Bushfire Environmental Management Consultancy

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

BUSH FIRE ASSESSMENT REPORT

Residential Development

46 Lawford Crescent, Griffith, NSW

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Title	Bush Fire Assessment Report			
Description	New Dwelling – 46 Lawford Crescent, Griffith, NSW			
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1	DSL	FINAL	03/05/2021	Completed

TABLE OF CONTENTS

TABLES

FIGURES

PLATES

Abbreviations and Acronyms

APZ	Asset Protection Zone
AS/NZS 1221:1997	Australian Standard – Fire hose reels
AS1596-2014	Australian Standard – The storage and handling of LP Gas
AS2419-2017	Australian Standard – Fire hydrant installations
AS2441:2005	Australian Standard – Fire hose reels installation
AS3745:2010	Australian Standard – Planning for emergencies in facilities
BAL	Bush fire Attack Level
BCA	Building Code of Australia
BFAR	Bush Fire Assessment Report
BFSS	Bush Fire Strategic Study
BPA	Bush fire Prone Area (Also Bush fire Prone Land)
BPL Map	Bush fire Prone Land Map
BPMs	Bush fire Protection Measures
BV	Biodiversity Values
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
FFDI	Forest Fire Danger Index
GFDI	Grass Fire Danger Index
ha	Hectare
HOC	Heat Of Combustion
IPA	Inner Protection Area
kJ/kg	Kilo Joules per Kilo gram
LGA	Local Government Area
OPA	Outer Protection Area
PBP	Planning for Bush fire Protection
RF Act	*Rural Fires Act 1997*
RF Regs	*Rural Fires Regulations 2013*
RHG	Restricted Head Growth
SEED	Sharing and Enabling Environmental Data in NSW
SFR	Short Fire Run

Executive Summary

BEMC Pty Ltd was engaged by the Aboriginal Housing Office to complete a Bush Fire Assessment Report (BFAR) utilising Method 2 assessment pathway from AS3959:2018 on the proposed residential development located at 46 Lawford Crescent, Griffith NSW.

This report considers and assess the bush fire construction and planning requirements to determine compliance with the performance criteria in NSW Rural Fire Service Planning for Bush fire Protection 2019 (PBP 2019). This report applies the methodology in Appendix 1 and provided the required information in consideration of A2.2 of PBP 2019.

The identification of bush fire prone lands (BPL Map) in NSW is required under section 10.3 of the *Environment Planning and Assessment Act 1979* (EP&A Act). Section 4.14 of the EP&A Act requires developments to comply with NSW Rural Fire Service, *Planning for Bush fire Protection* (PBP 2019) if any part of a development site is affected by bush fire hazard as indicated within the BPL Map. This development falls within the Bush fire Vegetation Buffer zone on the Griffith Council bush fire prone land map which triggers development assessment provisions under 4.14 EP&A Act and compliance with PBP 2019. The consent authority can consult with the RFS under section 4.15 for development in bush fire prone lands.

The proposed development is classified as building Class 1 in accordance with Building Code of Australia (BCA). The EP&A Regulation requires a Certifying Authority, prior to issuing a construction certificate or complying development certificate, to be satisfied that the relevant requirements of the BCA will be met. The BCA calls-up *AS3959:2018 Construction of buildings in bush fire prone land* (AS3959:2018). Residential buildings classified a Class 1 located on bush fire prone land, must comply with the BCA and the construction requirements in PBP 2019.

To determine the planning and construction requirements a site assessment in accordance with Appendix 1 of PBP 2019 has be performed in April 2021 to determine the appropriate bush fire threat level, design, planning and construction standards required to comply with PBP 2019.

In summary, based upon this assessment of the plans it is recommendations that development consent be granted subject to the following conditions to comply with PBP 2019:

Asset Protection Zones and Landscaping

- A landscaping plan shall be provided with the development application.
- Prior to issuing occupation certificate the consent authority shall ensure the entire property is managed as an Inner Protection Area (IPA) as outlines within Appendix 4 of Planning for Bush fire Protection 2019, and NSW Rural Fire Service 'Standards for Asset Protection Zones'.
- If overhead power supply is provided, the const authority shall determine vegetation management is in accordance with Energy Australia 'Vegetation Safety Clearances' (NS179, April 2002).

Construction Standards

- A BAL 12.5 construction level is required for all elevations.

Access and Water

- The proposed development meets these performance criteria through the acceptable solutions.

Electricity services

- Were possible electricity should be placed underground.

Gas services

- If gas services are provided to the development, prior to issuing occupation certificate the consent authority shall ensure the location and design of gas services meets the requirements of Table 7.4a of PBP2019.

Emergency management

- It is recommended that the property owner and occupants familiarise themselves with relevant bush fire planning, protection, preparation and survival information and consider implementation of the '*NSW RFS Best Practise Guidelines – Dwelling upgrades'* for the upgrade of existing buildings to ensure compliance with the intent of the *Planning for Bush fire Protection (2019)* and *AS3959 – 2018 Construction of buildings in Bush fire Prone Areas*. A review of the site and proposed development layout indicates that compliance with the above recommendations can be achieved or practically implemented without substantial change to the proposed layout or construction methodology.

Finally, the implementation of the adopted measures and recommendations forwarded within this report comply with Planning for Bush fire Protection (2019) and will contribute to the amelioration of the potential impact of any bush fire upon the development, but they do not and cannot guarantee that the area will not be affected by bush fire at some time.

Table 1 Planning for bush fire protection compliance (PBP 2019)
Chapter 7 - Infill developments on bush fire prone lands

	PERFORMANCE CRITERIA	ACCEPTABLE SOLUTION	COMPLIANCE
APZs	APZs are provided commensurate with the construction of the building and defendable space is provided	• An APZ is provided in accordance with Tables A1.12.2 or A1.12.4 in Appendix 1 of PBP 2019.	**Acceptable Solution** – Refer to section 4.2
	APZs are managed and maintained to prevent the spread of a fire towards the building	• APZs are managed in accordance with the requirements of 'Asset protection zone standards' of Appendix 4 of PBP 2019.	**Acceptable Solution** – Refer to section 4.2
	The APZ is provided in perpetuity APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised.	• APZs are wholly within the boundaries of the development site • APZ are located on lands with a slope less than 18 degrees	**Acceptable Solution** – Refer to section 4.2
CONSTRUCTION STANDARDS	The proposed building can withstand bush fire attack in the form of embers, radiant heat and flame contact	• BAL is determined in accordance with tables A1.12.5 to A1.12.7 • Construction provided in accordance with the Building Code of Australia and as modified by table 7.5.	**Acceptable Solution** – Refer to section 4.3
	Proposed fences and gates are designed to minimise the spread of bush fire	• Fencing and gates are constructed in accordance with section 7.6.	**Acceptable Solution** – Refer to section 4.3
	Proposed Class 10a buildings are designed to minimise the spread of bush fire.	• Class 10a buildings are constructed in accordance with section 8.3.2	**Acceptable Solution** – Refer to section 4.3
ELECTRICITY	Location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.	• Where practicable, electrical transmission lines are underground; and • Where overhead, electrical transmission lines are proposed as follows: ○ Lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas; and ○ No part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.	**Acceptable Solution** – Refer to section 4.6

GAS	Location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	• Reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used. • All fixed gas cylinders are kept clear of all flammable materials to 10m and shielded on the hazard side. • Connections to and from gas cylinders are metal. • Polymer-sheathed flexible gas supply lines are not used; and • Above-ground gas service pipes are metal, including and up to any outlets	**Made condition of consent** – Refer to section 4.7

LANDSCAPING	Landscaping is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind-driven embers to cause ignitions	• Compliance with the NSW RFS 'Asset Protection Zone standards' (see Appendix 4 of PBP 2019).
		• A clear area of low-cut lawn or pavement is maintained adjacent to the house
		• Fencing is constructed in accordance with Section 7.6
		• Trees and shrubs are planted such that:
		  • the branches will not overhang the roof
		  • the tree canopy is not continuous
		  • any proposed windbreak is located on the elevation from which fires are likely to approach
			Made condition of consent – Refer to section 4.8

ACCESS	Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation	• Property access roads are two-wheel drive, all weather roads	**Acceptable Solution** – Refer to section 4.4
	The capacity of access roads is adequate for firefighting vehicles	• The capacity of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating.	**Acceptable Solution** – Refer to section 4.4
	There is appropriate access to water supply	• Hydrants are provided in accordance with AS2419.1:2005; and There is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available	**Acceptable Solution** – Refer to section 4.4

ACCESS REQUIREMENTS	Firefighting vehicles can access the dwelling and exit safely	• At least one alternative property access road is provided for individual dwellings or groups of dwellings that are located more than 200m from a public tough road.
		• There are no specific access requirements apply in areas where firefighting can occur directly from the hydrant in accordance with AS 2419. In circumstances where this cannot occur, the following requirements apply:
		  • Minimum carriageway width of 4m;
		  • In forest, woodland and heath situations, rural property roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m, at the passing bay
		• A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, and
		• Property access must provide a suitable turning area in accordance with Appendix 3, and
		• Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress
		• The minimum distance between inner and outer curves is 6m, and
		• The crossfall is not more than 10°, and
		• Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads, and
		• A development comprising more than three dwellings has formalised access by dedication of a road and not by right of way.
		
		Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.
			Acceptable Solution – Refer to section 4.4

WATER SUPPLIES	A water supply is provided for firefighting purposes	• Reticulated water is to be provided to the development, where available a static water supply is provided where no reticulated water is available	**Acceptable Solution** – Refer to section 4.5
	A water supplies are located at regular intervals the water supply is accessible and reliable for firefighting operations	• Fire hydrant spacing, design and sizing comply with the Australian Standard AS 2419.1:2005, and • Hydrants are not located within any road carriageway, and • Reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter road	**Acceptable Solution** – Refer to section 4.5
	Flows and pressure are appropriate	• Fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2005	Fire hydrant flows and pressures was not tested as part of this report
	The integrity of the water supply is maintained	• All above-ground water service pipes external to the building are metal, including and up to any taps	**Acceptable Solution** – Refer to section 4.5
	A static water supply is provided for firefighting purposes in areas where reticulated water is not available	• Where no reticulated water supply is available water for firefighting purposes is provided in accordance with table 5.3d, and • A connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; 65mm Storz outlet with a ball valve is fitted to the outlet, and • Ball valve and pipes are adequate for water flow and are metal, and • Supply pipes from tank to ball valve have the same bore size to ensure flow volume, and • Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank, and • A hardened ground surface for truck access is supplied within 4m, and • Above-ground tanks are manufactured from concrete or metal, and • Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F AS 3959), and • Unobstructed access can be provided at all times, and • Underground tanks are clearly marked, and • Tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters, and	**Acceptable Solution** – Refer to section 4.5

		• All exposed water pipes external to the building are metal, including any fittings, and • Where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump, and are shielded against bush fire attack; any hose and reel for firefighting connected to the pump shall be 19mm (internal diameter), and • Fire hose reels are constructed in accordance with AS/NZS 1221:1997 Fire hose reels, and installed in accordance with AS 2441:2005 Installation of fire hose reels	

BUSH FIRE CERTIFICATION

The report has been endorsed by Duncan Scott-Lawson, BPAD level 3 certifier BPAD 47789. I certify that the proposed development design conforms to the relevant specifications and requirements of PBP 2019 and AS 3959-2018 detailed in Section 4.14 (1) (b) of the *Environmental Planning and Assessment Act* (1979).

