ATTACHMENT 9

Bushfire Management Plan

BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

202 Baileys Mountain Road, Upper Coomera

Client: MG Land C/- Urban Strategies
Reference: S523094_BHAMP_v1.5
Date: 27 February 2025

Table of Contents

ABBREVIATIONS IV
1.0 INTRODUCTION 1
2.0 STATUTORY REQUIREMENTS 4
2.1 Development Applications in Bushfire Prone Areas 4
3.0 METHODOLOGY 5
3.1 Bushfire Hazard Assessment 5
3.2 Modification of Potential Intensity of Small Patches and Corridors 6
3.3 Radiant Heat Exposure Assessment 6
3.4 Short Fire Run 7
4.0 BUSHFIRE HAZARD ASSESSMENT 9
4.1 Potential Fire-line Intensity Assessment 9
4.2 Hazardous Vegetation 14
5.0 BUSHFIRE ATTACK LEVEL ASSESSMENT 15
6.0 BUSHFIRE MANAGEMENT PLAN 17
6.1 Bushfire Behaviour 17
6.2 Bushfire Damage Sources 18
6.3 Management and Mitigation Measures – Permanent Buildings 19
7.0 CONCLUSION 23
8.0 REFERENCES 24
APPENDIX A: BUSHFIRE HAZARD OVERLAY CODE RESPONSE 26
APPENDIX B: FLAMESOL INPUTS AND OUTPUTS 39
APPENDIX C: SLOPE LINES AND CALCULATIONS 43

Figures

Figure 1. Site Aerial (source: Nearmap, date: 13/11/23) 2

Figure 2. Extract of Site Layout (source: Red Door Architecture, drawing no. 23008, DA-010, rev. 22, Review Issue dated: 28/08/24)....3

Figure 3 CoGC Bushfire Hazard Mapping within and in Proximity to the Site 4

Figure 4 Schematic diagram of simple elliptical fire growth model (Van Wagner 1969) from NSW Rural Fire Surface (2019) 8

Figure 5. Extract of Vegetation Hazard Classes from Catalyst....9

Figure 6. Modified Vegetation Hazard Classes based on Ground-truthed Conditions and Future Land Use. 12

Figure 7. Slope in Proximity to the Proposed Development 13

Figure 8. Potential Fire Line Intensity 14

Figure 9. BAL Setbacks....15

Figure 10. Effects of Topography on Bushfire (source: Country Fire Authority) 17

Figure 11. Fire Danger Rating (source: source: QFES [updated: 2023])....18

Figure 12. Ember Attack (source: Country Fire Authority) 18

Figure 13. Radiant Heat (source: Country Fire Authority)....19

Figure 14. Bushfire Management Zone 21

Tables

Table 1. Site Description....1

Table 2 Potential Bushfire Intensity Classification 5

Table 3 Steps to Downgrade Bushfire Intensity....6

Table 4 BAL and Radiant Heat Exposure....6

Table 5 Parameter inputs for Method 2 from AS3959-2018 7

Table 6 Summary of VHCs and their Associated Fuel Continuity and Loads....12

Table 7. Summary of Setbacks and BAL Scores for the Proposed Development 15

Table 8. BAL Requirement for Proposed Lots 16

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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
CoGC	City of the Gold Coast
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
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 Urban Strategies, on behalf of their client MG Land, to undertake a Bushfire Hazard Assessment and Management Plan (BHAMP) as supporting documentation for a Development Application for a Reconfiguring a Lot (Boundary Realignment 2 into 2), Material Change of Use (Multiple Dwelling – Townhouses) and Operational Works (Changes to Ground Level and Vegetation Clearing) at 202 Baileys Mountain Road, Upper Coomera, further described as Lot 13 on RP835832. Refer to Table 1.

The aim of this BHAMP 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 not exposed to an unacceptable bushfire risk and can comply with the relevant legislative bushfire requirements.

Table 1. Site Description

Address	202 Baileys Mountain Road, Upper Coomera	RPD	Lot 58 on SP191940
LGA	City of Gold Coast (CoGC)	Site Area	3.08 ha (post-boundary realignment)
Zone	Rural residential	Tenure	Freehold
Current State	Lot 58 on SP191940, herein referred to as the 'subject site', is a modified lot containing a dwelling on the south-western extent, accessed via an unsealed driveway. Yaun Creek waterway is situated south of the existing residence in the south-eastern extent of the lot. The subject site and southern and north-western adjacent lots are zoned as Rural residential, with Medium density residential lots to the north-west. Refer to Figure 1, below.		
Proposed Development	S5 Environmental understand that the proposed development is for DA will be for Reconfiguring a Lot (Boundary Realignment 2 into 2), Material Change of Use (Multiple Dwelling – Townhouses) and Operational Works (Changes to Ground Level and Vegetation Clearing), for a 73-townhouse development. The development will include a boundary realignment with the western adjacent property. The northern extent of the site is proposed as a road reserve, with an eastern portion of the site proposed as a future road/land dedication to CoGC. The southern extent of the site is proposed as a dedicated park, which will undergo rehabilitation. Refer to S523094_BRMP_001-005(B) for the Basic Rehabilitation Management Plan (BRMP). A 5 m recreation link pathway will separate the rehabilitated dedicated park with the development footprint, which includes the townhouses, internal roads, and a		

	bio-basin. Refer to Figure 2, for the proposed development site boundary post-boundary realignment.
Potentially Hazardous Vegetation	Post development, potentially hazardous vegetation is situated to the south-west of the subject site. This vegetation has been mapped as category B under the Vegetation Management Act, with a Regional Ecosystem (RE) of 12.3.11, 12.11.24 and 12.11.27. These REs are described as follows: RE 12.3.11: *Eucalyptus tereticornis* ± *Eucalyptus siderophloia*, *Corymbia intermedia* open forest on alluvial plains usually near coast; RE 12.11.24: *Eucalyptus tindaliae*, *E. carnea*, *Corymbia intermedia* ± *E. siderophloia* or *E. crebra*, *Corymbia citriodora* subsp. *variegata* woodland on metamorphics ± interbedded volcanics; and RE 12.11.27: *Eucalyptus racemosa* subsp. *racemosa* and/or *E. seeana* and *Corymbia intermedia* woodland on metamorphics ± interbedded volcanics.

Figure 1. Site Aerial (source: Nearmap, date: 13/11/23)

Figure 2. Site Plan of Layout
(source: Red Door Architecture, drawing no. 23008, DA-010, rev. C, 21/01/25)

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 (SPP) 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. It is understood that the CoGC *Planning Scheme 2022* has appropriately integrated all aspects of the SPP, including the Safety and Resilience to Hazards (Natural Hazards, Risk and Resilience – Bushfire) State Interest. As such, only the CoGC planning scheme mapping and overlay code apply to a proposed development within this local government area. The CoGC Bushfire hazard overlay map was consulted to determine the preliminary bushfire hazard ratings of the site and locality (within 150 m of the proposed development), refer to Figure 3 below.

The CoGC Bushfire hazard overlay has mapped a patch of native vegetation as Medium potential bushfire intensity, whilst the balance of the subject site has been mapped as Potential impact buffer. Numerous patches of native vegetation throughout the assessment area have similarly been mapped as Medium Potential Bushfire Intensity, with much of the remaining assessment area being mapped as Potential impact buffer. A patch of native vegetation to the south of the subject site has been mapped as Very High Potential Bushfire Intensity.

Figure 3 CoGC Bushfire Hazard Mapping within and in Proximity to the Site

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. PFLI is delineated into a number of hazard categories shown in Table 2, 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 2 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 150 m 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 4,000 kW/m and as such, are considered to be low hazard and not classed as a Bushfire Prone Area. The *SPP Technical Reference Guide - Bushfire Resilient Communities* (2019) summarises research by Leonard and Opie (2017) outlines four steps to filter out small patches and narrow corridors of continuous fuel (see Table 3, below).

Table 3 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, this calculation reflects the level of bushfire risk for a proposed development (see Table 4).

Table 4 BAL and Radiant Heat Exposure

BAL Score	Radiant Heat Exposure
Low	-
12.5	12.5 kW/m^2
19	19 kW/m^2

BAL Score	Radiant Heat Exposure
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 is one set of inputs for a Method 2 calculation in accordance with AS3959-2018 or Bushfire Resilient Communities (BRC) accepted by the CoGC. Inputs to the BAL/radiant heat exposure assessment include the sets of parameters as summarised in Table 5.

