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BUSHFIRE ASSESSMENT REPORT

Subdivision – Stage 10 of Warnervale Town Centre
Lot 1/DP 1275060 Hakone Road, Woongarrah, NSW



**BRONZE
MEMBER**
Fire Protection
Association Australia



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Title	Bush Fire Assessment Report - Subdivision			
Description	Subdivision development – Stage 10 of Warnervale Town Centre Lot 1/DP 1275060 Hakone Road, Woongarrah, NSW			
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TABLE OF CONTENTS

1	Executive Summary and Recommendations	5
2	Introduction	9
2.1	Description of proposed development	9
2.2	Objectives of Assessment	10
2.3	Specific Objectives of Residential and rural residential Subdivisions	10
2.4	Method 2 Fire Behaviour Calculations	11
3	Bush Fire Strategic Study	12
4	Bushfire Hazard Assessment	13
4.1	Fire Danger Index	13
4.2	Assessment Methodology	13
4.3	Vegetation Assessment	13
4.3.1	Vegetation classification, exclusions, and downgrades	14
4.3.2	Predominant Vegetation Classification	14
4.4	Separation Assessment	15
4.5	Slope Assessment	15
4.6	Effective and Site Slope Assessment	15
4.7	Short Fire Run	16
4.8	Flame Length	17
4.9	Shielding	17
4.10	Other Method 2 inputs	17
5	Additional S. 45 Requirements	20
5.1	CL (2) (e) and (f) S.45 RF REGS - Threatened Species, Populations and communities	20
5.2	CL (2) (g) Additional bush fire assessment	20
6	Bushfire Assessment and Performance Measures	21
7	Conclusion and Recommendations	29
8	References	31
9	APPENDIX 1 Subdivision Plans	33
10	APPENDIX 2 Plates (Photographs) and Transects	34
11	APPENDIX 3 NSW Sharing and Enabling Environmental Data	36
12	APPENDIX 4 AHIMS Search	38
13	APPENDIX 5 NSW Bushfire Planning Protection Measures	39
14	APPENDIX 6 Method 2 outputs	53

TABLES

Table 1 Description of Proposed development	9
Table 2 Bush fire strategic study.....	12
Table 3 Bushfire Hazard Assessment (Method 2 AS3959:2018)	19
Table 4 Planning for bush fire protection compliance (PBP 2019) - Chapter 5 – Rural and Residential subdivisions developments on bushfire prone lands	21

FIGURES

Figure 1 Property Location of Lot 1/DP 1275060 Hakone Road, Woongarrah, NSW (Six maps, 2022) .	7
Figure 2 Bush fire Assessment	8
Figure 3 Vegetation in and around the site (Extract from the SEED Portal).....	14
Figure 4 LiDAR 1m DEMS slope analysis	16

PLATES

Plate 1 Access along Hakone Road	34
Plate 2 Downgraded Woodland vegetation to the north.....	34
Plate 3 Effective slope of Transect 1.....	35
Plate 4 Vegetation on site to be cleared.	35

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
BFSA	Bush Fire Safety Authority
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	<i>NSW Environmental Planning and Assessment Act 1979</i>
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
NCC	National Construction Code
OPA	Outer Protection Area
PBP	Planning for Bush fire Protection
RF Act	<i>Rural Fires Act 1997</i>
RF Regs	<i>Rural Fires Regulations 2013</i>
RHG	Restricted Head Growth
SEED	Sharing and Enabling Environmental Data in NSW
SFR	Short Fire Run

1 EXECUTIVE SUMMARY AND RECOMMENDATIONS

BEMC Pty Ltd was engaged by Landcorp NSW Pty Ltd, to complete a Bush Fire Assessment Report (BFAR) on proposed 55lot subdivision (stage 10 of Warnervale centre precinct) located at Lot 1/DP 1275060 Hakone Road, Woongarra, NSW, NSW (**Figure 1, page 7**).

BEMC has used Method 2 assessment pathway from AS3959:2018 to undertake this assessment and to prepare the Bush Fire Assessment Report (BFAR).

Based upon the assessment, perusal of the site plan prepared by Beveridge Williams (**Appendix 1, page 32**), and a site visit, it is recommended that development consent be granted subject to the following conditions to comply with PBP 2019:

Recommendation 1 - Asset Protection Zones and Construction

A 25m s.88b Conveyancing Act easement is recommended within 5211/DP1200804 for the benefit of residential development (Lots 1023 to 1030) along the western boundary of stage 10 subdivision.

Alternatively, if a s88b Conveyancing Act easement can't be achieved, restricting the sale of the western lots 1024 to 1029 until the construction certificate is issued for the development on 5211/DP1200804 will result in a BAL 12.5 construction standard applied to the subject lots.

Upgrading Hakone Road will provide ample separation to achieve BAL 29 building envelope for the residential lots along the northern boundary of stage 10 subdivision.

The following restrictions and BAL construction levels apply until construction certificate is issued for the development on Lot 56/DP663082 to the east.

- Lots 1055 and 1001 will be undevelopable – restricted sale until CC on Lot 56/DP663082.
- BAL 29 construction standard for Lots 1054 and 1002.
- BAL 19 construction standard for Lots 1003 and 1053.

Once the construction certificate is issued (and the vegetation that creates a bushfire risk within neighbouring Lot 56/DP663082 to the east will be removed), Lots 1053, 1054, 1055 and, 1001, 1002, and 1003 can be built to BAL 12.5 standard

Recommendation 2 - Landscaping

A landscaping plan is required to illustrate:

- Roadside landscaping features are constructed to not prohibit access by emergency services vehicles.
- Fencing is within 6m of a building or in areas of BAL-29 or greater shall illustrate constructed of non-combustible materials.
- APZ standards as illustrated within Appendix 4 of PBP 2019.
- If the s88b easement is applied the landscaping plan shall reflect the management of the APZ to Inner Protection Area (IPA) standards.

Recommendation 3 - Access

Traffic management devices and roadside landscaping features are constructed to not prohibit access by emergency services vehicles.

All road constructed to 23T capacity.

Hakone Road associated with the subdivision be upgraded to perimeter road standards.

All non-perimeter roads to comply with non-perimeter road requirements of PBP.

Recommendation 4 - Water Supply

Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2021.

Fire hydrant to be located no greater than 70m from any lot.

Recommendation 5 - Electricity services

Electricity to be provided underground.

Furthermore, the applicant wishes the Commissioner, when determining the application, to consider whether it would be appropriate for the future erection of the dwelling houses, dual occupancies or secondary dwellings concerned to be excluded from the application of section 4.14 of the *Environmental Planning and Assessment Act 1979*.

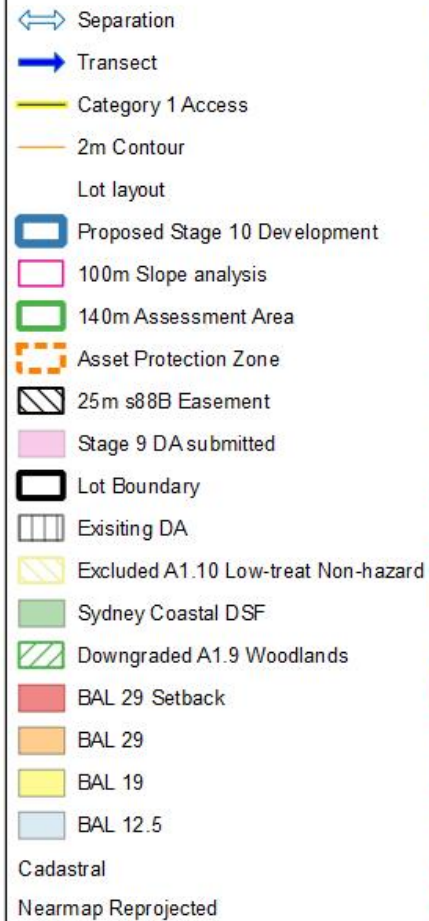
Consent conditions referred to in this report can be applied for subsequent '*build-outs*'. Furthermore, BAL29 easements shall be identified on the title of individual lots to ensure '*build-outs*' conform with bushfire requirements.





Figure 1 Property Location of Lot 1/DP 1275060 Hakone Road, Woongarrah, NSW (Six maps, 2022)

Figure 2 Bush fire Assessment



2 INTRODUCTION

BEMC Pty Ltd was engaged by Landcorp NSW Pty Ltd to complete a Bush Fire Assessment Report (BFAR) to accompany a Development Application for a proposed subdivision at Lot 1/DP 1275060 Hakone Road, Woongarra, NSW, hereafter referred to as the 'site' (**Figure 1, page 7**).

The identification of bush fire prone lands (BPL Map) in NSW is required under s 10.3 of the *EP&A Act*. S. 4.14 of the *EP&A Act* requires development to compliance with Planning for Bushfire Protection, 2019 (PBP 2019) if any part of a development site is affected by bush fire hazard as indicated within the BPL Map. Section 100B of the *Rural Fires Act (1997) (RF Act)* identifies specific developments as integrated and requiring a Bush Fire Safety Authority (BFSa) from NSW RFS.

This development falls within the Bush Fire Vegetation category 1 within the Central Coast Council bush fire prone land map and is considered an integrated development in consideration of s 100B of the *Rural Fires Act 1997 (RF Act)*. The applicant is required to submit a bush fire assessment in accordance with s 45 of the *Rural Fires Regulation 2013 (RF Regs)*. This document forms bushfire assessment to support an application for a Bush Fire Safety Authority.

The proposed development is not listed under s 46 of the *Rural Fire Regulation 2013 (RF Regs)* excluded from requirements for BFSa. The proposed development is listed under s100B RF Act which requires the adherence to the requirements of s 45 of the RF Regs and the requirement to obtain a Bush Fire Safety Authority (BFSa).

The proposed development is a land subdivision that falls within the bush fire vegetation category 1 vegetation within the Central Coast Council Bush fire Prone Land Map. The development is considered an integrated development in consideration of s 100B of the *Rural Fires Act 1997*. The applicant is required to submit a bush fire assessment in accordance with s 45 of the *Rural Fires Regulation 2013*. This document forms the bush fire assessment to support an application for a Bush Fire Safety Authority.

It is clear from the investigation and assessment of the property that the site is located within Bush fire Prone Land.