1 INTRODUCTION

BEMC Pty Ltd was engaged by the Aboriginal Housing Office to complete a Bush Fire Assessment Report (BFAR) on the proposed development located at 46 Lawford Crescent, Griffith, NSW, hereafter referred to as the 'site' (**Figure 1**).

To determine the planning and construction requirements a site assessment in accordance with Appendix 1 of PBP 2019 has be performed in April 2021 to determine the appropriate bush fire threat level, design, planning and construction standards required to comply with PBP 2019.

Site Particulars are illustrated within **Figure 1**.

1.1 DESCRIPTION OF PROPOSED DEVELOPMENT

Table 2 Description of Proposed development

Boundaries	The site is in a residential development area, with a south-easterly facing aspect onto Lawford Crescent, classifiable vegetation to the north-west.
Topography	Upslope to the northwest.
Type of development	Class 1a – `Dual occupancy
Roof construction	Colourbond
External wall construction	Fibre cement cladding
Landscaping plan provided	No
Bush fire Prone Land	Yes – Griffith Council – FFDI - 80

The proposed location of the development is provided in Figure 1 with further development details provided in **Appendix 1**.

1.2 OBJECTIVES OF ASSESSMENT

This assessment has been undertaken to enable council to make a determination of the proposed development in consideration of the requirements of s4.14 of the EP&A Act 1979, PBP 2019 and AS 3959:2018.

The report assesses the requirements of the development to meet the six objectives listed in section 1.1 of PBP 2019, which provide for the protection of human life and minimize impacts on property.

- Afford buildings and their occupants protection from exposure to a bush fire.
- Provide for a defendable space to be located around buildings.
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings.
- Ensure appropriate operation access and egress for emergency services personnel and residents is available.
- Provide for ongoing management and maintenance of Bush fire Protection Measures (BPMs); and
- Ensure the utility services are adequate to meet the needs of firefighters.

1.3 Specific Objectives of Residential Infill Developments

The aims and objectives listed in section 1.1 of PBP 2019 remain applicable to residential infill development, however further consideration has been given to these types of developments to ensure BPMs are fully incorporated at the design stage of the development. The specific objectives of residential infill developments outlined in section 7.3 of PBP 2019 are:

- Provide a defendable space to enable unimpeded access for firefighting around the building.
- Provide better bush fire outcomes on a redevelopment site than currently exists, commensurate with the scale of works proposed.
- Design and construct buildings commensurate with the bush fire risk.
- Provide access, services, and landscaping to aid firefighting operations.
- Not impose an increased bush fire management and maintenance responsibility on adjoining landowners.
- Increase the level of bush fire protection to existing dwellings based on the scale of the proposed work and level of potential risk.

1.4 Method 2 assessment pathway

The design fire methodology outline in Appendix B of AS3959:2018 Detailed BAL Assessment provides the mathematical methodology and accepted inputs that the simplified BAL assessment Method 1 matrix was derived. Method 2 fire design model consists of accurately determining input into nested calculations within the modelling that provide increased accuracy in determining radiant heat flux and flame length.

Furthermore, Method 2 can consider the impact of Kataburn rate of spread, radiant heat shielding, and short fire runs will have on the radiant heat exposure of a proposed development.

Understanding the knowledge gaps for bush fire prediction is required to enable accurate interpretation of bush fire modelling and fire engineering calculations used through the detailed assessment (Method 2). The gaps in knowledge include:

- Duration of the initial fire growth phase.
- Fire spread on slopes, in complex terrain and extreme condition.
- Fire spread around the entire perimeter.
- Short-distance (wind-driven) spotting.
- Characteristics of flames in different fuel types.

When interpreting the results of the detailed method, each of these elements are considered when determining the effect on the outputs for the calculations.

Figure 1 Site Location of 46 Lawford Crescent, Griffith, NSW (Mecone Mosaic, 2020)

2 BUSH FIRE STRATEGIC STUDY

A Bush Fire Strategic Study (BFSS) has been prepared to inform the context of the assessment of the Bush Fire Assessment Report (BFAR). The level of information gathered and analysis within the BFSS depends upon the nature of development, scale of the proposal, the bush fire risk, and potential impact on the wider community and emergency management arrangements. This process provides an opportunity to assess if a proposed development is appropriate in the bush fire hazard context.

Table 3 Bush fire strategic study

Adjoining land	The proposed development and changing land use do not impact on the ability of adjoining landowners to implement Bush fire Protection Measures.
Surrounding infrastructure	The proposed development does not significantly impact on the pressures or flows of existing water supplies and does not impacted on high voltage power supplies or natural gas lines.
Access and egress	The capacity of the existing road network will not be significantly affected by the proposed development during a bush fire event. The proposed development is not isolated in the event of a bush fire.
Emergency services	The proposed development does not significantly impact on the ability of emergency service to plan, prepare, respond, or recover prior, during or after a bush fire event.
Land use assessment	The proposed development is a permitted use. The development is located within the central portion of the lot. The bush fire hazard is located to the north-west of the proposed development. The proposed siting of the development within the lot is appropriate.
Bush fire landscape assessment	The bush fire hazards around the site is Inland rock Hill woodlands with transitional floodplain woodlands on lower slopes.to the north-west. The potential fire behaviour and fire runs from the north-west will generate the greatest threat to the development. SEED portal identifies no wildfire within the proximity of the development. The highly disturbed landscape within the surrounding land use will reduce available fuel loads and break the run of moderate and low intensity fires. High intensity fires from the north-west will impact on the site. Ember attack and radiant heat are the principal bush fire attack mechanism on this development.

This Bush Fire Strategic Study identifies that the proposed development meets the broad aims and objectives and the specific objectives of residential infill developments of PBP 2019. The proposed development provides occupants the ability to shelter from a bush fire event, provides separation between the bush fire threat and building, will not significantly increase the spread of fire or limit the ability of emergency services ingress while occupants are looking to evacuate.

3 BUSH FIRE HAZARD ASSESSMENT

This section details the site assessment methodology in Appendix 1 of PBP2019. It provides detailed analysis of the vegetation, slope, exclusions, vegetation downgrades and shielding elements to provide the required Bush fire Protection Measures.

3.1 FIRE DANGER INDEX

Method 2 assessment considers the worst-case scenario for bush fire impacts and calculates fire behaviour determined from specific inputs. This assessment utilises council area derived FFDI of 80.

3.2 ASSESSMENT METHODOLOGY

The assessment of the vegetation, slope and other bush fire characteristics within and surrounding the site has been carried out with the aid of the follows:

- Nearmap and sixmap aerial Photograph Interpretation.
- Kogan 6*25 Laser distance finder.
- Photo Theodolite application supported by contour and terrain profiles.
- SEED Portal - Sharing and Enabling NSW Environmental Data portal.
- Reference to regional vegetation community mapping, and

Plates 1 – 5 depict the elements in and around the site that are considered within the bush fire hazard assessment. The classified vegetation, separations, effective and site slope, short fire run and shielding are identified in **Table 4** and displayed in **Figure 2**. Any vegetation exclusions and downgrades are identified in **Figure 2**.

3.3 VEGETATION ASSESSMENT

In accordance with PBP 2019, an assessment of the vegetation over 140m in all directions from the building was undertaken.

Vegetation that may be considered a bush fire hazard was identified and classification based on available fuel loads for sub-formations are provided through vegetation fuel monitoring project administered by the University of Wollongong, University of Melbourne and CSRO Ecosystems Science and Bush fire Dynamics and Applications. The results of this research are commonly referred to as the '*NSW Comprehensive Fuel Loads*'.

3.3.1 Vegetation exclusions, and downgrades

The size and shape of small areas of vegetation influences the behaviour of bush fires and the associated risk to the built environment. Section A1.10 of PBP 2019 determines small or narrow parcels of vegetation have less opportunity to support fully developed bush fires because of their limited size. Modified landscapes, coastal wetlands and riparian areas vary significantly in structure and composition, but are generally considered as bush fire hazards, except for saline wetlands. Non-hazard and non-vegetated areas are not required to be considered for the purposes of PBP 2019.

The separation provided by the transmission lines easement and mineral earth track is adequate to impede the upslope fire spread towards the site. The radiant heat generated by the vegetation immediately to the north-west will be impeded by the proposed colour bond fence along the rear boundary and have been excluded as a fire threat.

3.3.2 Predominant Vegetation Classification

Vegetation in and around the site is classified as Transitional Floodplain Woodlands in accordance with the '*NSW Comprehensive Fuel Loads*'.

3.4 Separation Assessment

The separation between the proposed building envelope and the classifiable vegetation that creates bush fire threat one of the significant BPMs to reduce the risk of bush fire impacting on the development. The land within the separation must conform to the standards of an Asset Protection Zones to be accepted within the separation areas.

The separations between the classifiable vegetation and building are provided in **Table 4**.

3.5 Slope Assessment

This section details the site assessment methodology in Appendix 1 of PBP2019 to assess the effective slope (under classified vegetation) and site slope (slope between the vegetation and proposed development) within the 100m of the proposed building envelope.

The effective and site slopes use within this assessment are provided in **Table 4**.

3.5.1 Effective and Site Slope Assessment

The slope of the land under the classified vegetation has a direct influence on the rate of fire spread, the intensity of the fire and the ultimate level of radiant heat flux.

The effective slope is the slope of the ground under the hazard (vegetation). The slope between the vegetation and the proposed building envelope is the site slope. When identifying the effective and site slopes, it may be found that there are a variety of slopes covering different distances. The effective slope is the slope under the vegetation which will most significantly influence the bush fire behaviour for each aspect.

