S5 ENVIRONMENTAL

BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

46 Kraft Road, Pallara

Client	Yu Fen Li C/ Plan A Town Planning Pty Ltd
File Ref	S50684_BHAMP_V1.0
Date	17 June 2022

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Quality Control

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Date	**17 June 2022**

Version Control

Version	Description	Date	Author	Reviewer	Approver
1.0	RFI	17 June 2022	CH (Ecologist)	SL (Senior Ecologist)	RS (Director)

Disclaimer

S5 Consulting Pty Ltd trading as S5 Environmental has developed this Bushfire Hazard and Bushfire Attack Level Assessment, taking into consideration the Australian Standard (AS3959-2018) - Construction of Buildings in Bushfire-prone Areas, the State Planning Policy and relevant local authority policies and guidelines. However, there can be no guarantee that following the recommendations made in this assessment can guarantee safety of property and human life.

Fire is an element of nature, and as such fire events (small or large) can have disastrous outcomes even with the best planning in place. The authors of this report and S5 Consulting Pty Ltd accept no responsibility for any harm to property or human life caused by fire or any other cause to persons utilising property or structures.

Abbreviations

AHD	Australian Height Datum
AS 3959-2018	*Australian Standard 3959-2018 Construction of Buildings in Bushfire-prone Areas*
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BMP	Bushfire Management Plan
BRC	Bushfire Resilient Communities (The State of Queensland 2017)
CFA	Country Fire Authority
DES	Department of Environment and Science
DNRME	Department of Natural Resources, Mines and Energy
DoR	Department of Resources
FFDI	Forest Fire Danger Index
ha	Hectares
LCC	Logan City Council
NCC	National Construction Code
RE	Regional Ecosystem
SEQ	South East Queensland
SPP	*State Planning Policy, 2017*
VHC	Vegetation Hazard Class

1.0 INTRODUCTION

S5 Environmental was commissioned by Plan A Town Planning Pty Ltd on behalf of their client, Yu Fen Li, to conduct a Detailed Ecological Assessment for a Reconfiguration of a Lot (RoL), situated at 46 Kraft Road, Pallara. Refer to **Table 1**.

The aim of this Bushfire Hazard Assessment and Management Plan is to undertake a site-specific bushfire hazard assessment, determine any set back required between the proposed development and hazardous vegetation and prepare a Bushfire Management Plan to ensure the proposed development is exposed to an acceptable bushfire risk and can comply with the relevant legislative bushfire requirements.

Table 1. Site Description

Address	46 Kraft Road, Pallara	**RPD**	Lot 108 on RP87803
LGA	Brisbane City Council (BCC)	**Site Area**	1.6 hectares (ha)
Zone	Low density residential	**Tenure**	Freehold
Current State	Lot 108 on RP87803, herein referred to as the 'subject site', currently contains a single dwelling and two greenhouse structures. The site additionally contains a concrete driveway and path, open grassed areas, scattered trees around the single dwelling and vegetation lining the south-eastern and north-eastern boundaries, refer to **Figure 1** below.		
Proposed Development	The client is proposing to subdivide the site for a residential development (1 into 30 RoL), with two 10m Environmental Covenants (Covenant A and Covenant B) at the rear of the development. Refer to **Figure 2** below**.**		
Potentially Hazardous Vegetation	Post development, potentially hazardous vegetation is predominantly situated to the north and east of the subject site. This vegetation has been identified by the Department of Resources (DoR) as the pre-clear/regrowth Regional Ecosystem (RE) 12.3.11, described below: **RE 12.3.11:** *Eucalyptus tereticornis +/- E. siderophloia* and *Corymbia intermedia* open forest to woodland. *Corymbia tessellaris, Lophostemon suaveolens* and *Melaleuca quinquenervia* frequently occur and often form a low tree layer.		

Figure 1. Site Aerial (source: Nearmaps, date: 03/06/22)

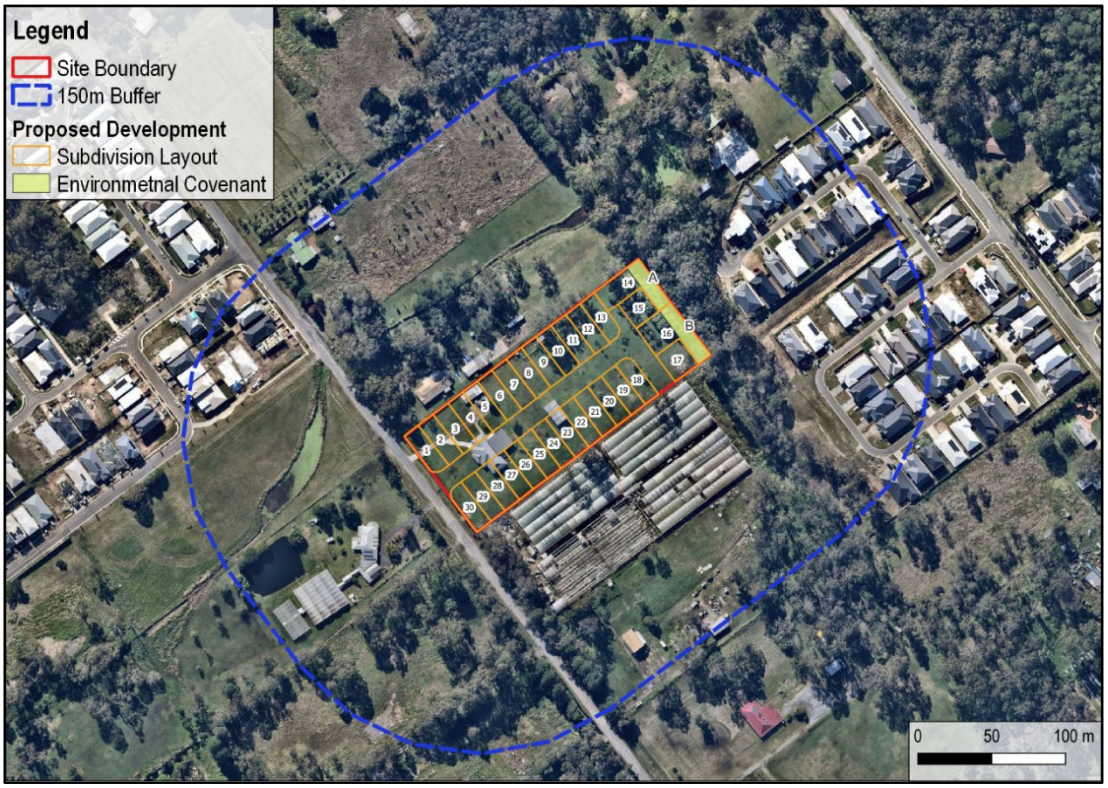

Figure 2. Proposed Development (source: AJS Surveys)

2.0 STATUTORY REQUIREMENTS

2.1 Development Applications in Bushfire Prone Areas

Bushfire Prone Areas are identified at both the State and Local Government Level. The State Planning Policy Bushfire Prone Area map was developed by CSIRO to map areas with Very High, High and Medium Potential Bushfire Intensity. The SPP also maps a 100 m Potential Impact Buffer.

The BCC *City Plan 2014* implements the *Bushfire Hazard Overlay Code* which acts as a development constraint within the BCC locality. It is understood that the *City Plan 2014* has appropriately integrated all aspects of the State Planning Policy (SPP), except for the Safety and Resilience to Hazards (Natural Hazards, Risk and Resilience – Bushfire Prone Areas) State interest. As such, the BCC Bushfire Hazard Overlay map, alongside the SPP Bushfire Prone Area map, were consulted to determine the preliminary bushfire hazard ratings of the site and locality (within 150 m), refer to **Figure 3** and **Figure 4.**

The BCC Bushfire Hazard Overlay maps a minor intrusion into the 150m buffer from the High hazard area buffer mapping, associated with vegetation beyond the locality, whereas the SPP mapping maps the northern extent of the subject site as containing Medium potential bushfire intensity with Potential impact buffer mapped over the majority of the site.

Due to potentially hazardous vegetation being mapped within and around the proposed development site, further investigation of the site-specific bushfire hazard characteristics has been undertaken to determine the actual hazard of the site.

