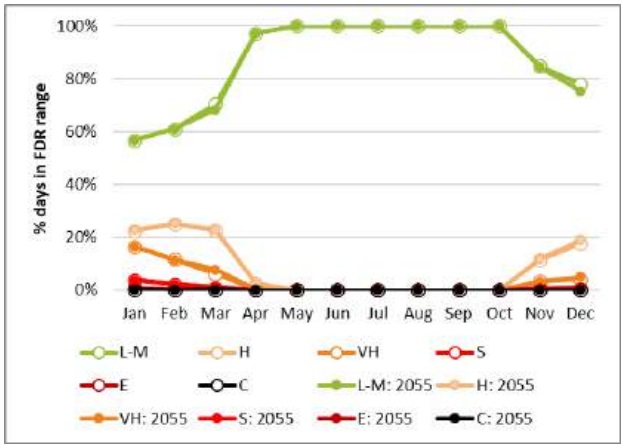
Climate models suggest that the main projected changes in climate for the region under the RCP8.5 scenario are for:

- **Increased temperature** – temperatures are projected to increase throughout the year, with annual average maximum temperatures approximately 2.0°C warmer by 2055
- **Decreased cool season rainfall** – summer rainfall is projected to increase slightly, and rainfall in all other seasons is projected to decline slightly. With warmer conditions, bush fire fuel availability is expected to be slightly greater at the commencement of the fire danger period than is currently the case

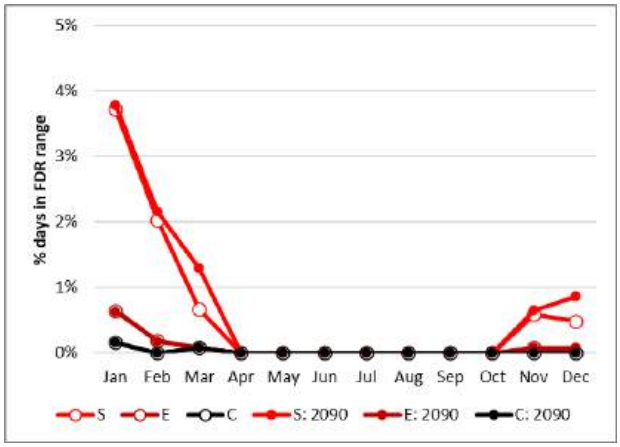
- **Decreased relative humidity** – changes in relative humidity can be expected due to increased temperatures and small changes in the seasonality of a rainfall. Relative humidity is projected to decrease throughout the year, particularly during spring
- **Small changes to wind** – average wind speeds are projected to decrease slightly through much of the year, with small increases in some months.

Combined, these projections indicate that bush fire weather will become harsher. However, the effects on overall GFDI and FDR is only projected to be marginal, considering the incidence of dangerous fire weather already experienced in the region (**Figure 4-4**, **Table 4-1**).

Note: Bushfire conditions in January 2021 exceeded the projected GDFI for both 2055 and 2090. This is because the climate change projections assume a specific baseline, which ends in 2015. Conditions in January 2021 were in fact worse than those projected for that month at the end of this century.



a) Percentage of days with maximum daily GFDI in each fire danger rating scale for the reference period (hollow markers) and projected for 2055 (solid markers)



b) Percentage of days with maximum daily GFDI in the higher categories of fire danger rating scale for the reference period (hollow markers) and projected for 2090 (solid markers)

Low-moderate: L-M; high: H; very high: VH; severe: S; extreme: E; catastrophic: C. Based on records for 1976-2015 from Deniliquin and climate change projections for RCP8.5.

Figure 4-4 Percentage of days with maximum daily GFDI in various FDRs projected for a) 2055 and b) 2090 under RCP8.5

Table 4-1 Fire danger index, indicative fire behaviour and average occurrence at the Project area for the baseline period (1976-2015), and projected for 2055 and 2090 under RCP8.5

FDR	Fire behaviour guidance	Average number of days/y		
		Baseline	2055	2090
Low-moderate GFDI<12	There is some potential for fires and those that occur will normally stop (meteorological conditions allowing) at roads, tracks and watercourses. Fires that occur can generally be extinguished by the use of hand operated water sprays and fire beaters.	320 (88%)	318 (87%)	315 (86%)
High GFDI 12-<25	Fires are capable of spreading rapidly, particularly in the absence of preventative measures and may require additional work effort to be extinguished.	30 (8%)	31 (9%)	32 (9%)
Very high GFDI 25-<50	Fires are capable of spreading rapidly, with or without preventative measures. Fire containment may require significant effort and the use of earthmoving equipment and/or backburning.	12 (3%)	13 (4%)	15 (4%)

FDR	Fire behaviour guidance	Average number of days/y		
		Baseline	2055	2090
Severe GFDI 50-<100	Fires are capable of being uncontrollable, unpredictable and extremely fast moving. They will NOT be contained without extensive effort on established fire lines with adequate personnel and equipment (this may include water bombing aircraft).	2 (0.6%)	2 (0.7%)	3 (0.7%)
Extreme GFDI 100-150		0.3 (0.1%)	0.3 (0.1%)	0.3 (0.1%)
Catastrophic GFDI>150	Fires are capable of being uncontrollable, unpredictable, and extremely fast moving, and will NOT be contained without extensive effort on very large established fire trails with extensive personnel and equipment (this will include water bombing aircraft).	0.1 (0.02%)	0.1 (0.02%)	0.1 (0.02%)

4.3 Topography

The Project area is largely flat with altitudes varying between 100 metres and 114 metres AHD. Average slope in the Project area is approximately 1%, with maximum slopes approaching 4% over short distances.

4.4 Vegetation and land uses

Most of the Project area currently supports grassland with sparsely scattered trees and shrubs, with some wetlands and patches of woodland, particularly in the riparian zone of Yanco Creek. Much of the area is used for grazing native vegetation (Category 3 vegetation under the PBP classification), with some patches of grazing modified vegetation (Category 3 vegetation) or irrigated cropping (not considered BPL unless within 30 m of the Category 3 vegetation or 100 m of Category 1 vegetation; **Figure 4-5**).