The topography of the site and surrounds has been assessed to identify the maximum slope present under the classified vegetation (hazard). These values help determine the vegetation that possess bush fire threat and significantly influence fire behaviour.

3.6 Short Fire Run and Restricted Fire Head Growth

An analysis of the size and shape of the classifiable vegetation in and around the site has determined no Short Fire Run (SFR) or Restricted Head Growth (RHG) considerations within this assessment.

3.7 Flame Length

Weise and Biging (1996) research Byram's original equation relating fireline intensity to flame length overestimated flame length.

The 'trench effect' arises because of the geometry affects the flames and hot plume attaching to the bottom surface Drysdale et al. (1992). Edgar *et al.* (2015) reported the flame and hot plume flow characteristics depended on the inclination, with the hot plume separating from the surface at 10 and 20 degrees, although a distinctly laminar structure developed, and the hot plume attached to the surface at 30 degrees which gave rise to hotter and faster moving fire. Grumstup *et al.* (2017), Drysdale and Macmillan (1992) and Wu *et al.* (2000) illustrate the plume commences a pronounced lean when slopes exceed 15° angle and ground attachment commences although detachment quickly from the surface.

Edgar *et al.* (2015) research supports Dold and Zinoviev (2009); Wu *et al.* (2000) of a threshold angle of inclination that demarcates the separation between turbulent and laminar flow regime that predominantly determine flame attachment to the ground. This threshold angle is around 24 to 26 degrees. Edgar *et al.* (2015b) reports the laminar flow, once established, was more stable within tunnels of greater inclination, indicating disruption of the laminar flow could be achieved at 20 degrees, although did not impact the laminar flow at 30 degrees. Edgar *et al.* (2016) illustrates the attachment of the plume for tunnel inclinations above 24° was associated with the development of a pressure deficit in the region immediately upslope of the heat source supporting the theory that the mechanism for flame attachment of the plume arises due to an imbalance between the upslope and downslope entrainment of air into the plume heat source and is independent of the convective intensity of the plume. Edgar *et al.* (2016) reported distinctly different plume behaviour depending on whether the trench was inclined above or below the critical angle of 24°.

The contemporary research illustrates flame length ground attachment is not possible at slopes below horizontal and below 15 degrees and is not considered further within this assessment.

3.8 SHIELDING

Where an elevation is shielded from direct radiant heat arising from bush fire attack, then the construction requirements for that elevation can be reduced to the next lower BAL. An elevation is deemed to be not exposed to the source of bush fire attack if all the straight lines between that elevation and the source of bush fire attack are obstructed by another part of the building.

The shielding of an elevation shall apply to all the elements of the wall but shall not apply to subfloors or roofs. The construction requirements for a shielded elevation shall be not less than that required for BAL-12.5 unless the building has been assessed as being BAL-LOW. The reduced construction requirements do not apply where any elevation is BAL-FZ.

An analysis of the potential shielding from fencing and other buildings has determined that the rear color bond fence provides a shielding effect of the radiant heat from a potential bush fire event. This radiant heat shield has been included into this assessment along Transect 1.

3.9 OTHER METHOD 2 INPUTS

Heat of Combustion

Heat of Combustion (HoC) is an important characteristic in the simulation of wildfires. It is frequently used in the assessment of fuel flammability and a key input to calculate fire-line intensity which provides for flame length calculations. Despite the variability of natural fuels HoC is considered a constant. Research since the development of the method 2 calculations illustrate that fuel moisture content has a significant impact on HoC and argue that lowering the current default heat of combustion of 18600 kJ/kg in forest fire behaviour models.

Flame Emissivity

AS3959:2018 indicates a nominal flame emissivity of 0.95 is justified as the bush fire flames under design fire weather scenarios are generally optically thick ($\varepsilon \approx 1$). The predicted flame emissive power is extremely sensitive to flame temperature. The selection of the nominal flame temperature for calculation is critical to make sure that the construction standard determined with this flame temperature together with other input parameters can provide an adequate bush fire construction level.

Moisture Factor

Fuel moisture factor is only used in Marsden–Smedley and Catchpole (1995) fire model for Tussock Moorland and is default to 5. This input has no effect on fire modelling calculations in other vegetation.

Ambient temperature and Relative Humidity

The default value for ambient air temperature during worst-case scenario fire weather conditions defaults to 35°, converted to Kelvin is 308K. The default value for Relative Humidity is 25%. Worst case scenario fire weather conditions in NSW are generally from the North-west which have high temperatures and low relative humidity. For bush fire threats a from directions other than the north, north-west, and west the ambient temperature and relative humidity can significantly change, especially in coast environments.

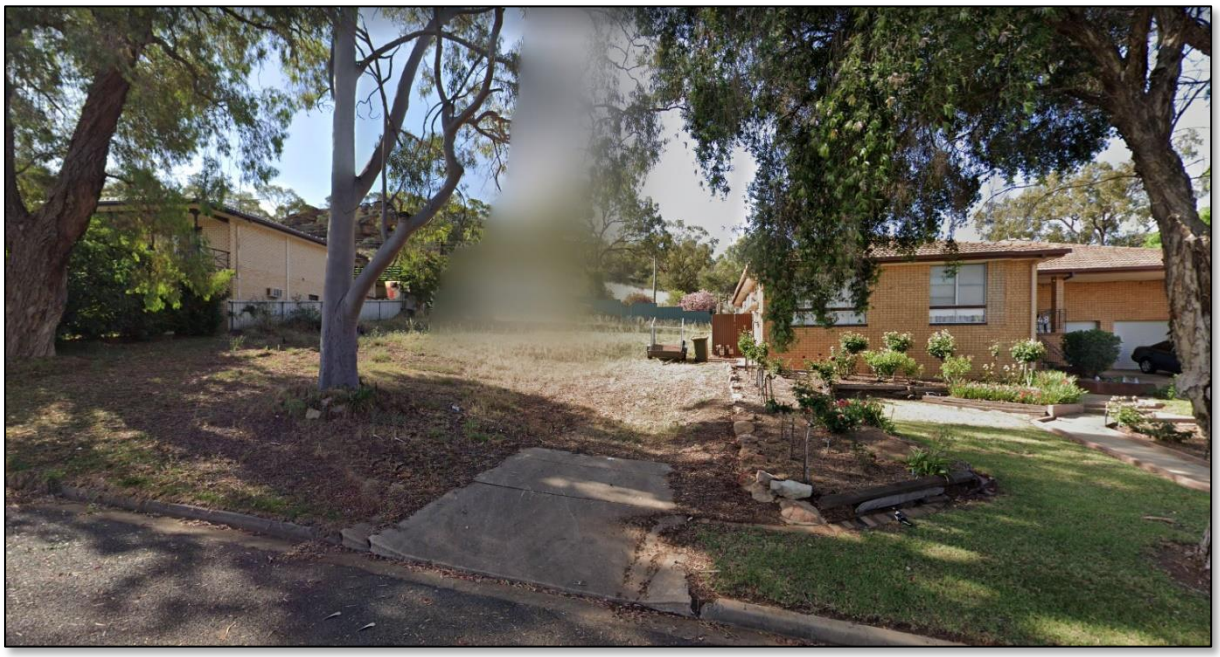

Plate 1 Google street view of the site

Plate 2 Goggle street view of access along Lawford Crescent to the south

Plate 3 Goggle street view vegetation to the north-west of the site, eastern side of Scenic Drive

Plate 4 Goggle street view vegetation to the north-west of the site, western side of Scenic Drive

Plate 5 Water hydrant on the left, site on the right of goggle street view image

Table 4 Bush fire Hazard Assessment (Method 2 AS3959:2018)

Elements	Method (unit)	Transect 1
Vegetation	NSW Comprehensive Fuel Loads	6m
Provided separation	Site -Laser finder (m)	30m
Effective slope	Site visit – Theodolite (°)	10 degree up
Site slope	Site visit – Theodolite (°)	8 degree up
Shielding width	Site Plans / Site Visit (m)	N/A
Shielding height	Site Plans / Site Visit (m)	N/A
Elevation of receiver	Site Plans (m)	2.4
Flame temperature	1090 / 1200 Kelvin	1090
Upslope fire	Kataburn correction	Yes
Fire Danger Index (FFDI)	Douglas Graham (2017)	106
Heat of Combustion (HoC)	Default at 18600 kJ/kg	18600
Flame emissivity	Default at 0.95	0.95
Moisture factor	Default at 5	5
Ambient temperature	BoM (Default at 308 Kelvin)	308
Relative Humidity (RH)	BoM (Default at 25%)	25
Short Fire Run (SFR)	Bush Fire Safety Study	N/A
Restricted Head Growth (RHG)	Bush Fire Safety Study	N/A
SFR / RHG Fire Modelling	Vesta / McArthur	N/A
OUTPUTS (Appendix 2)		
Separation to Achieve BAL40		6 - < 8m
Separation to Achieve BAL29		8 - < 12m
Separation to Achieve BAL19		12 - < 17m
Separation to Achieve BAL12.5		17 - < 100m
Bush fire Attack Level (BAL)		**BAL 12.5**