Table 5 Parameter inputs for Method 2 from AS3959-2018

Parameter	AS method 2
Surface fuel load (t/ha)	Surface fuel load for identified VHC (surface + near surface)
Overall fuel load (t/ha)	Total fuel load for identified VHC
Flame temperature	1200K
FDI/FFDI	From Catalyst/QSpatial
Standard inputs	Bushfire Resilient Communities (QG 2019)
Effective slope	Measured as the slope under the hazardous vegetation.
Site slope	Measured as the slope between the hazardous 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.

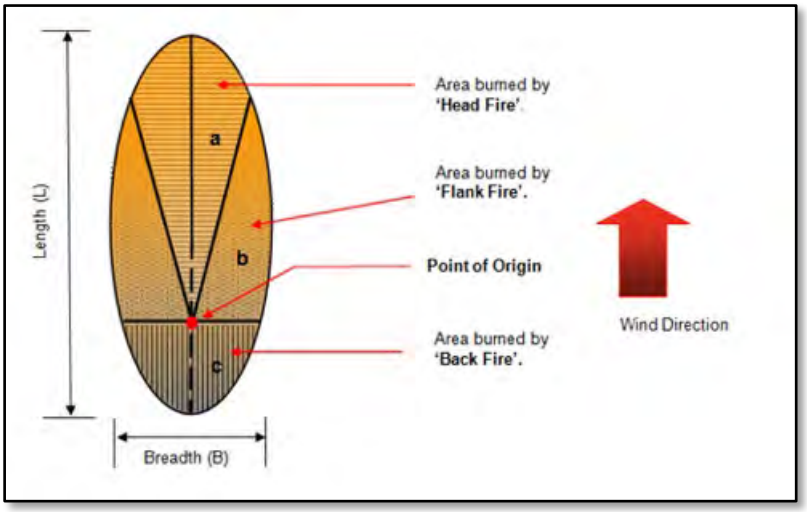

Figure 4 Schematic diagram of simple elliptical fire growth model (Van Wagner 1969) from NSW Rural Fire Surface (2019)

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 150 m of the proposed development and hazardous 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 5.

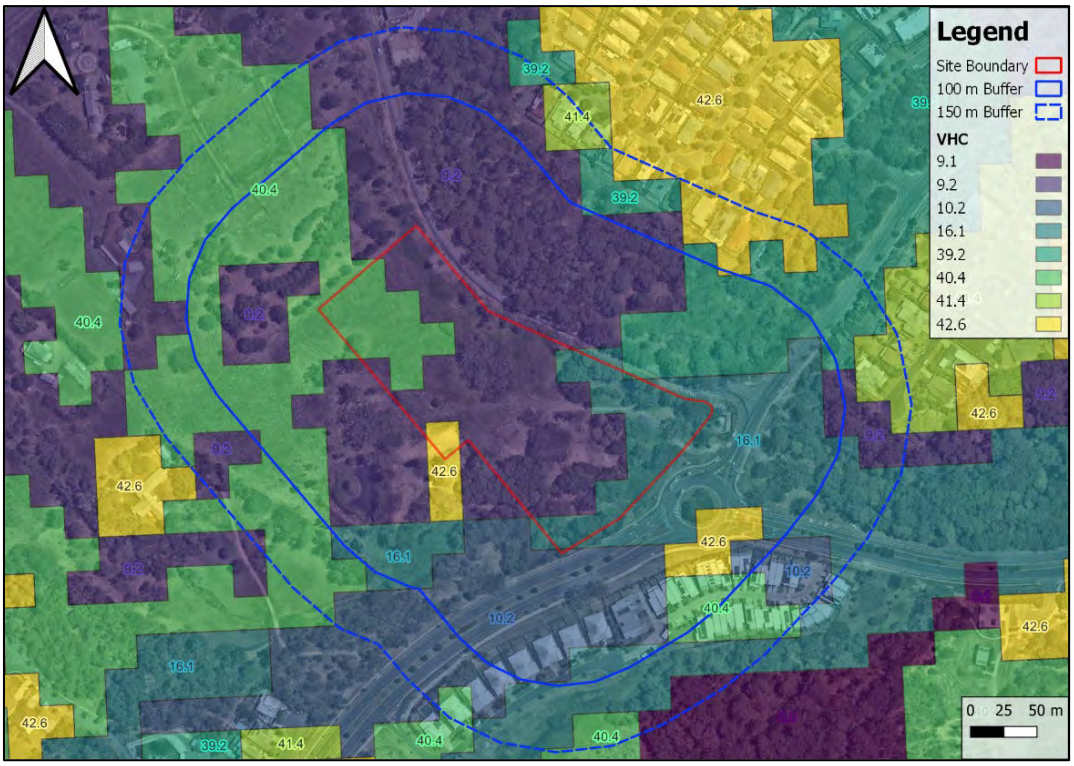

Figure 5. Extract of Vegetation Hazard Classes from Catalyst

4.1.2 Vegetation Hazard Class Verification

To ground-truth the State Government VHCs mapped within and adjacent to the subject site, S5 Environmental's Ecologists conducted a site visit on the 6th of June 2023 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.

Post development, the northern extent of the subject site will be developed for residential purposes and as such, the VHC within this area has been modified to VHC 39.2 '*Low to moderate tree cover in built-up areas.* This area also includes the bio-retention basin to the south of the dwellings. The road dedication, along the south-eastern boundary, has been conservatively modified to VHC 39.2 to represent the current state of the vegetation, however it is understood the area will eventually be cleared by Council for road widening activities. The south-western extent of the VHC 39.2 mapped area associated with the development extents into the adjacent with the site, as there is an agreement with the adjacent land owner that a patch to the south of the built area is to be maintained in a low fuel state as a Bushfire Management Zone. Vegetation within the southern extent of the site will undergo repatriation and has been ground-truthed as a mixed polygon of RE 12.3.1a and 12.3.11. As a conservative measure, this area has been mapped as the higher associated VHC of 16.1 '*Eucalyptus dominated forest on drainage lines and alluvial plains*'.

Outside the subject site, the native vegetation to the north and east has been mapped as VHC 16.1, reflecting the existing VHC mapping and ground-truthed conditions. A patch of VHC 9.1 '*Moist to dry eucalypt open forest on coastal lowlands and ranges'* has been mapped to the south of Reserve Road, reflecting the State VHC and Regional Ecosystem mapping.

Medium density housing to the north, east and south of the subject site has been mapped as VHC 39.2, to reflect the landscape state of the vegetation, with semi-rural lots to the north-west amended to VHC 40.4, to reflect the fairly continuous nature of low vegetation throughout these areas. The Reserve Road and Old Coach Road corridors to the south and east of the subject site have been modified to VHC 42.6, reflecting the limited extent of vegetation within the road corridor. Patches of VHC 40.4 were identified and modified to reflect ground-truthed conditions to the south and west of the subject site.

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 (see Figure 6). As spatially indicated in Figure 6, the modified VHCs have been restricted to a 150 m buffer from the subject site, as the more distant areas are not relevant for the purposes of this Bushfire Hazard Assessment. Refer to Plate 1 to Plate 6 below.

Plate 1 View of dense vegetation mapped as VHC 16.1 along the southern boundary (proposed rehabilitation).

Plate 2 Alternative view of native vegetation mapped as VHC 16.1.

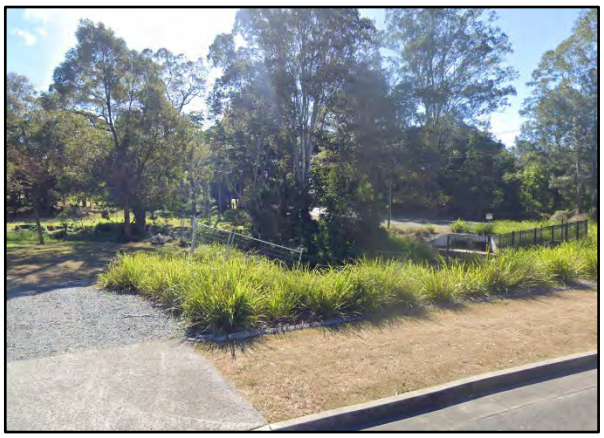

Plate 3 View of future road dedication area (VHC 39.2) (source: Google Maps 2021).

Plate 4 View of development area (VHC 39.2) (source: Google Maps 2021).

Plate 5 View of eastern vegetation across Baileys Mountain Road (VHC 16.1) (source: Google Maps 2021).

Plate 6 View of vegetation to the south of Reserve Road(VHC 9.1) (source: Google Maps 2021).