Publicly available bush fire prone land mapping in the Murrumbidgee Council area has not yet been updated to the most recent version of the BPL mapping guide, which recognises grazed grassland as Category 3 vegetation. In addition, adjoining councils have flagged the riparian vegetation associated with Yanco Creek as Category 1 vegetation (**Figure 4-5**).

This assessment considers the grazed lands to be Category 3 vegetation, with a small area of Category 1 vegetation in the Project area along the Yanco Creek. Cropped areas (irrigated and non-irrigated) are not considered to be bush fire prone, unless within 30 m of category 3 vegetation or 100 m of Category 1 vegetation.

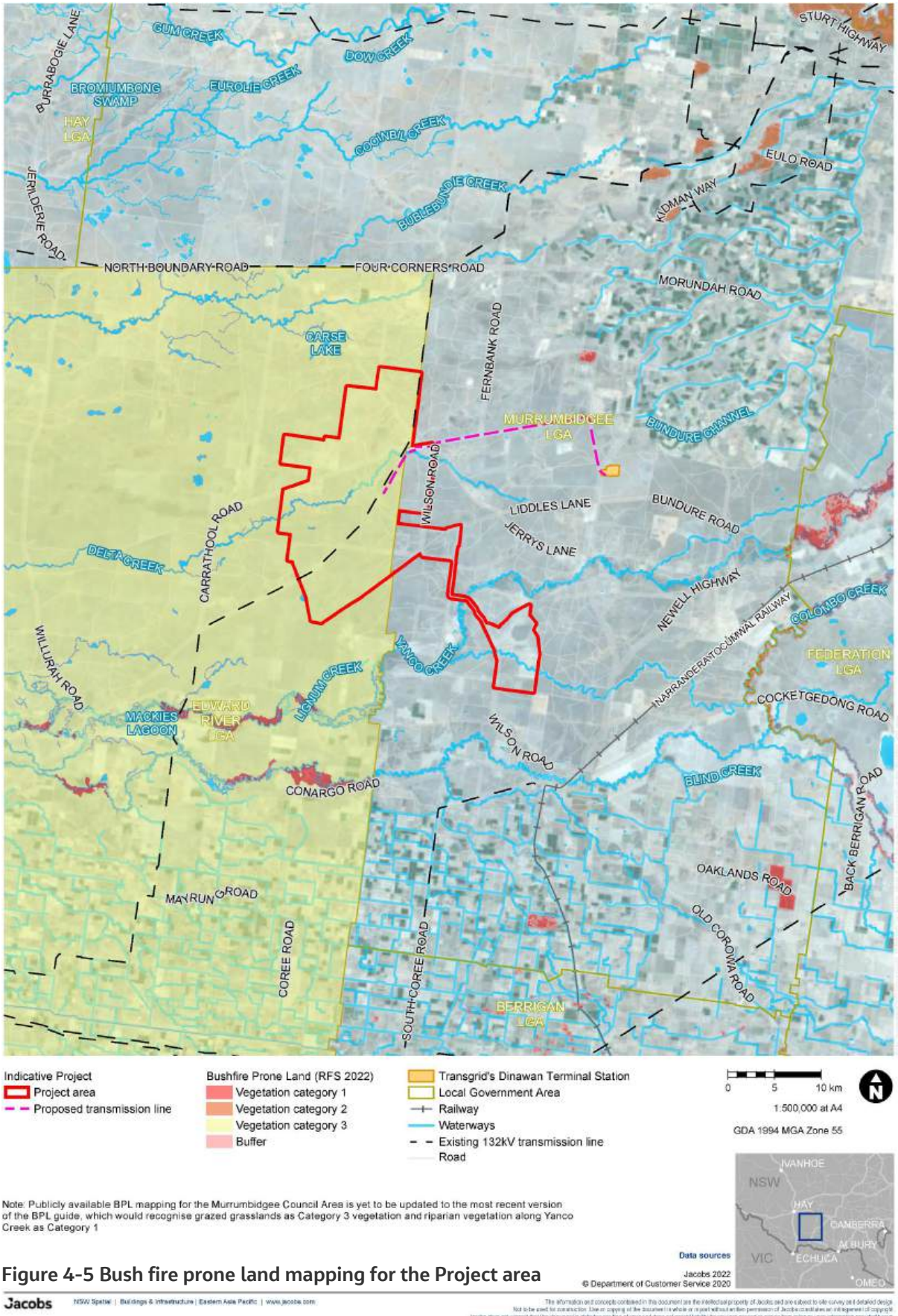


Figure 4-5 Bush fire prone land mapping for the Project area

Note: Publicly available BPL mapping for the Murrumbidgee Council Area is yet to be updated to the most recent version of the BPL guide, which would recognise grazed grasslands as Category 3 vegetation and some riparian vegetation along Yanco Creek as Category 1.

4.5 Fire history and ignition sources

Large wildfires have occurred in the landscape (**Figure 4-6**) including:

- The Project area was partially burnt in the Wanganella wildfire in January 1987
- In 1989 to 1990 the One Oak fire burnt approximately 8 km south of the Project area
- The 1990 to 1991 Glencoa fire came within 12 km of the Project area.

The most destructive fires tend to follow winters with high rainfall, causing rapid growth and accumulation of bush fire fuel (MMZ BFMC, 2009). Fires in the grasslands of the region tend to move quickly and burn at a high intensity.

The major sources of bush fire ignition in the region are (MMZ BFMC, 2009):

- Lightning strike
- Escaped hazard reduction/planned burns
- Escaped camp fires
- Power lines
- Machinery and traffic
- Hot works (e.g. cutting and welding).

4.6 Existing bush fire risk management

The Project area is in the region managed by the Mid Murray Zone Bush Fire Management Committee (MMZ BFMC). The Bush Fire Risk Management Plan for the region identify assets and values at risk, and sets out a five year plan detailing annual works for managing bush fire risk in the landscape (MMZ BFMC, 2009). Annual works programs are implemented by land management agencies and firefighting authorities, and include actions such as fuel reduction along roads, community education, managing permits to burn, and implementing hazard reduction burns to protect vulnerable areas.