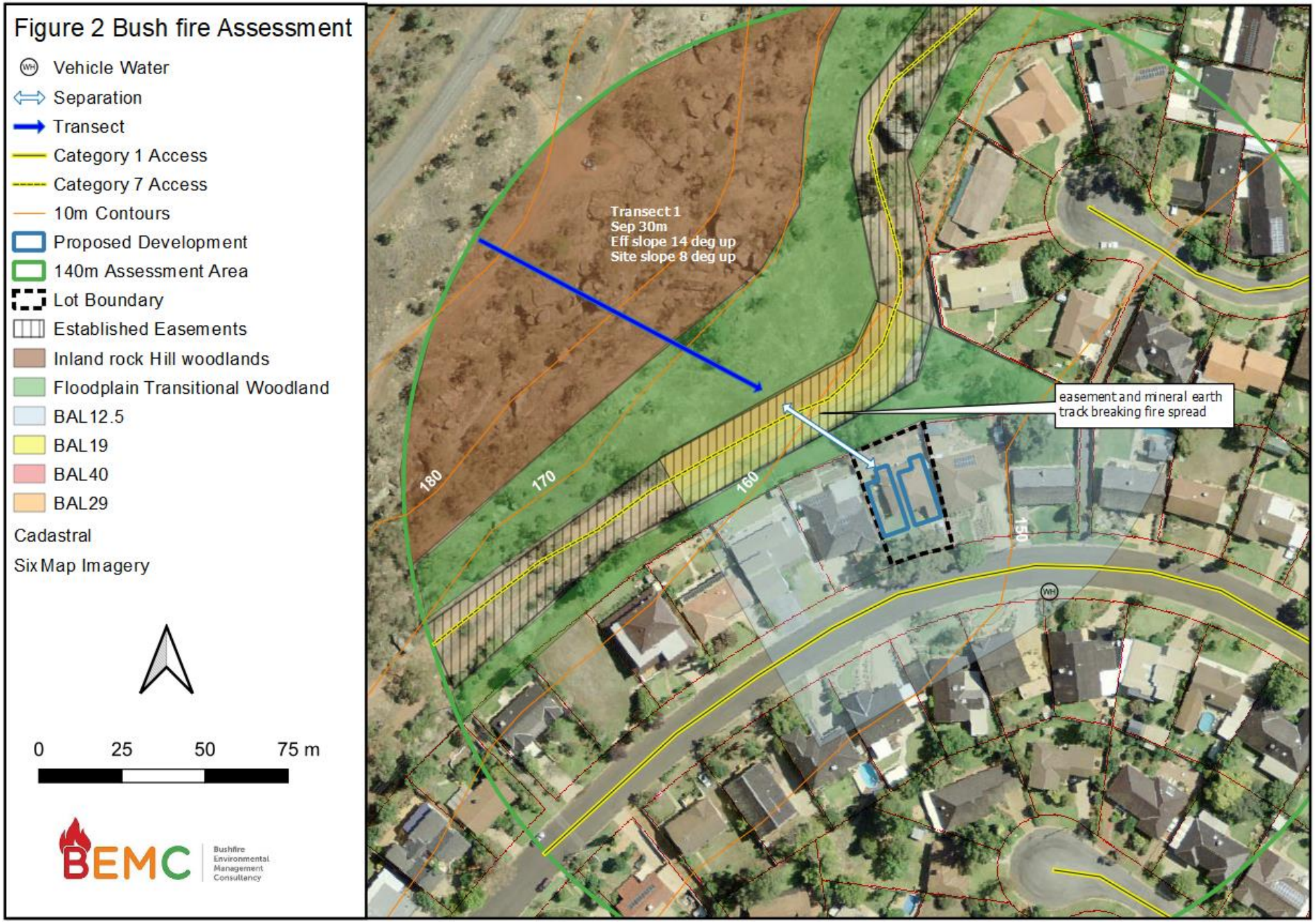
Figure 2 Bush fire Assessment
Vehicle Water
Separation
Transect
Category 1 Access
Category 7 Access
10m Contours
Proposed Development
140m Assessment Area
Lot Boundary
Established Easements
Inland rock Hill woodlands
Floodplain Transitional Woodland
BAL12.5
BAL19
BAL40
BAL29
Cadastral
Six Map Imagery
0
25
50
75 m
BEMC
Bushfire Environmental Management Consultancy
Transect 1
Sep 30m
Eff slope 14 deg up
Site slope 8 deg up
easement and mineral earth track breaking fire spread
180
170
160
150

4 BUSH FIRE ASSESSMENT

This section assesses BPMs for the proposed development in consideration of the acceptable solutions required for each performance criteria within PBP 2019. Were acceptable solutions are not meet details of the performance-based solution are provided.

4.1 DWELLING SITING, DESIGN AND LAYOUT

The design and sitting of a building can be of critical importance during bush fire attack event. The appropriate design and siting can reduce the impact of bush fire attack mechanisms of direct flame, radiant heat, ember attack, smoke, and wind. The following principles should be considered when siting and designing a dwelling, and future dwelling improvements in bush fire prone lands. These recommendations are not prescribed in PBP 2019 but facilitate meeting the aims and objectives of PBP 2019.

- Avoid building on ridges, saddles and build on level ground wherever possible.
- Utilise cut-in benches, rather than elevating the building when building on sloping land.
- Avoid raise floors and protect the sub-floor areas by enclosing or screening.
- Provide an appropriate shelter room that is located on the lowest non-bush fire hazard side of the building, near building exits and provides the occupant views of the outside environment.
- Use non-combustible fencing.
- Reduce bulk of building, limit re-entrant corners, and incorporate simplified roof that are able to self-clean of debris.
- No gutters on second or consecutive storeys of building and avoid box gutters.
- If gutters are installed, and if trees within 10m of building, incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Limit glazing elements on the sides of the building exposed to the bush fire threat and use shutters to protect glazing elements.
- Positioning of courtyards, gardens, and grassed areas in location to facilitate the protection of the building.
- Install pebble/rock garden beds avoiding the use of mulch and wood chip.
- Carparking provided in a location that does not interfere with escape routes.
- Establish a path immediately around the external wall of the building. Do not place garden beds adjacent to the external fabric of the building and under windows.
- Any proposed vegetation windbreaks are located on the side of the bush fire hazard, and
- Class 10a buildings (such as shed, carport, and garages) should be a minimum of 6m away from any other building.

Hazardous materials are any materials that can fuel the fire, such as leaf litter, grass, garden mulch and woodpiles. They can also be made up of solid combustibles or flammable liquids and gases such as petrol, kerosene, alcohol, LPG, natural gas, and acetylene. Vehicle, machinery, and other mechanical equipment that utilise fuels for operations can also be considered hazardous. The incorrect design and placement of carport and garages in residential developments could propagate fire towards the residential dwelling. Any liquids or fuels that are considered hazardous should be positioned away from the dominant bush fire threat. If located in a building/structure, it should be a minimum of 6m away from any other building. Vegetation surrounding these locations shall be maintained to IPA standards and the construction

standards shall minimise the impact of ember attack to ignite the structure. Fencing should be of non-combustible materials.

Specifically, the design of this development should follow the principles of appropriate siting and design. These elements are not prescribed in PBP 2019, and will not result in non-compliance, although incorporation will be beneficial to achieve alignment with the aims and objectives of PBP 2019.

4.2 Setbacks and Asset Protection Zones

The performance criteria within PBP 2019 are:

- A defendable space is provided on site (with additional emphasis on other BPMs).
- APZs are managed and maintained to prevent the spread of a fire towards the building, and
- The APZ is provided in perpetuity.

An APZ is an area surrounding a development that is managed to reduce the bush fire hazard to an acceptable level to mitigate the risk to life and property. The required width of the APZ varies with slope and the type of hazard. An APZ should be maintained in perpetuity, not on slopes >18° to ensure ongoing protection from the impact of bush fires. Section 3.2 within PBP 2019 indicates the APZ on adjoining lands is not encouraged, although road and properties managed to be consistent with APZ standards set out in Appendix 4 of PBP2019 and *NSW RFS document Standards for Asset Protection Zones* are appropriate to be included within a APZ. Maintenance of APZ should be undertaken on an annual basis, in advance of the fire season, as a minimum.

BCA P2.3.1 indicates that the class 1 buildings should be protected from other building fires and provides a minimum 900mm separation between the boundary and dwelling. Consideration should be given to increasing the side-set back to increase the distance between the dwelling to 6m neighbouring buildings to limit the potential of house-to-house fires. If this separation is not possible, that upgrade of the building aspect adjacent to the neighbouring building to BAL40 standards and other fire protection measures such as sprinklers and staggering glazing elements should be considered.

The ongoing maintenance of APZs are recognised under 100C of the RF Act and is supported in 2.8(1)(d) of the *Biodiversity Conservation Act* 2016. Any clearing of vegetation within the site to allow the development to occur may require assessment under the *Biodiversity Conservation Act* 2016.

An APZ is provided in accordance with Tables A1.12.2 or A1.12.4 in Appendix 1 of PBP 2019

- Performance-based solution has been performed. Method 2 calculations were used to determine the radiant heat exposure and Bush fire Attack Levels. The inputs to the method 2 calculations are provided in **Table 4**, **Appendix 2** and illustrated on **Figure 2**.

APZs are managed in accordance with the requirements of 'Asset Protection Zone standards' of Appendix 4 of PBP 2019.

- A landscape plan is required to be provided with the development application illustrating compliance.

APZs are wholly within the boundaries of the development site, and APZ are located on lands with a slope less than 18 degrees.

- The APZ on this site is wholly within the site boundaries and is not located on land >18 degrees slope.

APZ Requirements

- *A landscaping plan shall be provided with the development application.*
- *At the commencement of building works and in perpetuity, the entire property shall be managed as an Inner Protection Area (IPA) as outlines within Appendix 4 of Planning for Bush fire Protection 2019, and NSW Rural Fire Service 'Standards for Asset Protection Zones'.*

4.3 CONSTRUCTION STANDARDS

This section indicates the bush fire Attack Level (BAL) construction requirements of the proposal which are to meet the performance criteria in PBP2019. The performance criteria within PBP 2019 are:

- The proposed building can withstand bush fire attack in the form of embers, radiant heat, and flame contact,
- Proposed fences and gates are designed to minimise the spread of bush fire, and
- Proposed Class 10a buildings are designed to minimise the spread of bush fire.

Non-prescriptive bush fire mitigation activities during the construction phase and ongoing operations of the site are also recommended, although if not implemented will not result in non-compliance in consideration of PBP 2019.

4.3.1 Ground works and Sub-structure construction phase

During the ground phase potential ignition sources of the subject development may include hot works, incorrect disposal of cigarette butts and hot exhausts from vehicles, electrical failures, and sparks from metal contact.

Ground works and Sub-structure construction phase a fire management plan should be developed. Preparation of the site should include mitigating fire ignition sources. This should include vegetation management such as slashing and mowing long grasses in and around the development site, car parking and any access tracks. This is especially important during summer months where rates of spread of fire can significantly increase due to the prevailing weather condition.

Handheld fire extinguishers should be provided on site for quick access and suppression of fires. In locations where reticulated water is available, hoses should be considered as a preventative measure. Where reticulated water is not available a temporary 10,000 litre Static Water Supply may be established before the commencement of the development within proximity of the development site. The temporary supply may be removed when the prescribed fire-fighting water supply is installed.

4.3.2 Ongoing Operations

The routine inspection intervals of bush fire safety systems and equipment general occur annually and are supported by a Bush fire plan. Ideally these inspections should occur moving out of the colder months in preparation for the bush fire season. The most common types of inspections that are required are surface, near surface (grasses and debris) and elevated (shrub) fire fuel level accumulation in APZs, canopy separation requirements in APZs, and maintaining building fire hygiene such as cleaning gutters and down pipes.

