



**ENVIRONMENTAL**

# BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

20-46 Lindenthal Road, Park Ridge

Client: Bhavin Gandhi C/- JFP Urban Consultants  
Reference: S524144\_BHAMP\_v1.1  
Date: 21/01/25

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Version	Description	Date	Author	Reviewer	Approver
1.0	For Submission	21/01/25	JG (Env. Scientist)	RS (Director)	RS (Director)

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*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

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AHD	Australian Height Datum
AS 3959-2018	<i>Australian Standard 3959-2018 Construction of Buildings in Bushfire-prone Areas</i>
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BMP	Bushfire Management Plan
BMZ	Bushfire Management Zone
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	<i>State Planning Policy, 2017</i>
VHC	Vegetation Hazard Class

## 1.0 INTRODUCTION

S5 Environmental was commissioned by JFP Urban Consultants on behalf of their client, Bhavin Gandhi, to undertake a Bushfire Hazard Assessment and Management Plan (BHAMP) supporting documentation for a Development Application for a 1 into 14 lot residential subdivision, new road and drainage reserve at 20-46 Lindenthal Road, Park Ridge. 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**

<b>Street Address</b>	20-46 Lindenthal Road, Park Ridge	<b>RPD</b>	Lot 4 RP 815245
<b>LGA</b>	Logan City Council (LCC)	<b>Area</b>	10,010 m <sup>2</sup>
<b>Zone</b>	Emerging Community	<b>Tenure</b>	Freehold
<b>Current State</b>	<p>Lot 4 on RP815245, herein referred to as the 'subject site', is a moderately sized lifestyle lot which fronts onto Lindenthal Road to the west. A dwelling was observed within the sites north eastern corner, with several car ports and a larger shed identified through the centre and along the site's northern boundary. Access to these structures were achieved via two internal, unsealed driveways which connect onto Lindenthal Road to the west. Vegetation surrounding the structures within the northern extent of the site was observed to consist of landscaped canopy trees over a maintained grass understory. The landscape trees consisted predominantly of exotic and non-endemic species, with few native species scattered throughout. Numerous cars were parked throughout the northern half of the site.</p> <p>A fence was located approximately 10 m south of the shed within the centre of the site, separating the developed northern half and the undeveloped southern half of the site. The southern half of the site consisted of scattered patches of native canopy trees over a maintained slashed understory. Refer to <b>Figure 1</b>, below.</p>		
<b>Proposed Development</b>	<p>The proposed development is for a Reconfiguration of a Lot (RoL) for a 1 into 14 lot residential subdivision, new road and drainage reserve. The RoL will additionally include a drainage reserve basin within the southern extent (corner) of the site, as well as a minor dedication of approximately 843 m<sup>2</sup> to facilitate the widening of Lindenthal Road along the site's western boundary. Refer to <b>Figure 2</b>, below.</p>		
<b>Potentially Hazardous Vegetation</b>	<p>Post development, potentially hazardous vegetation is situated to the north-west and west of the subject site. This vegetation was mapped as a combination of Regional Rcosystem (RE) 12.9-10.4, 12.9-10.12, 12.9-10.17c and 12.5.3a, described as:</p> <p><b>RE 12.3.11:</b> <i>Eucalyptus racemosa subsp. racemosa woodland on sedimentary rocks;</i></p>		

RE 12.9-10.12: Mixed woodland usually containing *Corymbia intermedia*, *Angophora leiocarpa* and at least the presence of *Eucalyptus seeana* on sedimentary rocks;

RE 12.9-10.17c: *Eucalyptus acmenoides*, *E. major*, *E. siderophloia* +/- *Corymbia citriodora* subsp. *variegata* open forest on sedimentary rocks; and

RE 12.5.3a: *Eucalyptus racemosa* subsp. *racemosa* woodland on remnant Tertiary surfaces.



Figure 1. Site Aerial (source: Nearthmaps, date: 20/09/24)

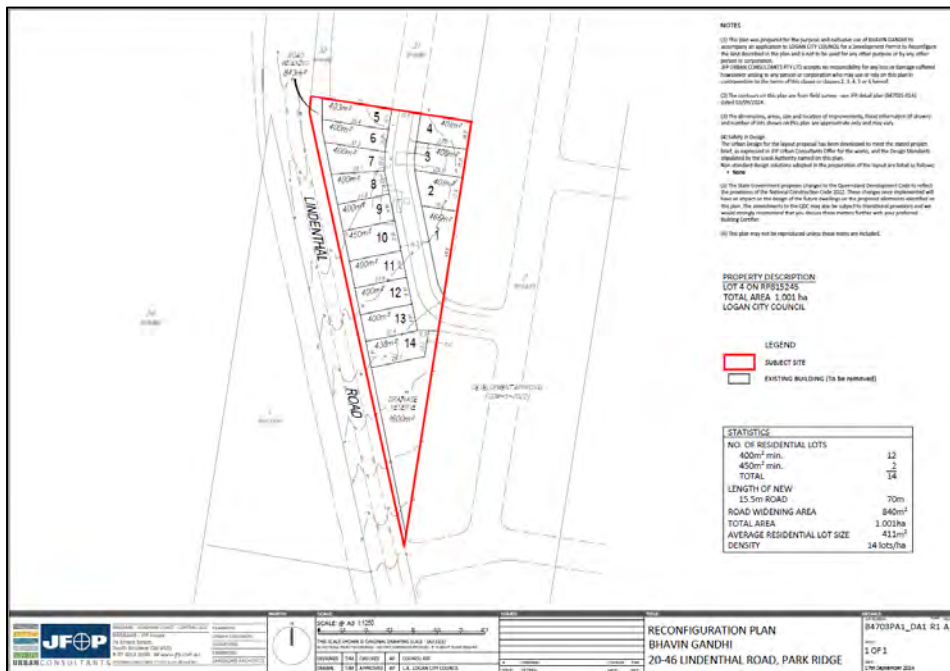


Figure 2. Reconfiguration Plan (source: JFP Urban Consultants, job no: B4703PA1\_DA1, plan: R1, issue: A, dated: 17-09-24)

## 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.

The LCC *Planning Scheme 2015* implements the Bushfire Hazard Overlay Code which acts as a development constraint within the LCC locality (**Appendix B**). It is understood that the *Planning Scheme 2015* has appropriately implemented all aspects of the SPP, including the Safety and Resilience to Hazards (Natural Hazards, Risk and Resilience – Bushfire) State Interest. Accordingly, the LCC Bushfire Hazard Overlay was consulted to determine the preliminary bushfire hazard ratings of the site and locality (within 150 m of the development footprint). Refer to **Figure 3**.

The LCC Bushfire Hazard Overlay has mapped patches of Medium Potential Bushfire Intensity to the north-east, south-east and south-west of the subject site. Potential Impact Buffer mapping extends off these patches of Medium Potential Bushfire intensity extent into the southern half of the subject site. The balance of the assessment area is unmapped.

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.