NSW RFS is the primary bush fire emergency response agency for any incident affecting the Project area. Several fire appliances are stationed in the vicinity of the Project area, including Goolgumbla and North Coree. The Finley Rural Fire Brigade is located approximately 50 km by road south of the Project. The NSW RFS also has facilities in Deniliquin (approximately 65 km south-west), Tocumwal (90 km south), Barooga (over 70 km south) and Griffith (over 110 km north-east of the Project by road). One or more of these brigades may respond to fires at the Project area.

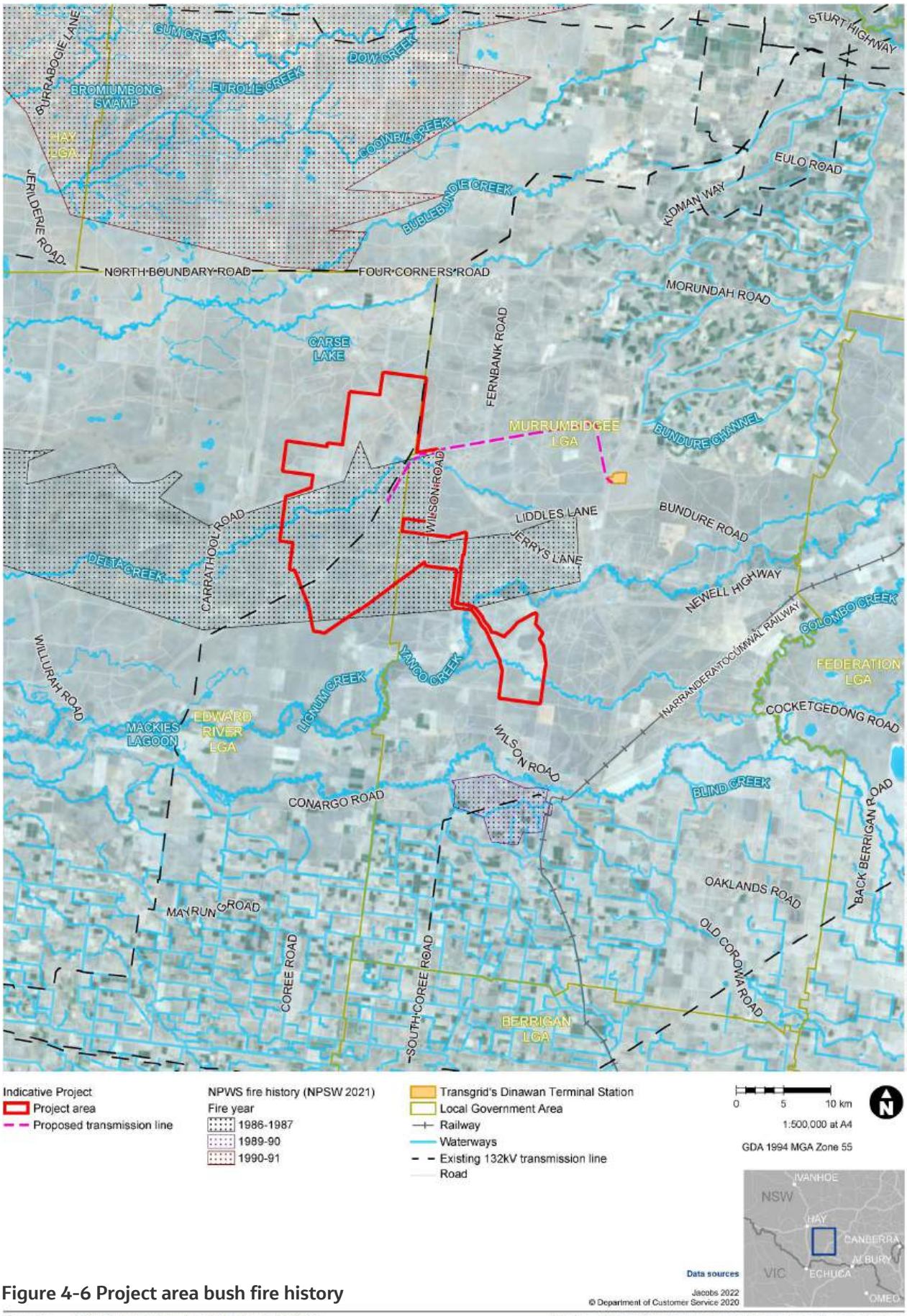


Figure 4-6 Project area bush fire history

4.7 Values at risk from bush fire ignitions

Bush fire in the region can threaten the life and safety of people living, working and visiting the area. Nearby towns include Jerilderie (est. pop. 1,029) located approximately 10 km south of the Project, Deniliquin (est. pop. 7,862) located approximately 57 km south-west of the Project, and Coleambally (est. pop. 1,331) approximately 32 km north-east of the Project. In addition, there are rural properties scattered throughout the landscape.

Much of the land area in the region is used for commercial enterprise including cereal cropping and grazing, with supporting infrastructure such as silos, fences, and outbuildings.

Oolambeyan National Park is located approximately 24 km north-west of the Project area. The small Murray Valley National Park is located 33.5 km south-west of the Project area. Three small nature reserves of South West Woodland are located 8 km west, 17 km east, and 23 km south of the Project area.

The Neighbourhood Safer Places in the region are:

- Monash Park (sports ground), corner of Bolton St and Mahonga St, Jerilderie (19 km by road south of the Project)
- Yamma Hall (building), 1334 Gilbert Road, Coleambally (35 km by road east of the Project)
- Conargo Hall Car Park (Conargo Road, Conargo) (55 km by road SSW of the Project).

Once constructed, the Project infrastructure; including WTGs, substations, BESS, operations and maintenance facility, meteorological towers, above-ground electrical cables and poles; will also be at risk of bush fire in the landscape.

Heat flux thresholds for electrical substations can be applied to all electrical infrastructure associated with the Project (**Table 4-2**). WTGs may be considered "unprotected metal" and incur damage with a heat flux of 30 kW/m^2.