4.3.3 Building Construction Standards

Australian Standard 3959 ''Construction of buildings in bush fire-prone areas" provides for six (6) levels of building construction these being BAL - Low, BAL - 12.5, BAL - 19, BAL - 29, BAL - 40 and BAL - FZ. The Australian Standard 3959:2018 specifies construction standards for buildings within various Bush fire Attack Levels as determined by PBP 2019. Class 10 structures, such as fencing, and gates shall be non-combustible.

BAL is determined in accordance with Tables A1.12.5 to A1.12.7 of PBP 2019.

- Performance-based solution has been performed. Method 2 calculations were used to determine the radiant heat exposure and Bush fire Attack Levels. The inputs to the method 2 calculations are provided in **Table 4**, **Appendix 2** and illustrated on **Figure 2**.

Construction provided in accordance with the Building Code of Australia and as modified by section 7.5 of PBP 2019.

- Construction material schedules have not been provided to be assessed.

Fencing and gates are constructed in accordance with section 7.6 of PBP 2019.

- Construction material schedules have not been provided to be assessed.

Class 10a buildings are constructed in accordance with section 8.3.2 of PBP 2019.

The proposal has not identified the construction of any class 10 buildings with 6m of the occupied dwelling.

Construction Requirements

- *The radiant heat exposure from the north-west creates the greatest bush fire threat to the development. A BAL 12.5 construction level is required for all elevations*.

4.4 ACCESS

The performance criteria within PBP 2019 are:

- Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation,
- The capacity of access roads is adequate for firefighting vehicles,
- There is appropriate access to water supply, and
- Firefighting vehicles can access the dwelling and exit safely.

In the event of a serious bush fire threat to the proposed development, it will be essential to ensure that access is adequate for ingress of emergency services while occupants' egress from the bush fire attack.

In this case, where the most distant external part of the dwelling is less than 70m unobstructed path from a public road with a speed limit <70km/hr, no bush fire access provisions are required.

Access Requirements

- *The development meets acceptable solutions.*

4.5 WATER SUPPLY

The performance criteria within PBP 2019 are:

- A water supply is provided for firefighting purposes,
- Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation,
- The capacity of access roads is adequate for firefighting vehicles,
- There is appropriate access to water supply (water supply not within road carriageway), and
- Firefighting vehicles can access the dwelling and exit safely.

An adequate supply of water is essential for firefighting purposes, and the location of gas and electricity should be considered when assessing the ability of firefighters to access and use water supplies. The proposal relies on reticulated water supplies.

Reticulated water is to be provided to the development, where available a static water supply is provided where no reticulated water is available.

- Reticulated water provided.

Fire hydrant spacing, design and sizing comply with the Australian Standard AS 2419.1:2017.

- This report has not tested or determined if the fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2017.

Hydrants are not located within any road carriageway.

- Reticulated water supply is provided. A water hydrant is located approximately 25m from the proposed development on Lawford Crescent. Access to this water supply is readily accessible and easily located to assist in fire suppression operations.

Reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter road.

- The proposed development is in a subdivision that does not have a perimeter road.
- This report has not confirmed the system for reticulated water.

Fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2017

- This report has not tested or determined if the fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2017.

All above-ground water service pipes external to the building are metal, including and up to any taps

- Site layout plans or construction schedules do not identify construction materials of above ground water supplies.

Water Requirements

- *The development meets acceptable solutions.*

4.6 ELECTRICITY SERVICES

The performance criteria within PBP 2019 are:

- Location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.

Electricity services have been found to contribute to bush fire ignition and spread, as well as impeding access during bush fire events.

The existing electrical supply to the local area is via overhead electrical transmission. Periodic inspection should be undertaken to ensure the lines into the private property are not fouled by the growth of trees. Landscaping and vegetation should be maintained to comply with Energy Australia 'Vegetation Safety Clearances' (NS179, April 2002).

Electricity Requirements

- *Were possible electricity should be placed underground.*

4.7 GAS SERVICES

The performance criteria within PBP 2019 are:

- A water supply is provided for firefighting purposes,
- Firefighting vehicles are provided with safe, all-weather access to structures and hazard vegetation,
- The capacity of access roads is adequate for firefighting vehicles,
- There is appropriate access to water supply, and
- Firefighting vehicles can access the dwelling and exit safely.

Gas services have been found to contribute to fire spread and building loss when not positioned correctly or non-combustible elements are used.

Any reticulated or bottled gas shall be installed and maintained in accordance with the below requirements as outlined in Table 7.4a of PBP:

- Reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used.
- All fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side.
- Connections to and from gas cylinders are metal.
- Polymer-sheathed flexible gas supply lines are not used; and
- Above-ground gas service pipes are metal, including and up to any outlets.

Gas Requirements

- *If gas services are provided to the development, prior to issuing occupation certificate the consent authority shall ensure the location and design of gas services meets the requirements of Table 7.4a of PBP2019.*

4.8 LANDSCAPING AND VEGETATION MANAGEMENT

The performance criteria within PBP 2019 are:

- Landscaping is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind-driven embers to cause ignitions.

Compliance with the NSW RFS 'Asset protection zone standards' (see Appendix 4 of PBP 2019).

- Landscaping plan not provided.

A clear area of low-cut lawn or pavement is maintained adjacent to the house.

- Landscaping plan not provided.

Fencing is constructed in accordance with Section 7.6.

- Site layout plans identify non-combustible fencing construction material.
- Fence is within 6m of a building or in areas of BAL-29 or greater, they should be made of non-combustible material only.

Trees and shrubs are planted such that the branches will not overhang the roof, the tree canopy is not continuous, any proposed windbreak is located on the elevation from which fires are likely to approach.

- Landscaping plan not provided.

Landscaping Requirements

- *A landscaping plan is required to be submitted with the DA to the consenting authority. It is further recommended that the consent authority ensure the landscaping plan is implemented in consideration of APZ and landscaping requirements outlined in PBP 2019 prior to issuing occupancy certificate.*

4.9 Emergency Management and Bush fire Survival Plans

State bush fire authorities have established kits to help residential and small property owners to develop appropriate plans to plan and prepare for bush fire events. In NSW Bush fire survival Plans can be accessed from https://www.rfs.nsw.gov.au/plan-and-prepare/bush-fire-survival-plan.

It is recommended that the property owner and occupants familiarise themselves with relevant bush fire planning, protection, preparation and survival information and consider implementation of the 'NSW RFS Best Practise Guidelines – Dwelling upgrades' for the upgrade of existing buildings to ensure compliance with the intent of the PBP 2018 and AS3959 Construction of buildings in Bush fire Prone Areas.

5 CONCLUSION AND RECOMMENDATIONS

It is clear from this investigation and assessment that the site is located within Bush fire Prone Land. An assessment in accordance with Appendix 1 of PBP2019 has been undertaken implementing detailed assessment pathway described in Appendix B of AS3959:2018. This BFAR found the classifiable vegetation of Floodplain Transitional Woodland as described by NSW Comprehensive Fuel Loads upslope to the north west of the site creates the greatest bush fire threat.

In accordance with the provisions of PBP 2019, the recommendations outlined within this assessment will reduce the risk of damage and/or harm in the event of a bush fire event to acceptable levels. Compliance with the below recommendations can be achieved or practically implemented without substantial change to the proposed layout or construction methodology. It is recommendations that development consent be granted subject to the following conditions:

Asset Protection Zones and Landscaping

- A landscaping plan shall be provided with the development application.
- Prior to issuing occupation certificate the consent authority shall ensure the entire property is managed as an Inner Protection Area (IPA) as outlines within Appendix 4 of Planning for Bush fire Protection 2019, and NSW Rural Fire Service 'Standards for Asset Protection Zones'.
- If overhead power supply is provided, the const authority shall determine vegetation management is in accordance with Energy Australia 'Vegetation Safety Clearances' (NS179, April 2002).

Construction Standards

- The radiant heat exposure from the north-west creates the greatest bush fire threat to the development. A BAL 12.5 construction level is required for all elevations.

Access and Water

- The proposed development meets these performance criteria through the acceptable solutions.

Electricity services

- Were possible electricity should be placed underground.

Gas services

- If gas services are provided to the development, prior to issuing occupation certificate the consent authority shall ensure the location and design of gas services meets the requirements of Table 7.4a of PBP2019.

Emergency Management

- There are no performance criteria requirements for this type of development within PBP 2019.