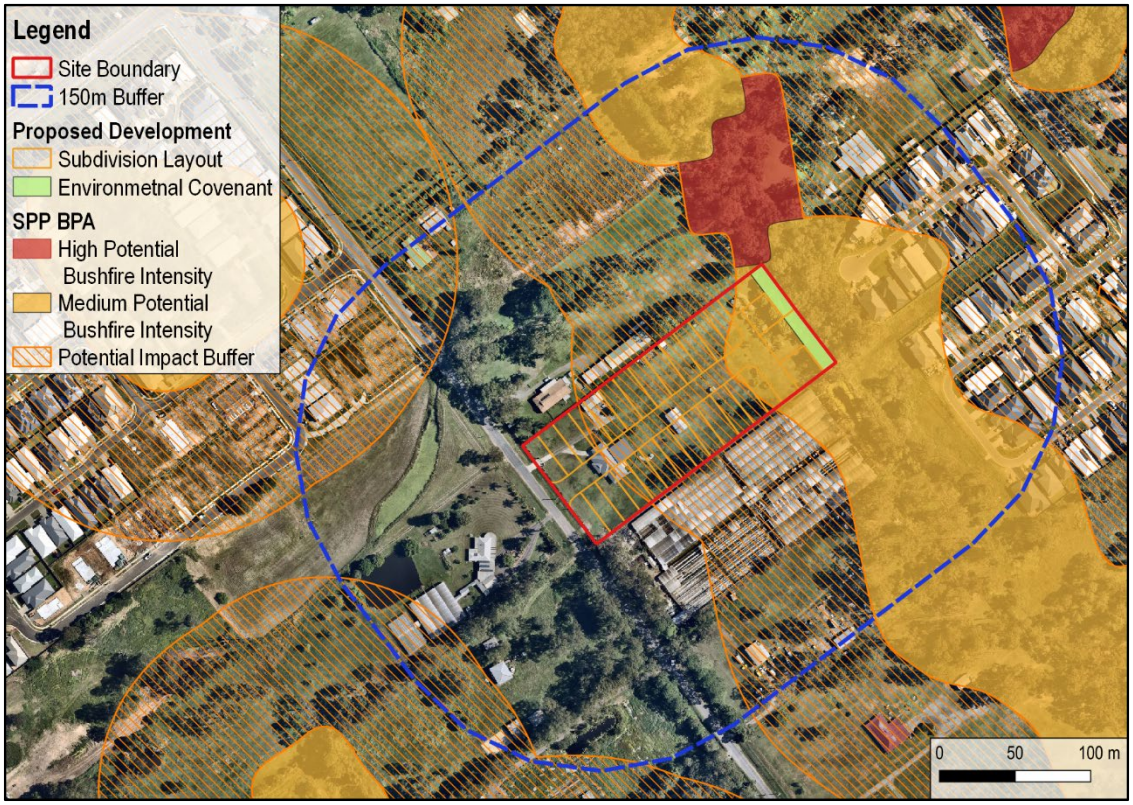

Figure 3. Extract of the SPP Bushfire Prone Area

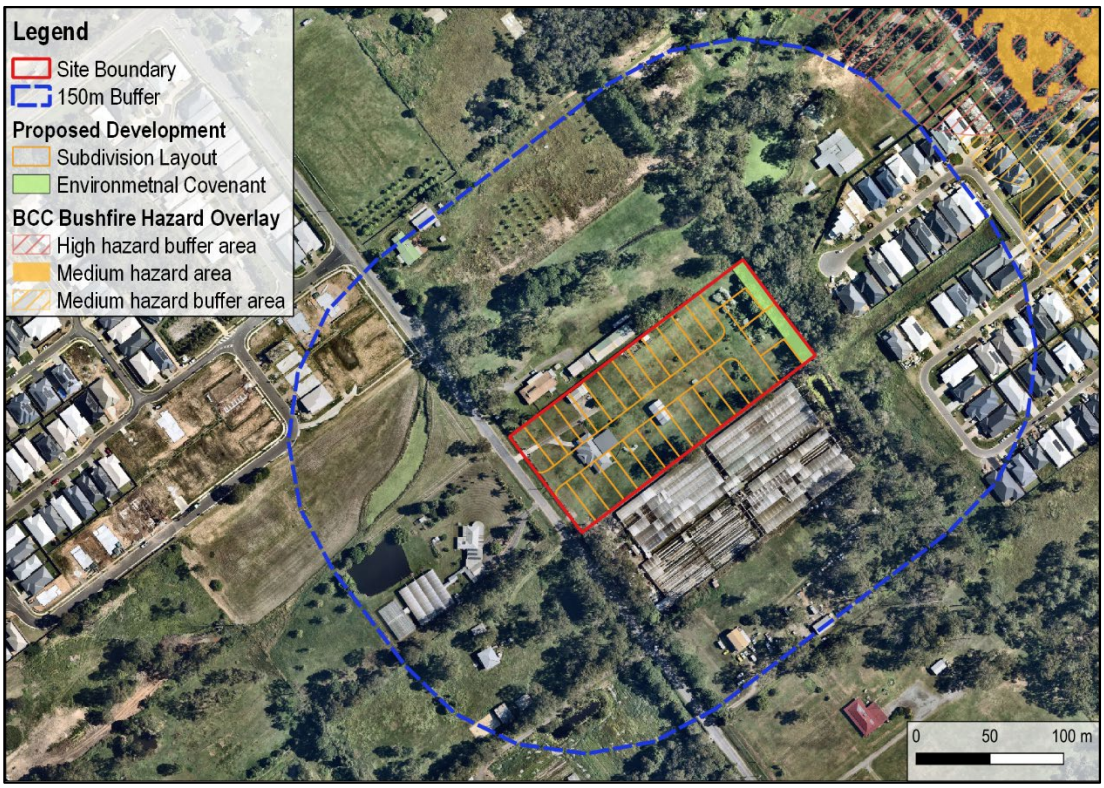

Figure 4. Extract of the BCC Bushfire Hazard Overlay

2.2 Construction of Buildings in Bushfire Prone Areas

The Building Code of Australia (BCA) triggers bushfire assessment in accordance with the Australian Standard 3959-2018 *Construction of Buildings in Bushfire Prone Areas* (AS3959-2018) for Class 1, 2, 3 and associated Class 10a buildings that are proposed to be constructed in Bushfire Prone Areas. The proposed subdivision is for a residential purpose, and it is anticipated that future habitable Class 1, 2 and/or 3 buildings with or without ancillary Class 10a buildings will be sited within the new proposed lots. According to the BCA, these dwellings will require a BAL assessment if constructing within areas of Medium and High Hazard and must adhere to the relevant AS 3959-2018 Construction Standards. Refer to **Table 2**, below**.**

Table 2. Summary of Building Classes 1, 2, 3, and 10a

Class	Description
Class 1	**Class 1a:** A single dwelling being – (i) A detached house, or (ii) One of a group of two more attached dwellings, each being a building, separated by fire resisting wall, including a row house, terrace house, town house or villa unit **Class 1b:** (i) A boarding house, guest house, hostel or the like – a) With a total area of all floors not exceeding 300 m^2 measured over the enclosing walls of the Class 1b; and b) In which not more than 12 persons would ordinarily be resident, o r (ii) Or more single dwellings located on one allotment and used for short-term holiday accommodation
Class 2	A building containing two or more sole-occupancy units each being a separate dwelling
Class 3	A residential building, other than a building of class 1 or 2, which is a common place of long term or transient living for several unrelated persons, including – a) A boarding house, guest house, lodging house or backpacker's accommodation; or b) A residential part of a hotel or motel; or c) A residential part of a school; d) Or accommodation for the aged, children or people with disabilities; or e) A residential part of a health-care building which accommodates members or staff; or f) A residential part of a detention centre.
Class 10a	A non-habitable building or structure – a) A non-habitable building being a private garage, carport, shed, or the like.

Source: Modified from Building Code of Australia

3.0 METHODOLOGY

3.1 Bushfire Hazard Assessment

The SPP Potential Bushfire Intensity classifications are based on the *New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland* (Leonard *et al.* 2014). This State-wide mapping methodology was developed to identify Bushfire Prone Areas in support of bushfire hazard provisions of Queensland's State Planning Policy. The new methodology scales bushfire hazard based on the Potential Fire-line Intensity (PFLI) of a severe bushfire and can be used to predict the radiation profile of areas located adjacent to potentially hazardous vegetation and an associated Potential Impact Buffer.

Accordingly, the classification of an area's PFLI is calculated as a combination of the following three metrics, using the below equation (Leonard *et al.* 2014):

- Total fuel load (W);
- The McArthur Forest Fire Danger Index (FFDI), and
- Maximum Landscape Slope (θ in ^{o}).

$$FI = 0.62\, W^2\, FFDI \exp(0.069\, \theta)$$

For the purposes of the bushfire hazard assessment, S5 Environmental have utilised data from the Queensland Fire and Emergency Services (QFES) published to the Queensland Government's Queensland Spatial Catalogue (QSpatial) for fuel load and FFDI for the purpose of the bushfire hazard assessment.

PFLI is classified into the categories shown in **Table 3**, and each patch of hazardous vegetation can be classed as very high, high, medium, grassland or low hazard according to the PFLI determined for that specific patch. Any patch of hazardous vegetation classed as very high, high or medium is buffered by 100m called the Potential Impact Buffer. The Potential Impact Buffer is also considered a Bushfire Prone Area, along with hazardous vegetation with a PFLI of very high, high or medium. Any development within a bushfire prone area requires further assessment of radiant heat exposure, assessment against the relevant local planning scheme bushfire code and/or an assessment against the SPP assessment benchmarks for Natural hazards, risk and resilience relevant to bushfire and the development of a site-specific bushfire management plan to ensure that the proposed development is exposed to an acceptable or tolerable bushfire risk.

Table 3 Potential Bushfire Intensity Classification

Potential Bushfire Intensity Class	Potential Fire-line Intensity (PFLI)
Very high	>40,000kW/m
High	20,000 – 40,000kW/m
Medium	4,000 – 20,000kW/m
Low	<4,000kW/m

3.2 Modification of Potential Intensity of Small Patches and Corridors

Using the Bushfire Resilient Communities (BRC) methodology in Section 4.2.6 (The State of Queensland 2019b), small patches of hazardous vegetation and narrow corridors were removed from the map of hazardous vegetation within 150m of the proposed development. This is as small, isolated and/or narrow patches of hazardous vegetation are not large enough to support a fully developed fire. As stated in the BRC methodology (The State of Queensland 2019b), small, isolated or narrow patches are unlikely to reach a potential fire-line intensity greater than 4,000kW/m and as such, are considered to be low hazard and not classed as a Bushfire Prone Area. The BRC summarises research by Leonard and Opie (2017) outlines four steps to filter out small patches and narrow corridors of continuous fuel (see **Table 4** below).

Table 4 Steps to Downgrade Bushfire Intensity

Step	Description
1	Remove small, isolated patches of **continuous** fuel (< 1ha) surrounded completely by either discontinuous fuel or no fuel. These patches must be further than 100 m from other continuous fuel patches greater than 2 ha in area.
2	Downgrade intensity of small patches (0.5 to 3 ha) of **continuous** vegetation surrounded completely by either discontinuous or no fuel, which is more than 100 m from other **continuous** fuel patches greater than 2 ha in area.
3	Remove narrow corridors of **continuous** fuel (50 m, or less in width). The process erodes, then dilates by 25 m in width all **continuous** fuel patches in relation to **discontinuous** areas.
4	Remove small fragments (<0.5 ha) of shrub-dominated or hazardous tree vegetation.

3.3 Radiant Heat Exposure Assessment

Radiant heat exposure for the proposed development was calculated using a Method 2 from the AS3959-2018. This Method 2 calculates the Bushfire Attack Level (BAL) for a proposed development by determining the minimum distance between hazardous vegetation and the development to achieve each BAL level. As BAL directly correlates to radiant heat exposure (see **Table 5**), this calculation reflects the level of bushfire risk for a proposed development.

Table 5 BAL and Radiant Heat Exposure

BAL Score	Radiant Heat Exposure
10	10 kW/m^2
12.5	12 kW/m^2
19	19 kW/m^2
29	29 kW/m^2
40	40 kW/m^2
Flame zone (FZ)	>40 kW/m^2

To determine the radiant heat exposure for the proposed development, the online Flamesol Minimum Distance Calculator (FPA 2017) was used to determine the required setbacks to hazardous vegetation to achieve an acceptable radiant heat exposure for the proposed development. Currently, S5 Environmental understand there are four sets of inputs for a Method 2 calculation in accordance with AS3959-20148 that are accepted by local councils. Inputs to the BAL/radiant heat exposure assessment include the sets of parameters as summarised in **Table 6**.

Table 6 Parameter inputs for Method 2 from AS3959-2018

Parameter	Australian Standard (AS) Method 2(a)	AS Method 2(b)	AS method 2(c)	QFES Asset Protection Zone Calculator
Surface fuel load (t/ha)	Input from Table B3 in Appendix 3 of AS3959 for the identified vegetation type (e.g. forest)	Overall fuel load for identified Vegetation Hazard Class (VHC)	Surface fuel load for identified VHC (surface + near surface)	Automated from surface fuel load from identified VHC
Overall fuel load (t/ha)	Input from Table B3 in Appendix 3 of AS3959 for identified vegetation type (e.g. forest)	Total fuel load for identified VHC and (*if not short fire run and vegetation is forest or woodland*) + 10t/ha	Total fuel load for identified VHC	Automated from overall fuel load from identified VHC
Flame temperature	1090K	1090K	1200K	1200K
FDI/FFDI	40	From Catalyst/QSpatial	From Catalyst/QSpatial	From Catalyst/QSpatial
Standard inputs	AS3959-2018	AS3959-2018	Bushfire Resilient Communities (QG 2019)	Bushfire Resilient Communities (QG 2019)
Effective slope	Measured as the slope under the Classifiable Vegetation.			

Parameter	Australian Standard (AS) Method 2(a)	AS Method 2(b)	AS method 2(c)	QFES Asset Protection Zone Calculator
Site slope	Measured as the slope between the Classifiable Vegetation and the site.			
Flame Width	Flame width is assumed to be 100 m (AS 3959-2018) unless a short-fire run.			

3.4 Short Fire Run

Small or narrow patches of hazardous vegetation are unlikely to support a fully developed bushfire due to their limited size (see **Figure 4** for a schematic representation of how fire moves across a landscape, demonstrating this). As such, the flame width and height in these small patches will not reach the standard inputs for the Method 2 from AS3959-2018 as these standard inputs are based on a fully developed bushfire. In these cases, a short fire run calculation can be used. The short fire run methodology can only be applied when there is a maximum fire run of 150m as measured on the effective slope. In these cases where a short fire run can be justified, and thus a reduced flame width and height for a Method 2 calculation, the method from the *Short Fire Run: Methodology for Assessing Bush Fire Risk for Low Risk Vegetation* (NSW Rural Fire Service, 2019) is adopted.