Table 4-2 Radiant heat flux level and damage

Impact of radiant heat flux	Heat flux (kW/m^2)
Sufficient to cause damage to process equipment	37.5
Equipment failure	35
Damage to unprotected metal	30
Spontaneous ignition of wood	25
Cable insulation degrades	20
Pilot ignition of wood	12.5
Plastic melts	12.5
Pain threshold reached after 8 s Second-degree burns after 20 s	9.5
Possible failure of ceramic bushings	5
Skin burns	5

Reproduced from IEEE Std 979-2012: IEEE Guide for Substation Fire Protection

5. Impact assessment

This chapter discusses potential impacts to the Project from bush fire in the landscape, and the potential impacts to surrounding areas from a fire ignited on the Project area.

Grassfires can move extremely quickly, and produce large amounts of radiant heat that can prove fatal to anyone caught in the fire.

5.1 On-site bush fire ignition

There are several potential ways in which construction, operation and/or decommissioning of the Project may cause a fire to ignite; including:

- Works that may create a spark or generate hot particles (hot works; e.g. use of angle grinder, welding)
- Off-road vehicle use or parking leads to contact between bush fire fuels (particularly dry grasses) and hot parts of vehicles
- Lightning strikes a WTG or other elevated structure
- WTG fault causes an elevated fire on the tower structure
- An extreme wind event, structural fault, defect, contact with a vehicle or farm machinery or act of sabotage results in the collapse of a WTG and/or a live transmission powerline contacting the ground, vegetation and/or another live powerline
- Contact between vegetation or wildlife and powerlines or switchgear at a substation
- Explosive failure of a transformer at a substation
- Explosive failure at the BESS.

A fire ignited in any of the ways described above and that escaped beyond the immediate vicinity of the Project area could lead to injury, loss of life, psychological trauma and/or damage and/or disruption to property, land uses, and the environment in the surrounding landscape. The consequence or impact of an on-site fire would vary, depending on scale to which the fire was able to develop and the speed at which it spread through the landscape. In the worst case, lives could be lost. Assets, land uses or other features of value (such as described in **Section 4.7**) could be damaged and/or disrupted.

Bush fire protection measures outlined in **Chapter 6** minimise the risk of on-site ignition and fire spread.

5.2 Off-site bush fire ignition

There are several ways in which a bush fire burning in the landscape (landscape fire or off-site ignition) may affect Project infrastructure and personnel during construction, operation and/or decommissioning. These include:

- Effects on personnel engaged in construction, operational and/or decommissioning activities
- Damage to transmission infrastructure and/or equipment at construction sites or laydown areas from flames, radiant heat, smoke or embers
- Interruption to power supplies due to damage to transmission line infrastructure or the need to deactivate power supplies due to safety issues associated with fire in the vicinity of electricity transmission infrastructure.

Depending on the severity of the fire, warning time, personnel or equipment present at the time and the effectiveness of mitigation measures; an off-site ignition could, in the worst case, lead to deaths and/or serious injuries among construction, maintenance or decommissioning crews and severe psychological trauma among those involved. Direct fire damage to Project infrastructure (during construction or operation) is unlikely to be severe due to the materials used and their inherent fire resilience. A fire burning in the landscapes of the Project area is unlikely to generate its own weather and hence not likely to create winds that would cause a WTG to collapse. While power supplies may be temporarily be disrupted during the passage of a fire front across the transmission corridor, this would most likely be limited to no more than a few hours.

Bush fire protection measures outlined in **Chapter 6** minimise the risk to the Project from a fire moving into the Project area.

5.3 Risk to firefighting operations

There are several concerns commonly raised regarding the impact of wind farms on fire suppression efforts for fires in the landscape, including:

- Wind farms acting as direct obstacles to aerial firefighting operations
- Moving blades and wake turbulence creating a major hazard to aircraft, if not marked appropriately (Australian and New Zealand National Council for Fire and Emergency Services [AFAC], 2018). In clear conditions and with the WTGs turned off, the blades are clearly visible to aircraft and are not likely to constrain aerial operations (Clean Energy Council, 2017). However, transmission infrastructure, meteorological towers and guy ropes can be difficult to see and can therefore limit aerial firefighting operations
- Smoke exacerbating electrocution risks from powerlines
- Wind farms may interfere with local and regional radio transmissions (Australian Wind Energy Association, 2004), hampering bush fire response
- Fire crews may be unable to work in the immediate vicinity of the transmission lines due to electrical safety concerns associated with electrical induction through flame and smoke, use of water near the powerlines and/or structural failure of the infrastructure. If they could not directly attack fires burning in the immediate vicinity of powerlines or undertake backburning, the effectiveness of attack or backburning may be diminished.

An impairment of fire suppression efforts on an active fire front or backburning to help contain a fire once fire activity has moderated could lead to the fire spreading to a greater extent than may otherwise have been the case. This could result in larger or more severe impacts on people, property, and/or the environment. However, any effect, apart from an air safety incident, is expected to be quite localised.

As such, the Project has the potential to affect firefighting operations. The implementation of bush fire protection measures outlined in **Section 6.1.8**, however, would minimise this impact.

5.4 Fire in the landscape

Wind farms are not expected to worsen fire behaviour in the landscape, nor create a major ignition risk (AFAC, 2018). As such, the consequences of a given fire in the landscape to receptors outside of the Project area are not changed by the construction and operation of the Project.

WTGs may attract lightning strike (one of the major causes of fire in the region). With the WTGs' inbuilt lightning protection, likelihood of fires in the landscape due to lightning strike may decrease.

6. Bush fire protection measures

Bush fire protection measures have been developed for construction and operational phases of the Project, based on guidance from PBP (RFS, 2019a). Adoption of the measures described here is expected to reduce, to an acceptable level, both the risk of bush fire ignition by construction and/or operation of the assets and the risk that bush fires in the landscape pose to the assets.