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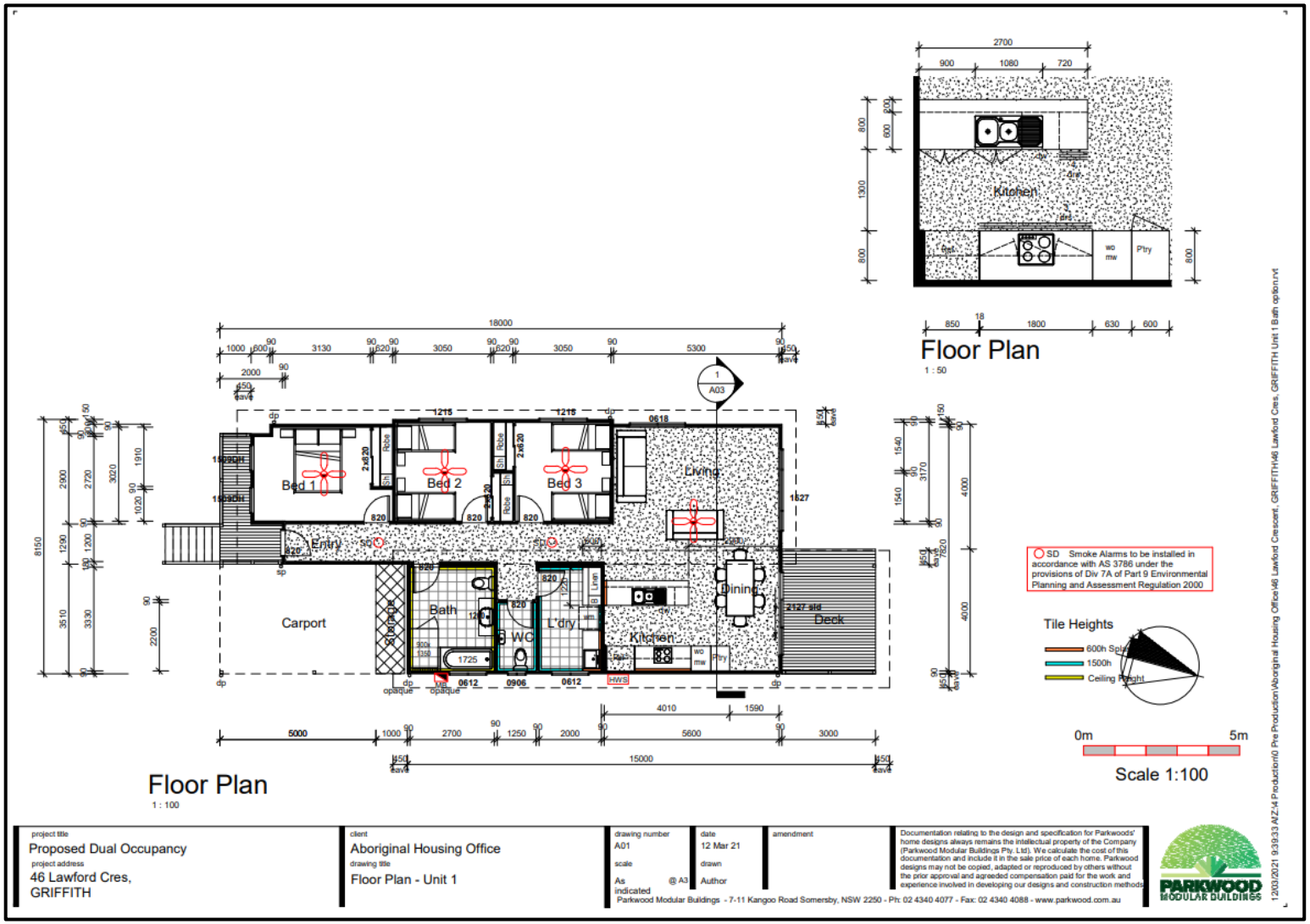
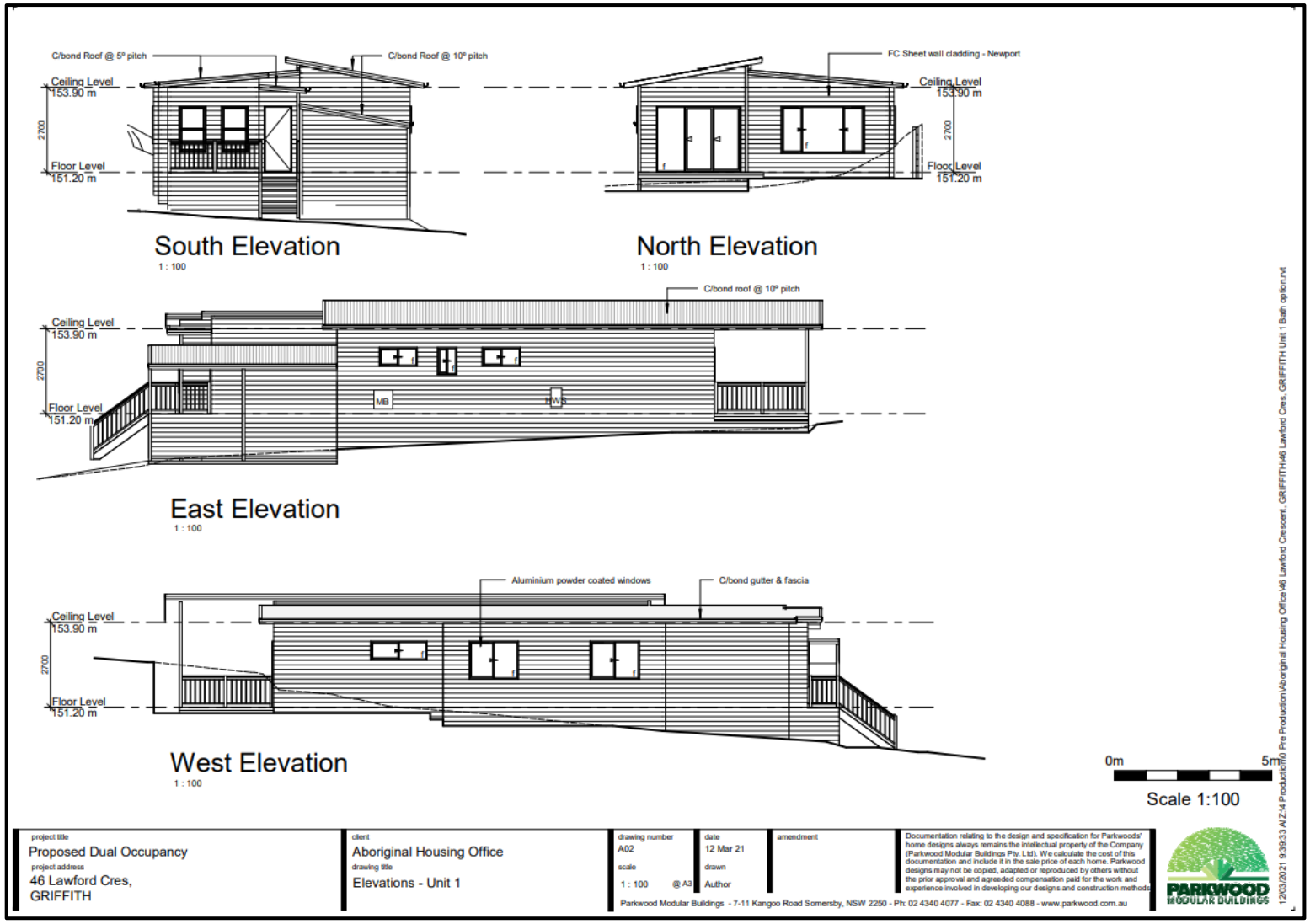
APPENDIX 1 SITE LAYOUT PLANS




C/bond Roof @ 5° pitch
C/bond Roof @ 10° pitch
Ceiling Level
153.90 m
Floor Level
151.20 m
2700
South Elevation
1 : 100
FC Sheet wall cladding - Newport
North Elevation
1 : 100
C/bond roof @ 10° pitch
MB
HWS
East Elevation
1 : 100
Aluminium powder coated windows
C/bond gutter & fascia
West Elevation
1 : 100
0m
5m
Scale 1:100
project title
Proposed Dual Occupancy
project address
46 Lawford Cres,
GRIFFITH
client
Aboriginal Housing Office
drawing title
Elevations - Unit 1
drawing number
A02
date
12 Mar 21
scale
1 : 100 @ A3
drawn
Author
amendment
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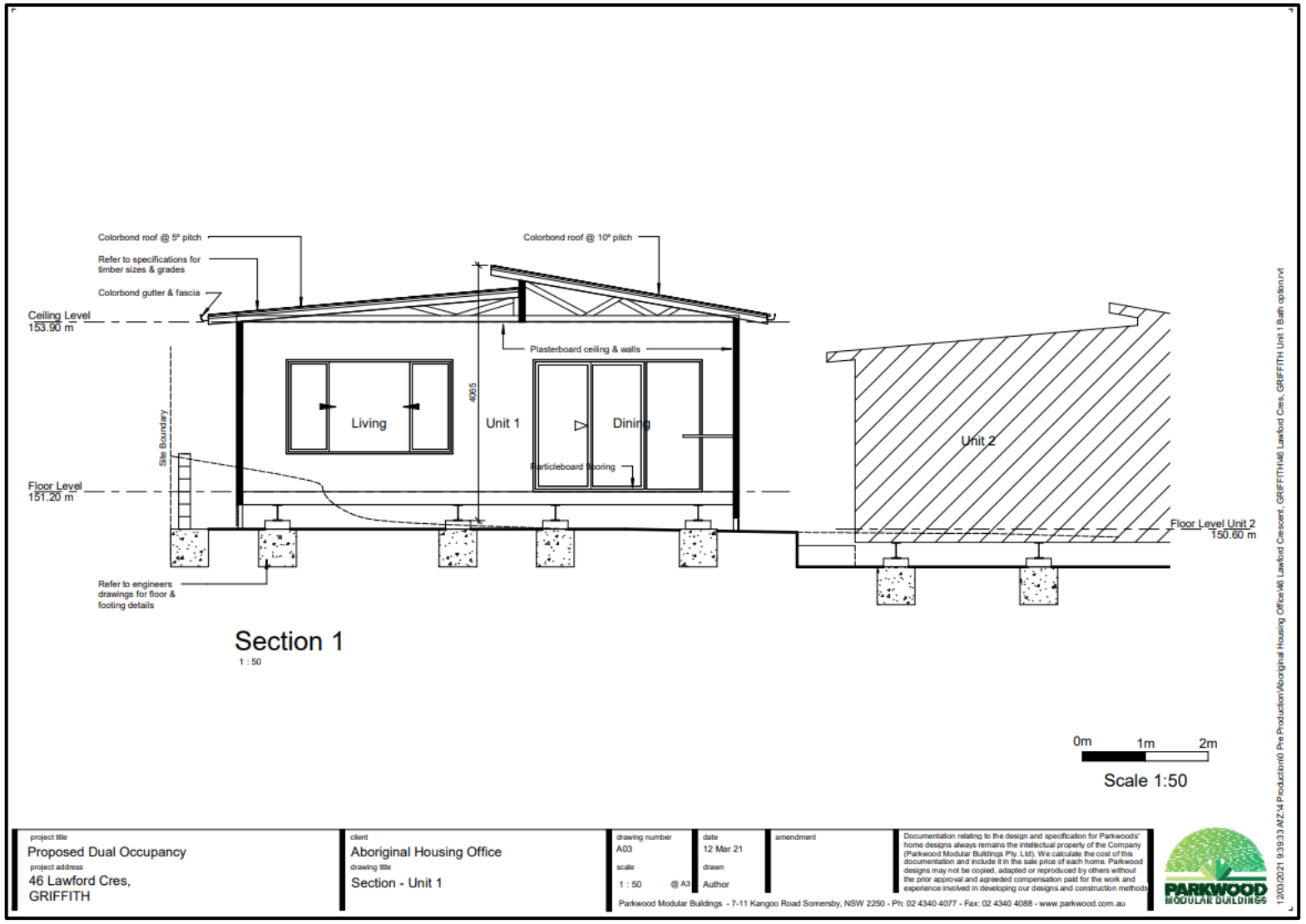
PARKWOOD MODULAR BUILDINGS
12/03/2021 9:39:33 AM Z:\4 Production\0 Pre Production\Aboriginal Housing Office\46 Lawford Crescent, GRIFFITH\46 Lawford Cres, GRIFFITH Unit 1 Bath option.rvt