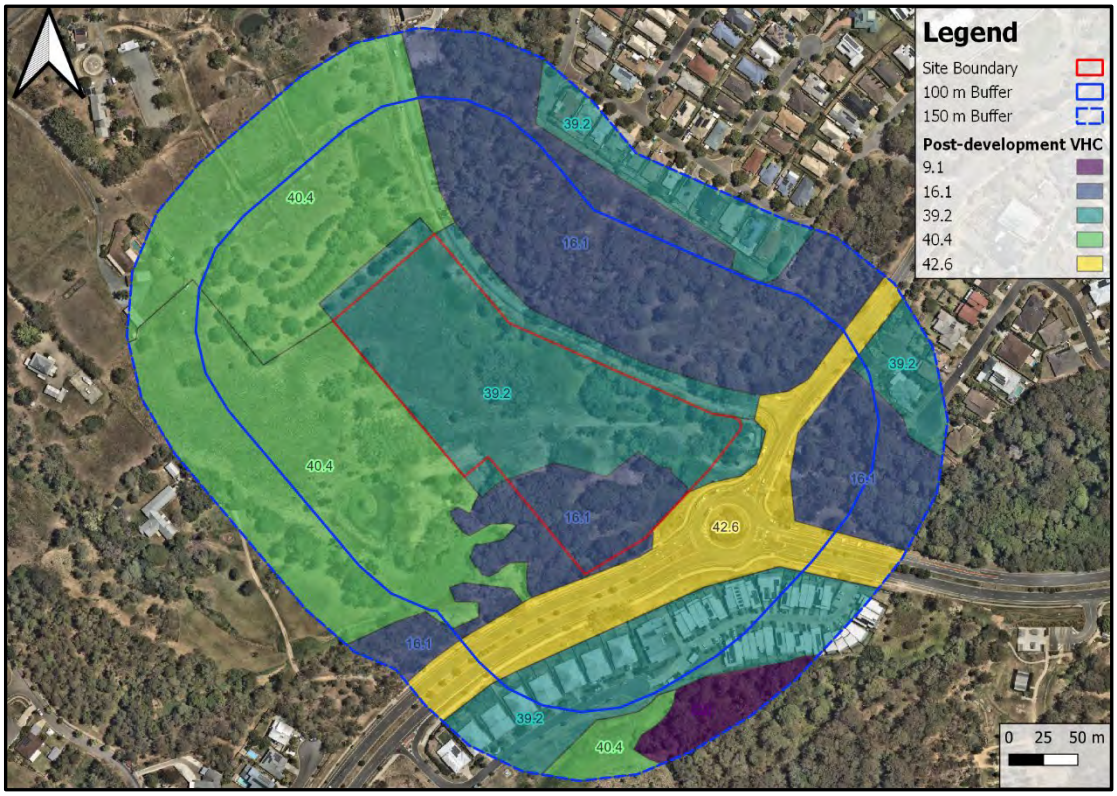

Figure 6. Modified Vegetation Hazard Classes based on Ground-truthed Conditions and Future Land Use.

4.1.3 Fuel Loads

Table 6 below, summarises the associated fuel-loads of the final VHCs in relation to the proposed development.

Table 6 Summary of VHCs and their Associated Fuel Continuity and Loads

VHC	VHC Description	Fuel Continuity	Potential Fuel Load * (t/ha)
			Total
9.1	Moist to dry eucalypt open forest on coastal lowlands and ranges	Continuous	24.2
16.1	Eucalyptus dominated forest on drainage lines and alluvial plains	Continuous	16.0
39.2	Low to moderate tree cover in built-up areas	Discontinuous	8
40.4	Continuous low grass or tree cover	Continuous	5
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.

4.1.4 Modification of Potential Intensity of Small Patches and Corridors

S5 Environmental have investigated the application of the processing stages and have identified that steps 1 to 4 do not apply to the proposed development as there are no small patches or corridors within 150 m of the proposed development.

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. Hazardous vegetation to the west and south is approximately level to the proposed development, whilst hazardous vegetation to the east is located slightly upslope. Refer to Figure 7.

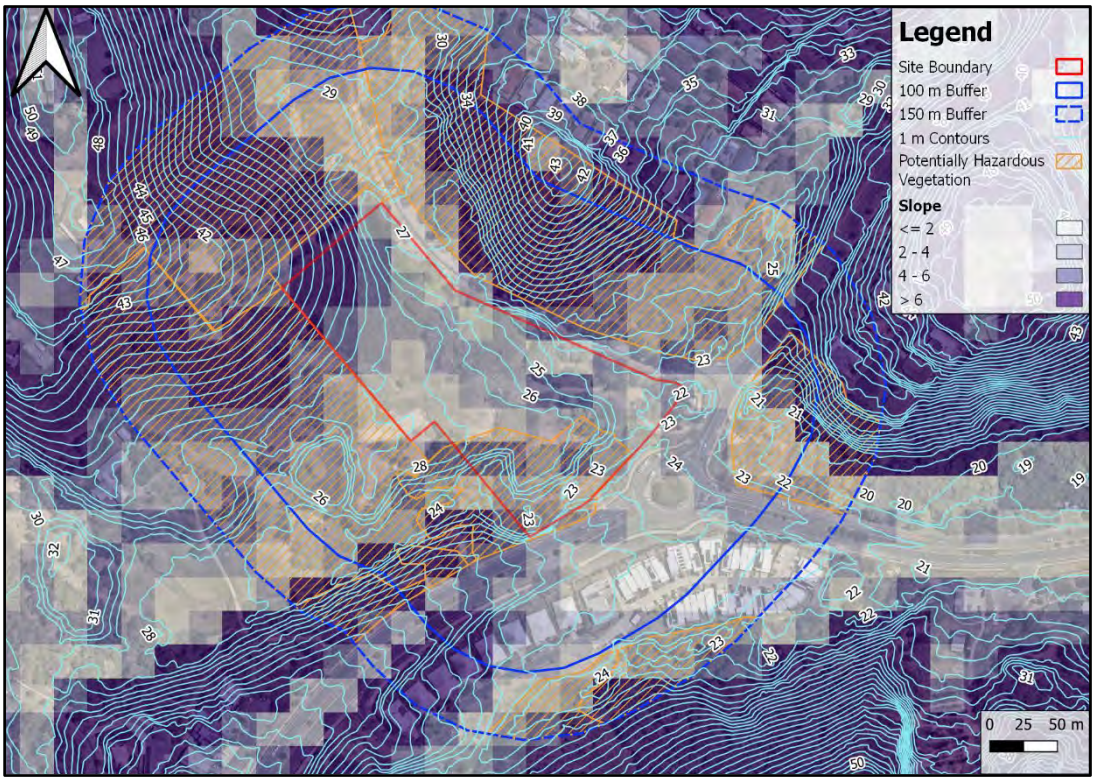

Figure 7. Slope in Proximity to the Proposed Development

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 53.

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 associated with VHC 16.1 within the southern extent of the subject site, as well as that located to the north-east and east of the site, was mapped to contain areas of Medium and High PFLI (i.e., 4,000 to 40,000 kW/m^2). The potentially hazardous vegetation to the south of the subject site, mapped as VHC 9.1, was mapped to contain areas of Medium and High (i.e., 4,000 to 40,000 kW/m^2). The balance of the assessment area, including areas mapped as VHC 40.4 has been mapped to contain Low PFLI (i.e. > 4,000 kW/m^2), and is therefore non-hazardous. Refer to Figure 8.

4.2 Hazardous Vegetation

Vegetation mapped as VHC 16.1 within the southern extent of the subject site, as well as that to the north-east and east of the subject site was determined to be the only hazardous vegetation. Vegetation mapped as VHC 9.1 to the south of the subject site was greater than 100 m from the development, and therefore was not considered hazardous to the proposed townhouse development. As vegetation mapped as VHC 16.1 is within 100 m of the development area, the proposed townhouse development 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 townhouse development may be exposed to, and what BAL score and subsequent building requirements the development will have to adhere to.