This report considers and assesses the bush fire construction and planning requirements to determine compliance with the performance criteria in NSW Rural Fire Service PBP 2019. This report applies the required methodology and assessment indicated within Appendix 1 and A2.1 of PBP 2019, and cl. 45 of the RF Regs to inform the issuance of a Bush Fire Safety Authority (BFSa).

Site Particulars are illustrated within **Table 2 below** and **Figure 1, page 7**, and subdivision plans in **Appendix 1, page 32**.

2.1 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed development includes a 55-lot subdivision forming stage 10 of the Warnervale Town centre precinct development.

Table 1 Description of Proposed development

Boundaries	Hakone Road north, sporadic forested vegetation north, west and east.
Topography	Downslope in all directions.
Type of development	Stage 10 of Warnervale town centre.
Urban Release Area	Yes
Proposed dwellings	Class 1a Residential
Vegetation proposed to be cleared	Yes
Current land-use	B4 Mixed Use zoning to R1 General Residential.
Fire weather	Central Coast Council – FFDI – 100

2.2 OBJECTIVES OF ASSESSMENT

To assess the proposed development in consideration of s4.14 of the EP&A Act 1979, PBP 2019 and AS 3959:2018 to enable council to make a determination.

This report assesses whether the development meets the six objectives listed in section 1.1 of PBP 2019, which provide for the protection of human life and minimize impacts on property as follows:

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

2.3 SPECIFIC OBJECTIVES OF RESIDENTIAL AND RURAL RESIDENTIAL SUBDIVISIONS

The aims and objectives listed in section 1.1 of PBP 2019 remain applicable to residential and rural residential 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 and rural residential development are outlined in section 5.2 of PBP 2019 are:

- Minimise perimeters of the subdivision exposed to the bush fire hazard (hourglass shapes, which maximise perimeters and create bottlenecks should be avoided).
- Minimise vegetated corridors that permit the passage of bush fire towards buildings.
- Provide for the siting of future dwellings away from ridge-tops and steep slopes, within saddles and narrow ridge crests.
- Ensure that APZs between a bush fire hazard and future dwellings are effectively designed to address the relevant bush fire attack mechanisms; ensure the ongoing maintenance of APZs.
- Provide adequate access from all properties to the wider road network for residents and emergency services.
- Provide access to hazard vegetation to facilitate bush fire mitigation works and fire suppression; and
- Ensure the provision of an adequate supply of water and other services to facilitate effective firefighting.

2.4 METHOD 2 FIRE BEHAVIOUR CALCULATIONS

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

Furthermore, Method 2 can consider the impact of the Kataburn rate of spread, radiant heat shielding, and short fire runs which may have an impact 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 Method 2 detailed assessment. 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 of the outputs of the calculations.

3 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 2 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 impact 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 services 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 XXX portion of the lot. The bush fire hazard is located to the XX 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 are patches and highly disturbed <i>Sydney Coastal DSF</i> down slopes to the west, north and east. The potential fire behaviour and fire runs from the west will generate the greatest threat to the development. 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 meeting the broad aims and objectives and the specific objectives of subdivision 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.

4 BUSHFIRE HAZARD ASSESSMENT

This section details the site assessment methodology in Appendix 1 of PBP2019 and includes the requirements of s44 of the RF Regs. It provides detailed analysis of the vegetation, slope, vegetation exclusions and downgrades to quantify the required Bush fire Protection Measures (BPMs).

4.1 FIRE DANGER INDEX

This assessment utilises Central Coast Council area with a FFDI 100.

4.2 ASSESSMENT METHODOLOGY

Vegetation classification over the site has been carried out as follows:

- Nearmap, sixmap aerial Photograph Interpretation.
- Kogan 6*25 Laser distance finder.
- Photo theodolite application supported by contour and LiDAR DEMs terrain profiles.
- SEED Portal - Sharing and Enabling NSW Environmental Data portal.
- Reference to regional vegetation community mapping, and
- Site assessment in September 2022.

4.3 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 CSIRO Ecosystems Science and Bush fire Dynamics and Applications. The results of this research are commonly referred to as the '*NSW Comprehensive Fuel Loads*'.

SEED Portal - Sharing and Enabling NSW Environmental Data portal and regional vegetation community mapping has been analysed to determine the vegetation in and around the development, which is illustrated in **Figure 3, page 14**.

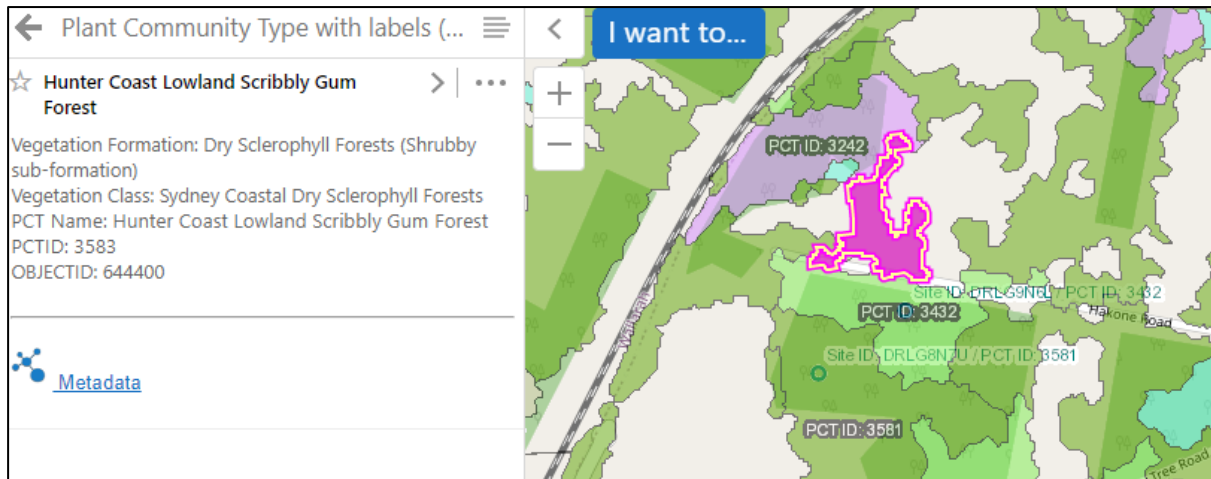


Figure 3 Vegetation in and around the site (Extract from the SEED Portal)

4.3.1 Vegetation classification, exclusions, and downgrades

An existing development consent (shopping centre) has been provided over Lot 5211/DP1200804 to the west of the proposed subdivision assessed within this report. Construction certificate has not been issued for this development and an s.88b Conveyancing Act APZ or stage release of the lots within the subdivision is being considered. Until the construction certificate is issued the vegetation has been assessed as PCT3582 Hunter Coast Lowland Apple-Bloodwood Forest.

Lot 56/DP663082 has a construction certificate for a residential subdivision, although the vegetation within the northern portion of Lot 56/DP663082 (Lot 402 within the subdivision plans for Lot 56/DP663082) directly to the east of the proposed subdivision assessed within this report is zoned B4 Mixed Use Zone. This area has threatened species that currently constrains development. Until the construction certificate is issued the vegetation has been assessed. Due to the high disturbance, lack of canopy vegetation this vegetation has been downgraded through A1.9 of PBP to woodlands and restricted head growth analysis has been performed to provide a realistic level of threat analysis.

Development Application of Stage 9 of the subdivision to the south-east of stage 10 (this assessment) is currently in process and can be removed as a bush fire threat.

The vegetation to the south-west is a proposed council reserve/parklands (Hill Top council Regional Park), is partially forested and is assumed that some level of vegetation will be retained, although will be disturbed by walking tracks and managed understorey. The bushfire threat will be significant but low and can be excluded under A1.10 of PBP.

The vegetation to the north, northern side of Hakone Road, is partially managed farmlands and has been downgraded to woodlands through A1.9 of PBP.

4.3.2 Predominant Vegetation Classification

Vegetation in and around the site is classified *Hunter Coast Lowland Scribbly Gum Forest* which is *Sydney Coastal Dry Sclerophyll Forests* and downgraded vegetation to *Woodlands* in accordance with the 'NSW Comprehensive Fuel Loads'.

4.4 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 the proposed dwellings are provided in **Table 3, page 19**.

4.5 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 3, page 19**.

4.6 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). Slope data has been calculated from a 1m LiDAR Digital Elevation Model (DEM). The source data sets have been captured to standards that are generally consistent with the Australian ICSM LiDAR Acquisition Specifications which require a fundamental vertical accuracy of at least 0.30m (95% confidence) and horizontal accuracy of at least 0.80m (95% confidence). The slope arrows indicated in **Figure 4, page 16** represent the slope calculated across the length of the arrow utilising LiDAR data within ERSI software. These values help determine the vegetation that poses a bush fire threat and significantly influences fire behaviour. Figure 4, page 16 illustrates the analysis of the LiDAR DEMs terrain profiles to determine the slope of the potential fire runs towards the site.