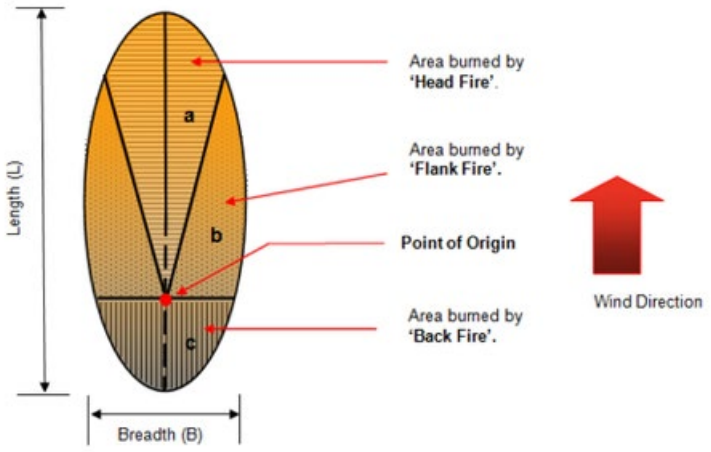

Figure 5 Schematic diagram of simple elliptical fire growth model (Van Wagner 1969) from NSW Rural Fire Surface (2019)

4.0 BUSHFIRE HAZARD ASSESSMENT

4.1 Potential Fire-line Intensity Assessment

In accordance with *A New Methodology for State-wide mapping of bushfire prone areas in Queensland* (Leonard *et al.* 2014), fuel loads derived from ground-truthed Vegetation Hazard Classes (VHCs), effective slope and FFDI were used to calculate the PFLI of hazardous vegetation within 150m of the proposed development and classified into the relevant PFLI category. The following sections discuss how these parameters were determined to calculate PFLI for hazardous vegetation in proximity to the proposed development.

4.1.1 Vegetation Hazard Class Mapping

In accordance with the *New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland* (Leonard *et al.* 2014), potential fuel loads are assigned to vegetation categories (Vegetation Hazard Classes – VHC) formed by amalgamating land use and vegetation types with a moderately consistent fuel load and structure.

The potential fuel load assigned to each VHC is generally representative of the higher fuel load expected for the typical vegetation types, landscape and site conditions within each VHC and approximates the ***80th percentile (%) fuel load of the "long unburnt condition"*** for the class (generally greater than 10 years without burning).

Using QFES Catalyst Mapping, numerous VHCs were mapped within and adjacent to the subject site. An extract of the Catalyst Mapping is shown below in **Figure 6**.

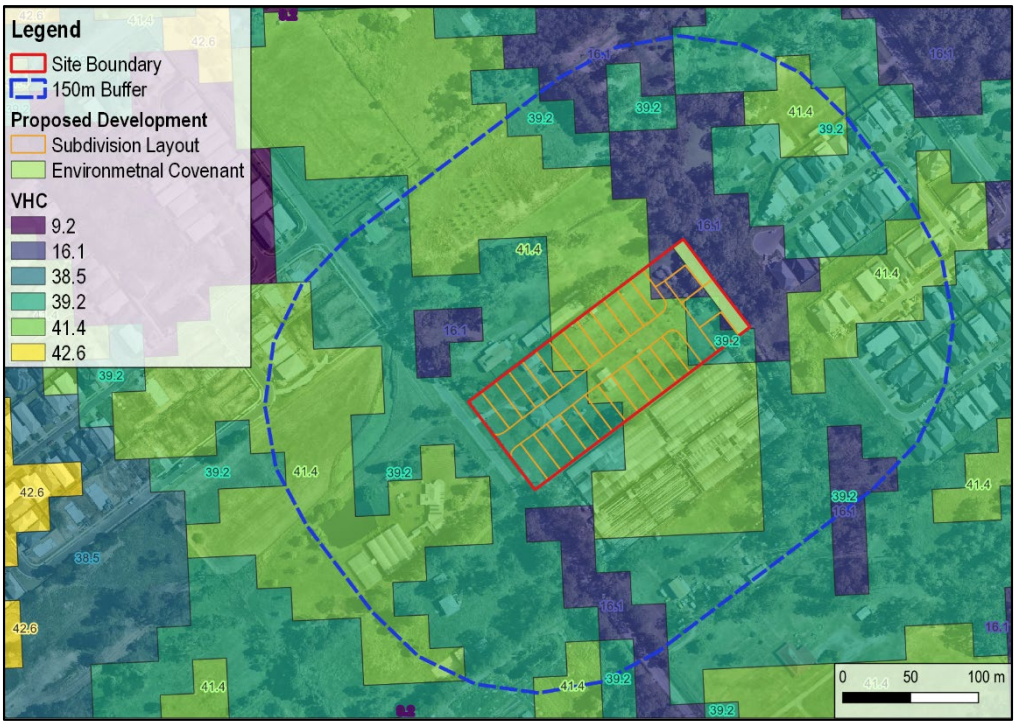

Figure 6. Extract of Vegetation Hazard Classes from Catalyst

4.1.2 Vegetation Hazard Class Verification

To ground-truth the State Government mapped VHCs mapped within and adjacent to the subject site, S5 Environmental's Ecologists conducted a site visit on the 20th of October 2020, and subsequently undertook a reliability assessment in accordance with BRC comparing available bushfire and vegetation mapping with on-ground conditions. The reliability assessment incorporated a comprehensive review of available aerial mapping of the site, including a 150 m buffered area, external to the proposed development.

The subject site is currently devoid of most vegetation, except for scattered fruit trees at the rear of the site. These are proposed to be removed, and a 10m Environmental Covenant will be located off the rear boundary, which will adjoin to vegetation on the northern adjacent lot. As rehabilitation is proposed within the vegetation mapped as High ecological significance (HES) under BCC's Biodiversity overlay, the VHC post-development will be 16.1 'Eucalyptus dominated forest on drainage lines and alluvial plains'. This VHC has been extended along the HES mapped vegetation outside the subject site and to the north, and some High Ecological Significant Strategic (HESS) to the east of the subject site, as the VHC description aligns with the eucalyptus dominated canopy observed. The VHC of the northern adjacent lot has been amended to 41.4 'Discontinuous low grass or tree cover'. The southern adjacent lot and the recent residential subdivision in the northern lot (A005024151) have been assessed to have a VHC of 42.6 'Nil to very low vegetation cover'. **Plates 1** to **6** below show the various areas existing across the site and locality.

Plate 1. Location of proposed Environmental Covenants, with northern adjacent lot seen on the right

Plate 2. View south into adjacent lot (VHC 42.6)

Plate 3. View of vegetation mapped as VHC 16.1 in northern lot

Plate 4. View north-west along Kraft Road

Plate 5. View through northern lot (VHC 41.4 into vegetation mapped as VHC 16.1

Plate 6. View southern lot, with VHC 16.1 visible in the background

The VHC mapping has, therefore, been modified to reflect the on-ground conditions more accurately, and to reflect the post-development state of the subject site and locality. As spatially indicated below in **Figure 7**, the modified VHCs have been restricted to the 150 m buffer from the subject site, as the more distant areas are not relevant for the purposes of this Bushfire Hazard Assessment.

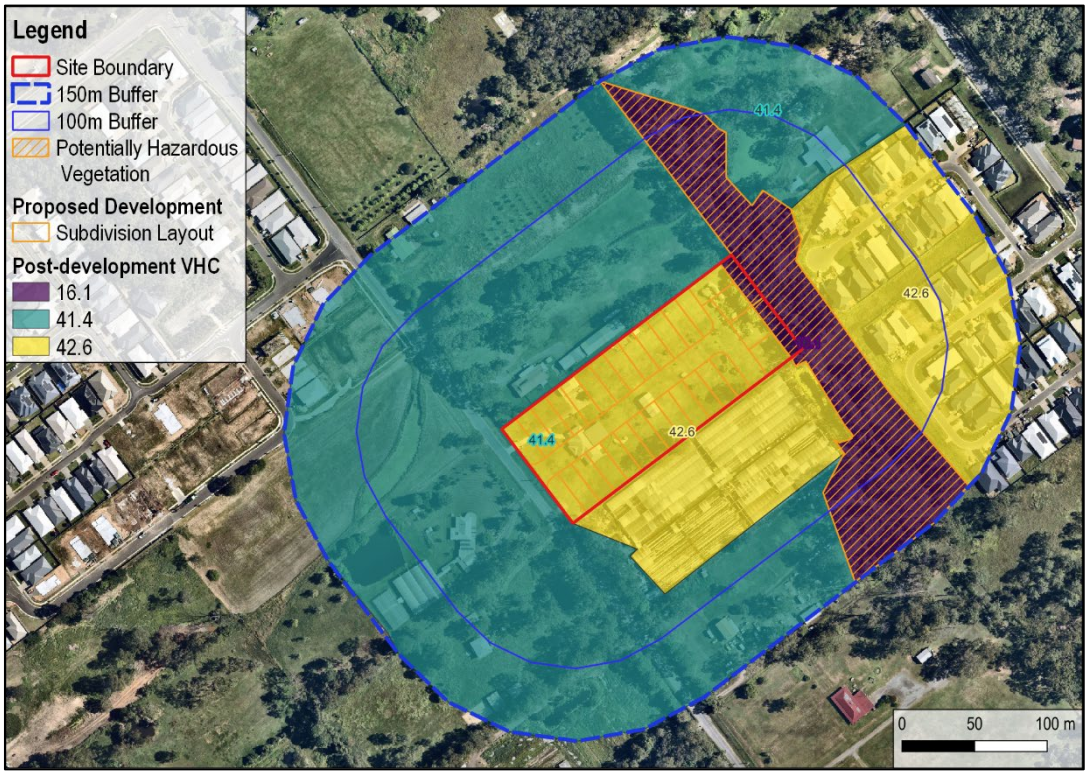

Figure 7. Ground-truthed and post-development Vegetation Hazard Classes

4.1.3 Fuel Loads

Table 7, below, summarises the associated fuel-loads of the modified VHCs after they have been ground-truthed. Only VHCs with continuous fuel types are hazardous vegetation and as such, the mapped area

associated with VHC 41.4 and 42.6 is not hazardous, consisting of a discontinuous fuel type and can be excluded from any further analysis of bushfire prone areas.

Table 7. Summary of VHCs and their associated Fuel Continuity and Loads

VHC	VHC Description	Fuel Continuity	Potential Fuel Load * (t/ha)
			Total
16.1	Eucalyptus forest on drainage lines and alluvial plains	Continuous	26**
41.4	Discontinuous low grass or tree cover	Discontinuous	3
42.6	Nil to very low vegetation cover	Discontinuous	2

*CSIRO A Methodology for State-wide Mapping of Annual Fuel Load and Bushfire Hazard in Queensland. Glenn Newnham, Kimberley Opie, Justin Leonard CSIRO Land and Water, 2017.