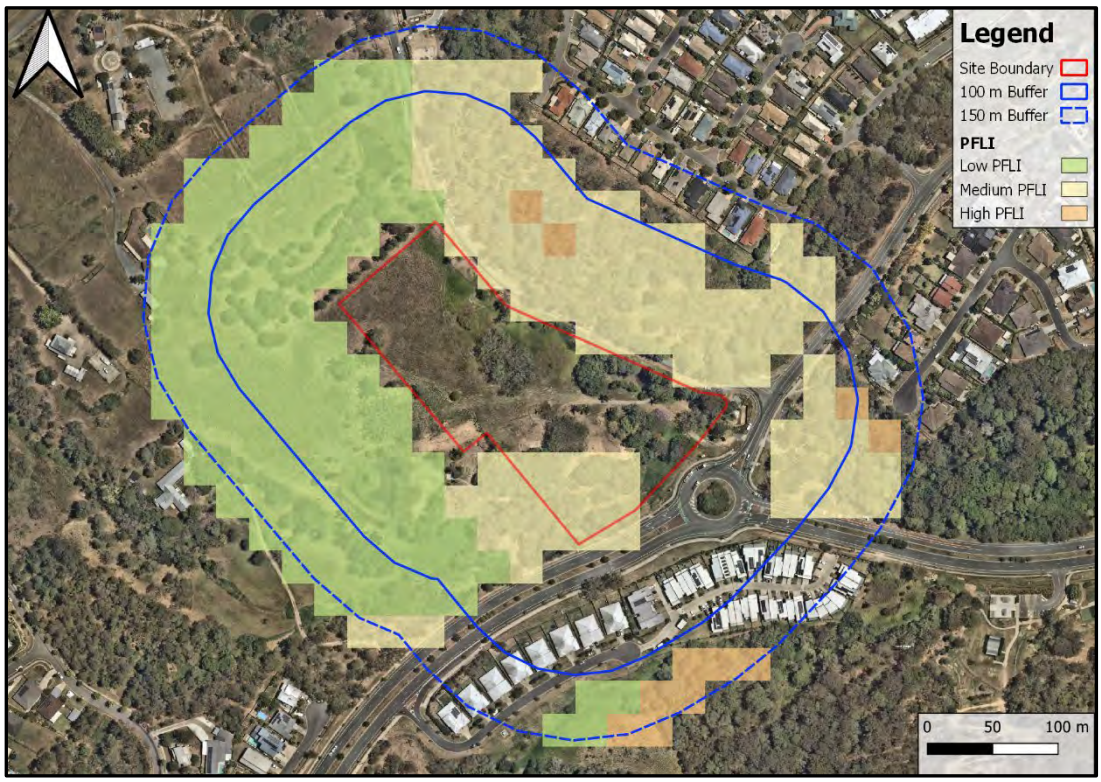

Figure 8. Potential Fire Line Intensity

5.0 BUSHFIRE ATTACK LEVEL ASSESSMENT

This Bushfire Attack Level assessment has focused on the potential impact of a fire event in hazardous vegetation located within 100 m of the subject site. Hazardous vegetation in relation to the proposed development was determined to be the vegetation to the north, east and south of the proposed development (refer to **Figure** 8). A Method 2 assessment in accordance with AS3959-2018 utilising the Flamesol Minimum Distance Calculator was undertaken to determine the required setbacks from hazardous (see **Table** 7). Refer to **Appendix B** for inputs and outputs from the Flamesol Minimum Distance Calculator.

Table 7. Summary of Setbacks and BAL Scores for the Proposed Development

Radiant Heat Exposure (kW/m²)	BAL	Setbacks Required from Hazardous Vegetation		
		North	East	South
-	LOW	100 m	100 m	100 m
12.5	12.5	23.3 m	27.9 m	22.1 m
19	19	17.4 m	19.5 m	16.8 m
29	29	12.5 m	13.2 m	12.3 m
40	40	9.5 m	9.7 m	9.4 m
> 40	FZ	< 9.5 m	< 9.7 m	< 9.4 m

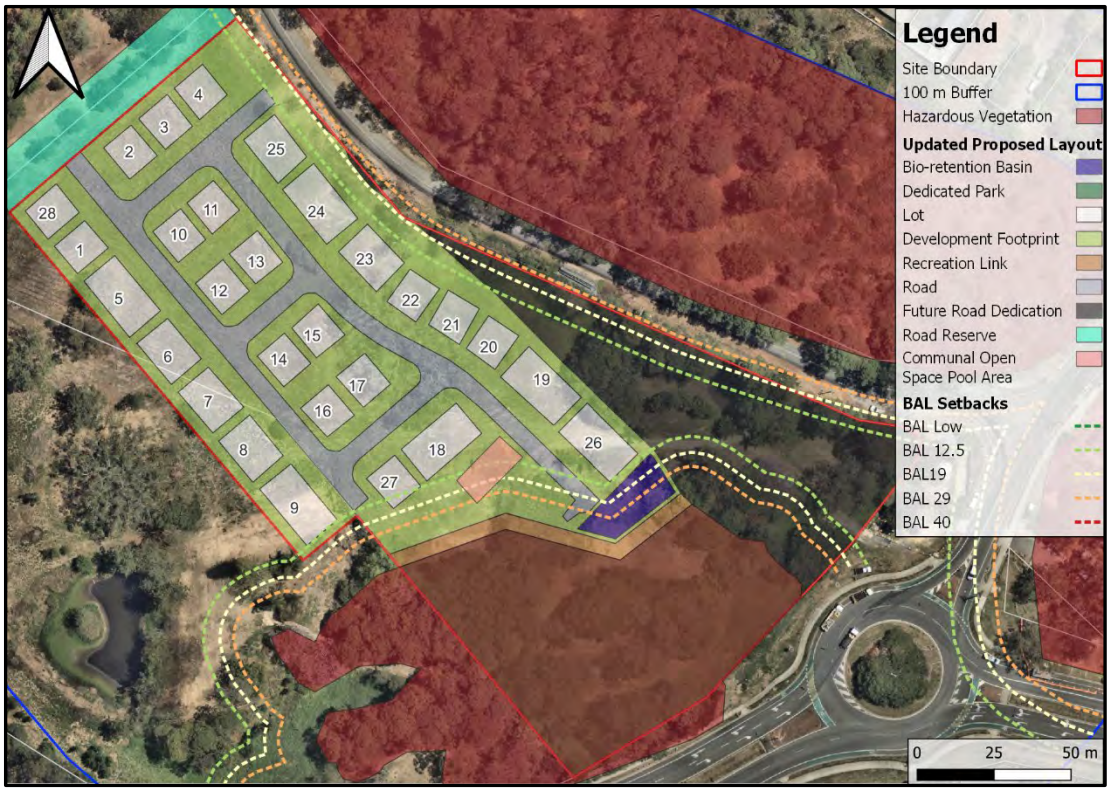

Figure 9. BAL Setbacks

Each townhouse grouping was numbered so as to differentiate them and identify their applicable BAL scores (refer to Figure 9). Based on the results of the radiant heat exposure assessment, townhouse groupings 1-8, 10-17 and 20-25 will achieve a BAL score of 12.5. The remaining townhouse groupings, 9, 18 and 19 achieve a BAL score of 19 with the southern edge of group 9 and the south-western corners of group 18 and 19 just inside the BAL 19 contour. Refer to Table 8, below. Accordingly, a Bushfire Management Plan has been prepared and presented in Section 6.0.

Table 8. BAL Requirement for Proposed Lots

Townhouse Groupings	Applicable BAL Score
1-26 and 28	BAL 12.5
27	BAL 19

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 Figure 10, below.

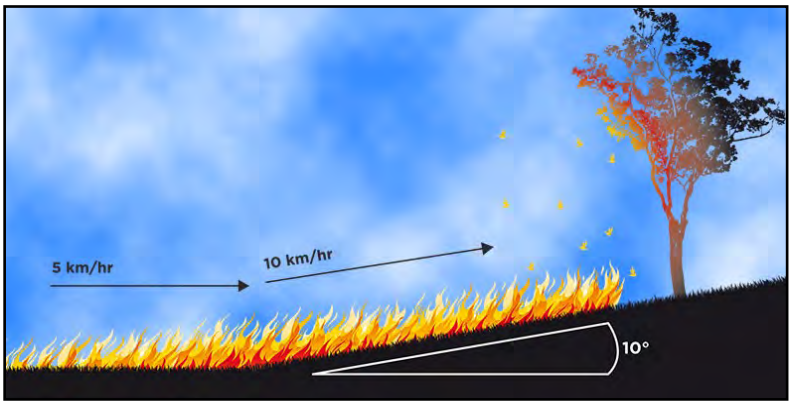

Figure 10. Effects of Topography on Bushfire (source: Country Fire Authority)

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 Figure 11).

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.

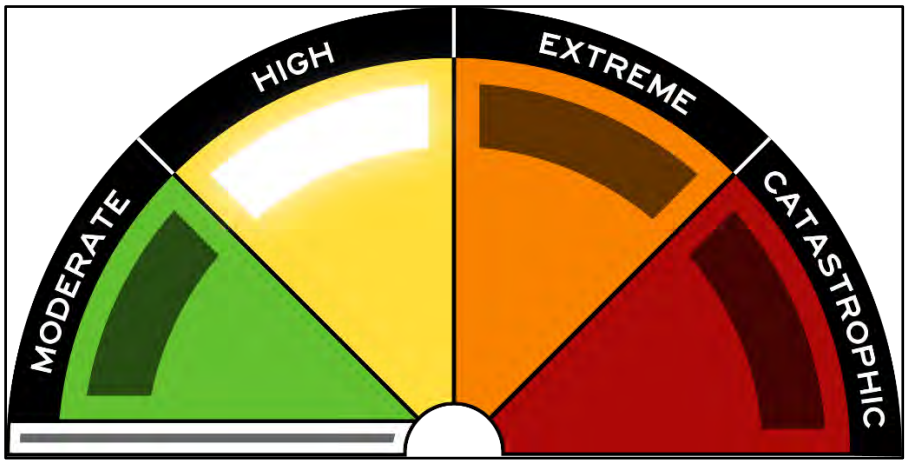

Figure 11. Fire Danger Rating (source: source: QFES [updated: 2023])

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.