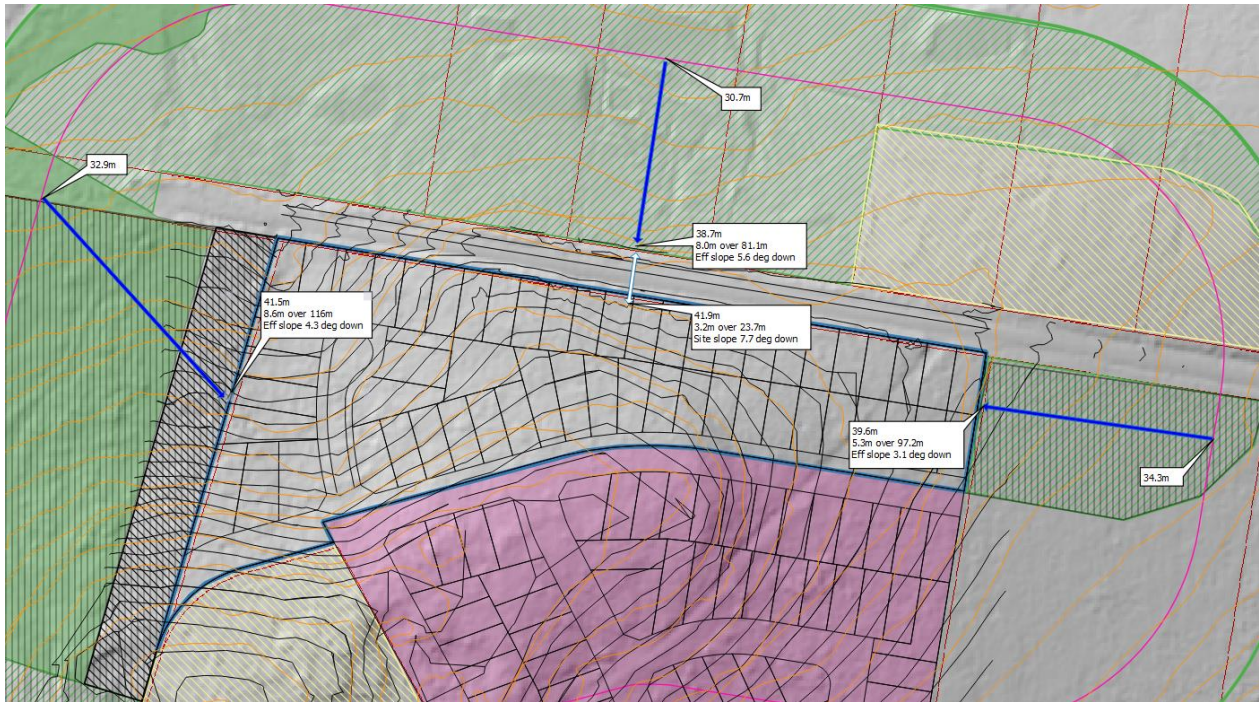


Figure 4 LiDAR 1m DEMS slope analysis

4.7 SHORT FIRE RUN

NSW RFS Rural Fire Service (2019a). Short Fire Run - Methodology for Assessing Bush Fire Risk for Low-Risk Vegetation demonstrates the size and shape of a bush fire hazard will influence the behaviour of bush fire and the associated risk to the built environment. Small or narrow parcels of vegetation have less opportunity to support fully developed bush fires because of their limited size. These areas are referred to in this document as a Short Fire Run (SFR) or Restricted Head Growth (RHG).

The SFR and RHG fire calculates the head width and flame length to determine the radiant heat likely to impact a building. The proposed model relies on several assumptions to calculate the modified fire shape and flame height, these are:

- Wind direction and speed is constant in the direction of fire spread.
- Slope is considered relatively flat and uniform throughout the length of the fire run.
- Fuel load is distributed equally and is continuous for the entire fire run length.
- The shape of the fire is based on a uniform slope.
- The fire develops from a single ignition point and does not consider time of ignition or fire growth.
- Flaming is restricted to surface, near surface and elevated fuels.
- The fire does not become a crown fire (scorching and intermittent involvement of the canopy fuels permitted, no sustained crown fire). A nominal fire run of 150 metres has been assumed as is measured on the effective slope.
- Fire run is measured perpendicular to contours, and
- No allowance for ember showers has been considered.

The classifiable vegetation to the east is restricted by road infrastructure to 55m and a Restricted Head Growth (RHG) analysis has been performed on this patch of vegetation.

4.8 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. Grumstrup *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.

4.9 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.

4.10 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 is 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 illustrates that fuel moisture content has a significant impact on the HoC and argues that lowering the current default heat of combustion of 18600 kJ/kg in forest fire behaviour models could be considered. In this case default heat of combustion of 18600 kJ/kg is applied.

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 ($\epsilon \approx 1$). 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. In this case nominal flame emissivity of 0.95 is applied.

Moisture Factor

Fuel moisture factor is only used in the 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 and hence is not applicable to this study.

Ambient Temperature and Relative Humidity

The default value for ambient air temperature during worst-case scenario fire weather conditions defaults to 35°, or when 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 from directions other than the north, north-west, and west, the ambient temperature and relative humidity can significantly change, especially in coastal environments.

Outcomes of the Bushfire Attack Level assessment implementing (Method 2 AS3959:2018) are outlined in **Table 3, page 19**.

Table 3 Bushfire Hazard Assessment (Method 2 AS3959:2018)

Elements	Method (unit)	Transect 1	Transect 2	Transect 3
Vegetation	NSW Comprehensive Fuel Loads	Sydney Coastal DSF	Woodland	Woodland
Separation	Spatial analysis	27m	23m	15m
Site slope	Site visit – Theodolite (°)	Level	8 deg down	4 deg down
Effective slope	Site visit – Theodolite (°)	5 deg down	6 deg down	4 deg down
Shielding width	Site Plans / Site Visit (m)	N/A	N/A	N/A
Shielding height	Site Plans / Site Visit (m)	N/A	N/A	N/A
Elevation of receiver	Site Plans (m)	6m	6m	6m
Flame temperature	1090 / 1200 Kelvin	1090	1090	1090
Upslope fire	Kataburn correction	No	No	No
Fire Danger Index	Council Area	100	100	100
Heat of Combustion	Default at 18600 kJ/kg	18600	18600	18600
Flame Emissivity	Default at 0.95	0.95	0.95	0.95
Moisture Factor	Default at 5	5	5	5
Ambient temperature	BoM (Default at 308 Kelvin)	308	308	308
Relative Humidity	BoM (Default at 25%)	25	25	25
RHG Fire Model	Vesta / McArthur	Vesta	Vesta	Vesta
RHG width	Bush Fire Safety Study	N/A	N/A	55m
OUTPUTS (Appendix 6, page 52)				
BAL 29 APZ set-back		<27m	<15m	<15m
Separation to Achieve BAL 29		27 - < 38m	15 - < 22m	15 - < 21m
Separation to Achieve BAL 19		38 - < 52m	22 - < 31m	21 - < 28m
Separation to Achieve BAL 12.5		52 - < 100m	31 - < 100m	28 - < 100m
Separation for BAL29 building @		BAL 29	BAL 19	BAL 29

5 ADDITIONAL S. 45 REQUIREMENTS

S. 45 of the RF Reg indicates the assessment requirements for s 100B RF Act developments to obtain a bush Fire Safety Authority. This section illustrates the remaining elements identified within S. 45 of the RF Reg that are not covered within bush fire hazard assessment process (section 3 and 4 of this report) or within the performance criteria of PBP 2019 (section 6 of this report).

5.1 CL (2) (E) AND (F) S.45 RF REGS - THREATENED SPECIES, POPULATIONS AND COMMUNITIES

A search on the NSW Government Central Resource for Sharing and Enabling Environmental Data for significant environmental values was completed.

The search identified no Critical Endangered Ecological Communities (CEEC) or species listed under the *Biodiversity Conservation Act 2016* near or within the site.

The results of the Sharing and Enabling Environmental Data is provided in **Appendix 3, page 35.**

There will be no additional impacts on natural heritage values.

A search of the Aboriginal Historic Information Management System (AHIMS) was completed on the 17th December 2022 which indicated no known aboriginal artefacts of site within the development area.

The output of the search is provided in **Appendix 4, page 37.**

There will be no additional impacts on cultural heritage values.

5.2 CL (2) (G) ADDITIONAL BUSH FIRE ASSESSMENT

The capacity of nearby public roads to handle increased volumes of traffic when a bush fire emergency occurs.

The Warnervale precinct has been developed through a stage process with an overarching analysis of traffic requirements for all stages and associated residential development.

Whether or not nearby public roads that link with the fire trail network have two-way access.

Nearby roads do not link with any fire trails.

The adequacy of sprinkler systems and other fire protection measures to be incorporated into the development.

Sprinkler systems are not proposed. A s88b Conveyancing Act easement maybe proposed to mitigation radiant heat towards the proposed residential development along the western boundary of the subdivision.

Registered fire trails on the property.

There are no fire trails on the property.

6 BUSHFIRE ASSESSMENT AND PERFORMANCE MEASURES

This section assesses Bushfire Performance Measures (BPMs) for the proposed development at Lot 1/DP 1275060 Hakone Road, Woongarra, NSW in consideration of the acceptable solutions required for each performance criteria within PBP 2019. Outcomes are outlined in Table 4, below. Where acceptable solutions are not met details of the performance-based solution are provided.

Table 4 Planning for bush fire protection compliance (PBP 2019) - Chapter 5 – Rural and Residential subdivisions developments on bushfire prone lands

PERFORMANCE CRITERIA		ACCEPTABLE SOLUTION	COMPLIANCE for Lot 1/DP 1275060 Hakone Road, Woongarra, NSW
APZs	Potential building footprints must not be exposed to radiant heat levels exceeding 29 kW/m ² on each proposed lot.	<ul style="list-style-type: none"> APZs are provided in accordance with Tables A1.12.2 and A1.12.3 based on the FFDI. 	<p>COMPLIES - PERFORMANCE SOLUTION</p> <p>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 3 page 19; Appendix 6, page 52 and illustrated on Figure 2, page 8.</p> <p>All lots are exposed to BAL 12.5 construction standard or higher.</p> <p>Transect 1 (west) a 27m separation will achieve a BAL 29 building envelope. BAL 29 construction is achievable in Lots 1029 and 1024, and BAL 19 in 1023, 1025, 1026, 1027 1028, and 1030.</p> <p><i>NOTE: Once the construction certificate is issued (and the vegetation that creates a bushfire risk within neighbouring Lot 5211/DP1200804 to the west will be removed), Lots 1023 to 1030 can be built to BAL 12.5 standard.</i></p> <p>Transect 2 (north) a 15m separation from the northern side of Hakone Road will achieve a BAL 29 building envelope. BAL 19 construction is achieved in Lots 1034 to 1052.</p>

		<p>Transect 3 (east) a 15m separation will achieve a BAL 29 building envelope. The following restrictions and BAL construction levels apply until construction certificate is issued for the development to the east.</p> <ul style="list-style-type: none"> • Lots 1055 and 1001 will be undevelopable. • BAL 29 construction standard for Lots 1054 and 1002. • BAL 19 construction standard for Lots 1003 and 1053. <p><i>NOTE: Once the construction certificate is issued (and the vegetation that creates a bushfire risk within neighbouring Lot 56/DP663082 to the east will be removed), Lots 1053, 1054, 1055 and, 1001, 1002, and 1003 can be built to BAL 12.5 standard.</i></p>
	APZs are managed and maintained to prevent the spread of a fire towards the building.	<ul style="list-style-type: none"> • APZs are managed in accordance with the requirements of Appendix 4. <p>REFER TO LANDSCAPING</p>
	The APZs is provided in perpetuity	<p>COMPLIES - ACCEPTABLE SOLUTION</p> <p>The APZ is not wholly within the site boundaries, although complies with section 3.2 of PBP 2019 and is not located on land >18 degrees slope.</p> <p>A 25m s.88b Conveyancing Act easement is recommended within 5211/DP1200804 for the benefit of residential development (Lots 1022 to 1030) along the western boundary of stage 10 subdivision.</p>
	APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised.	<ul style="list-style-type: none"> • APZs are located on lands with a slope less than 18 degrees. <p>COMPLIES - ACCEPTABLE SOLUTION</p> <p>The APZ is not located on land >18 degrees slope.</p>
ELECTRICITY	Location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.	<ul style="list-style-type: none"> • Where practicable, electrical transmission lines are underground; and • Where overhead, electrical transmission lines are proposed as follows: <p>COMPLIES - ACCEPTABLE SOLUTION</p> <p>Where possible electricity should be placed underground.</p>