** Total potential fuel load + 10t/ha, as in accordance with AS Method 2b

4.1.4 Modification of Potential Intensity of Small Patches and Corridors

S5 Environmental have investigated the application of the processing stages and have implemented Step 3 for narrow corridors (<50m) surrounded by areas of discontinuous fuel loads. This step has excluded a narrow corridor which is located between the 14 to 17 and the northern adjacent subdivision. This includes the vegetation within the proposed Environmental Covenants. This vegetation is not expected to be capable of maintaining a full fire front that could pose a significant risk to habitable buildings. Refer to **Figure 8.**

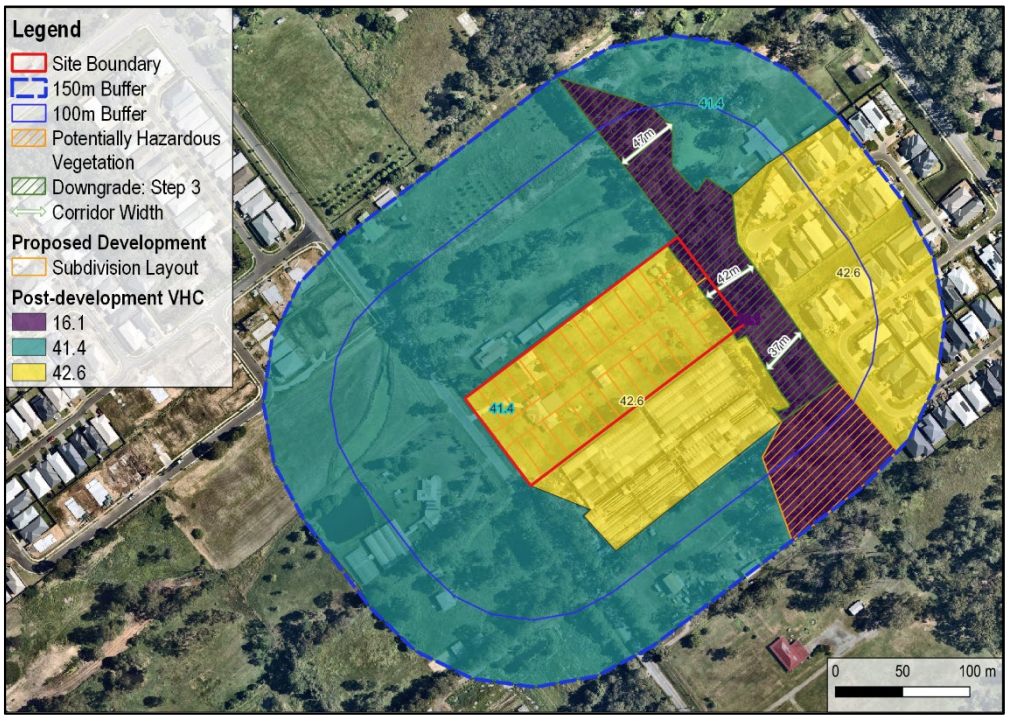

Figure 8. Final Post-development VHC

4.1.5 Slope Assessment

The slope of vegetated land over which a bushfire passes has a strong influence on both the intensity and rate of spread of the bushfire. From a Bushfire Hazard Assessment perspective, the relevant slopes to consider are the slopes beneath areas of potentially hazardous vegetation, defined as "effective slope" in AS 3959-2018, that would be retained within or adjacent to the proposed development site. Also relevant, is whether the vegetated land is situated upslope or downslope of the proposed development. As fire travels faster upslope, there is a significant reduction in risk and fire-line intensity for sites that sit below the vegetation.

The classifiable vegetation has been calculated to slope slightly down towards the proposed development (refer **Figure 9**).

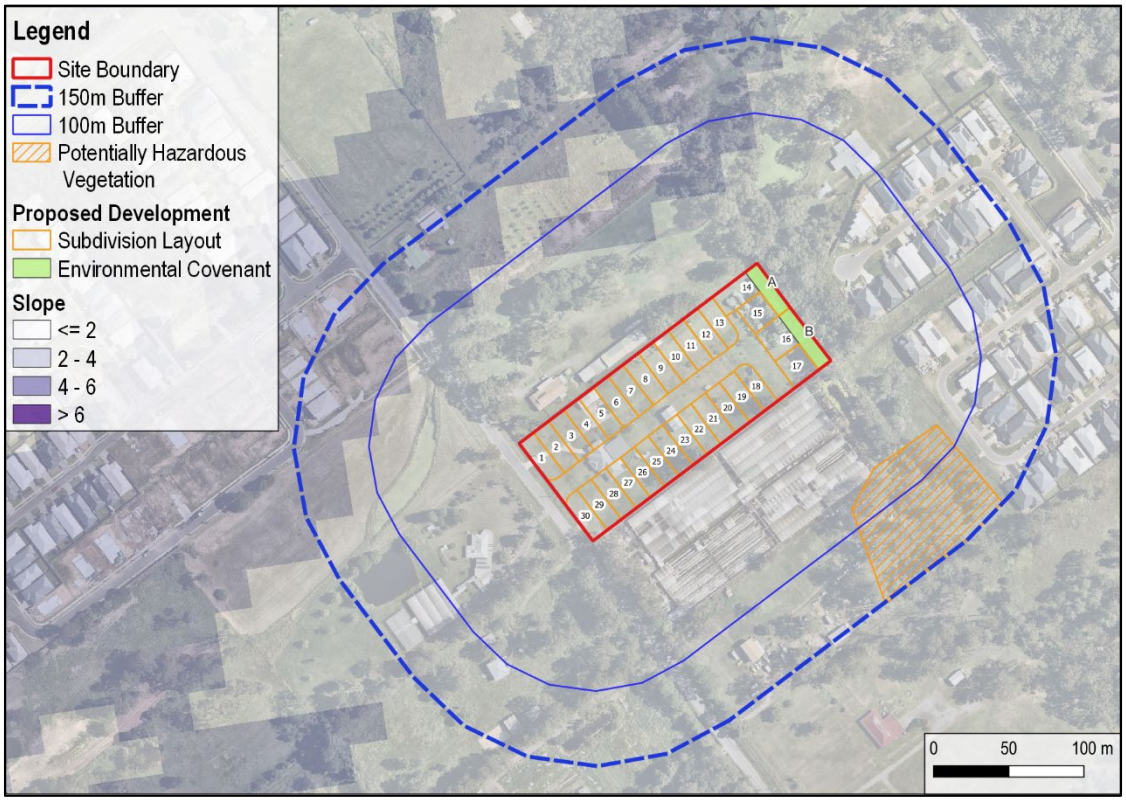

Figure 9. Slope under hazardous vegetation to the north

4.1.6 Forest Fire Danger Index

In accordance with the Australian Standard (AS) 3959-2018, *Construction of Buildings in Bushfire Prone Areas*, the Fire Danger Index (FDI) indicates the chance of a fire starting, its intensity, rate of spread and the difficultly of its suppressions, according to several combinations of relative humidity, air temperature, wind speed as well as long- and short-term drought effects. The QFES Catalyst Mapping indicates that the site-specific Forest Fire Danger Index (FFDI) for the subject site is **55.**

4.1.7 Final PFLI

A final PFLI for patches of hazardous vegetation (determined in **Section 4.1**) has been calculated using the PFLI equation in **Section 3.1**. Based on this PFLI calculation, the potentially hazardous vegetation to the south-east of the proposed development was mapped to contain areas of high potential bushfire intensity (i.e., 20,000 to 40,000 kW/m) associated with VHC 16.1, surrounded by a large area of non-bushfire prone area (low potential bushfire intensity i.e., <4,000 kW/m) (refer to **Figure 10**).

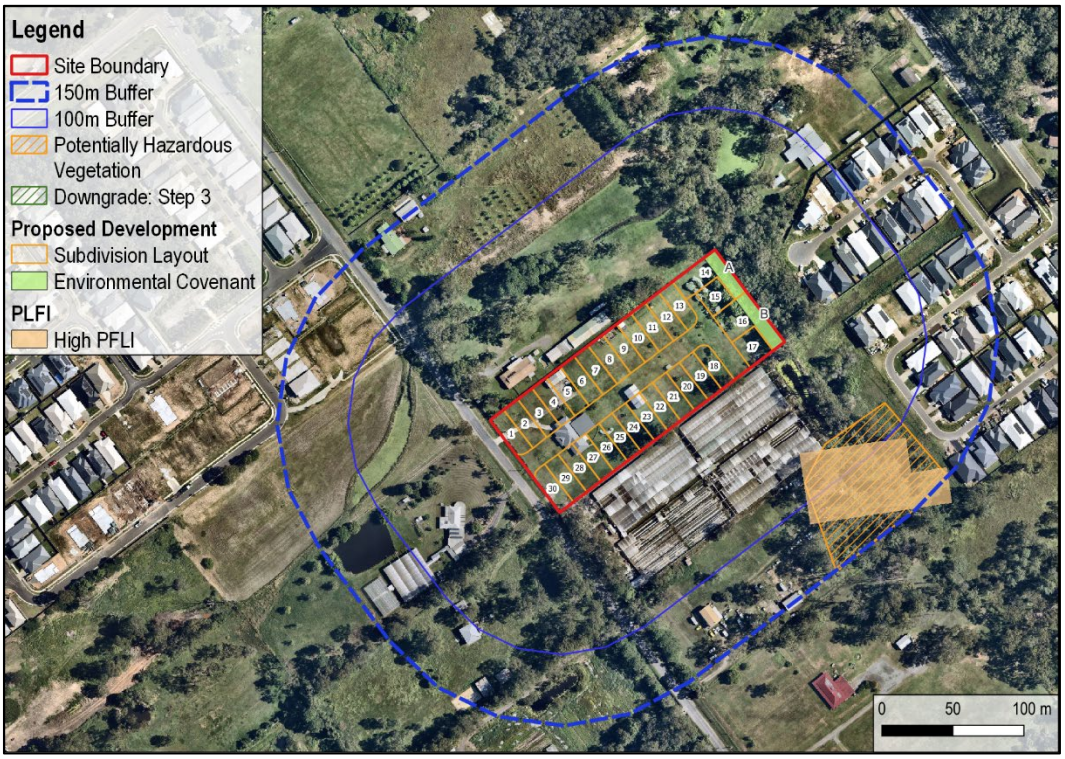

Figure 10. Potential Fire Line Intensity

4.2 Hazardous Vegetation

Vegetation mapped as VHC 16.1 to the south-east of the development was determined to be the only hazardous vegetation within the assessment area. As this vegetation is within 100m of the proposed development area, the residential subdivision is therefore within a Bushfire Prone Area. As such, a Bushfire Attack Level (BAL) assessment has been conducted to determine the radiant heat flux the subdivision may be exposed to, and what BAL score and subsequent building requirements the proposed development will have to adhere to (refer to **Figure 11**).

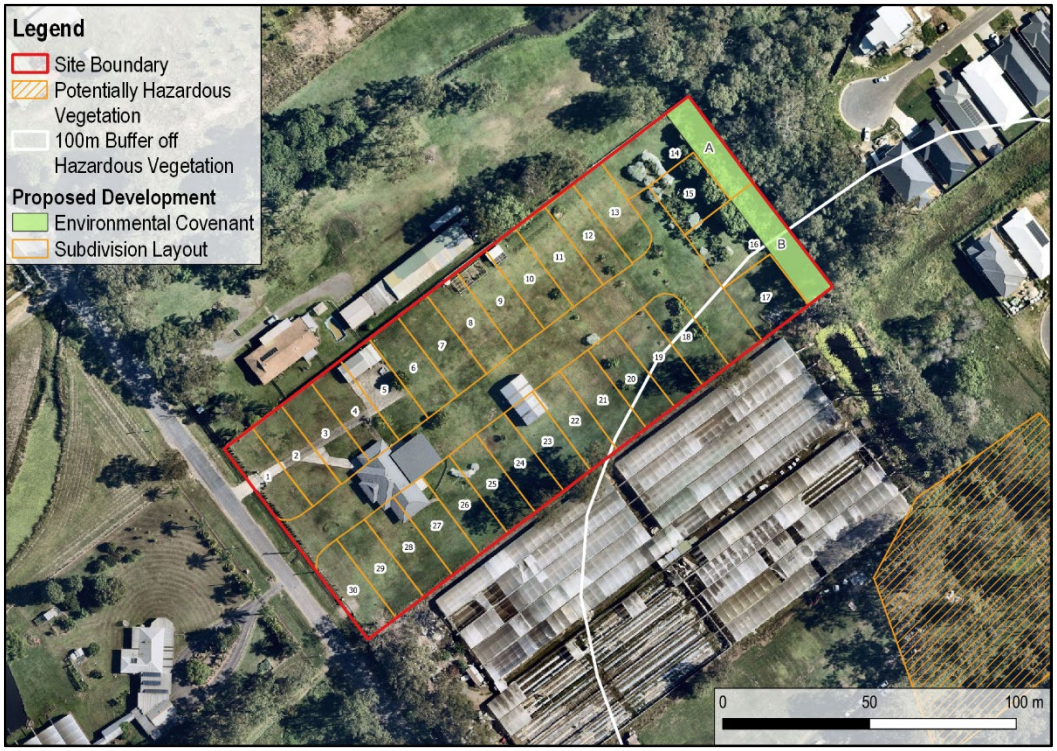

Figure 11. Hazardous vegetation located within 100m of proposed development

5.0 RADIANT HEAT EXPOSURE ASSESSMENT

This BAL assessment has focused on the potential impact of a fire event in Classified Vegetation located within 100 m of the subject site. Classified vegetation was determined to be the vegetation immediately to the south-east of the subject site (refer to **Figure 11**). A Method 2 assessment in accordance with AS3959-2018 utilising the Flamesol Minimum Distance Calculator was undertaken to determine the required setbacks from classified vegetation to the north of the proposed development (see **Table 8**). Refer to **Appendix B** for inputs and outputs from the Flamesol Minimum Distance Calculator.