<u>Ember Attack</u>

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 Figure 12, below). Ember attack is addressed within the AS 3959-2018 through Construction Standard requirements.

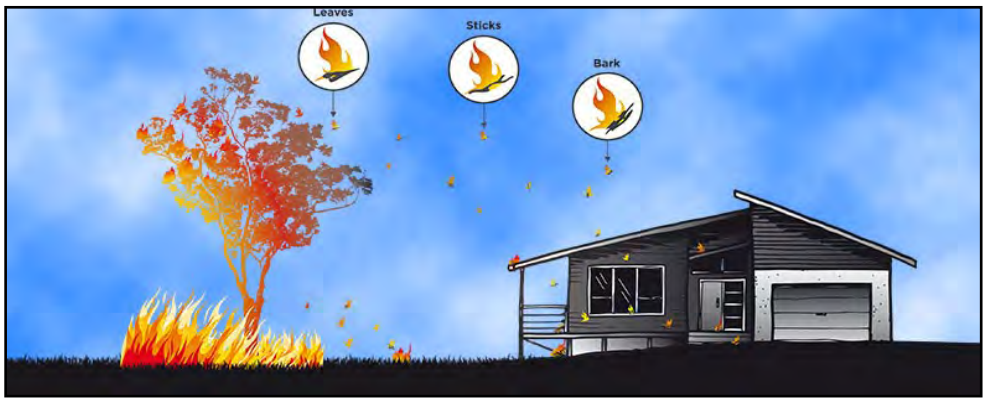

Figure 12. Ember Attack (source: Country Fire Authority)

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 Figure 13, below). The most common cause of loss of human life is via radiant heat (CFA, 2018).

Figure 13. 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

The proposed townhouse development will gain access via a crossover which ill adjoin a new road adjacent the northern boundary. S5 Environmental recommend constructing the internal road to meet the requirements as outlined within AO6.1 of the CoGC Bushfire hazard overlay code and within SC6.11 City Plan policy – Land development guidelines, Section 2 – Transport network standards. This will ensure that the internal road will be appropriately constructed to carry emergency fire-fighting appliances and provide emergency evacuation during a bushfire event.

Siting of Development

The proposed townhouse development is situated within 100 m of potentially hazardous vegetation to the south-west. As mentioned above, townhouse groups 1-8, 10-17 and 20-25 will achieve a BAL score of 12.5, whilst townhouse groups 9, 18 and 19 are located just inside the BAL 19 zone contour. These BAL scores have been modelled utilising the Flamesol BAL Minimum Distance Calculator (refer to Appendix B). The siting of the development is considered to ensure the proposed development is exposed to an acceptable level of bushfire risk.

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 development must adhere to the relevant BAL construction Standards based on their location. Refer to Table 8.

Fencing erected within 20 m of any building within the development will be constructed out of non-combustible or fire-retardant materials. Additionally, fencing will be designed to facilitate the safe movement of fauna and will provide access to the site for fire-fighting purposes.

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 Pimpama Fire and Rescue Station is located on the neighbouring Lot, to the south-east of the subject site, approximately 190m away (by road). The contact details for the Pimpama Fire and Rescue Station are:

- Address: 1 Cox Road, Pimpama 4209
- Phone: (07) 5549 8500

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

S5 Environmental further recommend new occupants are provided with a copy of the most up to date Bushfire Management Plan, complete with the Queensland Fire and Emergency Services cover sheet for their information.

Bushfire Management Zone

A Bushfire Management Zone (BMZ) is proposed to the north of the southern hazardous vegetation, largely associated with the rehabilitated dedicated park. The BMZ begins north of the recreation link (cement bikeway). The BMZ is to be buffered approx. 21-24 m off the hazardous vegetation to the south, and will ensure that Townhouse Groups 9, 18 and 26 can achieve a BAL 12.5 score, with Townhouse Group 27 also achieving a BAL 19 score. The BMZ will include a portion of cleared land on the adjacent property, communal open space and pool area and the bio-basin. No trees are proposed to be retained within the BMZ.

Planting within the bio-basin must consist of low-flammability species, such as mat-rushes (*Lomandra* spp.), and must be regularly monitored for accumulation of leaf matter and woody debris. Organic mulch is not to be used within the BMZ; S5 Environmental recommend groundcover planting density be increased in this area so mulch can be replaced with native grasses and sedges. Any grass within the BMZ must not exceed 10 cm in height. Low fuel canopy species can be planted in the BMZ, but there must be vertical and horizontal separation between species. The BMZ partially falls within the realigned Lot 57 SP214370. We understand the future intent of this area to be a continuation of the LGIP recreational link and a proposed stormwater basin. Applying the above recommendations will ensure the BMZ is maintained in a low fuel state. Refer to Figure 14 below.

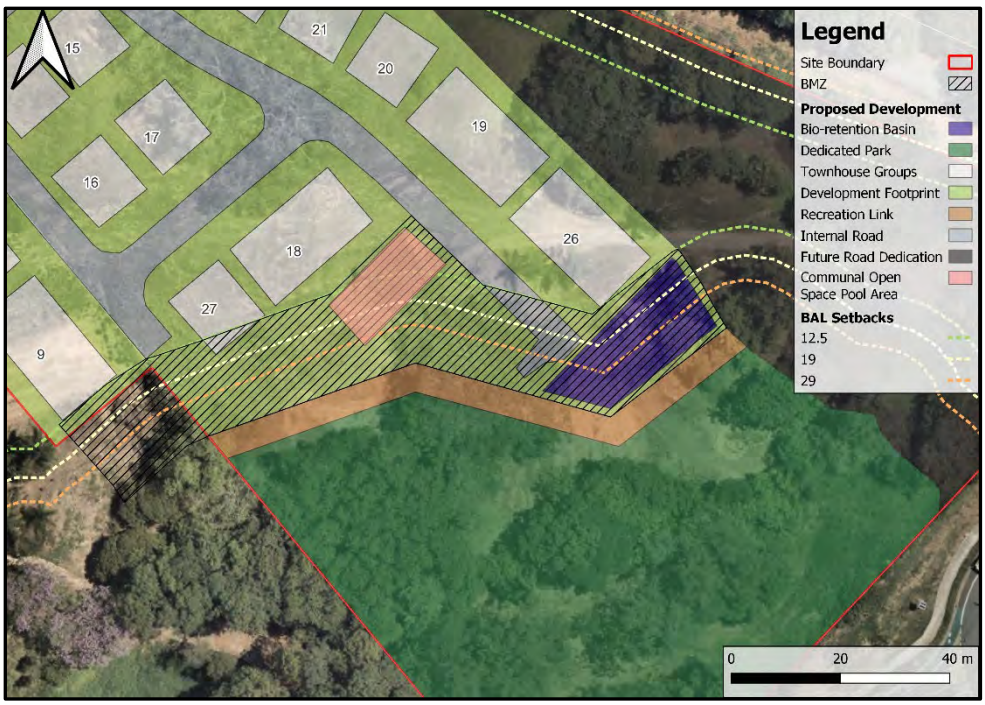

Figure 14. Bushfire Management Zone

Landscaping

Throughout the entity of the development, S5 Environmental recommend that Townhouse owners and Body Corporate 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 buildings' 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 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 to the south-west. The AS 3959-2018 Bushfire Attack Level assessment for the proposed multiple dwelling development determined Townhouse Groups 1-26 and 28 will achieve a BAL score of 12.5, with Townhouse Group 27 achieving a BAL score of 19. Accordingly, all buildings exposed to BAL 12.5 or greater will have to adhere to the relevant construction requirements set out in AS 3959-2018.

S5 Environmental have prepared a site-specific Bushfire Management Plan has to support the proposed residential subdivision, which recommends key mitigation measures to be implemented to ensure the risk to people, infrastructure and property is acceptable and minimised.

Overall, the proposed development complies with the relevant CoGC bushfire related assessment benchmarks, refer to Appendix A.