		<ul style="list-style-type: none"> ○ 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. 	
GAS	Location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	<ul style="list-style-type: none"> • 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. 	COMPLIES - ACCEPTABLE SOLUTION The proposed layout provides ample opportunity for future residential development to comply with gas acceptable solutions.
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	<ul style="list-style-type: none"> • Landscaping is in accordance with Appendix 4; and • Fencing is constructed in accordance with section 7.6. 	COMPLIES - PERFORMANCE SOLUTION A landscaping plan is required to illustrate: <ul style="list-style-type: none"> ▪ Roadside landscaping features are constructed to not prohibit access by emergency services vehicles. ▪ Fencing is within 6m of a building or in areas of BAL-29 or greater shall illustrate constructed of non-combustible materials. ▪ APZ standards as illustrated within Appendix 4 of PBP 2019. ▪ If the s88b easement is applied the landscaping plan shall reflect the management of the APZ to Inner Protection Area (IPA) standards.

ACCESS (GENERAL REQUIREMENTS)	<p>Firefighting vehicles are provided with safe, all-weather access to structures.</p>	<ul style="list-style-type: none"> • Property access roads are two-wheel drive, all-weather roads. • Perimeter roads are provided for residential subdivisions of three or more allotments. • Subdivisions of three or more allotments have more than one access in and out of the development. • Traffic management devices are constructed to not prohibit access by emergency services vehicles. • Maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient. • All roads are through roads. • Dead end roads are not recommended, but if unavoidable, are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end; • Where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road. • Where access/egress can only be achieved through forest, woodland and heath vegetation, secondary access shall be provided to an alternate point on the existing public road system; and • One way only public access roads are no less than 3.5 metres wide and have designated parking bays with hydrants located outside of these areas to ensure accessibility to reticulated water for fire suppression. 	<p>MADE CONDITION OF CONSENT</p> <p>Traffic management devices and roadside landscaping features are constructed to not prohibit access by emergency services vehicles.</p>
	<p>The capacity of access roads is adequate for firefighting vehicles</p>	<ul style="list-style-type: none"> • 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. 	<p>MADE CONDITION OF CONSENT</p> <p>Capacity of roads surface to be 23T</p>

	<p>There is appropriate access to water supply</p>	<ul style="list-style-type: none"> • hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression. • Hydrants are provided in accordance with the relevant clauses of AS 2419.1:2005 - Fire hydrant installations System design, installation and commissioning; 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. 	<p>MADE CONDITION OF CONSENT</p> <p>Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2021.</p> <p>Fire hydrant to be located no greater than 70m from the furthest elevation of future building envelopes</p>
PERIMETER ROADS	<p>Access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management on the interface.</p>	<ul style="list-style-type: none"> • Are two-way sealed roads. • Minimum 8m carriageway width kerb to kerb. • Parking is provided outside of the carriageway width. • Hydrants are located clear of parking areas. • Are through roads, and these are linked to the internal road system at an interval of no greater than 500m. • Curves of roads have a minimum inner radius of 6m. • The maximum grade road is 15 degrees and average grade of not more than 10 degrees. • The road crossfall does not exceed 3 degrees; and • A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided. 	<p>MADE CONDITION OF CONSENT</p> <p>Hakone Roads associated with the subdivision be upgraded to perimeter road standards.</p>

NON-PERIMETER ROADS	<p>Access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating.</p>	<ul style="list-style-type: none"> • Minimum 5.5m carriageway width kerb to kerb. • Parking is provided outside of the carriageway width. • Hydrants are located clear of parking areas. • Roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m. • Curves of roads have a minimum inner radius of 6m. • The road crossfall does not exceed 3 degrees; and • A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided. 	<p>MADE CONDITION OF CONSENT</p> <p>Non-perimeter roads to comply with this requirement.</p>
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PROPERTY ACCESS	<p>Firefighting vehicles can access the dwelling and exit the property safely.</p>	<ul style="list-style-type: none"> • There are no specific access requirements in an urban area where an unobstructed path (no greater than 70m) is provided between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles. <p>In circumstances where this cannot occur, the following requirements apply:</p> <ul style="list-style-type: none"> • Minimum 4m carriageway width. • In forest, woodland and heath situations, rural property access 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. • Provide a suitable turning area in accordance with Appendix 3. • 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. • The crossfall is not more than 10 degrees. • Maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads; and • A development comprising more than three dwellings has access by dedication of a road and not by right of way. 	<p>COMPLIES - ACCEPTABLE SOLUTION</p> <p>The proposed subdivision provides an opportunity for the most distant external part of the dwelling to be less than 70m unobstructed path from a public road with a speed limit <70km/hr, offering future s4.14 developments the opportunity to meet access acceptable solutions.</p>
WAT	<p>Adequate water supplies is provided for firefighting purposes.</p>	<ul style="list-style-type: none"> • Reticulated water is to be provided to the development where available. 	<p>COMPLIES - ACCEPTABLE SOLUTION</p> <p>Reticulated water supplied for firefighting purposes.</p>

	<ul style="list-style-type: none"> • A static water and hydrant supply is provided for non-reticulated developments or where reticulated water supply cannot be guaranteed; and static water supplies shall comply with Table 5.3d. 	
Water supplies are located at regular intervals, and The water supply is accessible and reliable for firefighting operations.	<ul style="list-style-type: none"> • Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2005. • Hydrants are not located within any road carriageway; and • Reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads. 	<p>MADE CONDITION OF CONSENT</p> <p>Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2021.</p> <p>Fire hydrant to be located no greater than 90-m from the furthest elevation of future building envelopes.</p>
Flows and pressure are appropriate	<ul style="list-style-type: none"> • Fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2005. 	<p>N/A</p> <p>This report has not tested or determined if the fire hydrant flow and pressures to comply with Table 2.2 of AS 2419.1:2017.</p>
The integrity of the water supply is maintained	<ul style="list-style-type: none"> • All above-ground water service pipes are metal, including and up to any taps; and • Above-ground water storage tanks shall be of concrete or metal. 	<p>MADE CONDITION OF CONSENT</p> <p>Site layout plans or construction schedules do not identify construction materials of above ground water supplies.</p>

7 CONCLUSION AND RECOMMENDATIONS

It is clear from this investigation and assessment that the site is located within Bushfire 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 *Sydney Coastal DSF* and downgraded *Woodlands* as described by NSW Comprehensive Fuel Loads downslope to the north, east and west creates a bushfire 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 bushfire event to acceptable levels. The following recommendations are provided to inform the planning of the development to obtain development consent.

Asset Protection Zones, Landscaping and Construction

All lots are exposed to BAL 12.5 construction standard or higher.

A 25m s.88b Conveyancing Act easement is recommended within 5211/DP1200804 for the benefit of residential development (Lots 1023 to 1030) along the western boundary of stage 10 subdivision.

Alternatively, if a s88b Conveyancing Act easement can't be achieved, restricting the sale of the western lots 1024 to 1029 until the construction certificate is issued for the development on 5211/DP1200804 will result in a BAL 12.5 construction standard applied to the subject lots.

Upgrading Hakone Road will provide ample separation to achieve BAL 29 building envelope for the residential lots along the northern boundary of stage 10 subdivision.

The following restrictions and BAL construction levels apply until construction certificate is issued for the development on Lot 56/DP663082 to the east.

- Lots 1055 and 1001 will be undevelopable – restricted sale until CC on Lot 56/DP663082.
- BAL 29 construction standard for Lots 1054 and 1002.
- BAL 19 construction standard for Lots 1003 and 1053.

Once the construction certificate is issued (and the vegetation that creates a bushfire risk within neighbouring Lot 56/DP663082 to the east will be removed), Lots 1053, 1054, 1055 and, 1001, 1002, and 1003 can be built to BAL 12.5 standard

A landscaping plan is required to illustrate:

- Roadside landscaping features are constructed to not prohibit access by emergency services vehicles.
- Fencing is within 6m of a building or in areas of BAL-29 or greater shall illustrate constructed of non-combustible materials.
- APZ standards as illustrated within Appendix 4 of PBP 2019.
- If the s88b easement is applied the landscaping plan shall reflect the management of the APZ to Inner Protection Area (IPA) standards.

Access

Traffic management devices and roadside landscaping features are constructed to not prohibit access by emergency services vehicles.

All road constructed to 23T capacity.

Hakone Road associated with the subdivision be upgraded to perimeter road standards.

All non-perimeter roads to comply with non-perimeter road requirements of PBP.

Water Supply

Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2021.

Fire hydrant to be located no greater than 70m from the furthest elevation of future building envelopes.

Electricity services

Electricity to be provided underground.

Gas services

The proposed layout provides ample opportunity for future residential development to comply with gas acceptable solutions.