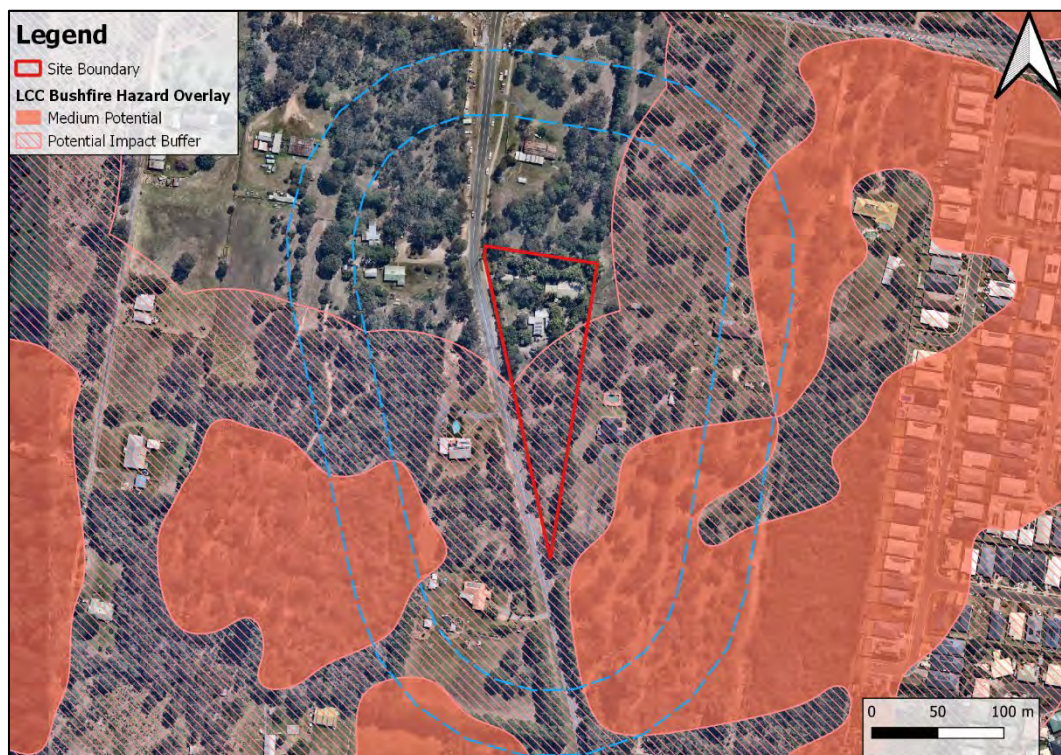


Figure 3 LCC Bushfire Hazard Mapping within and in Proximity to the Site

## 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 ( $\theta$  in  $^{\circ}$ ).

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

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 <b>continuous</b> 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 <b>continuous</b> vegetation surrounded completely by either discontinuous or no fuel, which is more than 100 m from other <b>continuous</b> fuel patches greater than 2 ha in area.
3	Remove narrow corridors of <b>continuous</b> fuel (50 m, or less in width). The process erodes, then dilates by 25 m in width all <b>continuous</b> fuel patches in relation to <b>discontinuous</b> 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**).

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.

Inputs to the BAL/radiant heat exposure assessment used for the purposes of this assessment include the sets of parameters as summarised in **Table 5**.

Table 4 BAL and Radiant Heat Exposure

BAL Score	Radiant Heat Exposure
Low	-
-	10 kW/m <sup>2</sup>
12.5	12.5 kW/m <sup>2</sup>
19	19 kW/m <sup>2</sup>
29	29 kW/m <sup>2</sup>
40	40 kW/m <sup>2</sup>
Flame zone (FZ)	> 40 kW/m <sup>2</sup>

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	1,200 K
FDI/FFDI	From Catalyst/QSpatial
Standard inputs	Bushfire Resilient Communities (QG 2019)
Effective slope	Measured as the slope under the hazardous vegetation. A minimum effective slope of 1 ° is utilised if vegetation is sloped uphill or is at the same elevation as the development footprint (flat) (AS 3959-2018; BRC). Effective slope is capped at 20 ° as per BRC.
Site slope	Measured as the slope between the hazardous vegetation and the site. A minimum site slope of 1 ° is utilised if vegetation is sloped uphill or is at the same elevation as the development footprint (flat) (AS 3959-2018; BRC). Effective slope is capped at 20 ° as per BRC.
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.

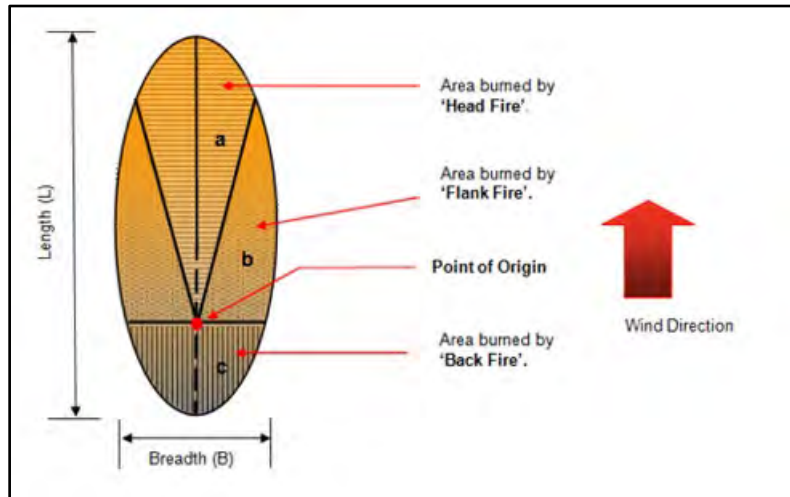


Figure 4. Schematic Diagram of Simple Elliptical Fire Growth Model (Van Wagner 1969) from NSW Rural Fire Surface (2019)

## 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 150m 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 – VHCs) 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**.