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APPENDIX A

Bushfire Hazard Overlay Code Response

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
Bushfire Hazard			
PO1 In a bushfire hazard area, the fire mitigation methods used at the site are adequate for the bushfire hazard of the individual site, having regard to: (a) vegetation type; (b) slope; (c) aspect; (d) bushfire history; (e) conservation values of the site; (f) ecological restoration, including forest succession; (g) ongoing maintenance; (h) climate change; and (i) on site and off-site1 fire hazard implications. Note: This includes potential hazard from land up to 10kms away from the site. For example, how might large tracts of forest away from the site impact on the bushland that surrounds the site.	AO1 A written assessment by a suitably qualified and experienced bushfire management consultant confirms that the site is not in a bushfire hazard area. OR The development complies with an approved Bushfire management plan prepared in accordance with SC6.3 City Plan policy – Bushfire management plans. OR The development complies with an existing approved Bushfire management plan as referenced within the approved reconfiguration of a lot. Note: Prior to: (a) plan sealing for a Reconfiguration of a lot; or (b) the issue of a Building final or Certificate of classification for Building work; or (c) the commencement of use where building work is not proposed. Whichever comes first, the applicant must submit to Council, certification from an appropriately qualified and experienced person that the development has been completed in accordance with, and complies with the approved Bushfire management plan and that all risk treatments are functioning in accordance with the approved plan.	Complies S5 Environmental have prepared a Bushfire Management Plan in accordance with SC6.3 City Plan Policy. S5 Environmental are of the understanding the proposed development will comply with the recommendations as outlined within this Bushfire Management Plan.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
Land Use			
PO2 In a bushfire hazard area, development: (a) does not result in a high concentration of people living, working, or congregating in a bushfire hazard area; (b) does not result in the bulk manufacture or storage of hazardous materials; and (c) 'essential' community infrastructure is able to function effectively during and immediately after a bushfire event.	AO2 The following land uses are not located in a bushfire hazard area: (a) Child care centre; (b) Community care centre; (c) Community use; (d) Development involving the manufacture or storage of hazardous material in bulk; (e) Educational establishment; (f) Hospital; (g) Residential care facility; (h) Retirement facility; (i) Rooming accommodation; (j) Sport and recreation uses; (k) Tourist attraction; (l) Tourist park; and (m) Utility installation (waste management facilities). AND In a bushfire hazard area permitted essential community infrastructure is designed to function effectively during and immediately after bushfire events, as demonstrated in a Bushfire management plan. Note: A Bushfire management plan prepared by a suitably qualified person and in accordance with SC6.3 City Plan policy – Bushfire management plans is Council's preferred method for addressing this acceptable outcome.	Not Applicable S5 Environmental understand the proposed land use will be for a townhouse development.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
Development design and lot layout			
PO3 In a bushfire hazard area, developments, including lot layout are designed to avoid bushfire hazard and provide safe sites for people, property and buildings. Editor's note – The development should be located: (a) away from the most likely direction of a fire front (refer Figure 8.2.3-1: Preferred house site location in bushfire hazard areas); and (b) so that elements of the development least susceptible to fire are sited closest to the bushfire hazard.	AO3 Development, Lots and/or building envelopes are not located within bushfire hazard areas. OR The development is located in accordance with the approved Bushfire management plan as referenced within the approved reconfiguration of a lot. OR The development is designed to adequately demonstrate that the risk to life and property is minimised to achieve acceptable levels and ensure ongoing site management.	Complies S5 Environmental are of the opinion that the development has been adequately designed to minimize bushfire risk with BAL 19 being the maximum BAL rating achieved by the townhouse development.	
	AO3.2 The development design incorporates bushfire radiation zone/s that: (a) use existing or natural fire breaks & minimise the need to clear native vegetation; (b) do not impact matters of environmental significance; (c) are located entirely within the boundaries of the private property of the development site; and (d) incorporates landscaping species that are less likely to exacerbate a bushfire event.	Complies The development proposed rehabilitation of areas identified as matters of environmental significance (i.e., areas associated with Yaun Creek), while also achieving a suitable setback. The townhouse group 27 within proximity of the rehabilitation area to the south, is able to achieve a BAL 19 based on the proposed layout. A BMZ is proposed to ensure townhouse group 27 can achieve a BAL 19, and groups 9, 18 and 26 can achieve a BAL 12.5.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
		The maintained BMZ will include the 5 m wide recreation link, a portion of cleared land on the adjacent property, open areas within the proposed development and partial areas of the bio-basin. No trees are proposed to be retained within the BMZ. S5 Environmental have additionally recommended the implementation of low flammability landscaping throughout the development to minimize overall bushfire risk of the proposed development. This is outlined within the BMZ and Landscaping section of the Bushfire Management Plan. The BMZ partially falls within the realigned Lot 57 SP214370. We understand the future intent of this area to be a continuation of the LGIP recreational link and a proposed stormwater basin. This will ensure the BMZ is maintained in a low fuel state.	
PO4 In a bushfire hazard area, when designing for bushfire hazard mitigation the lot layout must avoid impacts on matters of environmental significance.	AO4 Development design, Lot size, and layout avoids impact on matters of environmental significance and minimises impacts such as fragmentation, habitat loss and edge effects for any matters of environmental significance.	Not Applicable Outside the scope of this report.	
PO5 Development uses fencing that:	AO5 Fences are constructed:	Complies	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
(a) does not contribute to the spread of bushfire; (b) facilitates the safe movement of fauna; and (c) provides access for fire-fighting purposes.	(a) using non-combustible or fire retardant materials within 20m of any building used for accommodation; (b) that do not impede the safe movement of fauna (where applicable); and (c) has gates that can be freely accessed for fire-fighting purposes (if applicable).	(a) S5 Environmental have recommended that fences constructed within the proposed development be constructed out of non-combustible material; (b) The development proposes appropriate fencing. If fencing is to be installed on the east and western boundary of the rehabilitation area, fencing to be fauna friendly fencing; and (c) As per the BRMP, the rehabilitation area fencing is to install a self-closing access gate, which can be utilised for firefighting (if needed).	
Vehicular Access			
PO6 In a bushfire hazard area, vehicular access (including internal roads) is designed to mitigate against bushfire hazard by ensuring adequate access for: (a) fire-fighting and other emergency vehicles, and (b) the evacuation of residents and emergency personnel, during a bushfire event.	AO6.1 The development design incorporates a perimeter road that: (a) is located between the boundary of the lots and/or buildings and the adjacent natural area and/or bushfire hazard area; (b) has a minimum cleared width of 20m; (c) has a constructed minimum road width of 6m; (d) has a maximum gradient of 12.5%; (e) is constructed to an all-weather standard; and (f) is constructed to ensure all culverts and bridges have a minimum load bearing of 15 tonnes (if applicable). (refer Figure 8.2.3-2b).	Performance Solution It is acknowledged that the development does not propose a perimeter road. A BMZ is proposed between the townhouses and the hazardous vegetation (rehabilitation area to be dedicated to CoGC as a park). The BMZ incorporates a recreation link and other maintained areas and will function as a sufficient low flammability setback. The development can comply with cleared heights, road widths, gradient and standard requirements. No culverts are proposed as part of the development.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	AO6.2 The road design is capable of providing access for fire-fighting and other emergency vehicles, in accordance with SC6.11 City Plan policy – Land development guidelines, Section 2 – Transport network standards.	Complies S5 Environmental have recommended that the proposed road will be constructed to the construction standards in accordance with SC6.11 and hence will provide access for firefighting and other emergency vehicles.	
	AO6.3 The road design does not include dead end roads (refer Figure 8.2.3-2a).	Performance Solution The proposed layout includes 3 dead end road designs. These areas are in proximity to 'T' or 'Y' style intersection, which will allow for which will allow for additional turning space, if required. S5 Environmental are of the opinion that the dead end will not increase the bushfire risk for the proposed development.	
Clearing			
PO7 In a bushfire hazard area, the development layout is designed to avoid the requirement to clear vegetation to achieve risk reduction.	AO7 The Bushfire management plan details the required extent of vegetation clearing and landscaping and where required modify development design and/or lot layout to minimise clearing of vegetation. Note: For guidance on how to prepare a Bushfire management plan refer to SC6.3 City Plan Policy – Bushfire management plans.	Complies S5 Environmental understands the development does not propose to clear additional vegetation to reduce its overall level of bushfire risk.	
Open space management plan			