Emergency Management

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

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

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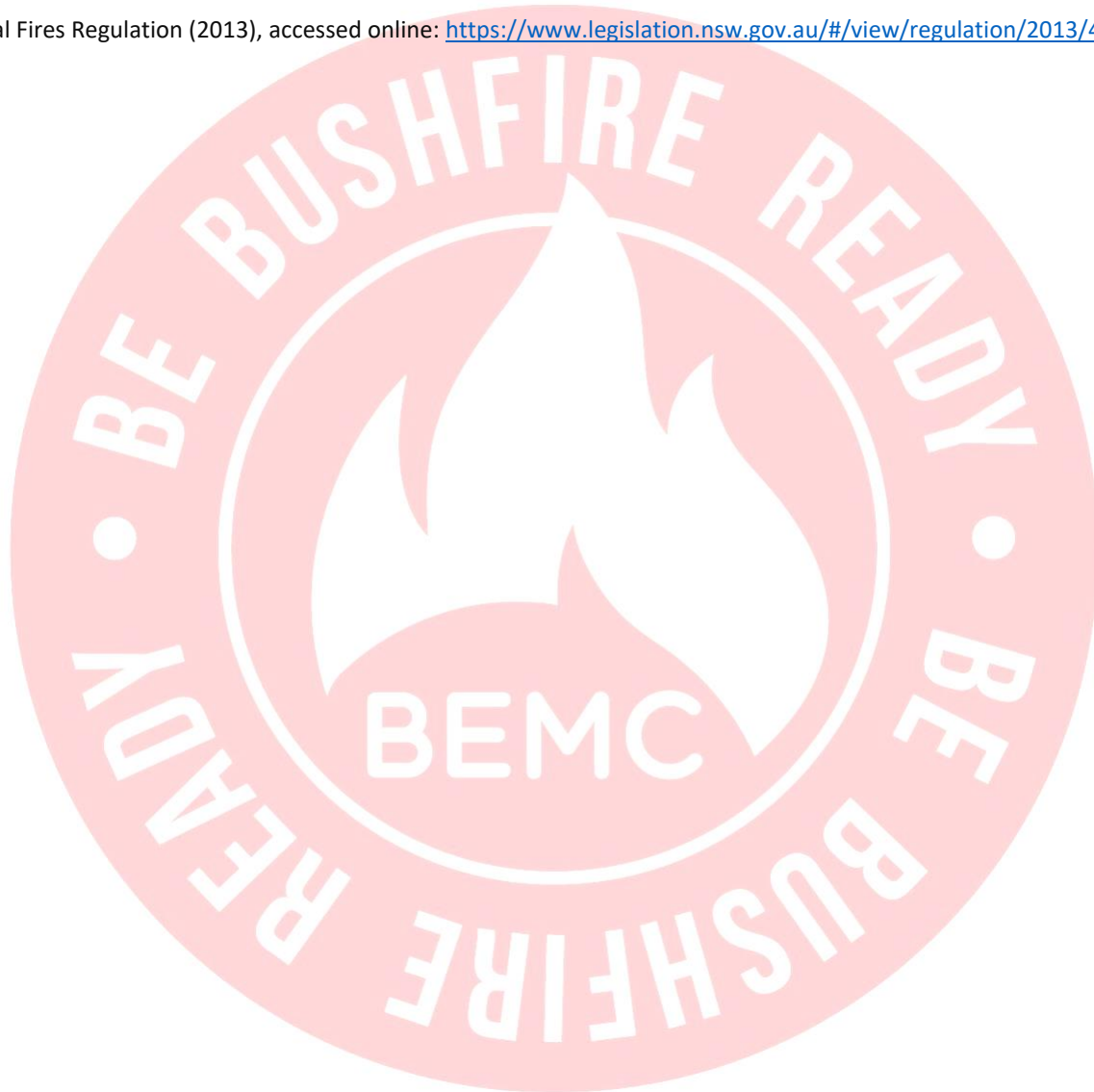
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10 APPENDIX 2 PLATES (PHOTOGRAPHS) AND TRANSECTS

Plates 1 – 4 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 are identified in **Table 3, page 19** and displayed in **Figure 2, page 8**.



Plate 1 Access along Hakone Road



Plate 2 Downgraded Woodland vegetation to the north

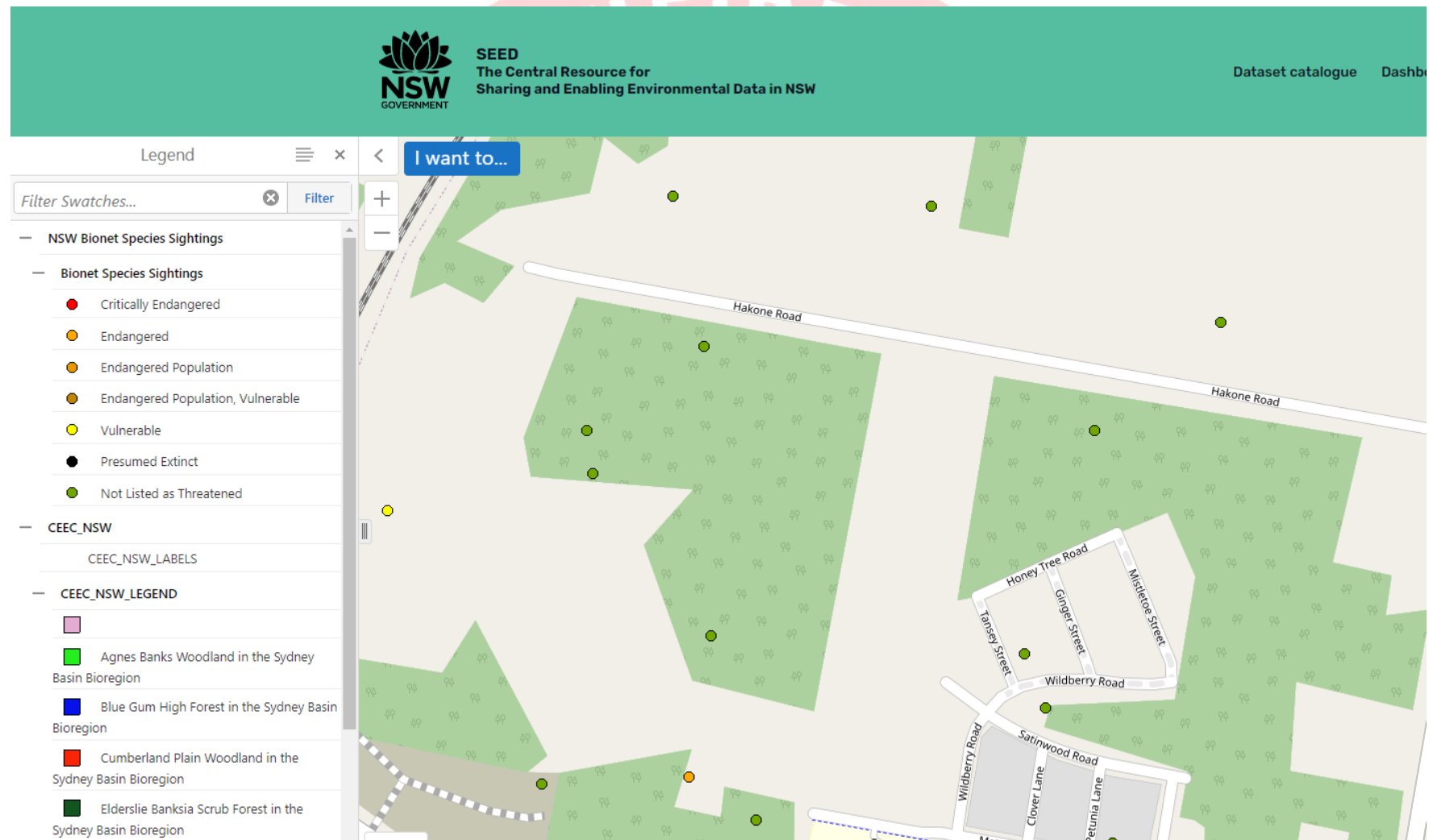


Plate 3 Effective slope of Transect 1



Plate 4 Vegetation on site to be cleared.

11 APPENDIX 3 NSW SHARING AND ENABLING ENVIRONMENTAL DATA





Biodiversity Values Map and Threshold Tool

Home

Biodiversity Values Map and Threshold Tool

The Biodiversity Offsets Scheme (BOS) Threshold is used to determine when it is necessary to engage an accredited assessor to apply the Biodiversity Assessment Method (the BAM) to assess the impacts of a proposal.

It is used for local developments (development applications submitted to councils) and native vegetation clearing not requiring development consent in urban areas and areas zoned for environmental conservation (under the State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017).

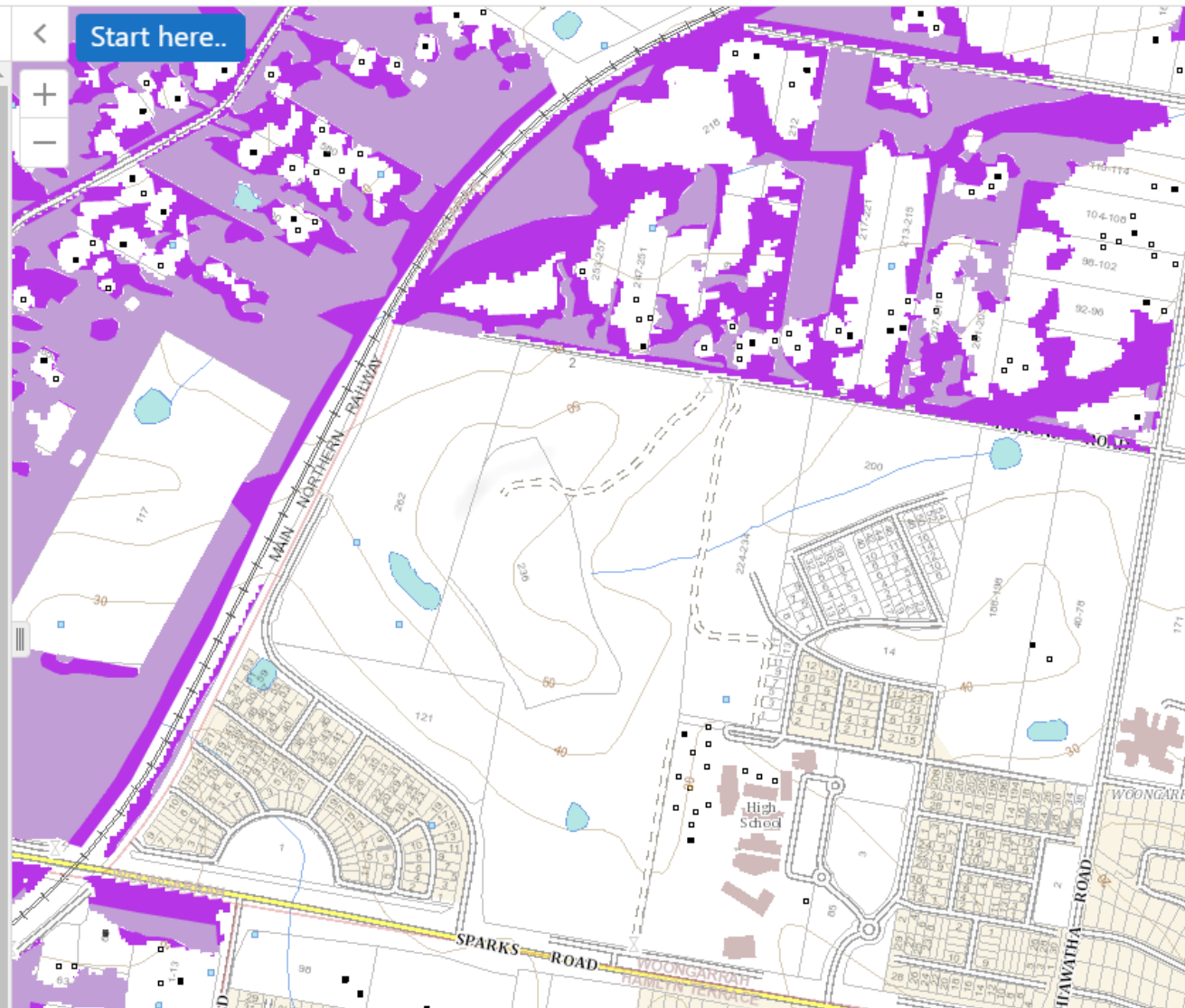
The Biodiversity Conservation Regulation 2017 sets out threshold levels for when the BOS applies. The threshold has two elements:

- whether the amount of native vegetation being cleared exceeds a threshold area, or
- whether the impacts occur on an area mapped on the Biodiversity Values Map.

If clearing or other impacts exceeds either trigger, the BOS applies to the proposed development.

If the BOS is not triggered, the Threatened Species Test of Significance must be used to determine if a local development is likely to significantly affect threatened species.

Proponents need to supply evidence relating to the BOS Threshold triggers and the test of significance when submitting their application to the consent authority. The report generated by this tool can be provided to indicate if your proposal triggers the BOS Threshold.



12 APPENDIX 4 AHIMS SEARCH



AHIMS Web Services (AWS) Search Result

Your Ref/PO Number : Stage 10 Warnervale

Client Service ID : 741446

Duncan Scott-Lawson

Date: 17 December 2022

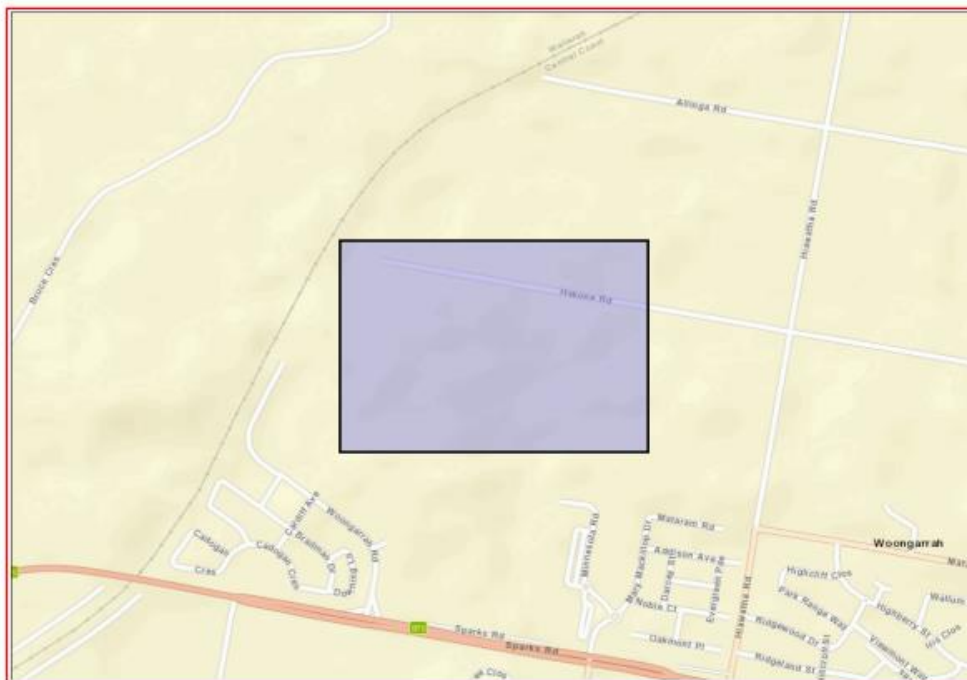
Attention: Duncan Scott-Lawson

Email: duncan@emconsultancy.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat. Long From : -33.2392, 151.4624 - Lat. Long To : -33.2347, 151.4701, conducted by Duncan Scott-Lawson on 17 December 2022.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

13 APPENDIX 5 NSW BUSHFIRE PLANNING PROTECTION MEASURES

The following information on building survivability and the application of Bushfire Protection Measures should be considered continually for the life of the development. These measures facilitate meeting the aims and objectives of PBP 2019 and mitigating bushfire risk and are provided to inform the client.

Why do buildings burn during bush fires?

Research has been undertaken over the last decades to analyse and determine the elements that determine the survivability of a building during a bush fire event. As the research is validated, these elements are incorporated into planning documentation that guides construction in bush fire prone areas, such as Australian Standard 3959 and NSW RFS Planning for Bushfire Protection.

Research has illustrated that there are three ways a bush fire impacts a building:

1. Direct flame contact,
2. Radiant heat from the bush fire, and
3. Embers generated by the bush fire.

Most people expect direct flame contact to be the biggest risk to homes in a bush fire, but this is not the case. Over 80% of house loss during bush fires occurs because of ember attack; the burning firebrands of bark, leaves and twigs with winds drive away from the main fire front. They find weaknesses in houses such as gaps, cracks to combustible construction materials and can quickly lead to ignition of the building. **Significantly, vegetation is established adjacent to the building and within the Asset Protection Zone following the construction of the building, which provides fuel for burning embers to ignite** and increase the ignitability of the building. It is critical that the Asset Protection Zones are maintained throughout the life of the property, so that wildfire is not encouraged closer to the building.

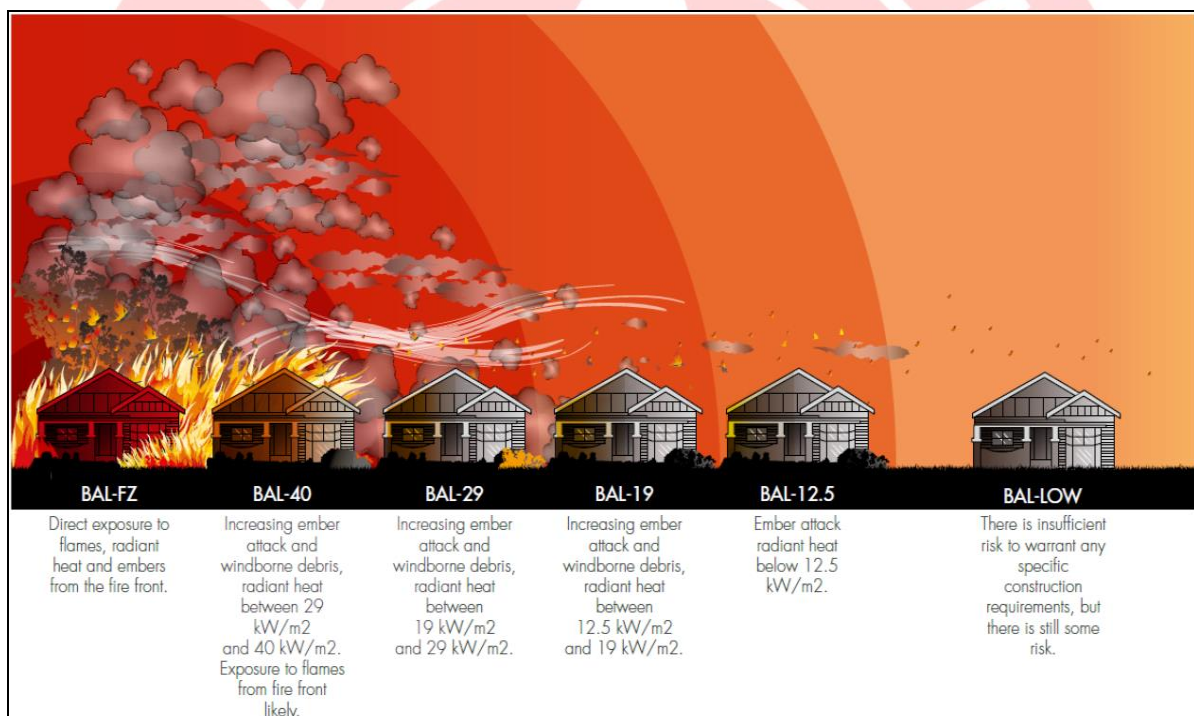
In terms of subdivision development, the research has illustrated maintaining the separations between the building and bush fire threat (known as the Asset Protection Zones (APZ)) to low flammability is critical. Elements within subdivision planning that can be incorporated are:

- Restricted landscaping and gardens within the APZ.
- Delineate the edge of the APZ through fencing, bollarding and signage to mitigate vegetation creep over time.
- Registration of the APZ within the relevant bushfire risk management plan.
- Dedication of resources to ensure ongoing maintenance.
- Non-combustible fencing associated with the APZ.
- Ensure water provisions are provided on both the bushfire threat and building sides of roads.

Australia Standard 3959 Construction of buildings in Bush fire prone areas and Bush fire Attack Level (BAL)

Bush fire Attack Level (BAL) ratings refer to the fire intensity your house is likely to be subjected to in a bush fire, expressed in terms of radiant heat. The BAL assessment forms the construction component of the bush fire assessment process. The other component is the Bush fire planning, which includes Asset Protection Zones (APZ), separation to provide defensible spaces, access, water, electricity, gas, landscaping and emergency management.

Furthermore, the measures contained in the *Australian Standard 3959 Construction of buildings in Bushfire Prone Areas* for each BAL construction level are not for fire resistance. The building will burn. The construction standards are aimed at slowing the ignition and fire spread of the building to provide adequate time to enable occupants to shelter within the building as the bushfire front passes. The degree of vegetation management within the APZ, the unpredictable nature of behaviour of fire, and extreme weather conditions make building adjacent to vegetation very dangerous.