The main bush fire protection measures that are applicable to construction and operation of the Project are:

- *APZs* – provide a buffer zone between a bush fire hazard and buildings or other structures. APZs are managed to minimise fuel loads and reduce radiant heat levels, flame, ember and smoke attack. They help to provide a defendable space for firefighters and other emergency services personnel responding to a fire event and reduce opportunities for any fire igniting on site to escape to surrounding areas. A 10 m wide APZ is proposed to be established and maintained around each WTG (accomplished by the hardstands, and a 20 m APZ surrounding each substation (including BESS and collector substations), and the operations and maintenance building. These separation distances from the surrounding grasslands reduces Bushfire Attack Level (BAL) to BAL-29 for the WTGs, and BAL-12.5 for the operations and maintenance building, the substations and BESS
- *Firebreak* – a fuel reduced area surrounding the Project area (or the area containing all Project infrastructure). This can provide a defendable space for fire attack (conditions permitting) and reduce the likelihood of fire crossing into or out of the Project area
- *Vegetation management* – the Project area will continue to be grazed, following current land management practice on the property. All vegetation (including grasses) would to be removed within the perimeter of the substations and BESS to reduce opportunities for a fire entering the site and for a fire being ignited by electrical infrastructure escaping from the site. Vegetation clearance standards around overhead powerlines would be maintained
- *Access roads* – provide safe operational access to and within the Project area for emergency services personnel. Access roads would also provide safe egress for site personnel in case of a bush fire or other emergency
- *Fire water supply* – provide water for fire suppression and/or protection of structures or equipment located on site
- *Refuge of last resort* - emergency shelter for the use of site personnel if evacuation is not possible (noting safety cannot be guaranteed)
- *Fire and life safety systems* – inbuilt systems and equipment to minimise the risk of ignition on site. These include fire protection systems for the WTGs, substations and BESS
- *Emergency management planning* – Construction and Operations Emergency Management Plans will direct staff activities in the prevention and response to fire.

Through these measures and the relevant design standards (e.g. AS3959:2018, relevant electrical safety standards), essential equipment would be designed and housed to minimise the impact of fires on the Project, and to not create a bush fire risk to the surrounding landscape.

Emergency and evacuation planning typically forms part of bush fire protection measures. Emergency responses to bush fire would be addressed with other hazards as part of the operator's site emergency management plan. These bush fire protection measures will be incorporated into the Project's Hazard Management Plan.

These measures are described in more detail in this chapter.

6.1 Permanent bush fire protection measures

6.1.1 Asset Protection Zones

APZs provide a low fuel hazard buffer between buildings (or other structures) and a bush fire hazard. They create a space to help manage the flame, radiant heat and ember exposure of the structures and any emergency service personnel or other persons in place. They typically require the removal of native overstorey vegetation and regular maintenance of the grasses or other low vegetation that form the understorey.

The following APZs are recommended:

- A 10 m APZ surrounding each WTG to reduce the risk of grassfire damage to the turbines (noting this will be accomplished by the WTG hardstands, with no additional vegetation management necessary). This brings the WTGs to a maximum of BAL-29, below the threshold for heat damage to unprotected metal (**Table 4-2**)
- A 20 m APZ around each substation/BESS to reduce the risk of bush fire ignition from these facilities as well as the risk of fire damage to the facilities; composed of a 10 m area that is bare of grass and all other vegetation, and a 10 m area maintained to the APZ standards. This brings the assets to BAL-12.5, at or below the thresholds for temperature damage to this equipment (**Table 4-2**). This also mitigates the risk of these assets providing an ignition source due to explosive electrical failure
- A 20 m APZ around the maintenance/operations building, to provide sufficient protection to a refuge of last resort (see **Section 6.1.6**). This brings the building to BAL-12.5

The standards for an Inner Protection Area as defined in PBP apply to all APZs defined for the Project, with the exception of the 10 m inner zone surrounding substations and batteries which is to be bare earth/mineral cover. The requirements for an APZ are (NSW RFS, 2019a):

- Tree canopy cover to be <15% at maturity and separated by 2-5 m, not to touch or overhang buildings, lower limbs removed up to 2 m above the ground, and preference given to smooth barked and evergreen trees
- Shrubs arranged such that there are large discontinuities/gaps, not located under trees, not form >10% ground cover, and clumps of shrubs be separated from exposed windows and doors by a distance of at least twice the height of the vegetation
- Grass to be kept at no more than 100 mm in height
- Leaves and vegetation debris to be removed.

Additional vegetation clearances apply to power poles and transmission towers (ISSC3):

- All woody vegetation is required to be cleared within 2 m of all power poles
- All woody vegetation is required to be cleared within 3 m in all directions around transmission tower structure, or 12 m radius from the centre of the tower (whichever is greater).

These areas are smaller than the disturbance footprint for these structures. Grasses may be re-established around the towers and poles, but these areas are to be kept clear of shrubs and woody vegetation.

These recommendations are consistent with:

- *ISSC3 Guide for the management of vegetation in the vicinity of electricity assets* (Industry Safety Steering Committee [ISSC], 2016) specifications for APZ for substations/switchyards)
- PBP 2019 specifications for renewable energy generation facilities (NSW RFS, 2019a).

6.1.2 Firebreaks

The individual properties making up the Project area currently implement 5 m perimeter firebreaks, maintained as bare earth during the fire season. These would remain in place for the duration of the Project operations, subdividing the Project area. These firebreaks may help provide defendable spaces (conditions permitting) for firefighters, and reduce the likelihood of fire moving through or crossing into or out of the Project area.

Note: the firebreaks are currently in place, following standard land management practice for the region. No additional vegetation clearing is required to implement this control.

6.1.3 Vegetation management

Current land management practices (grazing sheep on native grassland) is planned to continue throughout the Project area throughout its operational phase. Grazing will contribute to the ongoing mitigation of bush fire risk to the Project through reduction of bush fire fuel across the whole Project area. Prior to and during the bush fire season, these practices should ensure (at least) a mosaic of fuel-reduced areas throughout the Project area, such that there are no large contiguous stretches of High, Very High or Extreme fuel hazard (as per Hines *et al.*, 2010).

Consistent with industry practice, the areas within the substations and BESS would be maintained free of all forms of vegetation. This would help to prevent embers from a landscape fire causing an ignition within the substations or BESS and prevent failure of any of the electrical infrastructure in the facilities from causing a fire that escaped into the surrounding landscape.

Under hot conditions, overhead power lines lengthen and sag. In windy conditions, conductors are blown in the horizontal plane. Hot and windy conditions cause live conductors to be occupying space outside of their usual zone. If these conditions cause conductors to contact vegetation, bush fire ignition can occur, in highly unfavourable conditions for fire suppression and control. Under relevant legislation (**Section 2.2.3**), the Project has a responsibility to reduce this risk as low as reasonably practicable.