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
PO8 For areas to be dedicated to Council as open space, management strategies to mitigate bushfire risk must be identified.	AO8 The Bushfire management plan contains a separate section detailing management strategies for areas to be dedicated to Council that can be included within the Open space management plan. Note: For guidance on how to prepare a Bushfire management plan refer to SC6.3 City Plan Policy – Bushfire management plans.	Not Applicable The proposed development does not included areas of open space to be dedicated to council.	
Fire trails			
PO9 In a bushfire hazard area, fire trails must be provided to: (a) enable access for fire fighters, residents and equipment; (b) contribute to (where required) bushfire radiation zone(s); (c) mitigate against bushfire hazard; and (d) allow access for hazard reduction management programs. Note: fire trails should be located, constructed and maintained with due regard for landscape and ecological values and should not result in soil disturbance or erosion.	AO9.1 Fire trails are located on public land (including public open space areas) to facilitate access for fire brigades. OR Fire trails located on private property are located as close as possible to the property boundaries and the adjoining bushfire hazard area, and an access easement is granted in favour of City of Gold Coast and Queensland Fire and Emergency Services. Note: Design and construction of all fire trails located on land to be dedicated to the City as Conservation Estate are in accordance with SC6.3 City Plan policy – Bushfire management plans, Section 3.5(f). For other fire trails, AO9.2 – AO9.6 apply.	Performance Solution No fire trial is proposed as part of the development, however a BMZ is proposed adjacent the hazardous area. Once the road dedication has been dedicated to Council, the recreation link will directly adjoin the site boundary and road corridor area. The recreation link will be 5 m in width, with adjacent maintained area of approx. 1.5 m, totaling at minimum approx. 6.5 m of available area accessible from a public road corridor for firefighting purposes. No culverts are proposed within the site. The BMZ can comply with vertical clearance, crossfall, width and maximum gradient.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	AO9.2 The fire trail has: (a) a minimum cleared width of 6m; (b) a minimum of 4.8m vertical clearance; (c) across fall of no greater than 10 degrees; (d) a minimum formed width of 4m; (e) a maximum gradient of 12.5%, with adequate drainage to prevent soil erosion and minimise ongoing trail maintenance; and (f) culverts and/or bridges with a minimum load bearing of 8 tonnes (if applicable).	Currently the BMZ and recreation link do not continue to the west, however, adjacent development is expected which will provide continued access and separation adjacent potentially hazardous vegetation. The BMZ and recreation link within the site is approx. 112 m and provides turning opportunities given the adjacent open space within the site.	
	AO9.3 Vehicular links are provided along the fire trail either to existing fire trails or roads, and these links are designed having regard to the topography of the site, fire fighter safety and the need to regularly access water supplies. Note: where possible, these links should be at intervals of approximately 200m		
	AO9.4 The fire trail has vehicular access at each end, and links either to existing fire trails or public roads.		
	AO9.5 The fire trail provides turning areas for fire-fighting appliances. The turning bay can be either: (a) a turning circle;		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	(b) a 'T' shaped turning bay; or (c) a 'Y' shaped turning bay.		
	AO9.6 The fire trail provides areas for vehicles to pass or turn at intervals of not more than 200m and with a maximum grade of 5% (1 in 20).		
Areas with water reticulation			
PO10 In a bushfire hazard area, the development maintains the safety of people and property by ensuring that the water supply is reliable and has sufficient flow and pressure requirements for fire-fighting purposes at all times.	AO10.1 The development is proposed in a bushfire hazard area, and reticulated water is supplied in accordance with SC6.11 City Plan policy – Land development guidelines, Section 6 – Water supply and sewerage reticulation standards.	Complies S5 Environmental understand the proposed development will be connected to a reticulated water source which meets the flow and pressure requirements as outlined within AO10.2.	
	AO10.2 Development involving new or existing buildings with a gross floor area of greater than 50m2, each lot has a reliable reticulated water supply that has sufficient flow and pressure characteristics for fire-fighting purposes at all times. It must have a minimum pressure and flow of 10 litres a second at 200 kPa.		
Areas with no water reticulation (private water supply)			
PO11	AO11.1	Not Applicable	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
In a bushfire hazard area, the development maintains the safety of people and property by ensuring that an adequate water supply for fire-fighting purposes is provided.	For development with a combined GFA less than 500m2 where one or more buildings are proposed, dedicated fire-fighting water storage is provided to protect each individual building. Each dedicated fire-fighting water storage must have a volume of water not less than 10,000 litres for each building, be provided within 10m of each building and be: (a) a separate tank that is either below ground level or of non-flammable construction; or (b) a reserve section in the bottom part of the main water supply tank that is either below ground level or of non - flammable construction. Note: dedicated fire-fighting water storage is in addition to water supply for household use and does not include swimming pools, creeks and dams.	The proposed development will be connected to a reticulated water supply.	
	AO11.2 For development that proposes one or more buildings with a combined GFA greater than 500m2 there is no acceptable outcome provided.		
PO12 In a bushfire hazard area, all fire-fighting water storage tanks, including domestic water supply tanks, are fitted with the standard rural fire brigade fittings.	AO12 The outlet pipe is 50mm in diameter, fitted with a 50mm male camlock (standard rural fire brigade fitting) and an isolating valve.	Not Applicable S5 Environmental understand the proposed development will be connected to a reticulated water supply.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
PO13 In a bushfire hazard area, water storage provided for fire-fighting purposes is safely located and accessible at all times.	AO13.1 The water supply outlet is located at least 9m from any potential fire hazards, such as venting gas bottles and combustible structures.	Not Applicable S5 Environmental understand the proposed development will be connected to a reticulated water supply.	
	AO13.2 A safe and accessible hard stand area capable of accommodating a fire fighting vehicle is provided not more than 3m from the water supply outlet.		
PO14 Development in a bushfire hazard area must provide adequate fire-fighting water storage. This infrastructure must be provided on public land so as to be readily accessible to fire brigades for hazard reduction and fire-fighting purposes.	AO14.1 Where public water supplies (e.g. fire hydrants or public water storage) do not exist, water supply tanks are provided for fire-fighting purposes on public land within the development. The water tanks must: (a) Be installed on land dedicated to Council; (b) hold a volume of at least 22,500 litres per every 20 dwellings; (c) be of concrete construction; and (d) have an outlet pipe of 50mm in diameter, fitted with a 50mm male camlock (standard rural fire brigade fitting) and an isolating valve.	Not Applicable S5 Environmental understand the proposed development will be connected to a reticulated water supply.	
	AO14.2 Development on public land provides a safe and accessible hardstand area capable of accommodating a fire fighting vehicle not more than 3m from the water supply outlet.		

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
Storage of Hazardous Materials			
PO15 Development does not cause: (a) an unacceptable risk to people, property and the environment due to the impact of bushfire on hazardous chemicals; (b) excess danger or difficulty to emergency services for emergency response or evacuation.	AO15 Development involving the storage, handling or manufacture of hazardous chemicals is not located within a Bushfire hazard area.	Not Applicable S5 Environmental understand the proposed use is for a townhouse development, which will not involve the storage, handling, or manufacture of hazardous chemicals.	
Advice to new residents			
PO16 In a bushfire hazard area, new residents/occupants of a development in a bushfire hazard area are informed about: (a) the potential bushfire hazard on their site; (b) their responsibility for fire management; (c) the measures required for ongoing fire hazard mitigation; and (d) emergency procedures during a bushfire or on bad fire weather days. Editor's note - Further information on bushfire preparation can be found at www.ruralfire.qld.gov.au	AO16 A copy of the Bushfire management plan, complete with the Queensland Fire and Emergency Services cover sheet and any other addendums is provided to each resident/occupant for their information. Note: the QFES cover sheet is attached to the approved Bushfire management plan and a notification will be placed on the property's rates notice.	Complies S5 Environmental have outlined within the Bushfire Management Plan that new residents are to be provided with a copy of this bushfire management plan with the Queensland Fire and Emergency Services cover sheet.	