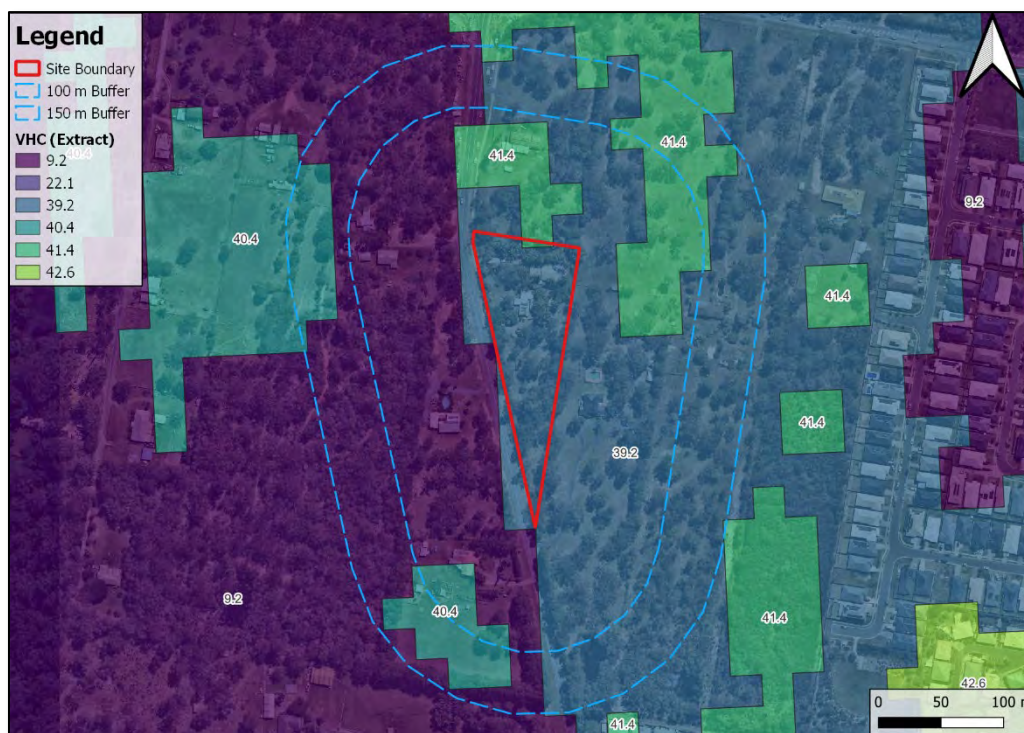


Figure 5. Extract of Vegetation Hazard Classes from Catalyst

#### 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 Senior Ecologist and Environmental Scientist conducted a site visit on the 11<sup>th</sup> of October 2024 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 was mapped by the State as VHC 39.2 '*Low to moderate tree cover in built-up areas*', which was determined to reflect the pre-clear conditions of the site. Post-development, much of the subject site will be developed and converted into increased density residential lots which will contain a reduced extent of vegetation. Accordingly, the development footprint for the proposed lot, internal road and road resumption (i.e., widening of Lindenthal Road) along the site's western boundary, have been modified to VHC 41.4 '*Discontinuous low grass or tree cover*'. A drainage reserve is proposed within the southern corner of the subject site, which has been conservatively modified to VHC 40.4 '*Continuous low grass or tree cover*' to reflect the potentially unmaintained state of vegetation within this area.

Outside the subject site, much of the assessment area to the north and east of the subject site was mapped by the State as VHC 39.2. This mapping was confirmed to reflect the current extent of vegetation throughout the adjacent lots within these directions and was retained within the post-development VHC mapping. A ROL application (COM-5-2022) has been approved for the lot immediately east of the subject site, identified as Lot 2 on RP164124. The balance of the site will be reconfigured into moderately sized residential lots which are serviced by an internal road. These lots and the internal road have been modified to VHC 41.4. The southern extent of this site has been earmarked for a local park and bioretention basin. The park has been modified to VHC 39.2 whilst the bioretention basin has been modified to VHC 40.4.

A corridor of VHC 9.2 '*Moist to dry eucalypt woodland on coastal lowlands and ranges*' was mapped by the State running north-south to the west of the subject site. This was more accurately modified to reflect the State Regulated Vegetation mapping, which identified two smaller patches of VHC 9.2 to the north-west and south-west of the site. Several small patches of VHC 39.2 were observed to the west of the site, with the balance of the western extent of the assessment area being modified to VHC 41.4, reflecting the discontinuous and maintained nature of vegetation within this area.

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.

**Plates 1 to 4** below show the various areas and communities existing across the site and throughout the assessment area.



**Plate 1** View through the southern extent of the subject site. This area has been modified from VHC 39.2 to 41.4 to reflect the proposed ROL.



**Plate 2** Looking south along the site's western boundary along Lindenthal Road. The road corridor has been modified to VHC 41.4, whilst the southern extent of the subject site has been mapped as 40.4.



**Plate 3** View of vegetation currently within the northern extent of the subject site. This has been modified to VHC 41.4 to reflect the future conditions of the site.



**Plate 4** View of scattered canopy trees over a maintained understory to the east of the site. This vegetation has been maintained as VHC 39.2.

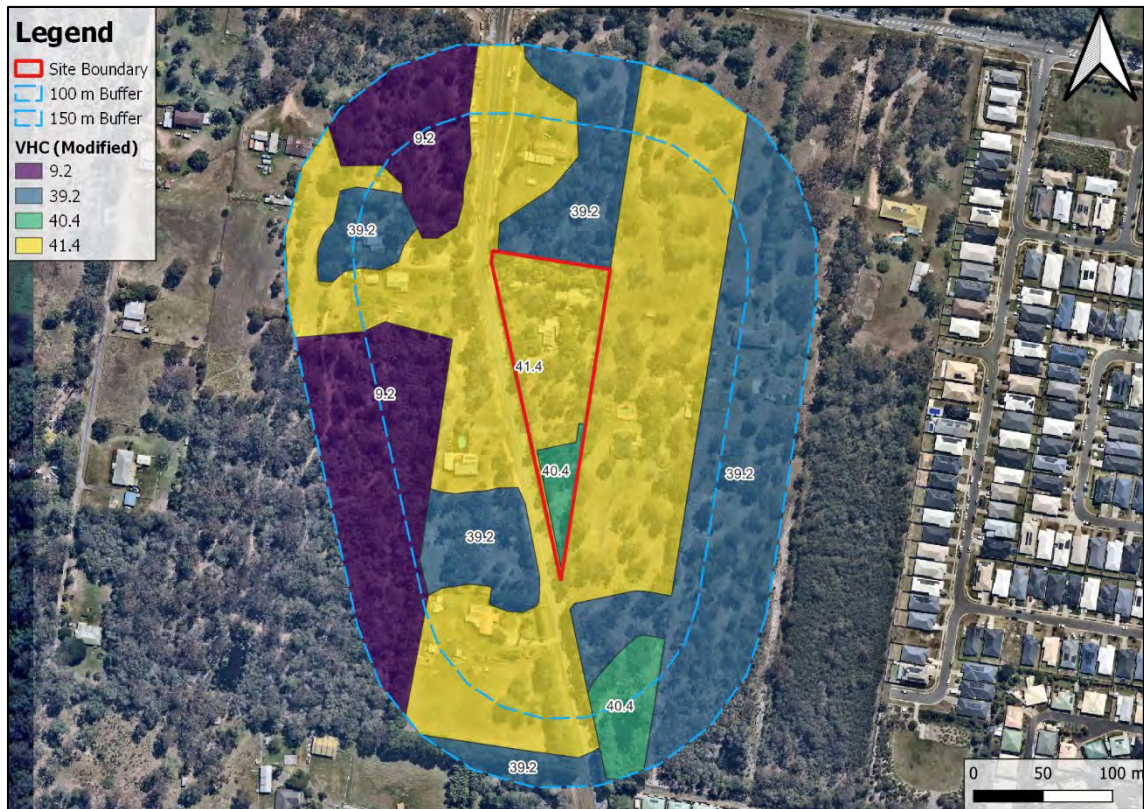


Figure 6. Ground-truthed and Post-development Vegetation Hazard Classes

#### 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
9.2	Moist to dry eucalypt woodland on coastal lowlands and ranges	Continuous	24.2
39.2	Low to moderate tree cover in built-up areas	Discontinuous	8
40.4	Continuous low grass or tree cover	Continuous	5
41.4	Discontinuous low grass or tree cover	Discontinuous	3

\*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.