Colorbond roof @ 5° pitch
Refer to specifications for timber sizes & grades
Colorbond gutter & fascia
Colorbond roof @ 10° pitch
Ceiling Level 153.90 m
Plasterboard ceiling & walls
Site Boundary
Living
Unit 1
Dining
4065
Unit 2
Particleboard flooring
Floor Level 151.20 m
Floor Level Unit 2 150.60 m
Refer to engineers drawings for floor & footing details
Section 1
1 : 50
0m 1m 2m
Scale 1:50
project title
Proposed Dual Occupancy
project address
46 Lawford Cres, GRIFFITH
client
Aboriginal Housing Office
drawing title
Section - Unit 1
drawing number
A03
scale
1 : 50 @ A3
date
12 Mar 21
drawn
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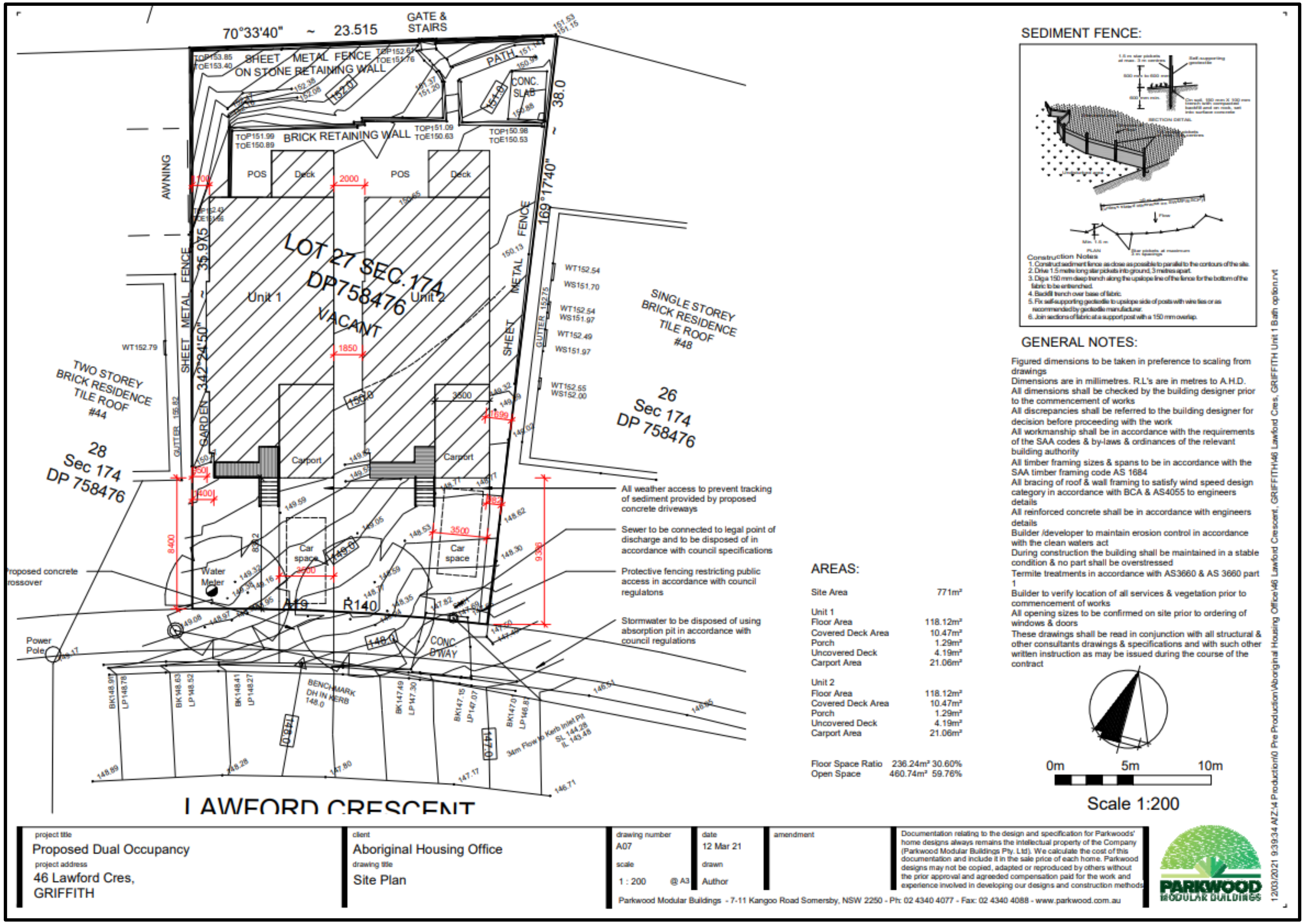
12/03/2021 9:39:33 AM Z:\4 Production\0 Pre Production\Aboriginal Housing Office\46 Lawford Crescent, GRIFFITH\46 Lawford Cres, GRIFFITH Unit 1 Bath option.rvt


70°33'40" ~ 23.515
GATE & STAIRS
SHEET METAL FENCE ON STONE RETAINING WALL
PATH
CONC. SLAB
38.0
BRICK RETAINING WALL
AWNING
POS
Deck
POS
Deck
169°17'40"
LOT 27 SEC.174 DP758476 VACANT
Unit 1
Unit 2
SHEET METAL FENCE
GARDEN
35.975
342°24'50"
TWO STOREY BRICK RESIDENCE TILE ROOF #44
28 Sec 174 DP 758476
SINGLE STOREY BRICK RESIDENCE TILE ROOF #48
26 Sec 174 DP 758476
Carport
Carport
Car space
Car space
Water Meter
Proposed concrete crossover
Power Pole
CONC D'WAY
BENCHMARK DH IN KERB 148.0
LAWFORD CRESCENT
All weather access to prevent tracking of sediment provided by proposed concrete driveways
Sewer to be connected to legal point of discharge and to be disposed of in accordance with council specifications
Protective fencing restricting public access in accordance with council regulatons
Stormwater to be disposed of using absorption pit in accordance with council regulations
SEDIMENT FENCE:
Construction Notes
GENERAL NOTES:
Figured dimensions to be taken in preference to scaling from drawings
Dimensions are in millimetres. R.L's are in metres to A.H.D.
All dimensions shall be checked by the building designer prior to the commencement of works
All discrepancies shall be referred to the building designer for decision before proceeding with the work
All workmanship shall be in accordance with the requirements of the SAA codes & by-laws & ordinances of the relevant building authority
All timber framing sizes & spans to be in accordance with the SAA timber framing code AS 1684
All bracing of roof & wall framing to satisfy wind speed design category in accordance with BCA & AS4055 to engineers details
All reinforced concrete shall be in accordance with engineers details
Builder /developer to maintain erosion control in accordance with the clean waters act
During construction the building shall be maintained in a stable condition & no part shall be overstressed
Termite treatments in accordance with AS3660 & AS 3660 part 1
Builder to verify location of all services & vegetation prior to commencement of works
All opening sizes to be confirmed on site prior to ordering of windows & doors
These drawings shall be read in conjunction with all structural & other consultants drawings & specifications and with such other written instruction as may be issued during the course of the contract
AREAS:
Site Area 771m²
Unit 1
Floor Area 118.12m²
Covered Deck Area 10.47m²
Porch 1.29m²
Uncovered Deck 4.19m²
Carport Area 21.06m²
Unit 2
Floor Area 118.12m²
Covered Deck Area 10.47m²
Porch 1.29m²
Uncovered Deck 4.19m²
Carport Area 21.06m²
Floor Space Ratio 236.24m² 30.60%
Open Space 460.74m² 59.76%
0m 5m 10m
Scale 1:200
project title
Proposed Dual Occupancy
project address
46 Lawford Cres, GRIFFITH
client
Aboriginal Housing Office
drawing title
Site Plan
drawing number A07
date 12 Mar 21
amendment
scale 1 : 200 @ A3
drawn Author
Parkwood Modular Buildings - 7-11 Kangoo Road Somersby, NSW 2250 - Ph: 02 4340 4077 - Fax: 02 4340 4088 - www.parkwood.com.au
PARKWOOD MODULAR BUILDINGS

APPENDIX 2 METHOD 2 OUTPUTS

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 3/05/2021 **Assessment Date:** 30/05/2021

Site Street Address: 46 Lawford Crescent, Griffith

Assessor: ;

Local Government Area: Griffith **Alpine Area:** No

Equations Used

Transmissivity: Fuss and Hammins, 2002
Flame Length: RFS PBP, 2001/Vesta/Catchpole
Rate of Fire Spread: Noble et al., 1980
Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005
Peak Elevation of Receiver: Tan et al., 2005
Peak Flame Angle: Tan et al., 2005

Run Description: Transect 1

Vegetation Information

Vegetation Type:	Western Slopes Grassy Woodland		
Vegetation Group:	Woodlands		
Vegetation Slope:	10 Degrees	Vegetation Slope Type:	Upslope
Surface Fuel Load(t/ha):	10.5	Overall Fuel Load(t/ha):	18.3
Vegetation Height(m):	0.9	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope	8 Degrees	Site Slope Type:	Upslope
Elevation of Receiver(m)	2.4	APZ/Separation(m):	30

Fire Inputs

Veg./Flame Width(m):	100	Flame Temp(K):	1090

Calculation Parameters

Flame Emissivity:	95	Relative Humidity(%):	44
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	316
Moisture Factor:	5	FDI:	80

Program Outputs

Level of Construction	BAL 12.5	Peak Elevation of Receiver(m):	7.49
Radiant Heat(kW/m2):	4.72	Flame Angle (degrees):	74
Flame Length(m):	6.78	Maximum View Factor:	0.081
Rate Of Spread (km/h):	0.71	Inner Protection Area(m):	30
Transmissivity:	0.763	Outer Protection Area(m):	0
Fire Intensity(kW/m):	6671		