Table 8. Summary of Setbacks and BAL Scores for the Proposed Development

Radiant Heat Exposure (kW/m^2)	BAL	Distance from Classifiable Vegetation to the North
-	LOW	100 m
12.5	12.5	24.2 m
19	19	16.7 m
29	29	11.3 m
40	40	8.3 m
>40	FZ	<8.3 m

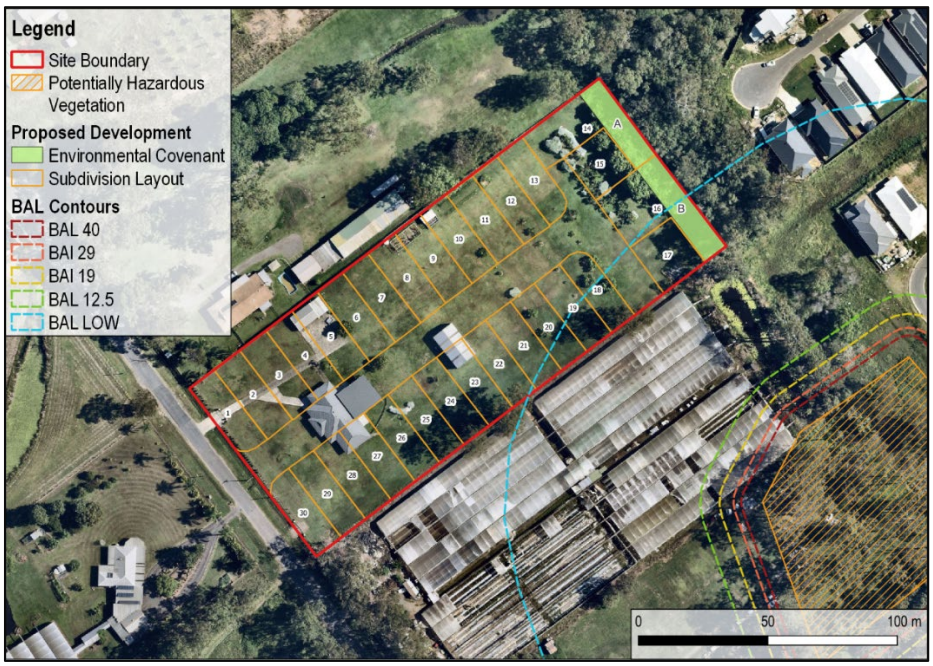

Figure 12. BAL Setbacks

Based on the results of the BAL assessment, Lots 16 to 22 will achieve a BAL score of 12.5. The balance of the lots (1 to15 and 23 to 30) will achieve a BAL-LOW score (refer **Figure 12** and **Table 10**).

Accordingly, a Bushfire Management Plan has been prepared and presented in **Section 6.0**.

Table 9 BAL Requirement for Proposed Lots

Lot/s	Applicable BAL Score
1 to 15 and 23 to 30	BAL-LOW
16 to 22	BAL-LOW or 12.5*

* Siting of BLE within lot will determine final BAL score

6.0 BUSHFIRE MANAGEMENT PLAN

This Bushfire Management Plan (BMP) identifies management measures that must be implemented to ensure that the risk of bushfire attack is reduced to an acceptable level. It is first important to understand the processes that influence bushfire behaviour (**Section 6.1**), and the sources of damage that threaten people, infrastructure and property (**Section 6.2**).

6.1 Bushfire Behaviour

Understanding bushfire behaviour is imperative when planning new development. There are three main factors which influence fire behaviour as follows:

1) Topography

Slope influences the speed and intensity of a fire. Fire is known to burn faster uphill as flames and radiant heat preheat the vegetation ahead of the fire, drying it out and making it increasingly flammable. As a rule of thumb, for every 10 degrees slope, fire doubles in speed. Refer to **Plate 7**, below.

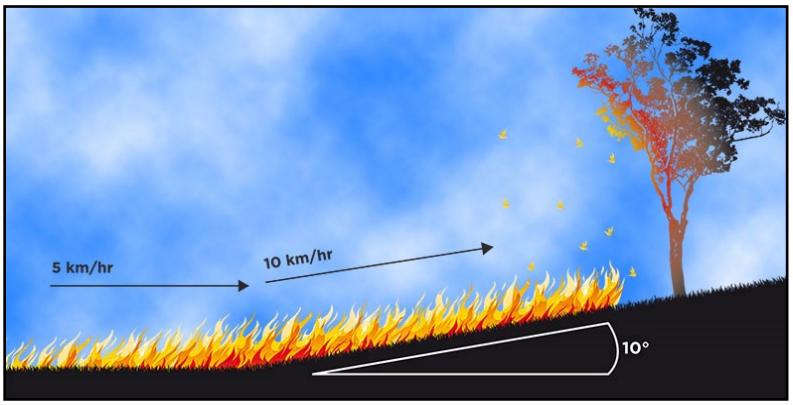

Plate 7 Effects of Topography on Bushfire

Source: Country Fire Authority

2) Weather Conditions

Bushfire weather conditions are fundamentally defined by temperature, humidity, wind, atmospheric conditions and past rainfall. For example, summer weather conditions increase the flammability of vegetation. Wind influences the speed and direction in which fire travels, fire intensity and possibility of spot fires from burning debris. A measure of weather conditions is the Forest Fire Danger Index (FFDI) and Grassland Fire Danger Index (GFDI). These measures are useful in determining the fire danger rating (refer to **Fire Danger Rating** in **Plate 8**, below).

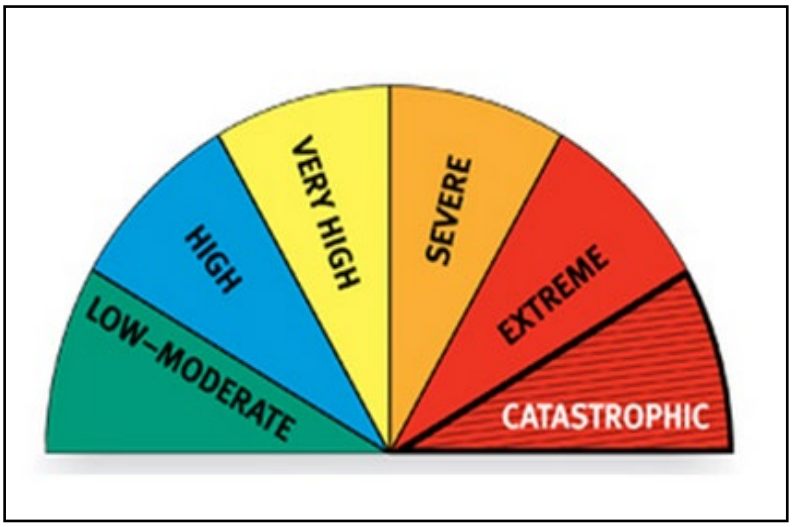

Plate 8 Fire Danger Rating

Source: Queensland Government, Emergency Services and Safety

3) Vegetation

Vegetation is the source of fuel for a bushfire. The amount of fuel surrounding a building can directly impact a buildings survival. Vegetation management, landscaping for bushfire and breaking the continuity of vegetation can limit the spread of fire.

6.2 Bushfire Damage Sources

The Country Fire Authority (2009) states, "*Bushfires can vary in intensity and scale across the landscape*". As the past bushfire events throughout Australia have illustrated, bushfires can be devastating and lead to long-running fires which are difficult to suppress. Building survival is influenced by many interacting factors. The four main ways buildings are destroyed during a bushfire include:

- Ember attack;
- Radiant heat;
- Direct flame contact; and
- Fire-driven wind.

Ember Attack

Research indicates that the most common way buildings catch on fire is through ember attack (80% of house loss). Ember attack occurs when small burning twigs, bark, leaf are carried by wind and land in and around a building. Embers can ignite flammable plants, leaf litter, fences, outdoor furniture and sheds (refer to **Plate 9**, below). Ember attack is addressed within the AS 3959-2018 through Construction Standard requirements.

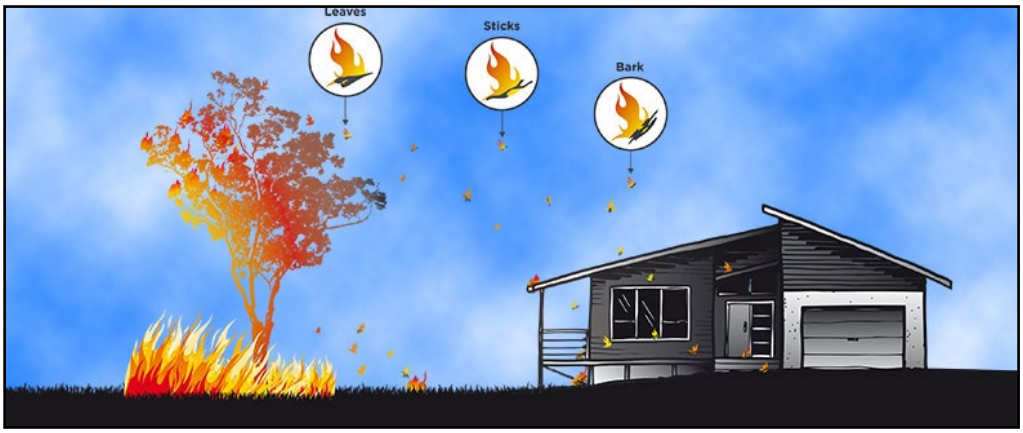

Plate 9 Ember Attack

Source: Country Fire Authority

Radiant Heat

Radiant heat is the heat created from burning fuel during a bushfire. Radiant heat can ignite surfaces without direct flame contact or ember attack, dry out vegetation ahead of the bushfire, crack glass (allowing embers to enter a building) and distort and melt materials (refer to **Plate 10**, below). The most common cause of loss of human life is via radiant heat (CFA, 2018).

Plate 10 Radiant Heat

Source: Country Fire Authority

Direct Flame Contact

Direct flame contact occurs when a fire front reaches a building, this is referred to as the 'Flame Zone'. Approximately 20% of house loss occurs when houses/buildings are directly adjacent to bushland.