After ground-truthing the VHCs within the assessment area, continuous VHCs were rasterized to undergo the processing stages. Continuous and discontinuous fuel VHCs are defined as:

- **Continuous:** Vegetation and land uses which possess generally consistent fuel loads which can develop a full flame front; and
- **Discontinuous:** Vegetation and land uses which possess fuel loads which are incapable of supporting a full flame front.

The rasterization process extracts the attribute value of the polygon which occupies the centre of the raster pixel (a 25 m by 25 m cell) and uses it to populate the same cell within a raster layer. This will result in continuous VHCs within the assessment area being rasterized whilst discontinuous VHCs remain unrasterized. Refer to **Figure 7**.

The radiant heat setbacks, as calculated in the AS 3959 2018 Method 2 radiant heat exposure assessment (refer to **Section 5.0**), will ultimately be setback off the 'smoothed' ground-truthed VHCs, not off the pixelated VHCs. The rasterization process is used to as a guide to identify and downgrade hazardous vegetation.

#### 4.1.4 Modification of Potential Intensity of Small Patches and Corridors

Following the rasterization of the continuous VHCs as outlined above (i.e., VHC 9.2 and 40.4), S5 Environmental have applied Step 3 in accordance with the downgrading stages outlined within both Leonard and Opie (2017) and Bushfire Resilient Communities (2017). Step 3 is separated into two parts:

- A. the shrinking of continuous fuel load pixels adjacent to discontinuous fuel loads (i.e., continuous fuel pixels adjacent to discontinuous fuel are removed); and
- B. the dilation of residual continuous fuel patches by one pixel (i.e., residual continuous fuel pixels are dilated back out one pixel).

This will result in the removal of narrow corridors less than 50 m in width, as following the initial shrinking of continuous fuel pixels adjacent to discontinuous vegetation (Step 3A), no residual pixels associated with the narrow corridor will remain and dilation cannot occur (Step 3B).

A narrow corridor of VHC 9.2 to the north-west of the subject site, as well as the continuous fuel associated with the drainage basin within the subject site and the site to the east, have been downgraded through implementing Step 3. Refer to **Figure 7** and **Figure 8**.

Following the implementation of the processing stages, continuous vegetation has been confirmed to the south of the proposed development (refer to **Figure 9**). This pixelated form of the finalized continuous vegetation was smoothed to reflect ground-truthed conditions (refer to **Figure 10**).

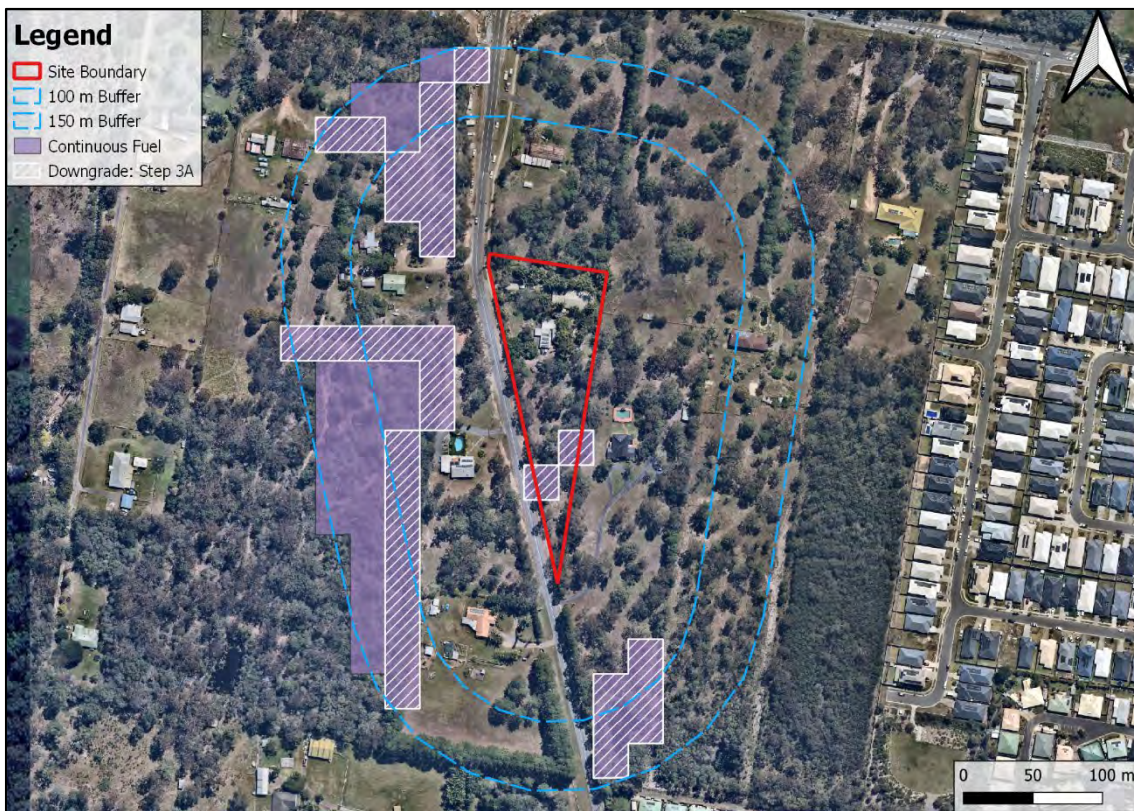


Figure 7. Step 3a – Shrinking of Patches of Continuous Fuel at the Interface with Non-Continuous Fuel