Project power lines would need to comply with the requirements of *ISSC3 Guide for the management of vegetation in the vicinity of electricity assets* (ISSC, 2016); considering sag and blowout, and ongoing management of grow-in and fall-in vegetation risk. These requirements for the options relevant to the Project are provided in **Table 6-1**. These distances may be achieved (and not require ongoing active maintenance) through micro-siting of power poles and/or elevating the power line above the mature height of the trees in its path.

Table 6-1 Minimum vegetation clearance for overhead line conductors (ISSC, 2016)

Voltage	Conductor type	Portion of span	Span length (m)		
			100 - ≤ 200	200 - ≤ 300	300 - ≤ 400
11 – 33 kV	Steel conductor	First & last 1/6th	2.0	2.5	4.0 (horizontal) 4.5 (vertical)
		Middle 2/3rd	3.0	4.5	6.5 (horizontal) 4.5 (vertical)
33 – 66 kV	Bare conductors *(not including steel)*	First & last 1/6th	3.5	5.0	-
		Middle 2/3rd	4.5	6.5	-
132 kV	Bare conductors *(not including steel)*	First & last 1/6th	4.5	6.0	-
		Middle 2/3rd	4.5	7.0	-

Voltage	Conductor type	Portion of span	Span length (m)		
			100 - ≤ 200	200 - ≤ 300	300 - ≤ 400
132 kV	Aluminium conductor steel reinforced	First & last 1/6th	-	-	5.5 (horizontal) 7.0 (vertical)
		Middle 2/3rd	-	-	9.0 (horizontal) 7.0 (vertical)

Unless otherwise noted, clearance is in all directions from any conductor. Includes the additional 0.5 m clearance for bush fire prone areas.

A 60 m wide easement will be maintained around the transmission line. ISSC3 does not provide guidance on conductor clearance requirements for 330 kV or 500 kV conductors. It is therefore necessary to calculate the design sag and sway (as per AS/NZS 7000 Appendices S and R), and implement appropriate clearances to manage the risk of vegetation contact. This can include elevating the conductors above the mature tree height, to minimise vegetation clearance associated with the Project.

The Project is currently engaging with Transgrid and Lumea on the transmission line design. The final plan, including clearances, will align with the network operator's bushfire assessment controls for transmission lines.

6.1.4 Vehicle access

A general access/egress point to the Project would be via a designated and upgraded access track from Liddles Lane, four kilometres east of Wilson Road. Internal access roads would also be developed within the Project area and be available for emergency services. All internal roads and maintenance tracks would be 5 m wide and have a minimum vertical clearance of 4 m to allow fire appliance access. Further road standards including vehicle tonnages and turnarounds are provided in the NSW RFS Fire Trail Standards (RFS 2019b).

Construction of the Project requires roads that support heavy vehicle access. It is recommended that these roads are maintained throughout the life of the Project, as they will already be capable of supporting Category 1 fire appliance access (refer to NSW RFS Fire Trail Standards, RFS 2019b).

6.1.5 Water supply

A guaranteed water supply is required for fire attack on site. Water tanks containing an adequate quantity of water would be maintained at the site operations and maintenance facility, and sequestered for use in firefighting (e.g. in dedicated firefighting tanks). The volume of water to be maintained on site would be decided in consultation with the RFS during the preparation of Construction and Operations Environmental Management Plans (see **Section 6.1.8**). Water storage tanks would be equipped with standard fittings to enable use by emergency responders to refill fire response vehicles in the event of failure of the potable supply. Concrete hardstands would be constructed at the primary water access point, sufficient to support the weight and turning capacity of a fire appliance (23 tonne). The water point would be clearly signposted.

For more detail on Project water supply, refer to the Surface water quality and groundwater technical report (Jacobs, 2022a).

6.1.6 Refuge of last resort

In the event of a grass fire approaching the facility, all staff and visitors on site should evacuate.

The operations/maintenance facility is nominated as the refuge of last resort. It would have an APZ of at least 20 m width (see **Section 6.1.1**) and be constructed to BAL-12.5 standard as per AS3959:2018.

If evacuation is not possible, any persons on site should seek shelter in the refuge of last resort. **Note that the safety of people sheltering in a refuge of last resort cannot be guaranteed.**

6.1.7 Fire and life safety systems

A fire response vehicle will be kept at the operations and maintenance facility, equipped with appropriate suppressants for electrical fires.

Automatic shutdowns and isolation procedures within the WTGs provide a degree of protection against the risk of ignition caused by malfunction within the turbine (AFAC, 2018). Fire detection and suppression systems would be incorporated into the construction and operation of the WTGs; potentially including automatic fire detectors in the nacelle, piped extinguishing agents (such as nitrogen or carbon dioxide), and manual and remote triggers (or other measures as available at the time of construction). In the case of the protection systems failing, maintenance of an APZ around each tower (hardstand) and broader vegetation management throughout the Project area should moderate the intensity of a fire starting at the wind farm.

Electrical fault at the substations or batteries may cause ignition. Complete clearance of vegetation within these facilities, and maintenance of a 20 m APZ surrounding each, moderates the risk of a fire igniting and spreading rapidly. Each BESS container would have a layered protection system and fire suppression system. For more information, refer to the BESS Preliminary hazard analysis technical report (Jacobs, 2022b).

WTGs can attract lightning strike during thunderstorms, in which case the inbuilt protection mechanisms, including earthing, should prevent fire ignition.

Fire safety technology in WTGs is an area experiencing rapid technological advancement. It is likely that by the time the Project reaches construction, new technology will be available for use that does not yet exist. However, fire safety systems will either match or improve on that described here.