Fire-driven Wind

Fire-driven wind can carry embers, cause trees to fall onto buildings, can break windows and destroy structures. The closer a building is to a fire front, the more severe the impact of fire-driven wind.

6.3 Management and Mitigation Measures – Permanent Buildings

Management and mitigation measures are generally outlined in relevant planning instruments at both the State and Local Government level.

Mitigation measures emphasize resilience to bushfire and are categorised into the following groups for the permanent structures within the site.

- Layout design;
- Building and construction requirements;
- Firefighting infrastructure;
- Bushfire emergency plan; and
- Vegetation management and landscaping

Layout Design

Access and Egress

Post-development, the residential lot subdivision will gain access via Kraft Road, located on the southern boundary of the subject site. All proposed lots will have direct access onto the new internal road. S5 Environmental understand that the access driveways to service each proposed lot will be appropriately constructed to the relevant BCC *Brisbane Standard Drawing* (BSD).

Siting of Development

The proposed lots are situated within 100 m of potentially hazardous vegetation to the south-east of the subject site. As mentioned above, lots 16 to 22, i.e. those nearest to the potentially hazardous vegetation, will achieve a BAL score of either 12.5 or LOW, depending on the final location of the building. Finalisation of building location envelope (BLE) will confirm BAL building requirements. Proposed lots 1 to15 and 23 to 30 will achieve a BAL-LOW. These results are based on the calculations of BAL setbacks utilising the Flamesol BAL Minimum Distance Calculator.

Building and Construction Requirements

In accordance with the BCA, the AS 3959-2018 requirements for construction of buildings applies to any new Class 1, 2, 3 or 10a Building (when ancillary to a Class 1, 2, or 3 Building). Therefore, any future habitable Class 1, 2 and/or 3 buildings and their ancillary Class 10a building/s within the proposed Lots 1 to 30, must adhere to their relevant BAL Construction Standards, as described above in *Siting of Development*

Early Warning Systems

Smoke alarms should be installed in accordance with the Building Code of Australia and the AS 3786-1993 - *Smoke Alarms*. The Queensland Fire and Emergency Services recommends photoelectric smoke alarms (not ionization alarms). Photoelectric smoke alarms are generally more effective than ionization types as they detect visible particles of combustion.

Firefighting Infrastructure

The site is expected to be connected to a reticulated water supply network. It is expected that the reticulated water supply network within the area complies with the provisions outlined in the SEQ Water Supply, Sewage Design and Construction Code.

Bushfire Emergency

In the event of a Bushfire Emergency, the local QFES should be contacted immediately. The Durack Fire and Rescue Station is located approximately 10 km (by road) to the north-west of the subject site. The contact details for the Durack Fire and Rescue Station are:

- Address: 506 Blunder Rd, Durack QLD 4077
- Phone: (07) 3565 4181

Please note that in fire emergencies the triple zero (000) emergency telephone number should be used.

Vegetation Management and Landscaping

While no setbacks from hazardous vegetation are considered necessary for the proposed development, S5 Environmental recommend that future owners of lots 16 to 22 adhere to the following advice (outlined in the SPP Technical Reference Guide – Bushfire Resilient Communities) on low flammability landscaping.

Landscaping plays an important role in increasing a building's ability to endure bushfire attack. Landscaping for bushfire reduces the risk of ember attack which is the most common cause of building loss during bushfire. This includes utilisation of low flammability treatments such as rock mulches, concrete retaining blocks, and appropriate plantings.

Appropriate plant attributes to consider implementing in landscape design to reduce bushfire risk include:

- High leaf moisture content;
- Lower volatile oil content;
- Higher leaf mineral content;
- Broad-leaved species;
- Resilience to pruning;
- Low ignition likelihood;
- A low volume of persistent dead leaves/branches;
- Smooth or tightly held bark; and,
- Leaves and twigs that do not regularly fall,

Management of landscaped areas should ensure that there is no accumulation of litter and woody debris on garden beds and should ensure that there is horizontal and vertical separation of plants. Any grass within the proposed lots should never exceed 10 cm in height. Irrigation of garden and greenery areas could be considered to ensure a well-watered, low flammability landscape.

The Victorian Country Fire Authority (CFA) have produced an online Plant Selection Key which facilitates landscape designers and property owners to select fire wise garden plants. The CFA have also produced

the publication 'Landscaping for Bushfire: Garden Design and Plant Selection' (CFA, 2011). The publication outlines planning, designing, choosing suitable plants, maintaining gardens and provides a Plant Selection Key, and can be obtained from their website.

In addition, trees should not overhang the roofline of the building, touch walls or other elements of a building and plants greater than 10 centimetres in height at maturity must not be placed directly in front of a window or other glass feature.

7.0 CONCLUSION

This Bushfire Hazard Assessment concluded that the proposed development is within 100m of potentially hazardous vegetation. The AS 3959-2018 Bushfire Attack Level assessment for the proposed residential lot subdivision determined lots 1 to 15 and 23 to 30 will achieve a BAL-LOW score, with lots 16 to 22 achieving either a BAL-LOW and BAL-12.5 score, with the final siting of BLEs to determine the construction requirements. As such, the proposed development will be exposed to an acceptable bushfire risk.

S5 Environmental have prepared a site-specific Bushfire Management Plan to support the proposed subdivision and address the BCC Bushfire Hazard Overlay Code. The Bushfire Management Plan recommends key mitigation measures which should be implemented to ensure the risk to people, infrastructure and property is acceptable and minimised. This Bushfire Management Plan specifically recommends the use of low flammability landscaping within future lots exposed to a BAL-12.5, ensuring the canopy of trees does not overhang the dwelling and plants greater than 10cm in height at maturity not be placed directly in front of windows or other glass features (refer **Section 6.0**).

Overall, the proposed development complies with the relevant section/s of BCC's Bushfire Hazard Overlay Code (i.e., A, C and D), refer to **Appendix A** for a full assessment of the code.

8.0 REFERENCES

BCC (2021) Brisbane City Plan 2014 [online] http://eplan.brisbane.qld.gov.au/index.htm

BCC (2021) Brisbane City Plan 2014 Interactive Mapping. [online] http://cityplan2014maps.brisbane.qld.gov.au/CityPlan/

CFA 2011, *Landscaping for Bushfire,* Country Fire Authority, Victoria, viewed June 2022, <https://www.cfa.vic.gov.au/plan-prepare/landscaping>.

CFA 2018, *How Fire Behaves*, Country Fire Authority, Victoria, viewed June 2022, <https://www.cfa.vic.gov.au/plan-prepare/how-fire-behaves>.

FPA 2017, *Flamesol*, Fire Protection Association, Australia, viewed June 2022, <http://flamesol.com.au/MDc.php>.

Leonard, J, Opie, K, Newnham, G & Blanchi R 2014, 'A new methodology for state-wide mapping of bushfire prone areas in Queensland', CSIRO, Australia.

Leonard, J & Opie, K 2017, 'Estimating the potential bushfire hazard of vegetation patches and corridors', CSIRO, Australia.

Newnham, G, Opie, K & Leonard, J 2017, 'A methodology for state-wide mapping of annual fuel load and bushfire hazard in Queensland', CSIRO, Australia.

Standards Australia Committee FP – 020 2018, *Australian Standard – Construction of buildings in bushfire-prone areas (AS3959-2018)*, Council of Standards Australia, Sydney.

The State of Queensland 2016, *Natural hazards, risk and resilience*, Department of Infrastructure, Local Government and Planning, 1 William Street, Brisbane Qld 4000, Australia, viewed June 2022, <https://dsdmipprd.blob.core.windows.net/general/spp-guideline-natural-hazards-risk-resilience.pdf>.

The State of Queensland 2017a, *State Planning Policy Interactive Mapping System*, Department of Infrastructure, Local Government and Planning, Brisbane, viewed June 2022, <https://spp.dsdip.esriaustraliaonline.com.au/geoviewer/map/planmaking >.

The State of Queensland 2017b, *State planning policy*, Department of Infrastructure, Local Government and Planning, 1 William Street, Brisbane Qld 4000, Australia, viewed June 2022, <https://dsdmipprd.blob.core.windows.net/general/spp-july-2017.pdf>.

The State of Queensland 2018, *Queensland Spatial Catalogue*, viewed June 2022, <https://qldspatial.information.qld.gov.au/catalogue/custom/index.page>.

The State of Queensland 2019a, *Fire hydrant and vehicle access guidelines for residential, commercial and industrial lots*, Queensland Fire and Emergency Service, viewed June 2022, <https://www.qfes.qld.gov.au/sites/default/files/2021-05/FireHydrantandVehicleAccessGuidelines.pdf>.

The State of Queensland 2019b, *Bushfire resilient communities*, Queensland Fire and Emergency Services, Queensland Government, Australia, viewed June 2022, <https://www.qfes.qld.gov.au/sites/default/files/2021-05/Bushfire-Resilient-Communities.pdf>.

The State of NSW 2019, *Short Fire Run: Methodology for assessing bush fire risk for low risk vegetation*, NSW Rural Fire Service, viewed June 2022, <https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0014/103064/Short-Fire-Run-Fact-Sheet-V6.pdf>.