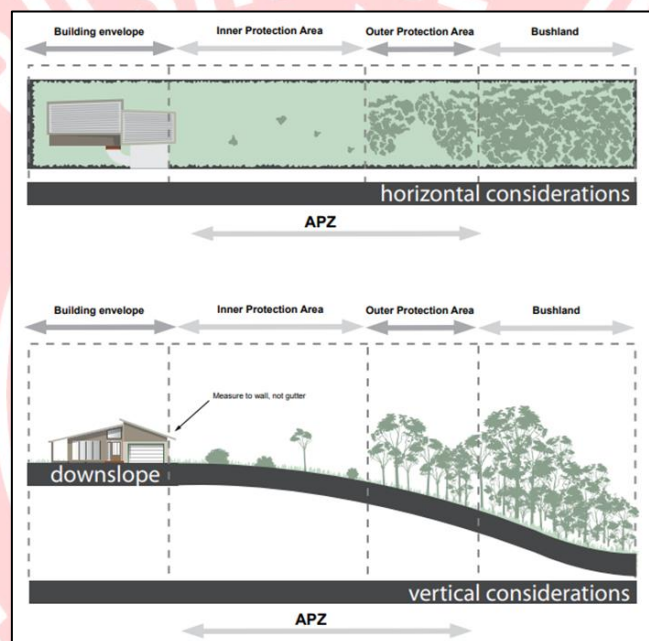
Relationship between fire behaviour and BAL (WA Guidelines for Planning in Bush fire Prone Areas, 2017)

Asset Protection Zones

An APZ is an area surrounding a development that is managed to reduce the bushfire 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 to ensure ongoing protection from the impact of bush fires. Maintenance to the below standards should be undertaken on an annual basis, in advance of the fire season, as a minimum.

For a complete guide to APZs and landscaping, download the NSW RFS document Standards for Asset Protection Zones at www.rfs.nsw.gov.au/resources/publications.

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 delineated by rural fencing, signposted or bollards (whatever is practical in the circumstances) to ensure vegetation creep does not occur and further landowners and ground management are aware that the area is to be maintained for Bush fire protection purposes. Examples are provided 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 defensible 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 bushfire.
- 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 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 understorey 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.

Furthermore, the edge of the APZ should be clearly delineated to ensure vegetation creep does not occur over time, reducing the separation between the bushfire hazard and building, as indicated below.

Gardens and vegetation within the APZ

All vegetation will burn under the right conditions.

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 defence 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 with vegetation 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 bushfire 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.
- Avoid gardens within 10m of the exterior building envelop.
- Trees and shrubs within 40m are not continuous, but instead arranged as discrete patches separated by a ground layer with low fuel hazard, such as mown grass.
- Position courtyards, gardens, and grassed areas in locations that facilitate the protection of the building.
- Install pebble/rock garden beds avoiding the use of mulch and wood chip.

Consideration should be given to vegetation fuel loads present on site. 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.**

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. The below list of well known ground fire-retardant plants is intended as a guide only, check with your local council for information more specific to your area.

- *Lomandra longifolia*
- *Lomandra hystrix*
- *Anigozanthos* hybrids
- *Agapanthus orientalis*
- *Liriope muscari*
- *Carpobrotus glaucescens*
- *Casuarina glauca*
- *Ajuga*
- *Brachyscome*
- *Dampiera*
- *Scaevola aemula*
- *Succulents (most)*
- *Carpobrotus (Pigface)*
- *Cotyledon*
- *Ajuga australis*
- *Myroporum*
- *Nepeta* (catmint)
- *Mesembryanthemum*
- *Arctotis*

Strategically positioned elevated vegetation (fire-retardant tree and shrub species) can act as 'windbreaks' and 'ember filter', reducing wind velocities and suppressing the density of embers attacking a building. It is critical that this vegetation is:

- On flat ground place >30m from the building (ideally 40m forming the outer perimeter of the IPA).
- >20m separation from the hazardous vegetation.
- Located on the side of the bush fire hazard.
- No gardens of shrubs under the trees.
- Shrub patches no greater than 10m².

The below list of well known fire-retardant trees and shrubs is intended as a guide only, check with your local council for information more specific to your area:

- *Melia azederach* (Cape Lilac)
- *Brachychiton acerifolius* (Flame tree)
- *Magnolia grandiflora*
- *Pyrus* (most ornamental pears)
- *Magnolia* Little Gem
- *Ulmus chinensis* (Chinese Elm)
- *Acacia howitii*
- *Cercis* (Judus Tree)
- *Acmena smithii* (Lilypilly)
- *Prunus* (all including ornamental)
- *Cupaniopsis anacardiopsis* (Tuckeroo)
- *Malus* (apple trees)
- *Eleocarpus*

- *Mullberry*
- *Citrus* trees
- *Loquat*
- *Arbutus Quercus* (only the deciduous oak trees)
- *Feijoa*
- *Gleditzia*
- *Ficus* (all including edible)
- *Aloe* (all)
- *Correa*
- *Acacia* *iteaphyla*
- *Scaevola crassifolia*
- *Viburnum tinus*
- *Atriplex* (saltbush)
- *Escallonia*
- *Maireana* (Cottonbush)
- *Acacia Cyclops*
- *Eremophila* (Emu bush)
- *Melaleuca nodosa*
- *Syzygium* (lilypilly)
- *Photinia*
- *Rhagodia* (saltbush)
- *Strelitzia*
- *Coprosma*
- *Santolina*
- *Plectranthus*
- *Leucophyta brownii*
- *Senna* (Silver Cassia)

Recent post-fire research from the 2019/20 bushfire season suggests greenness factor (the extent to which plants are actively growing) had an impact on building survivability to a bushfire, indicating that maintained green grasses and landscape watering features are beneficial during a bushfire.

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.

Landscaping features within the APZ

A combination of hard (materials) and soft (design) landscaping will benefit the survivability of a building during a bushfire event. The type, quantity and condition of fuel has a very important effect on bushfire behaviour in proximity to a building. Poorly located vegetation that burns readily may expose a house to increased levels of radiant heat and flame contact.

- Non-flammable features such as tennis courts, swimming pools, dams, patios, driveways or paths should be incorporated into the proposal, especially on the northern and western sides of the proposed building.
- Remove other flammable objects from around the house. These include sheds, caravans, outdoor furniture, barbeques, gas bottles, wood piles and organic mulch.
- Avoid flammable mulches within the APZ. Alternatives include gravel, scoria, pebbles, shells or recycled crushed bricks.
- Use non-combustible, moveable containers and pots that can be relocated in the summer.
- Restrict the use of door mats and place firewood stacks >10m from building.
- Restrict the use of timber and use materials such as brick, earth, stone, concrete and galvanised iron
- Metal screens can help to shield your house from radiant heat, direct flame contact and ember attack.
- An intensive area of planting centred on a contoured garden mound provide an effective screening.
- Fencing in BAL 29 or within 6m of a building should be of non-combustible materials.
- 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.
- Clumping shrubs and trees so they do not form a continuous canopy and are separated by areas of low fuel (maintained green grass lawn).

Further information can be found here - [Landscaping for bushfires](#)

Access Requirements

In the event of a serious bushfire threat to the proposed development, it will be essential to ensure that adequate ingress/ egress and the provision of defensible space are afforded in the development/building design.

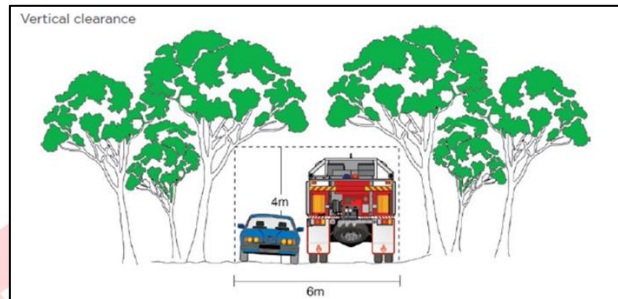
Local Area Traffic Management (LATM)

The objective of LATM is to attain an acceptable level of speed, volume, and composition of traffic within a local area and reduce the number of road accidents. This is achieved by modifying the street environment through the installation of various traffic control devices. LATM devices by their nature are designed to restrict and or impede the movement of traffic, especially large vehicles, which conflicts with the intent for access required by the NSW RFS and may significantly increase response times for emergency services.

Where LATM devices are provided they are to be designed so that they do not impede fire vehicle access.

Vertical clearance

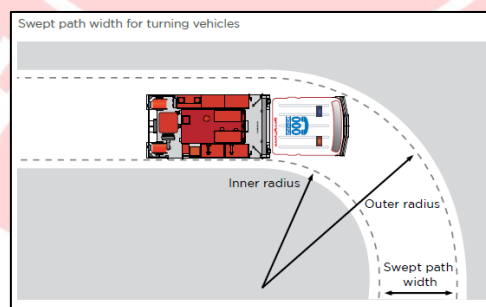
An unobstructed clearance height of 4 metres should be maintained above all access ways including clearance from building construction, archways, gateways/doorways, and overhanging structures (e.g., ducts, pipes, sprinklers, walkways, signs and beams). This also applies to vegetation overhanging roads and fire trails.

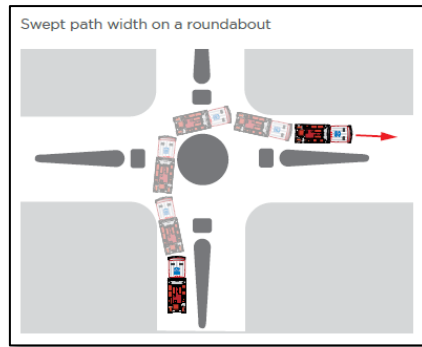


Vehicle Turning Requirements

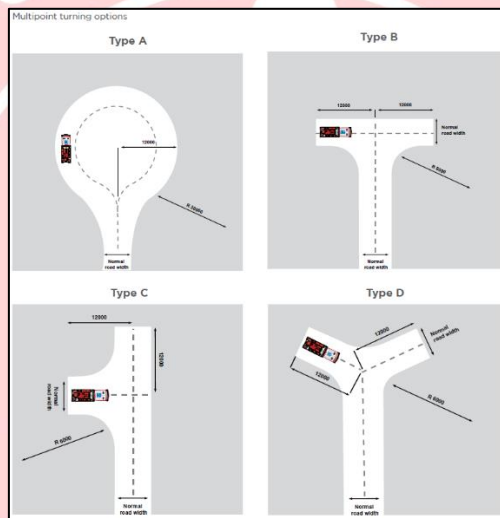
Fire crews must have rapid access and egress for vehicles, therefore curved carriageways should be constructed using the minimum swept path. The below diagrams from PBP2019 provide indication of the requirements to be achieved.