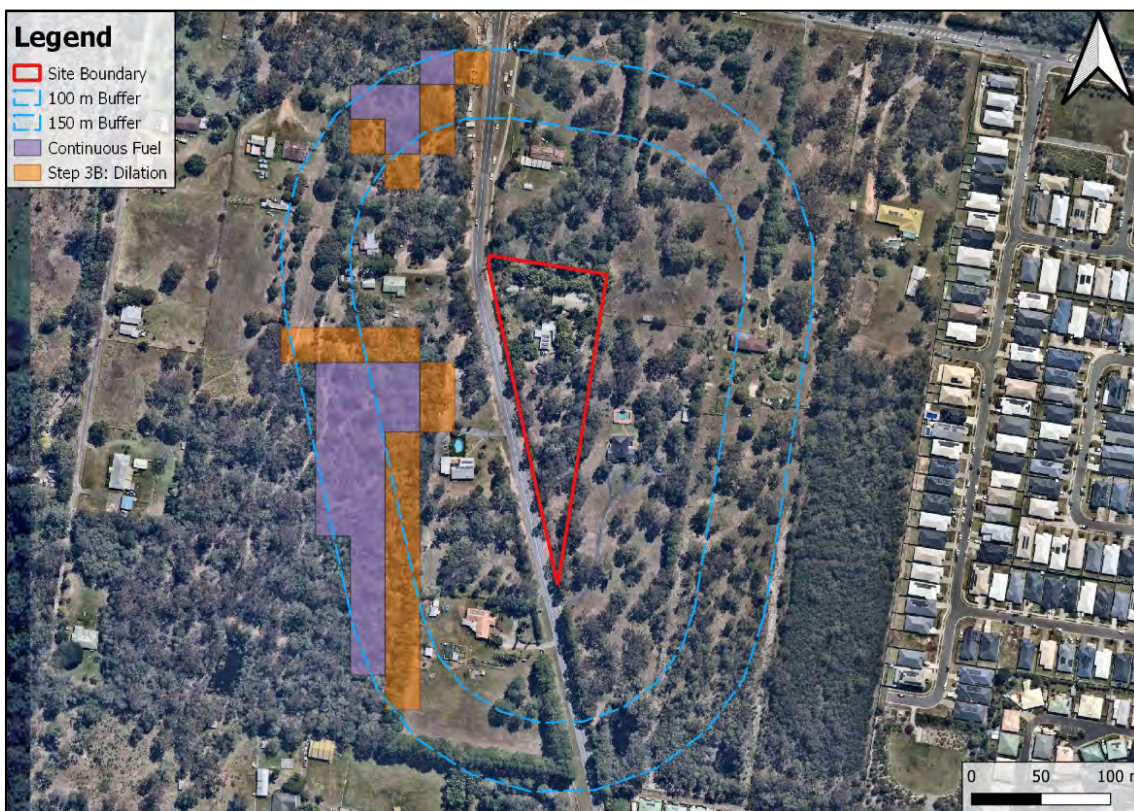


Figure 8. Step 3b – Dilation of Residual Continuous Fuel Pixels

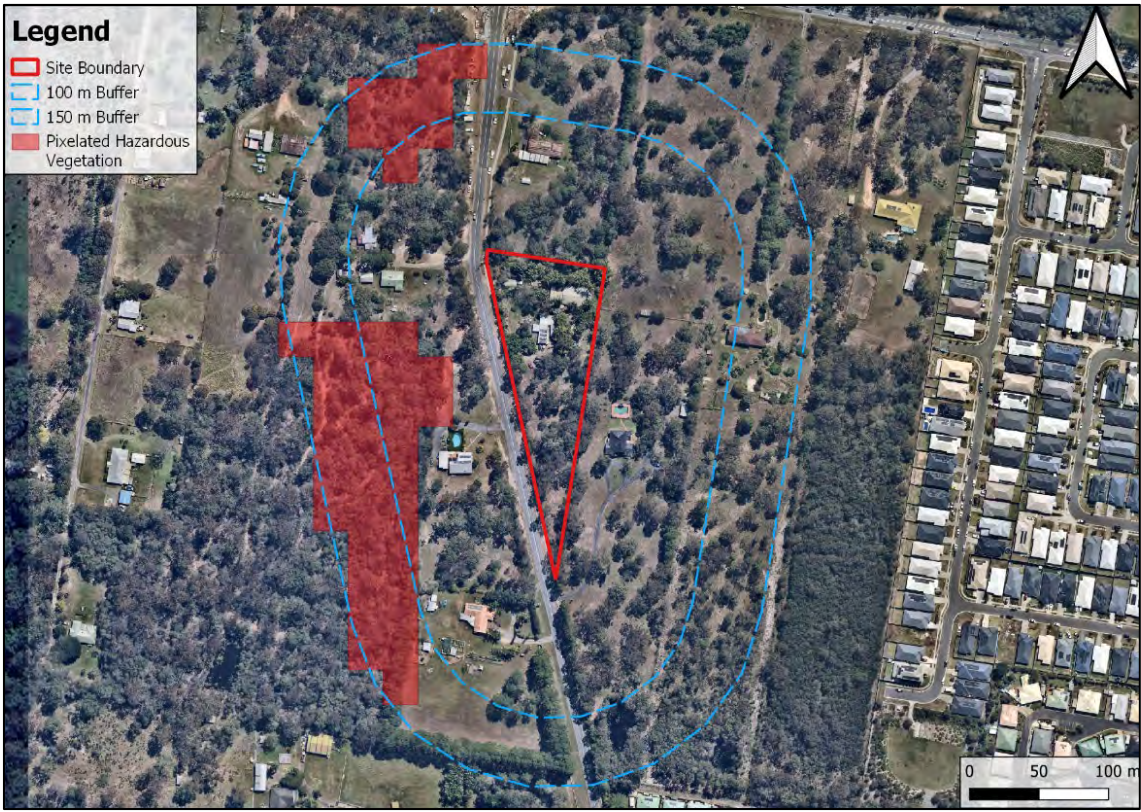


Figure 9. Finalized Pixelated Hazardous Vegetation within the Assessment Area



Figure 10. Smoothed Hazardous Vegetation to Reflect Ground-Truthed Conditions and Vegetation

#### 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. Potentially hazardous vegetation to the north-west was located at approximately the same elevation as the subject site, whilst potentially hazardous vegetation to the south-west was located slightly upslope of the subject site (refer Figure 11).

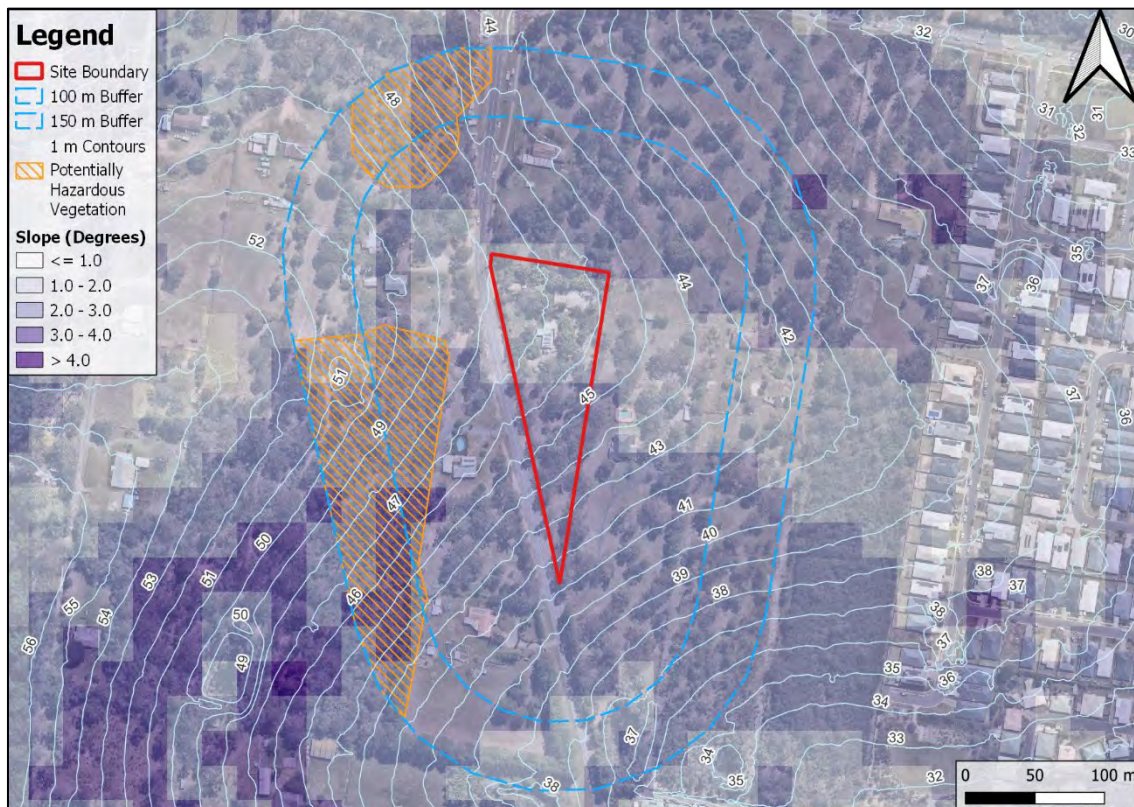


Figure 11. Slope within and in Proximity to the Proposed Development

#### 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 difficulty 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