APPENDIX A

BCC Bushfire Hazard Overlay Code

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
Section A—If for accepted development subject to compliance with identified requirements (acceptable outcomes only) or assessable development			
PO1 Development: a. minimises the bushfire hazard; b. maximises the protection of life and property from bushfire; c. addresses the bushfire hazard determined by a bushfire hazard assessment; d. where not in compliance with an approved bushfire management plan or development footprint: i. achieves a bushfire attack level that is less than or equal to BAL-29; or ii. achieves a bushfire attack level that is less than or equal to BAL-12.5 if for vulnerable uses, difficult to evacuate uses, assembly uses, essential community infrastructure or involving the handling or storage of hazardous chemicals exceeding amount specified in Table 8.2.5.3.D; or iii. if on a site of an existing premises and not a vulnerable use, difficult to evacuate use, assembly use, essential community infrastructure or involving the handling or storage of hazardous chemicals exceeding amounts specified in Table 8.2.5.3.D: A. does not extend beyond the bounds of the existing development footprint;	AO1.1 Development is designed and sited in compliance with: a. an approved bushfire management plan relevant to the full nature of the uses, which identifies the level of bushfire hazard and the location of hazardous vegetation affecting the development; or b. an approved development footprint identifying the development footprint plan and bushfire management footprint plan; or c. a bushfire hazard assessment and bushfire management plan prepared in accordance with the Bushfire planning scheme policy which: i. is undertaken by a suitably qualified person with technical expertise in the field of bushfire hazard identification and mitigation; ii. determines the relevant bushfire attack level for that part of the site in which development is proposed; iii. identifies the location of hazardous vegetation that poses a bushfire risk to the development. Note—Where a bushfire hazard assessment determines that the bushfire hazard for the part of the site in which development is proposed is 'low', no further assessment against this code is required. Note—A 'low' bushfire attack level must not be assumed for development in the Potential impact sub-category and in any areas subject to revegetation or regrowth vegetation even where the area is non-vegetated or vegetation is considered low threat in accordance with AS 3959 Construction of buildings in bushfire-prone areas. The Bushfire planning scheme policy provides advice about the sources of information to be consulted to determine areas subject to revegetation or regrowth	**S5 Environmental have prepared a site-specific Bushfire Hazard Assessment and Management Plan to support the proposed Development Application for Reconfiguring a Lot. All proposed lots will achieve a BAL score of less than or equal to BAL 12.5.**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
B. does not increase the GFA by 10% or 100m2, whichever is the greater; C. does not involve a new use on the site; D. is supported by a bushfire risk assessment prepared by a suitably qualified person with technical expertise in the field of bushfire hazard identification and mitigation, which demonstrates that the bushfire risk is acceptable. Note—Bushfire hazard is generally assessed based on the vegetation existing on site, adjacent and nearby to the site at the time of application. However, the level of bushfire hazard posed by any areas subject to revegetation or regrowth vegetation is assessed as if that area had reached its mature state. The Bushfire planning scheme policy provides advice about the sources of information to be consulted to determine areas subject to revegetation or regrowth vegetation and the hazard classification of that vegetation in its mature state. Note—Where a bushfire risk assessment is required it must be carried out in accordance with the State Planning Policy and the National Emergency Risk Assessment Guidelines prepared by the Australian Institute of Disaster Resilience.	vegetation and the hazard classification of that vegetation in its mature state. Note—A bushfire management plan is to be prepared having regard to any bushfire hazard assessment undertaken to prepare a neighbourhood plan. Note—Any bushfire management zone, asset protection zone or similarly defined area approved as part of a bushfire management plan used for bushfire management purposes is considered to be a bushfire management footprint plan. A building protection zone can compromise both the development footprint plan and the bushfire management footprint plan. AO1.2 Development where not in compliance with an approved bushfire management plan or development footprint identifying the development footprint plan and bushfire management footprint plan: a. achieves a bushfire attack level that is less than or equal to: i. BAL-29; or ii. BAL-12.5 if for vulnerable uses, difficult to evacuate uses, assembly uses, essential community infrastructure or involving the handling or storage of hazardous chemicals exceeding the amount specified in Table 8.2.5.3.D. Note—Bushfire attack level (BAL) is the radiant heat flux that will be experienced during a bushfire and is a measure of heat energy impact expressed as kW/m2. BAL is measured within the area of the nominated development footprint plan and excludes the area of any bushfire management footprint plan.		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
If for development other than reconfiguring a lot			
PO2 Development other than an extension to an existing building is sited, designed and maintained taking account of all relevant factors affecting the bushfire hazard on the site, including site topography, aspect, location and type and structure of vegetation to: a. minimise the number of buildings and people working, living or visiting a site exposed to bushfire risk; b. protect life during bushfire; c. increase the survival of buildings and structures during a bushfire; d. minimise bushfire risk from build-up of fuels around buildings and structures. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating achievement of this performance outcome.	AO2.1 Development is: a. sited in compliance with an approved development footprint identifying the development footprint plan and bushfire management footprint plan or bushfire management plan relevant to the full nature of the use; or b. if there is no approved development footprint identifying the development footprint plan and bushfire management footprint plan or bushfire management plan, where on a lot greater than 10 hectares, located in the area of lowest risk from bushfire on the site; and c. if there is no approved development footprint identifying the development footprint plan and bushfire management footprint plan or bushfire management plan, where on a lot greater than 2,500m2: i. located away from ridgelines in compliance with Figure a; ii. located on land with a gradient less than 15%; iii. preferably located on east- to south-facing slopes and avoiding north- to west-facing slopes unless the slope is clear of vegetation and is not located in the High hazard buffer area sub-category or the Medium hazard buffer area sub-category.	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	AO2.2 Development is sited within a building protection zone extending a minimum of 20m from the outermost projection of the main building or any habitable structure or to the maximum extent possible on sites less than 2500m2 where a building protection zone would extend into neighbouring properties; and a. clusters buildings and structures in the building protection zone; b. designs the inner 10m of the building protection zone to maintain a very low fuel state in the first 10m, and a fuel-reduced state to the extent of the building protection zone, in compliance with Figure b and Figure c. Note—The building protection zone includes the dwelling and all ancillary structures and may extend to a road or a building protection zone in an adjoining site.		
PO3 Development utilises fencing that: a. does not contribute to the spread of bushfire; b. in an urban area or in proximity to accommodation uses, contributes to reducing bushfire hazard to a building; c. facilitates the safe movement of fauna.	AO3.1 Development for a fence within 20m of any building used for accommodation comprises non-combustible or fire retardant materials.	**NA Development is for a ROL**	
	AO3.2 Development for a fence: a. incorporates gaps and spacing to allow the safe movement of fauna; or b. is designed to enable fauna to climb the fence.	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO4 Development ensures that the location, siting, and design of development and associated driveways and access routes: a. avoid potential for entrapment during a bushfire; b. facilitate safe and efficient emergency services to access and egress the site during a bushfire; c. enables safe evacuation of the site during a bushfire for site occupants. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO4 Development ensures that: a. the length of driveways or access routes does not exceed 70m between the most distant part of any occupied building and the nearest part of the public road; or b. where the length of the driveway or access route exceeds 70m: i. the driveway or private access route design meets the requirements of emergency vehicles in compliance with Table 8.2.5.3.C; ii. the driveway or access route provides all weather access for two-wheel-drive vehicles; iii. where relying on a private access route or driveway longer than 200m to reach a public road, a safe alternative access and egress route is provided.	**NA Development is for a ROL**	
PO5 Development has adequate road access to the site for emergency vehicles and safe evacuation in a bushfire.	AO5 Development has frontage to a constructed, all-weather public road capable of carrying emergency service vehicles.	**NA Development is for a ROL**	
PO6 Development makes adequate provision for fire-fighting requirements, including water supply.	AO6 Development ensures that: a. a reliable reticulated water supply and water pressure is available for fire-fighting requirements with water supply and pressure, which is in compliance with the standards specified by the relevant utilities provider; or: b. where sufficient reticulated water supply is not available for: i. residential lots, there is a minimum water supply available and retained for fire-fighting purposes in	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	compliance with Table 8.2.5.3.B, which may be in the form of a separate tank or a reserve section as part of a main water supply tank; or ii. development other than for residential lots involving new premises or an existing premises with a gross floor area greater than 50m2, on-site water storage is provided which is appropriate to the use, according to the standards specified by the relevant emergency services agency and is not less than 5,000 litres. Note—Water supply for fire fighting is in addition to water supply for household use. Where a non-reticulated supply of water is required, swimming pools, creeks and dams should not be used as a substitute for a dedicated static supply as these sources of water are not reliable during drought conditions.		
PO7 Development ensures that the water supply provided for fire-fighting is safely located and freely accessible for fire-fighting purposes at all times.	AO7 Development, for which sufficient reticulated water supply is not available, provides: a. a water supply outlet located away from any potential fire hazards, such as gas bottles; b. a hardstand area of 11m by 3.5m for fire-fighting vehicles within 2m of the water supply outlet; c. tanks on the bushfire hazard side of the buildings with adequate shielding for the protection of fire fighters; d. pumps which are shielded from bushfire hazard; e. an outlet pipe which is 50mm in diameter and fitted with a 50mm male camlock (standard rural fire brigade fitting); f. that any underground tank for fire-fighting purposes has an access hole of 200mm to allow a tanker to refill direct from the tank; g. that any above-ground water tank is made of concrete or metal and its stand is protected from bushfire hazard;	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS	COMMENTS	COUNCIL USE ONLY
		✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable		
	h. that all above-ground water pipes external to the building are metal, including and up to any taps. Note—Plastic tanks are not to be used.			
Additional performance outcomes and acceptable outcomes for all development in the Biodiversity areas overlay if on a site larger than 2,500m2				
PO8 Development through the siting, design, and construction of buildings, access routes and fire maintenance trails, and ongoing site management: a. provides effective separation from sources of bushfire risk; b. responds to the bushfire risk in that location; c. maintains the safety and protection of people and property over time; d. maximises the protection of vegetation in areas of high biodiversity value. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome that ensures: • ongoing site management, such as the bushfire risk to buildings, does not increase beyond the standard to which they have been designed and constructed; • appropriate design and maintenance of the site, and access routes and driveways.	AO8 Development locates building protection zones as shown on Figure b and Figure c, driveways and access routes and any fire maintenance trails: a. outside of the Biodiversity areas overlay; or b. within the existing disturbed, degraded or cleared areas, using natural fire breaks to avoid vegetation clearing and to avoid or otherwise minimise fragmentation or incursions into a habitat area, fauna movement corridor or remnant vegetation.	**Due to its narrow width (<50m), the Biodiversity mapping within the subject site post-development is not deemed to be a bushfire prone area. Recommendations made in section 6.3 should be implemented throughout the proposed development, with emphasis to be placed on lots adjacent to the Environmental Covenant (lots 14 to 17).**		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
Section B—If for assessable development other than ROL			
PO9 Development: a. provides for safe and efficient evacuation and emergency services access to the site during a bushfire; b. does not concentrate large numbers of people or locate significant worker or resident populations in an area of bushfire hazard; c. avoids locating the following uses in an area of bushfire hazard: i. vulnerable uses; ii. difficult to evacuate uses; iii. assembly uses. Note—This includes consideration of appropriate alternative shelter for vulnerable uses, management of health and wellbeing requirements during evacuation, safe site operation, and access and egress arrangements in bushfire events. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO9.1 Development: a. does not increase the number of people living, working on or visiting the site by more than 10%; or b. increasing the number of people living, working on or visiting the site, or vulnerable uses, difficult to evacuate uses or assembly uses by more than 10%, implements the recommendations of an approved bushfire management plan, which identifies measures that address the identified bushfire risk relevant to the development. AO9.2 Development provides alternative access routes that meet the road design requirements of items 1–7 in Table 8.2.5.3.C, for the following: a. an extension to existing premises which increases the number of people living, working on or visiting the site by more than 10%; b. the introduction of vulnerable, difficult to evacuate or assembly uses.	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS	COMMENTS	COUNCIL USE ONLY
		✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable		
Additional performance outcomes and acceptable outcomes if involving storage or handling on site of hazardous chemicals in quantities that would be equivalent to or exceed the threshold quantities set out in Table 8.2.5.3.D				
PO10 Development does not cause: a. unacceptable risk to people, property and the environment due to the impact of bushfire on the storage or handling on site of hazardous chemicals; b. excessive danger or difficulty to emergency services for emergency response or evacuation.	AO10 Development for storage or handling of hazardous chemicals: a. is not located within the bushfire overlay; or b. complies with an approved bushfire management plan prepared in accordance with the Bushfire planning scheme policy which identifies measures that ensure the development: i. mitigates the bushfire risk relevant to the development; ii. does not pose an unacceptable risk to people, public health and safety or risk environmental harm; iii. does not present significant difficulties to emergency services for emergency response or evacuation. Note—Bushfire management plans and site-based risk assessments are prepared in accordance with the Bushfire planning scheme policy. Guidance on the preparation of a hazard and risk analysis is provided in the Industrial hazard and risk assessment planning scheme policy. Note—Any risk mitigation measures, including construction of underground tanks or fire-protected above-ground tanks or package stores, are in compliance with AS 1940-2004 The storage and handling of flammable and combustible liquids.	**NA Development is for a ROL**		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
Additional performance outcomes and acceptable outcomes for essential community infrastructure			
PO11 Development for essential community infrastructure is located, designed and sited to: a. protect the safety of people during a bushfire; b. not create or increase the exposure of people to an unacceptable risk from a bushfire; c. minimise the risk to vulnerable populations from a bushfire; d. mitigate the impacts on the community and environment from the effects of a bushfire on the development.	AO11 Development for essential community infrastructure: a. is ancillary to and not relied on for the provision of the essential service during a bushfire; or b. implements an approved bushfire management plan prepared in accordance with the Bushfire planning scheme policy which identifies measures that: i. ensure the development allows for safe and efficient emergency access and site evacuation during a bushfire; ii. do not pose an unacceptable risk to people on a premises during a bushfire; iii. ensure the development is not at risk of failure during a bushfire which results in health or safety risks or adverse environmental impacts; iv. enable people and property to be defended safely and effectively from a bushfire.	**NA Development is for a ROL**	
Development for essential community infrastructure is able to function effectively during and immediately after bushfire events.	Development for essential community infrastructure: a. is ancillary to and not relied upon for the provision of the essential service during a bushfire; or b. containing elements vital to the function of the essential service during a bushfire is not located in the Bushfire overlay area; or c. implements an approved bushfire management plan prepared in accordance with the Bushfire planning scheme policy which identifies measures that ensure that: i. essential community infrastructure is able to function during bushfire events;	**NA Development is for a ROL**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	ii. access necessary to maintain safety or function of the development is not compromised by a bushfire; iii. mitigation measures are not unduly reliant on human activation to respond to a bushfire; iv. the safe storage of valuable records or items of cultural or historical significance, including storage of public records under the Public Records Act 2002, is able to be maintained during a bushfire event.		
Additional performance outcomes and acceptable outcomes if for landscaping or a park landscape plan is a requirement for development outcomes for essential community infrastructure			
PO13 Development provides landscaping that does not create an unacceptable risk to people or property and provides for ongoing management of risk to the development and people from a bushfire.	AO13 Development is in compliance with a landscaping plan which: a. is prepared in compliance with an approved bushfire management plan; b. preserves the requirements of any building protection zone; c. does not increase the exposure of a habitable building not located in a building protection zone to a bushfire hazard. Note—The requirements of a building protection zone are shown in Figure b and Figure c.	**NA Development does not contain essential community infrastructure**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO14 Development for a park is designed so that the park: a. is practical to maintain and requires minimal resources to be restored to its designed function and condition after a bushfire; b. provides for safe and efficient site evacuation and efficient emergency services access avoiding potential for entrapment during a bushfire; c. does not place unacceptable bushfire risk on an adjoining or nearby site, people and assets; d. provides efficient access for fire fighting; e. provides ongoing protection from bushfire for major park assets and buildings. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO14 Development provides a park landscape plan that complies with a bushfire management plan prepared in accordance with the Bushfire planning scheme policy	**NA – park landscape plan is outside of the scope of this assessment.**	
Section C—If for ROL			
PO15 Development does not materially increase the number of premises exposed to unacceptable risk during bushfire events.	AO15 Development does not materially increase the number of people living or working in the Bushfire overlay area.	**The proposed development does not materially increase the number of premises exposed to unacceptable bushfire risk.**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO16 Development is designed to: a. mitigate the risk of bushfire hazard to each lot; b. limit the spread of bushfire; c. achieve and maintain sufficient separation distance between development and hazardous vegetation to minimise bushfire hazard to future buildings during a bushfire; d. allow for emergency services access; e. locate buildings within a building protection zone Note—Lot size, location, configuration, dimensions and building measures are balanced to achieve an acceptable level of risk to future occupants. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO16 Development requires that lot number, size, shape and layout allow for the siting of future buildings within the lowest hazard locations on the site being located: a. within a building protection zone in accordance with Figure b and Figure c; b. away from ridgelines and hilltop sites in compliance with Figure a; c. on land with a gradient less than 15%; d. preferably on east to south facing slopes and avoiding north to west facing slopes unless the slope is clear of vegetation and is not located in the High hazard buffer area sub-category or Medium hazard buffer area sub-category.	**The proposed development achieves and can maintain sufficient separation distance between development and hazardous vegetation as the maximum radiant heat exposure for the proposal is 12.5kW/m².** **Emergency services can access the development.** **Bushfire management measures have been recommended in this report to limit the spread of bushfire and recommendations include maintaining lots in low fuel states to do this.**	
PO17 Development promotes safe site access, avoids creating a potential entrapment situation and supports accessibility and manoeuvring for fire fighting during bushfires. Note—This includes easements and boundary realignments. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO17 Development provides a lot layout which: a. provides direct road access and egress for new lots to public roads, rather than the creation of easements; b. in an urban category, avoids creating a new lot less than or equal to 2,500m2 which directly adjoins hazardous vegetation; c. in an urban category, locates a future building protection zone to avoid a driveway of longer than 70m from the road frontage to a habitable building;	**a. All proposed lots have direct access onto the new internal road** **b. Can comply - No lots adjoin potentially hazardous vegetation.** **c. Can comply – driveways do not exceed 70m.** **d. Not applicable**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	d. in a rural category, provides for an alternative access where the private access roads or driveways are longer than 200m to reach a public road.		
PO18 Development ensures that the road layout and design provides: a. efficient emergency services access to sites and manoeuvring within the subdivision; b. safe and efficient movement of residents, workers and visitors out of the subdivision and away from an approaching bushfire; c. safe and efficient movement of emergency services into the subdivision; d. alternative egress routes considering the most likely bushfire scenarios; e. ongoing availability and maintenance of access and egress routes for the purposes of evacuation and emergency services access. Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.	AO18.1 Development involving a new road or fire maintenance trail is designed and constructed in compliance with: a. Table 8.2.5.3.C; or b. an approved bushfire management plan.	**To be assessed by relevant specialist.**	
	AO18.2 Development has a road layout and design which: a. provides for alternative access routes to the subdivision, by public roads that meet the requirements in Table 8.2.5.3.C and are able to access the arterial road network; b. excludes cul-de-sacs, except where a perimeter road with a cleared width of 20m isolates the development from hazardous vegetation; c. does not include dead-end roads or if a dead-end road is unavoidable, it is a maximum of 60m long, or 200m where located in the Environmental management zone, Conservation zone, Rural zone, or Rural residential zone, and an alternative emergency evacuation and egress route		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	away from the most likely source of bushfire risk is provided for lots where multiple road access or exit points are not possible; d. links road within the subdivision to, or provides for future links to roads in adjacent subdivisions. Note—Where staged development occurs or development is in accordance with an approved master plan, a temporary perimeter road may be considered, subject to availability of reticulated water supply.		
PO19 Development involving new premises provides adequate infrastructure to support fire fighting.	AO19.1 Development involving new premises ensures that: a. lots have access to reticulated water supply and water pressure available for fire-fighting requirements with water supply and pressure that accord with the standards specified by the relevant utilities provider; or b. where reticulated water supply is not available for: i. residential lots, there is a minimum water supply available and retained for fire-fighting purposes in compliance with Table 8.2.5.3.B, which may be in the form of a separate tank or a reserve section as part of a main water supply tank; ii. development other than residential lots, onsite water storage is provided which is appropriate to the proposed future use according to the standards specified by the relevant emergency services agency and is not less than 5,000 litres.	**S5 Environmental understand that each proposed lot will be connected to a reticulated water supply network, with appropriate water supply and pressure characteristics.**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS	COMMENTS	COUNCIL USE ONLY
		✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable		
	Note—Water supply for fire-fighting is in addition to water supply for household use. Where a non-reticulated supply of water is required, swimming pools, creeks and dams should not be used as a substitute for a dedicated static supply as these sources of water are not reliable during drought conditions.			
	AO19.2 Development provides fire hydrants in accordance with Central SEQ Distributor-Retailer Authority, Queensland Urban Utilities (incorporating Water Services Association of Australia) standards.	**S5 Environmental understand that Fire Hydrants will be installed as required by relevant standards throughout the proposed subdivision.**		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS / COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
Section D—If for accepted development subject to compliance with identified requirements (acceptable outcomes only) or assessable development where in Potential impact sub-category			
PO20 Development is designed and constructed to reduce vulnerability to bushfire attack and addresses the bushfire hazard by a bushfire hazard assessment that: a. utilises a fit for purpose methodology prepared in accordance with the State Planning Policy – State interest technical manual – Natural hazards, risk and resilience; b. includes the following measures and inputs: i. potential fuel loads for vegetation in its mature state from areas subject to revegetation or regrowth vegetation; ii. a published vegetation hazard classification dataset from the relevant fire authority; iii. forest fire danger index of 54 (AEP 5%);	AO20.1 Development is designed and sited in compliance with an approved bushfire management plan relevant to the full nature of the uses, which identifies the level of future bushfire hazard and the location of future hazardous vegetation affecting the development. Note—The Bushfire planning scheme policy provides advice about the sources of information to be consulted to determine areas subject to revegetation or regrowth vegetation and the hazard classification of that vegetation in its mature state.	**NA The site is not within a Potential impact sub-category area**	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	SOLUTIONS	COMMENTS	COUNCIL USE ONLY
		✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable		
iv. potential flame length; v. potential rate of fire spread. c. is undertaken by a person suitably qualified and experienced with technical expertise in the field of bushfire hazard identification and mitigation, including protection of biodiversity values; d. determines the relevant bushfire attack level for that part of the site in which development is proposed. Note—The Bushfire planning scheme policy provides advice about the sources of information to be consulted to determine areas subject to revegetation or regrowth vegetation and the hazard classification of that vegetation in its mature state.	AO20.2 Development other than ROL determines bushfire attack level using: a. potential fuel loads for vegetation in its mature state from areas subject to revegetation or regrowth vegetation; Note—In the absence of an approved rehabilitation and revegetation plan refer to Figure d—Regional ecosystem vegetation communities. a. a published vegetation hazard classification dataset from the Relevant fire authority; b. forest fire danger index of 54 (AEP 5%). Note—Revegetation and regrowth vegetation may be planned within the Potential impact sub-category on both private and public lands. The level of bushfire hazard posed by any areas subject to revegetation or regrowth vegetation is to be assessed as if that area had reached its mature state. A 'low' bushfire attack level must not be assumed in these locations even where the area is non-vegetated or vegetation is considered low threat in accordance with AS 3959-2009 Construction of buildings in bushfire-prone areas. The Bushfire planning scheme policy provides advice about the sources of information to be consulted to determine areas subject to revegetation or regrowth vegetation and the hazard classification of that vegetation in its mature state.			