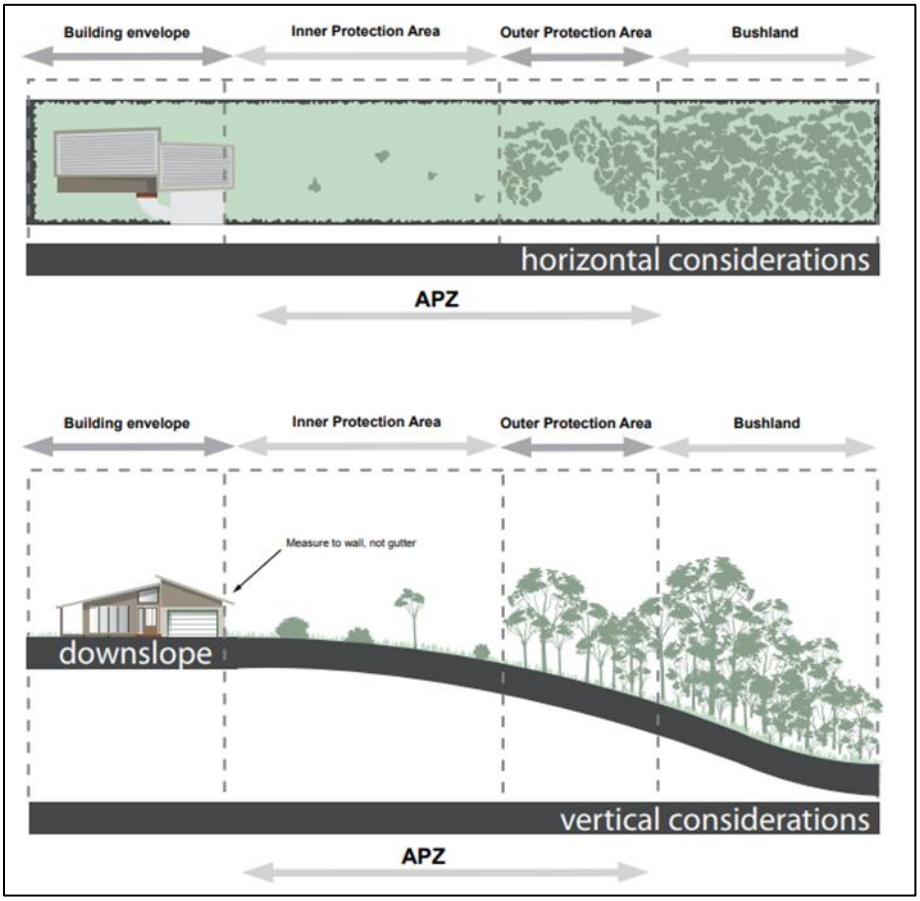
BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	6	8	12	17	28	2.4

APPENDIX 3 SIGNIFICANT BUSH FIRE PROTECTION MEASURES

Asset Protection Zone

An APZ can consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA) as indicated below.



Components of an APZ (Figure A4.1 - PBP 2019)

An APZ can include the following:

- footpaths.
- lawns.
- discontinuous gardens.
- swimming pools.
- driveways.
- unattached non-combustible garages with suitable separation from the dwelling.
- open space / parkland, and
- car parking.

Isolated areas of shrub and timbered vegetation are generally not a bush fire hazard as they are not large enough to produce fire of an intensity that will threaten dwellings. These areas include narrow

strips of vegetation along road corridors.

Any areas that are designated Asset Protection Zones, should be signposted to ensure community is aware that the area is to be maintained for Bush fire protection purposes, as indicated below.

Inner Protection Area (IPA)

The IPA extends from the edge of the OPA to the development. The IPA is the area closest to the asset and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and be a defendable space. The intent of an IPA is to stop the transmission of flame and reduce the transmission of radiant heat by the elimination of available fire fuel. This area also allows airborne embers to fall safely without igniting further outbreaks and provides a safer firefighting position and is operationally important for implementation of clear fire control lines.

In practical terms the IPA is typically the curtilage around the dwelling, consisting of a mown lawn and well-maintained gardens. When establishing and maintaining an IPA the following requirements apply:

- Vegetation within the IPA should be kept to a minimum level. Litter fuels (leaves and vegetation debris) within the IPA should be continually removed and kept below 1cm in height and be discontinuous. There is minimal fine fuel at ground level which could be set alight by a bush fire.
- Canopy cover should be less than 15% (at maturity). Trees (at maturity) should not touch or overhang the building and should be separated by 2 to 5m.
- Lower limbs of canopy trees should be removed up to a height of 2m above ground.
- Preference should be given to smooth barked and evergreen trees.
- Large discontinuities or gaps in the shrub vegetation shall be established to slow down or break the progress of fire towards buildings.
- Shrubs should not be located under trees and not form more than 10% ground cover
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.
- Grasses should be kept mown (as a guide grass should be kept to no more than 100mm in height), and
- Woodpiles, wooden sheds, combustible material storage areas, large areas / quantities of garden mulch, stacked flammable building materials etc. are not be permitted in the IPA.

Outer Protection Area (OPA)

An OPA is located between the IPA and the unmanaged vegetation. Vegetation within the OPA can be managed to a more moderate level. The reduction of fuel in this area substantially decreases the intensity of an approaching fire and restricts the pathways to crown fuels, reducing the level of direct flame, radiant heat, and ember attack on the IPA.

Because of the nature of an OPA, they are only applicable in forest vegetation. In practical terms the OPA is an area where there is maintenance of the understory and some separation in the canopy. When establishing and maintaining an OPA the following requirements apply:

- Tree canopy cover should be less than 30%, canopies should be separated by 2 to 5m
- Shrubs should not form a continuous canopy and form no more than 20% of ground cover
- Grasses should be kept to no more than 100mm in height with leaf and other debris should be mown, slashed or mulched.

Landscaping and Vegetation Management

In choosing plants for landscaping consideration should be given to plants that possess properties, which help to protect buildings. If the plants themselves can be prevented from ignition, they can improve the survivability of buildings by:

- Filtering out wind-driven burning debris and embers.
- Acting as a barrier against radiation and flame, and
- Reducing wind forces.

Consequently, landscaping of the site should consider the following:

- Meet the specifications of an Inner Protection Area (IPA) detailed in PBP 2019.
- Priority given to retaining or planting species which have a low flammability and high moisture content.
- Priority given to retaining or planting species which do not drop much litter in the bush fire season, and which do not drop litter that persists as ground fuel in the bush fire season, and
- Create discontinuous or gaps in the vegetation to slow down or break the progress of fire towards the dwellings.

Consideration should be given to vegetation fuel loads present on site with particular attention to APZs. Careful thought must be given to the type and physical location of any proposed site landscaping. Inappropriately selected and positioned vegetation has the potential to ‘replace’ any previously removed fuel load.

Bearing in mind the desired aesthetic and environment sought by site landscaping, some basic principles help minimise the chance of such works contributing to the potential hazard on site.

Whilst it is recognised that fire-retardant plant species are not always the most aesthetically pleasing choice for site landscaping, the need for adequate protection of life and property requires that a suitable balance between visual and safety concerns be considered.

It is essential that any vegetation and landscaped areas and surrounds are subject to ongoing fuel management and reduction to ensure that fine fuels do not build up.

Retrofitting buildings and construction standards

Homes built prior to August 2002 were not required to be built to meet bush fire construction standards. Constructions in Bush fire prone lands after August 2002 required bush fire construction standards, which have also changed over time.

The current construction standards are based on your Bush fire Attack Level (BAL). Evidence from large wildfire events over the last 20 years illustrate that house ignition in concentrated within 100m from the vegetation, although can occur kilometres from the burning vegetation under worst case scenarios. Development are outside the bush fire prone area (100m from the vegetation) will benefit from increasing construction standards to withstand ember-attack to protect the building during a bush fire event.

When undertaking alterations and additions to a dwelling in Bush fire prone land only the new construction is required to conform with the current requirements, although this only partially protects your home.

Significantly, not only the construction standard of your home is important, the provision of Asset Protection Zones and the maintenance of the potential fire fuel loads surrounding the building is critical to the protection of the home. Outbuildings, such as garages can act to propagate fire towards the home.

Research has illustrated that ember-attack from the wildfire is the principal mechanism that ignites home. The most vulnerable elements are timber decks, Eave fascia boards, gutters timber window frames and timber stairs. Furthermore, house-to-house fires occur following the ignition of a neighbouring property. Appropriate amount of effort should be placed to ensure that vegetation and landscaping should be maintained to reduce the likelihood of ember attack igniting fire fuels near the house, and separation between neighbouring houses is achieved to reduce house-to-house fires. The use of non-combustible fencing and appropriately positioned windows can go a long way to reducing the risk of house-to-house fires.

Water Supply

Intent of water measures is to provide adequate services of water for the protection of buildings during and after the passage of a bush fire. Commonly water pressure within the main system will drop due to excessive draw when undertaking fire-fighting operations along the residential interface.

Having access to an alternate water supply is advisable. Static water supply for fire-fighting purposes should be above-ground, accessible, clearly marked and manufactured from concrete or metal. If raised the tank stand should be made from non-combustible material. These static water supplies (tanks) should be positions on the non-hazard side of the building and have 65mm Storz outlet with a ball valve fitted to the outlet within the IPA. If not appropriate, they should be appropriately shielded to protect the tank and fire fighters accessing the water. Category 1 fire appliance should be able to access within 4 m of static water supply with a hardened ground surface to support this access.

All exposed water pipes, values, taps and fittings should be metal and the supply line from tank to ball valve have the same bore size.

Where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump and are shielded against bush fire attack. Any hose and reel for firefighting connected to the pump shall be 19mm (internal diameter), and fire hose reels are constructed in accordance with AS/NZS 1221:1997 Fire hose reels and installed in accordance with AS 2441:2005 Installation of fire hose

reels.

Emergency Management

No matter how big or small the development is within a bush fire prone area, a bush fire plan is critical to preparing the property in the event of a bush fire. To ensure appropriate measures are taken, the worst-case scenario bush fire behaviour should be used to determine the course of action.

There is extreme noise, smoke, heat, and wind during the passing of a bush fire front under worst-case conditions. Vision, hearing, breathing, and communication are significantly affected during this period.

State bush fire authorities have established kits to help residential and small property owners to develop appropriate plans to plan and prepare for bush fire events. In NSW Bush fire survival Plans can be accessed from https://www.rfs.nsw.gov.au/plan-and-prepare/bush-fire-survival-plan.

The principle elements of the Bush fire survival Plans are:

- Know your risk.
- Know and understand the bush fire alert levels.
- Access to 'Fires Near Me' app.
- Knowledge of Local radio, local ABC/emergency broadcaster frequency, and TV.
- Prepare yourself, your home and your family.
- Leave early or prepare to stay.
    - If leaving, when to leave, where will you go, how will I get there, what will I take, who will you call, what is your back-up plan.
    - If you stay, do you have all the equipment you need, what are the signal to start defending the dwelling, what to do before, during and after the passing of the fire front, do all members of the household know what to do, check your equipment, develop action checklist, what is your back-up plan.
- Discuss all elements with your family and neighbours.

Furthermore, knowledge of escape routes (generally the public road system around your dwelling), refuges and location of any nearby Neighborhood Safer Places is critical knowledge prior to a bush fire event.