north-west and south-west of the development area were mapped to contain areas of medium potential bushfire intensity (i.e., 4,000 – 20,000 kW/m), associated with VHC 9.2. Areas of vegetation mapped as VHC 39.2, 40.4 and 41.4 have been mapped to contain low potential bushfire intensity (i.e., <4,000 kW/m). Refer to Figure 13.



Figure 12. Potential Fire Line Intensity

## 4.2 Hazardous Vegetation

Vegetation mapped as VHC 9.2 to the north-west and south-west of the proposed development area was determined to be the only hazardous vegetation within the assessment area (refer to Figure 13). As this vegetation is within 100 m of the proposed development area, the proposed residential subdivision is therefore within a Bushfire Prone Area. As such, a radiant heat exposure assessment has been conducted to determine the radiant heat flux the industrial development may be exposed to.



Figure 13. Hazardous Vegetation

## 5.0 BUSHFIRE ATTACK LEVEL ASSESSMENT

This radiant heat exposure 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-west and south-west of the subject site (refer to **Figure 13**). A Method 2 assessment in accordance with AS3959-2018 utilising the online Flamesol Minimum Distance Calculator was undertaken to determine the required setbacks from hazardous vegetation (see **Table 7** and **Figure 14**). Refer to **Appendix B** for inputs and outputs from the Flamesol Minimum Distance Calculator.

**Table 7. Summary of Setbacks and Radiant Heat Exposure for the Proposed Development**

Radiant Heat Exposure (kW/m <sup>2</sup> )	BAL	Distance from Hazardous Vegetation to the North-west and South-west
-	Low	100 m
12.5	12.5	30.4 m
19	19	21.4 m
29	29	14.5 m
40	40	10.7 m
> 40	FZ	< 10.7 m



Figure 14 BAL Setbacks

Based on the results of the above BAL Assessment, lots 1 to 3 and 5 to 14 will achieve a maximum BAL score no greater than 12.5. Lot 4 will be located greater than 100 m away from hazardous vegetation and as such, will achieve BAL Low. Accordingly, a Bushfire Management Plan has been prepared and presented in Section 6.0.

## 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 15, below.

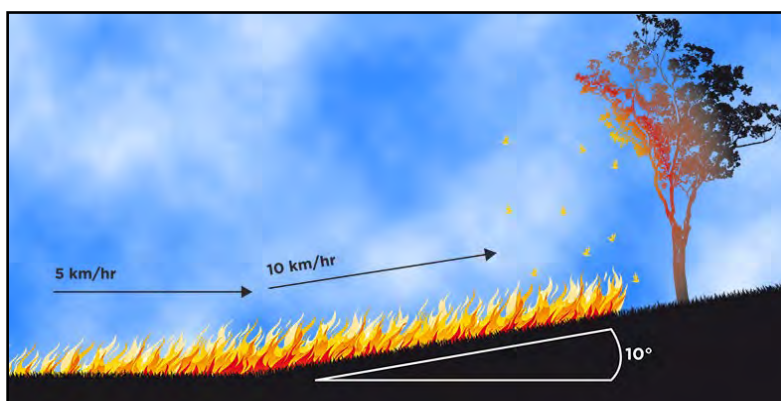


Figure 15. Effects of Topography on Bushfire (source: Country Fire Authority)

#### 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 16).

#### 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.

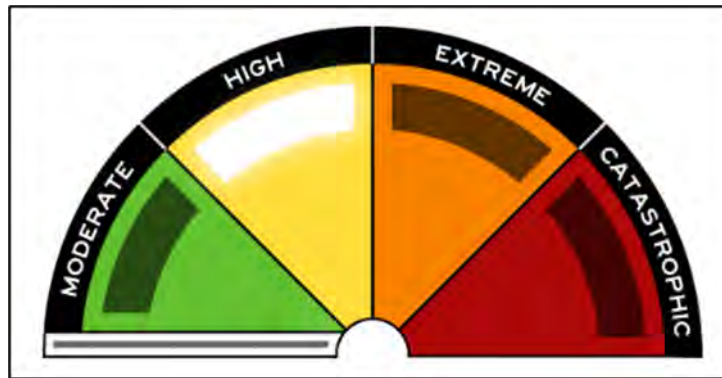


Figure 16. Fire Danger Rating (source: Queensland Government, Emergency Services and Safety)

## 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 **Figure 17**, below). Ember attack is addressed within the AS 3959-2018 through Construction Standard requirements.

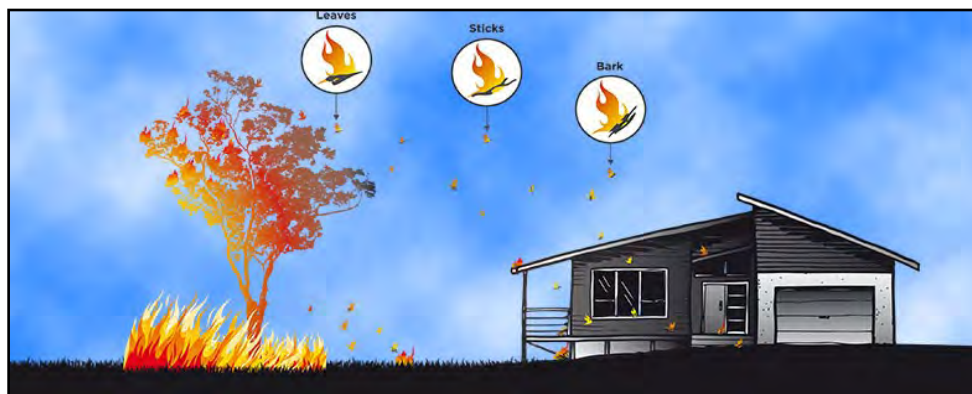


Figure 17. Ember Attack (source: Country Fire Authority)

## 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 18**, below). The most common cause of loss of human life is via radiant heat (CFA, 2018).



Figure 18. 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

### 6.3.1 Layout Design

#### Access and Egress

Access to the proposed residential subdivision will be achieved via a constructed internal access road which is proposed to adjoin the future subdivisions proposed for the lots to the north and east of the subject site. As this stage, S5 Environmental understand that only the subdivision to the east of the subject site has been submitted and approved (DA: COM-5-2022). S5 Environmental recommend the internal access road is designed in accordance with the appropriate State and Local government road design requirements (i.e., SC 6.2.5, Part 3, Movement Infrastructure Standards of the LCC *Planning Scheme 2015*) to facilitate egress and firefighting appliance access to the lot within a bushfire event.