APPENDIX B

Flamesol Inputs and Outputs

Summary of Input Parameters for Hazardous Vegetation to the South-east

Parameter	Input	Note
FFDI	55	Source: QFES Catalyst Mapping.
Surface Fuel Load	16 t/ha	VHC 16.1 total fuel load.
Overall Fuel Load	26 t/ha	Surface fuel load, plus 10 tonnes/ha in accordance with the BCC Technical Guideline.
Effective Slope	0 º	The slope under the hazardous vegetation does not change, as such 0 º has been used.
Site Slope	0 º	The eastern extent of the proposed development sits at an equal elevation to the hazardous vegetation.
Flame Temperature	1,090 K	Standard input, in accordance with the AS3959-2018.
Flame Width	100 m	Standard input, in accordance with the AS 3959-2018.

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Calculated June 15, 2022, 2:59 pm (MDc v.4.9)

46 Kraft Road, Pallara

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	55	Rate of spread	1.05 km/h
Vegetation classification	Forest	Flame length	9.98 m
Understorey fuel load	16 t/ha	Flame angle	53 °, 64 °, 72 °, 77 °, 79 ° & 84 °
Total fuel load	26 t/ha	Elevation of receiver	3.98 m, 4.48 m, 4.74 m, 4.86 m, 4.9 m & 4.96 m
Vegetation height	n/a	Fire intensity	14,185 kW/m
Effective slope	0 °	Transmissivity	0.881, 0.866, 0.845, 0.822, 0.8090000000000001 & 0.74
Site slope	0 °	Viewfactor	0.5938, 0.4366, 0.2937, 0.1992, 0.162 & 0.0443
Flame width	100 m	Minimum distance to < 40 kW/m²	8.300000000000001 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	11.3 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	16.7 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	24.2 m
		Minimum distance to < 10 kW/m²	29.1 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

Flamesol Calculator Outputs for Required Setbacks for Classifiable Vegetation to the South-East