Minimum curve radius (inside edge (m))	Swept path (m) wide
<40	4.0
40 -69	3.0
70 - 100	2.7
>100	2.5





Where a turning head is proposed the NSW RFS requires that dead ends having a length greater than 20 metres should be provided with a turning head area which avoids multipoint turns.



Passing Bays

The construction of passing bays, where required, shall be 20m in length, provide a minimum trafficable width at the passing point of 6m.



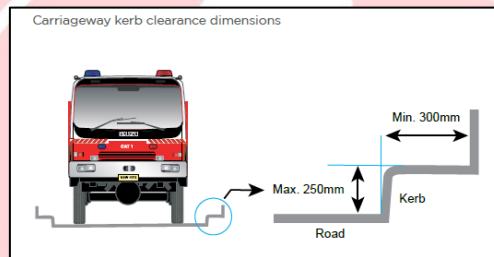
Parking

Parking can create a pinch point within the road reserve. The location of parking should be carefully considered to ensure fire appliance access is unimpeded. Hydrants should be located clear of any parking areas to ensure that access is always available.



Kerb Dimensions

All kerbs constructed around access lanes should be no higher than 250mm and free of vertical obstructions at least 300mm back from the kerb face to allow clearance for front and rear body overhang.



Road Types

Property access is required to be 4m wide all-weather road. Can be sealed or unsealed.



Water Supply

The intent of water measures is to provide adequate services of water for the protection of dwellings during and after the passage of a bush fire.

Where reticulated water supply is not provided, a 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 positioned 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 appliances 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, valves, 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.

Electricity, Gas supplies and Hazardous materials

The intent of electricity, gas and hazardous material measures is to locate these utilities and materials so as not to contribute to the risk of fire to a building.

Electricity

Location of electricity services should limit the possibility of igniting the surrounding bush land or the fabric of buildings. Where practicable, electrical transmission lines are underground. If overhead, electrical transmission lines are installed with short pole spacing (30m), unless crossing gullies, gorges, or riparian areas, then 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.

Gas

Any reticulated or bottled gas should be installed and maintained according to the requirements of the relevant authorities and AS/NZS 1596:2014. All fixed gas cylinders are kept clear of all flammable materials to 10m and shielded on the hazard side. All above-ground pipes and connections to and from gas cylinders are metal, and polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not permitted. Furthermore, if gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion. Gas utilities should be positioned to not impede fire fighters accessing water supplies while undertaking suppression operations.

Construction Requirements

Groundwork 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.

Groundwork and Sub-structure construction phase 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 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 carried on each vehicle and on site for quick access and suppression of fires.

Where neither reticulated water nor an existing static water supply is available during the construction phase, a temporary 10,000 litre Static Water Supply within proximity of the development site shall be provided before the commencement of any construction works. This temporary supply will allow for the replenishment of attending fire services which will facilitate the rapid suppression of any potential ignitions. The temporary supply may be removed when the prescribed fire-fighting water supply is installed.

Ongoing Operations

Routine inspections of bush fire safety systems and equipment generally occur annually and are supported by a Bushfire Plan. Ideally these inspections should occur moving out of the colder months in preparation for the bushfire 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 reequipments in APZs, and maintaining building fire hygiene such as cleaning gutters and down pipes.

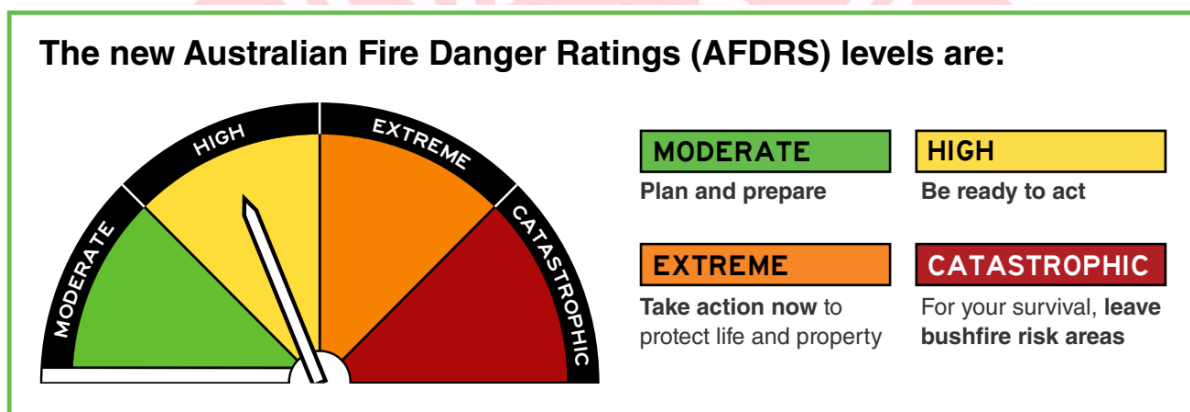
Developing and annually reviewing a bushfire plan, no matter how big or small the development, is critical to the ongoing maintenance of the Bushfire Protection Measures identified within this report.

Updated Australian Fire Danger Rating System

The principal objective of the new Australian Fire Danger Rating System (AFDRS) is to implement a more accurate and nationally consistent system that will enable improved decision-making by response agencies and industry and provoke the desired community response to messaging in order to improve public safety.

The AFDRS uses the latest scientific understanding about weather, fuel and how fire behaves in different types of vegetation to improve the reliability of fire danger forecasts. This strengthens the ability of those working in emergency services to be better prepared, make improved decisions, and provide better advice to the community.

It is aimed at a simplified, action-oriented Fire Danger Rating System.




MODERATE: *Plan and Prepare* - Have a plan and be ready to act if a fire starts.

HIGH: *Be ready to act* - Be alert for fires in your area and be ready to leave or be ready to defend.

EXTREME: *Take action* - Act before a fire starts.

CATASTROPHIC: *Leave high risk areas* - Protect your life, leave early.

14 APPENDIX 6 METHOD 2 OUTPUTS

 NBC Bushfire Attack Assessment Report V4.1 A S3959 (2018) Appendix B - Detailed Method 2		Print Date: 19/12/2022		Assessment Date: 19/12/2022		
Site Street Address:	Warnervale Stage 10, Warnervale					
Assessor:	Please Enter Your Name; Please Enter Company Name					
Local Government Area:	Central Coast	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:	Sydney Coastal DSF					
Vegetation Group:	Dry Sclerophyll Forests (Shrubby)					
Vegetation Slope:	5 Degrees	Vegetation Slope Type:	Downslope			
Surface Fuel Load(t/ha):	21.3	Overall Fuel Load(t/ha):	27.3			
Vegetation Height(m):	1.4	Only Applicable to Shrub/Scrub and Vesta				
Site Information						
Site Slope:	0 Degrees	Site Slope Type:	Level			
Elevation of Receiver(m):	6	APZ/Separation(m):	27			
Fire Inputs						
Veg./Flame Width(m):	100	Flame Temp(K):	1090			
Calculation Parameters						
Flame Emissivity:	95	Relative Humidity(%):	25			
Heat of Combustion(kJ/kg)	18600	Ambient Temp(K):	308			
Moisture Factor:	5	FDI:	100			
Program Outputs						
Level of Construction:	BAL 29	Peak Elevation of Receiver(m):	11.34			
Radiant Heat(kW/m2):	28.84	Flame Angle (degrees):	53			
Flame Length(m):	26.73	Maximum View Factor:	0.455			
Rate Of Spread (km/h):	3.61	Inner Protection Area(m):	16			
Transmissivity:	0.834	Outer Protection Area(m):	11			
Fire Intensity(kW/m):	50906					
BAL Thresholds						
	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kW/m2:	Elevation of Receiver:
Asset Protection Zone(m):	21	27	38	52	76	6



NBC Bushfire Attack Assessment Report V4.1

A S3959 (2018) Appendix B - Detailed Method 2

Print Date: 19/12/2022

Assessment Date: 19/12/2022

Site Street Address: Warnervale Stage 10, Warnervale

Assessor: Please Enter Your Name; Please Enter Company Name

Local Government Area: Central Coast

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 2

Vegetation Information

Vegetation Type: Grassy and Semi-Arid Woodland (including Mallee)

Vegetation Group: Forest and Woodland

Vegetation Slope: 5 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 10.5

Overall Fuel Load(t/ha): 20.2

Vegetation Height(m): 2

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 8 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): 6

APZ Separation(m): 23

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg): 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 19

Peak Elevation of Receiver(m): 3.63

Radiant Heat(kW/m2): 17.69

Flame Angle (degrees): 80

Flame Length(m): 13.99

Maximum View Factor: 0.282

Rate Of Spread (km/h): 1.78

Inner Protection Area(m): 23

Transmissivity: 0.826

Outer Protection Area(m): 0

Fire Intensity(kW/m): 18568

BAL Thresholds

BAL-40: BAL-29: BAL-19: BAL-12.5: 10 kW/m2: Elevation of Receiver:

Asset Protection Zone(m): 11 15 22 31 49 6



NBC Bushfire Attack Assessment Report V4.1

A S3959 (2018) Appendix B - Detailed Method 2

Print Date: 19/12/2022

Assessment Date: 19/12/2022

Site Street Address: Warnervale Stage 10, Warnervale

Assessor: Please Enter Your Name; Please Enter Company Name

Local Government Area: Central Coast

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 3

Vegetation Information

Vegetation Type: Grassy and Semi-Arid Woodland (including Mallee)

Vegetation Group: Forest and Woodland

Vegetation Slope: 4 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 10.5

Overall Fuel Load(t/ha): 20.2

Vegetation Height(m): 2

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Level

Elevation of Receiver(m): 6

APZ/Separation(m): 15

Fire Inputs

Veg./Flame Width(m): 55

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg) 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 5.84

Radiant Heat(kW/m2): 27.81

Flame Angle (degrees): 62

Flame Length(m): 13.22

Maximum View Factor: 0.427

Rate Of Spread (km/h): 1.66

Inner Protection Area(m): 15

Transmissivity: 0.857

Outer Protection Area(m): 0

Fire Intensity(kW/m): 17330

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	11	15	21	28	41	6