#### Siting of Development

The subject site is situated within an area of Low PFLI (i.e., < 4,000 kW/m) with a maximum BAL score achieved by the proposed lots no greater than BAL 12.5. These setbacks were 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.

### 6.3.2 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 **Section 5.0**.

S5 Environmental further recommend that fencing proposed surrounding the development is to be constructed out of non-combustible or fire-retardant materials. Additionally, fencing must allow 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.

### 6.3.3 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. Additionally, fire hydrants are to be designed, sited and installed within the subdivision in accordance with AS2419.1-2009.

### 6.3.4 Bushfire Emergency

In the event of a Bushfire Emergency, the local QFES should be contacted immediately. The West Logan Fire Station is located approximately 7.0 km (by road) to the north-west of the subject site. The contact details for the West Logan Fire Station are:

- Address: 2 Orr Court, Hillcrest QLD 4118
- Phone: (07) 3437 3200, **Please note that in fire emergencies the triple zero (000) emergency telephone number should be used.**

### 6.3.5 Vegetation Management and Landscaping

Although no specific bushfire management zones are recommended, S5 Environmental recommend that future lot owners 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 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). This publication, in conjunction with the 'Bushfire Resilient Building Guidance for Queensland Homes' (QLD Government and CSIRO, 2020), 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

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This Bushfire Hazard Assessment concluded that the proposed development is located within an area of Low PFLI (i.e., < 4,000 kW/m) and is within 100 m of potentially hazardous vegetation to the north-west and south-west. The AS 3959-2018 Method 2 BAL Assessment concluded that lots 1 to 3 and 5 to 14 will achieve BAL 12.5, with lot 4 achieving BAL Low (i.e., greater than 100 m from hazardous vegetation). Accordingly, all future buildings exposed to a BAL score of 12.5 or greater, must be constructed in accordance with the appropriate design requirements as per AS 3959-2018.

S5 Environmental have prepared a site-specific Bushfire Management Plan to support the proposed residential development, 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 LCC bushfire related assessment benchmarks, refer to **Appendix A**.

## 8.0 REFERENCES

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# APPENDIX A

## LCC Bushfire Hazard Overlay Code Response

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
For accepted development (subject to requirements) and assessable development			
Location, design and siting of development			
<p><b>PO1</b></p> <p>Development is designed to:</p> <ul style="list-style-type: none"> <li>a. minimise risk of bushfire hazard;</li> <li>b. provide safe premises;</li> <li>c. create efficient emergency access for fire-fighting and other emergency vehicles.</li> </ul> <p>Note - Planning scheme policy 6 - Management of bushfire hazard provides guidelines on how to achieve this outcome.</p>	<p><b>A01</b></p> <p>Development:</p> <ul style="list-style-type: none"> <li>a. does not increase the number of persons living in, or lots in, the Bushfire hazard area identified on Bushfire hazard overlay map OM-03.00; or</li> <li>b. is on a site that a bushfire hazard assessment prepared in accordance with the methodology in Planning scheme policy 6 - Management of bushfire hazard determines is of low bushfire hazard.</li> </ul>	<p>Complies – Following the approval of this report, the proposed development will be constructed on a site where an approved bushfire hazard assessment and management plan has been prepared.</p> <p>The bushfire hazard assessment determined that the proposed lots will be located in an area of Low PFLI and will achieve a maximum BAL score of 12.5.</p> <p>S5 Environmental have additionally recommended that the internal access route is constructed in compliance with State and Local transport network design requirements to facilitate</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
		egress and access to firefighter appliances in a bushfire scenario.	
<p><b>PO2</b></p> <p>Development is sited and constructed to minimise the bushfire hazard and maximise the protection of life and property from bushfire.</p> <p>Editor's note - Planning scheme policy 6 - Management of bushfire hazard contains guidance on the preparation of bushfire management plans.</p>	<p><b>AO2</b></p> <p>Development is located and constructed:</p> <ul style="list-style-type: none"> <li>a. where there is no bushfire management plan approved by an existing development approval: <ul style="list-style-type: none"> <li>i. such that the bushfire attack level is less than or equal to BAL-29;</li> <li>ii. away from the most likely direction of a fire front;</li> <li>iii. so that elements of the development least susceptible to fire are sited closest to the bushfire hazard;</li> <li>iv. such that asset protection zones are sited on land with a slope less than 18 degrees;</li> <li>v. such that asset protection zones are entirely within the boundaries of the private property of the development site; or</li> </ul> </li> <li>b. where an approved bushfire management plan directs development to be located.</li> </ul> <p>Note - BAL = Bushfire attack level is the radiant heat flux a building will experience during a bushfire and is a measure of heat energy</p>	<p>Complies – Following the approval of this report, the proposed development will be constructed in accordance with an approved bushfire management plan, informed by a bushfire hazard assessment in accordance with the State methodology.</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	<p>impacting on a surface expressed as kW/m2. BAL is calculated from the following factors; vegetation type, fuel loads, distance to vegetation, Forest Fire danger Index (FDI), flame length, fire behaviour/intensity and slope. BAL is used to determine the required construction level of a building and the size of asset protection zones (inner and outer radiation zones). Further information on calculating the BAL can be obtained from AS3959-2009.</p> <p>Editor's note - Asset protection zones are not located on slopes greater than 18 degrees to ensure maintenance is practical, soil stability is not compromised and the potential for crown/canopy fires is reduced.</p>		
<p><b>PO3</b></p> <p>Reconfiguring a lot ensures that lots are designed to minimise bushfire hazard and provide safe sites for people, property and buildings.</p>	<p><b>A03</b></p> <p>Lots:</p> <ol style="list-style-type: none"> <li>a. are suitable for people, property and buildings by: <ol style="list-style-type: none"> <li>i. having a bushfire attack level less than or equal to BAL-29; or</li> <li>ii. containing a development envelope area that has a bushfire attack level less than or equal to BAL-29;</li> </ol> </li> <li>b. provide asset protection zones that: <ol style="list-style-type: none"> <li>i. are located on land with a slope less than 18 degrees;</li> <li>ii. are located on the same lot.</li> </ol> </li> </ol>	<p>Complies – The Bushfire Attack Level Assessment confirmed that the maximum BAL score achieved by the proposed lots is BAL 12.5.</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
<b>Vehicular access and fire maintenance trails</b>			
<p><b>PO4</b></p> <p>Access for fire management and evacuation is provided by access that:</p> <ul style="list-style-type: none"> <li>a. separates premises from adjoining vegetation;</li> <li>b. is safely accessible by fire fighting vehicles;</li> <li>c. has regular vehicular access points for bushfire management, response and evacuation;</li> <li>d. has regular vehicle passing and turning areas for bushfire management, response and evacuation;</li> <li>e. allows access at all times for fire fighting vehicles;</li> <li>f. allows for maintenance, burning off and bushfire response;</li> <li>g. has vehicular links to an alternative through road;</li> <li>h. is readily maintained.</li> </ul>	<p><b>A04</b></p> <p>Access for fire management and evacuation is provided by vehicular access in the form of a perimeter road:</p> <ul style="list-style-type: none"> <li>a. with a minimum reserve width of 20 metres;</li> <li>b. located between the premises and adjoining vegetation;</li> <li>c. with a maximum gradient of 12.5 percent;</li> <li>d. constructed to otherwise comply with section 3.4 - Movement infrastructure standards of Planning scheme policy 5 - Infrastructure;</li> <li>e. that has a layout that does not include a cul-de-sac.</li> </ul>	<p>PS – Lindenthal Road to the west of the subject site will be located between the proposed subdivision and hazardous vegetation to the west. S5 Environmental understand that Lindenthal Road will be upgraded, with the width of the road corridor being increase.</p> <p>It is understood that Lindenthal Road is appropriately designed to support firefighting appliance access. It is understood that this road is readily maintained and would provide access at all time for firefighting appliances. Additionally, the road corridor width will be wide enough to support turning of firefighting appliances.</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
Editor's note - Planning scheme policy 6 - Management of bushfire hazard provides details on alternative solutions for providing fire management access and evacuation			
<b>Water supply</b>			
<p><b>PO5</b></p> <p>Development has access to adequate water supply for fire fighting purposes.</p>	<p><b>A05</b></p> <p>Development:</p> <ul style="list-style-type: none"> <li>a. is connected to a reticulated water supply scheme that has sufficient flow and pressure characteristics for fire fighting purposes at all times with a minimum pressure and flow of 10 litres per second at 200kPa; or</li> <li>b. has an on-site water storage in accordance with Table 8.2.3.3.2 - Water storage for fire fighting, dedicated or retained for fire fighting purposes that is made of fire resistant materials and is: <ul style="list-style-type: none"> <li>i. a separate tank; or</li> <li>ii. a reserve section in the bottom part of the main water supply tank.</li> </ul> </li> </ul> <p>Editor's note - The requirement in A05 is:</p>	<p>Complies – S5 Environmental understand the proposed development will be connected to a reticulated water supply which meets the pressure and flow requirements as detailed within the SEQ Water Supply, Sewage Design and Construction Code.</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	<ul style="list-style-type: none"> <li>- in addition to the requirement for potable water supply/storage in AO2 in Table 9.4.3.3.1 - Infrastructure code: accepted development (subject to requirements) and assessable development.;</li> <li>- reflected in AO5 in Table 9.4.3.3.1 - Infrastructure code: accepted development (subject to requirements) and assessable development.</li> </ul>		
<b>For assessable development</b>			
<b>Community infrastructure</b>			
<p><b>PO6</b></p> <p>Community infrastructure is not located in a bushfire hazard area or is able to function effectively during and immediately after a bushfire event.</p>	<p><b>AO6</b></p> <p>Community infrastructure is:</p> <ul style="list-style-type: none"> <li>a. not located in a Bushfire hazard area identified on Bushfire hazard overlay map OM-03.00; or</li> <li>b. located to ensure that: <ul style="list-style-type: none"> <li>i. the core services provided by the community infrastructure is able to function effectively during bushfire events;</li> <li>ii. access to the community infrastructure is not compromised by bushfire events;</li> <li>iii. the safe storage of valuable records, public records and items of cultural or historic</li> </ul> </li> </ul>	<p>NA – Proposed development will not include community infrastructure.</p>	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS	COUNCIL USE ONLY
	significance is able to be maintained during a bushfire event.		
<b>Hazardous materials</b>			
<p><b>PO7</b></p> <p>Public safety and the environment are not adversely affected by the adverse impacts of bushfire on hazardous materials including fuels, explosives and flammable chemicals manufactured or stored in bulk on premises.</p>	<p><b>A07</b></p> <p>Hazardous materials:</p> <ul style="list-style-type: none"> <li>a. storage is in compliance with AS1940 - The storage and handling of flammable and combustible liquids;</li> <li>b. manufacturing does not occur in a Bushfire hazard area on Bushfire hazard overlay map OM-03.00.</li> </ul>	<p>NA – Proposed development will not include the storage or manufacture of hazardous materials.</p>	