APPENDIX B

Flamesol Inputs and Outputs

Summary of Input Parameters for Hazardous Vegetation to the North

Parameter	Input	Note
FFDI	53	Source: QFES Catalyst Mapping
Surface Fuel Load	13.8 t/ha	Surface fuel load for VHC 16.1 (surface + near surface)
Overall Fuel Load	16.0 t/ha	Total fuel load for VHC 16.1
Effective Slope	1 ^{o}	The slope under the hazardous vegetation slopes downslope towards the development. A minimum Effective Slope of 1 ^{o} was utilised.
Site Slope	1 ^{o}	Hazardous vegetation to the north-east is sited at the same level as the proposed development. A minimum Site Slope of 1 ^{o} was utilised.
Flame Temperature	1,200 K	Standard input, in accordance with the AS3959-2018.
Flame Width	100 m	Flame width is assumed to be 100 m (AS 3959-2018)

Calculated July 5, 2023, 2:43 pm (MDc v.4.9)

North

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	53	Rate of spread	0.9399999999999999 km/h
Vegetation classification	Forest	Flame length	8.029999999999999 m
Understorey fuel load	13.8 t/ha	Flame angle	65 °, 70 °, 74 °, 77 °, 78 ° & 84 °
Total fuel load	16.0 t/ha	Elevation of receiver	3.47 m, 3.55 m, 3.55 m, 3.5 m, 3.46 m & 2.99 m
Vegetation height	n/a	Fire intensity	7,773 kW/m
Effective slope	1 °	Transmissivity	0.878, 0.866, 0.849, 0.832, 0.823 & 0.769
Site slope	1 °	Viewfactor	0.4058, 0.2994, 0.1996, 0.134, 0.1085 & 0.029
Flame width	40.4 m	Minimum distance to < 40 kW/m²	9.5 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	12.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	17.4 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	23.3 m
		Minimum distance to < 10 kW/m²	26.8 m

Flamesol Calculator Outputs for Required Setbacks for Hazardous Vegetation to the North

Summary of Input Parameters for Hazardous Vegetation to the East

Parameter	Input	Note
FFDI	53	Source: QFES Catalyst Mapping
Surface Fuel Load	13.8 t/ha	Surface fuel load for VHC 16.1 (surface + near surface)
Overall Fuel Load	16.0 t/ha	Total fuel load for VHC 16.1
Effective Slope	1 ⁰	The slope under the hazardous vegetation slopes downslope towards the development. A minimum Effective Slope of 1 ⁰ was utilised.
Site Slope	1 ⁰	The land between the hazardous vegetation and development area slopes slightly upwards. A minimum Effective Slope of 1 ⁰ was utilised.
Flame Temperature	1,200 K	Standard input, in accordance with the AS3959-2018.
Flame Width	100 m	Flame width is assumed to be 100 m (AS 3959-2018)

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Calculated April 18, 2024, 8:42 pm (MDc v.4.9)

East

Minimum Distance Calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	53	Rate of spread	0.9399999999999999 km/h
Vegetation classification	Forest	Flame length	8.029999999999999 m
Understorey fuel load	13.8 t/ha	Flame angle	67 °, 73 °, 78 °, 82 °, 83 ° & 86 °
Total fuel load	16 t/ha	Elevation of receiver	3.52 m, 3.6 m, 3.58 m, 3.49 m, 3.4 m & 2.54 m
Vegetation height	n/a	Fire intensity	7,773 kW/m
Effective slope	1 °	Transmissivity	0.877, 0.863, 0.842, 0.82, 0.8070000000000001 & 0.745
Site slope	1 °	Viewfactor	0.4063, 0.2987, 0.2012, 0.1362, 0.1105 & 0.03
Flame width	100 m	Minimum distance to < 40 kW/m²	9.699999999999999 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	13.2 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	19.5 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	27.9 m
		Minimum distance to < 10 kW/m²	33.4 m

Flamesol Calculator Outputs for Required Setbacks for Hazardous Vegetation to the East

Summary of Input Parameters for Hazardous Vegetation to the South

Parameter	Input	Note
FFDI	53	Source: QFES Catalyst Mapping
Surface Fuel Load	13.8 t/ha	Surface fuel load for VHC 16.1 (surface + near surface)
Overall Fuel Load	16.0 t/ha	Total fuel load for VHC 16.1
Effective Slope	1 ⁰	The slope under the hazardous vegetation slopes downslope towards the development. A minimum Effective Slope of 1 ⁰ was utilised.
Site Slope	1 ⁰	Hazardous vegetation to the south is sited at the same level as the proposed development. A minimum Site Slope of 1 ⁰ was utilised.
Flame Temperature	1,200 K	Standard input, in accordance with the AS3959-2018.
Flame Width	100 m	Flame width is assumed to be 100 m (AS 3959-2018)

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Calculated July 5, 2023, 2:45 pm (MDc v.4.9)

South

Minimum Distance Calculator - AS3959-2018 (Method 2)

Inputs		Outputs	
Fire Danger Index	53	Rate of spread	0.9399999999999999 km/h
Vegetation classification	Forest	Flame length	8.029999999999999 m
Understorey fuel load	13.8 t/ha	Flame angle	64 °, 68 °, 72 °, 75 °, 77 ° & 83 °
Total fuel load	16.0 t/ha	Elevation of receiver	3.44 m, 3.5 m, 3.52 m, 3.49 m, 3.47 m & 3.05 m
Vegetation height	n/a	Fire intensity	7,773 kW/m
Effective slope	1 °	Transmissivity	0.878, 0.867, 0.851, 0.836, 0.827 & 0.774
Site slope	1 °	Viewfactor	0.4051, 0.2967, 0.1981, 0.1337, 0.1079 & 0.0288
Flame width	34 m	Minimum distance to < 40 kW/m²	9.4 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	12.3 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	16.8 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	22.1 m
		Minimum distance to < 10 kW/m²	25.3 m

Flamesol Calculator Outputs for Required Setbacks for Hazardous Vegetation to the South

APPENDIX C

Slope Lines and Calculations

Project: 202 Baileys Mountain Road, Upper Coomera
Number: S523094

S5 ENVIRONMENTAL

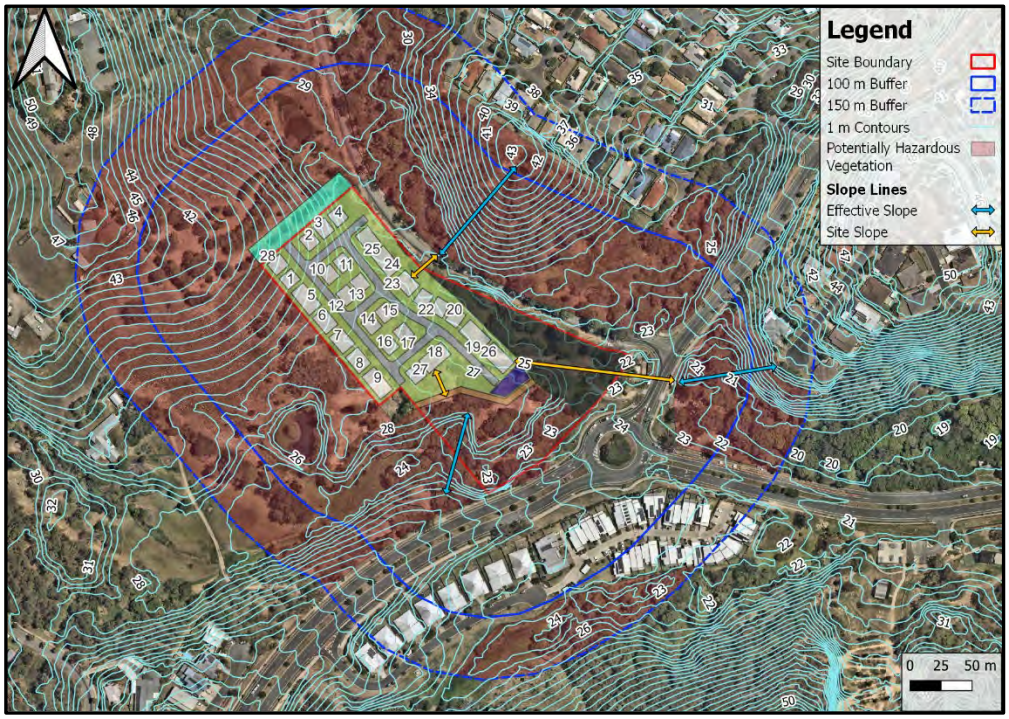
BUSHFIRE SLOPE CALCULATOR

North-east

Effective Slope						Site Slope					
Direction	Downslope					Direction	Flat				
Top Elevation	26	m				Top Elevation	26	m			
Bottom Elevation	43	m	Slope %	-18.09%		Bottom Elevation	26	m	Slope %	0.00%	
Distance	94	m	**Slope (˚)**	**-10.36**	1	Distance	28	m	**Slope (˚)**	**0.00**	1

East

Effective Slope						Site Slope					
Direction	Downslope					Direction	Upslope				
Top Elevation	22	m				Top Elevation	25	m			
Bottom Elevation	33	m	Slope %	-13.75%		Bottom Elevation	23	m	Slope %	1.43%	
Distance	80	m	**Slope (˚)**	**-7.88**	1	Distance	140	m	**Slope (˚)**	**0.82**	1

South

Effective Slope						Site Slope					
Direction	Upslope					Direction	Flat				
Top Elevation	27	m				Top Elevation	27	m			
Bottom Elevation	29	m	Slope %	-2.94%		Bottom Elevation	27	m	Slope %	0.00%	
Distance	68	m	**Slope (˚)**	**-1.69**	1	Distance	1	m	**Slope (˚)**	**0.00**	1