6.1.8 Emergency management planning

Both Construction and Operations Emergency Management Plans will be prepared for the Project. Consistent with PBP, these plans will include as a minimum:

- Specific measures to prevent bush fire ignition or spread from Project activities
- Work types that should not be conducted during TOBANs or elevated fire weather as relevant
- Storage location and safety arrangements for any fuels or other hazardous or flammable materials
- RFS notification protocols of any works with the potential to cause a fire in the surrounding vegetation
- Instructions and triggers to shut down WTGs with an approaching fire
- Any other measures required by the RFS or other authorities to manage risk to aerial firefighting in the region
- Notification protocols and contact details for the local NSW RFS Fire Control Centre, local fire brigades, CASA, Air Services Australia, Transgrid, and any other people or organisations who should be notified of an emergency at the Project area
- Location and volume of firefighting water, any alternative water supplies that may be available during an emergency, and any other fire suppression equipment held on site
- Bush fire emergency planning; including evacuation triggers, evacuation routes and when and where to take refuge.

The Plans will be developed in consultation with the RFS.

6.2 Bush fire protection measures during construction and decommissioning

Construction and decommissioning activities present a different risk profile to operation of the Project. This relates to differences regarding the risks of landscape fire for construction personnel with more people on site (150-300 per day), and of on-site ignitions (due to more hot works occurring during construction than operation) which may cause a fire that escapes from the site into the surrounding landscape. It is anticipated that these risks would be mitigated by site characteristics and specific management actions, as follows:

- *Access:* In the event of a fire, emergency services would likely access the site via existing public roads and Project construction roads
- *Fire water supply*: arrangements for firefighting water prior to the establishment of the permanent water supply would be made, such that water is available for fire suppression from the start of construction. This may include arrangements with the Host or adjacent landholders to access registered bores or farm dams (noting dams which dry out during summer are not appropriate choices for fire suppression), or trucking in and storing water on site
- *Stockpiles and laydown areas*: Stockpiles and laydown areas should be located and managed so as not to serve as a bush fire risk to the surrounding landscape. No materials considered to be vulnerable to bush fire are planned be stockpiled on site during construction
- *Hazardous materials*: it may be necessary during some construction stages to store diesel fuel and other potentially flammable materials on site. Storage of such materials should follow environmental protection guidance and be located at parts of the site with low radiant heat exposure in the event of a bush fire (i.e. within an area with at least 15 m clearance from the surrounding grassland). Since the entire Project area could be subject to ember attack, it will be particularly important to ensure storage areas for any hazardous materials are free of vegetation or any other combustible materials that could contribute to a fire ignition. Any fuel spills should be remediated immediately to ensure that they cannot be a source of ignition
- *Hot work controls:* works that have potential to generate sparks and ignite fires would be subject to the contractor's hot works safety management procedures. Hot works will not be undertaken on TOBAN days except where permission has been given by the RFS
- *Emergency management:* on site bush fire emergency management arrangements would be addressed through the construction contractor's site emergency management plan. Given the level of fire risk and proximity of the site to fire services, bush fire-specific fire-fighting equipment (e.g. the Project fire fighting vehicle) may be necessary to be held on site during construction during the fire danger season. If a fire is ignited and cannot be safely contained using fire extinguishers or other equipment at hand, construction crews will dial 000 and seek emergency service assistance.

Meteorological monitoring towers must also be appropriately marked to promote visibility, and registered in the Tall Structures Database maintained by Air Services Australia (CASA, 2018).

The broader landscape is predominantly grazed, with landholders managing the fuel and therefore fire risk on their properties. Such active management should moderate the behaviour of a fire, should one ignite, and reduce the threat it poses to construction personnel and the construction site.

6.3 Measures to reduce risk to firefighting operations

Procedures to shut down WTGs such that the blades are still (and preferably in the 'Y' position) during a fire event must be in place, including a threshold distance for shutdown. These procedures must include technology to allow shut down to be implemented remotely.

AFAC recommends that WTGs and blades be appropriately marked to promote visibility to aircraft operators during a fire event (AFAC, 2018). Meteorological monitoring towers and guy wires must also be appropriately marked to promote visibility, and registered in the Tall Structures Database maintained by Air Services Australia (Civil Aviation Safety Authority [CASA], 2018).

More information on the impact on aviation is provided in the Aeronautical Impact Assessment (L&B, 2022), noting that the assessment focuses on general aviation impacts rather than aerial bush fire firefighting in the immediate surrounds. The assessment notes the guidance around obstacle lighting on wind farms is currently undergoing review, which may result in no obstacle lighting being required on Project WTGs due to the distance from aerodromes, and the registration of the wind farm on aeronautical charts alerting pilots to its presence. The Aeronautical Impact Assessment will be finalised in consultation with the RFS.

At present, it is not known to what extent communications in the area may be affected (if at all). Refer to the Electric and magnetic fields technical report (Jacobs, 2022c) for further details. Any expected radio interference must be communicated to the NSW RFS, and appropriate protocols implemented to facilitate communication in the event of a fire.

6.4 Monitoring and maintenance

Annual monitoring of the bush fire protection measures would occur with sufficient time to rectify any non-compliances prior to the onset of the fire season (e.g. September). The monitoring checklist should include:

- Firebreak
- APZs
- Overall fuel hazard throughout the Project area
- Water supply and access
- Fire suppression systems in WTGs, substations and BESS
- Fire attack resources (Project firefighting vehicle).

Compliance with the conditions of hot works permits should be audited as the works are occurring.

6.5 Potential environmental impacts of proposed bush fire protection measures

Potential environmental impacts of the proposed bush fire protection measures are largely confined to the clearing of native vegetation within the Project area for APZs around the substations, BESS and operations and management facility; the firebreak, and clearance of the overhead lines. Clearing within the proposed substation and battery locations is incorporated into the initial planning for the Project and is also required for electrical safety.

WTGs may attract lightning strike (one of the major causes of fire in the region). With the WTGs' inbuilt lightning protection, risk of fires in the landscape due to lightning strike may decrease.

7. Environmental management measures

A summary of the bush fire protection measures detailed in **Chapter 6** are provided in **Table 7-1**. These measures have been developed to specifically manage potential bush fire risk which have been predicted during construction and operation of the Project.