# APPENDIX B

## Flamesol Inputs and Outputs

### Summary of Input Parameters for Hazardous Vegetation to the North-west and South-west

Parameter	Input	Note
FFDI	55	Source: QFES Catalyst Mapping.
Surface Fuel Load	14.9 t/ha	Surface and Near Surface Fuel Load – QFES VHC 9.2 Surface Fuel Loads.
Overall Fuel Load	17.2 t/ha	Total Fuel Load – QFES VHC 9.2 Total Fuel Loads.
Effective Slope	1 °	Hazardous vegetation is sited upslope of the proposed development. A minimum Effective Slope of 1 ° was utilised.
Site Slope	2.2 °	Hazardous vegetation is sited upslope of the proposed development. A minimum Site Slope of 1 ° was utilised.
Flame Temperature	1,200 K	Standard input in accordance with the BRC.
Flame Width	100 m	Standard input, in accordance with AS 3959-2018.



Calculated October 16, 2024, 4:43 pm (MDC v.4.9)

**Lindenthal (NW and SW)**

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	8.91 m
Understorey fuel load	14.9 t/ha	Flame angle	66 °, 73 °, 78 °, 81 °, 82 ° & 86 °
Total fuel load	17.2 t/ha	Elevation of receiver	3.88 m, 4 m, 3.98 m, 3.87 m, 3.78 m & 2.89 m
Vegetation height	n/a	Fire intensity	9,363 kW/m
Effective slope	1 °	Transmissivity	0.874, 0.859, 0.837, 0.8139999999999999, 0.802 & 0.741
Site slope	1 °	Viewfactor	0.4088, 0.3013, 0.2023, 0.137, 0.1113 & 0.0301
Flame width	100 m	Minimum distance to < 40 kW/m²	10.7 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	14.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	21.4 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	30.4 m
		Minimum distance to < 10 kW/m²	36.2 m

Flamesol Calculator Outputs for Required Setbacks from Hazardous Vegetation to the North-west and South-west

# APPENDIX C

## Slope Calculations

BUSHFIRE SLOPE CALCULATOR							
North-west							
<b>Effective Slope</b>				<b>Site Slope</b>			
Direction	Flat			Direction	Flat		
Top Elevation	48 m			Top Elevation	48 m		
Bottom Elevation	48 m			Bottom Elevation	48 m		
Distance	79 m			Distance	69 m		
	Slope %	0.00%			Slope %	0.00%	
	Slope (°)	0.00			Slope (°)	0.00	
South-west							
<b>Effective Slope</b>				<b>Site Slope</b>			
Direction	Upslope			Direction	Upslope		
Top Elevation	50 m			Top Elevation	48 m		
Bottom Elevation	48 m			Bottom Elevation	47 m		
Distance	99 m			Distance	56 m		
	Slope %	2.02%			Slope %	1.79%	
	Slope (°)	1.16			Slope (°)	1.02	