Table 7-1 Bush fire management measures

Impact	Reference	Environmental management measure	Responsibility	Timing
Bush fire	BU01	The Project will implement the following permanent bush fire protections: ▪ Asset Protection Zones (APZs) around each WTG (accomplished by hardstand, no additional vegetation management needed) ▪ APZs around the substations and BESS ▪ An APZ around the operation and maintenance facility, which is to be constructed to a BAL-12.5 standard as the Project refuge of last resort ▪ Perimeter firebreak ▪ Ongoing vegetation management (grazing, clearance around poles and overhead power lines) ▪ Access for emergency response vehicles ▪ A permanent, dedicated firefighting water source ▪ Controls on Project actions to prevent bush fire ignition ▪ Fire suppression systems in WTGs, substations, BESS ▪ Project fire fighting vehicle.	Contractor, operator	Construction, operation
Bush fire	BU02	Construction and Operation Bush fire Emergency Management Plans will be developed for the Project in accordance with Planning for Bush Fire Protection (PBP) (NSW Rural Fire Service [RFS], 2019) and in consultation with the NSW RFS (including any requirements in relation to aerial firefighting). These plans will identify all relevant bush fire risks and mitigation measures associated with the construction and operation of the Project, including those listed in BU01 and: ▪ Specific measures to prevent bush fire ignition or spread from Project activities ▪ Work types that will not be conducted during total fire bans ▪ Storage location and safety arrangements for any fuels or other hazardous or flammable materials ▪ Notification protocols to the NSW RFS of any work with the potential to cause a fire in the surrounding vegetation ▪ Instructions and triggers to shut down WTGs with an approaching fire ▪ Any other measures required by the NSW RFS or other authorities to manage risk to aerial firefighting in the region	Contractor	Prior to construction, construction, operation

Impact	Reference	Environmental management measure	Responsibility	Timing
		▪ Notification protocols and contact details for the local NSW RFS Fire Control Centre, local fire brigades, CASA, Air Services Australia, Transgrid, and any other people or organisations who will be notified of an emergency at the Project area ▪ Location of firefighting water, any alternative water supplies that may be available during an emergency, and any other fire suppression equipment held on site ▪ Bush fire emergency planning, including evacuation triggers, evacuation routes and when and where to take refuge.		
Bush fire	BU03	Risks to firefighting operations will be managed, including: ▪ Registering all towers (WTGs and meteorological monitoring towers) prior to emplacement on site ▪ WTG shutdown procedures in a Y-position in case of a fire in the area.	Contractor, operator	Construction, operation

8. Conclusions and recommendations

8.1 Bush fire hazard assessment

The Project would occur in a highly modified rural landscape dominated by grazing of native grasslands, with isolated patches of woody vegetation. The topography is largely flat, with localised small slopes. The area experiences a warm and persistently dry climate, and frequently experiences dangerous fire weather. Climate change is not projected to significantly alter the bush fire risk profile over the design life of the Project.

A fire in or around the Project area may threaten the life and safety of Project personnel and/or landholders in the surrounding landscape, and damage or destroy residences, stock, feed, crops, and/or farm infrastructure such as fences and outbuildings.

8.2 Bush fire protection measures

Bush fire management measures recommended in this report are summarised in **Table 8-1**.

Table 8-1 Summary of bush fire protection measures

Bush fire protection measure	Section	Summary of recommendation
Asset Protection Zones (APZs)	**6.1.1**	▪ 10 m wide APZ around each WTG (this can be accomplished by the hardstand with no additional vegetation management) ▪ 20 m wide APZ around each substation and the BESS, with an inner 10 m bare earth/mineral cover and outer 10 m managed according the APZ standard ▪ 20 m APZ around the operations and maintenance building ▪ Clearance of all woody vegetation within 2 m of power poles ▪ Clearance of all woody vegetation within 3 m of transmission tower structures/12 m from centre of tower (whichever is greater).
Firebreak	**6.1.2**	▪ 5 m wide perimeter firebreak.
Vegetation management	**6.1.3**	▪ Sheep grazing throughout Project area ▪ Areas within the substation and BESS to be maintained free of vegetation ▪ Vegetation clearance around overhead power lines ▪ Transmission line easement.
Vehicle access	**6.1.4**	▪ Access and internal roads to support Category 1 fire appliances (maintain standard built for heavy construction vehicles).
Water supply	**6.1.5**	▪ Guaranteed water supply at operations and maintenance facility for firefighting.
Refuge of last resort	**6.1.6**	▪ Operations and maintenance facility to be constructed to BAL-12.5 (according to AS3959:2018) for use as a refuge if evacuation is not possible.
Fire and life safety systems	**6.1.7**	▪ Fire response vehicle maintained on site, equipped with appropriate suppressants for electrical fires ▪ Automatic shutdown and fire suppression systems within WTGs, substations and BESS.

Bush fire protection measure	Section	Summary of recommendation
Emergency management planning	**6.1.8**	▪ Construction and Operations Emergency Management Plans to be prepared in consultation with the RFS, consistent with PBP and including the aspects listed in **Section 6.1.8**. Scope covers controls on ignition, notification protocols for the RFS and other agencies, and what to do in the event of a fire.
Construction and decommissioning	**6.2**	▪ Ensure provisions are made for access, water supply and other fire suppression resources prior to the implementation of the permanent bush fire protection measures detailed above ▪ Stockpiling and laydown areas located and managed so as not to present a bush fire risk ▪ Hazardous chemicals including fuel to be stored according to environmental protection standards in areas with cleared vegetation (at least 15 m clearance from surrounding grassland), and any spills remediated immediately ▪ Controls on hot works ▪ All towers to be registered in the Tall Structures Database as soon as (or preferably prior to) being raised ▪ Construction Emergency Management Plan (as above).
Management of risks to firefighting operations	**6.3**	▪ WTGs shut down with blades stationary and in the 'Y' position (can be triggered remotely) ▪ WTGs spaced to accommodate firefighting aircraft ▪ WTGs and meteorological monitoring towers registered in the Tall Structures Database ▪ If the Project causes any disruption to radio communications as used in emergency response, liaison with RFS and any other affected agencies to facilitate communication.

8.3 Potential environmental impacts of bush fire protection measures

Potential environmental impacts of these measures are limited to the clearance of native grassland to create the APZs and firebreaks (noting that these will be small additional areas compared to the Project disturbance area). Lightning protections may mean reduced numbers of unplanned fires in the region.

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