

BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

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April 2017
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1 INTRODUCTION

The following Bushfire Hazard Assessment and Management Plan (BHAMP) has been prepared by Litoria Consulting on behalf of Chris and Moira Smit to accompany a development application on land described as 72 Acacia Rd, Karawatha (Lot 1 on RP 54123). Figure 1 shows an aerial photo of the site.

The purpose of the BHAMP is to:

- i. Identify and measure site-specific factors which contribute to bushfire hazard.
- ii. Assess the extent of bushfire prone areas and calculate:
 - a. Potential fire intensity (PFI, kW/m),
 - b. Potential flame length (m),
 - c. Potential rate of fire spread (metres/second).
- iii. For development within bushfire prone areas or potential impact buffer (100m), assess Bushfire Attack Level (BAL) in accordance with Australian Standard 3959-2009 Construction of buildings in bushfire-prone areas (AS 3959-2009).
- iv. Where applicable, identify management measures to achieve compliance with the hazard and risk outcomes sought by:
 - a. State Planning Policy (SPP);
 - b. City Plan 2014 Bushfire overlay code; and,
 - c. AS 3959-2009.

The report is divided into the following sections:

- i. Proposed development;
- ii. Regulatory framework;
- iii. Methods;
- iv. Results;
- v. Management and planning; and,
- vi. A summary of assessment findings and recommendations.

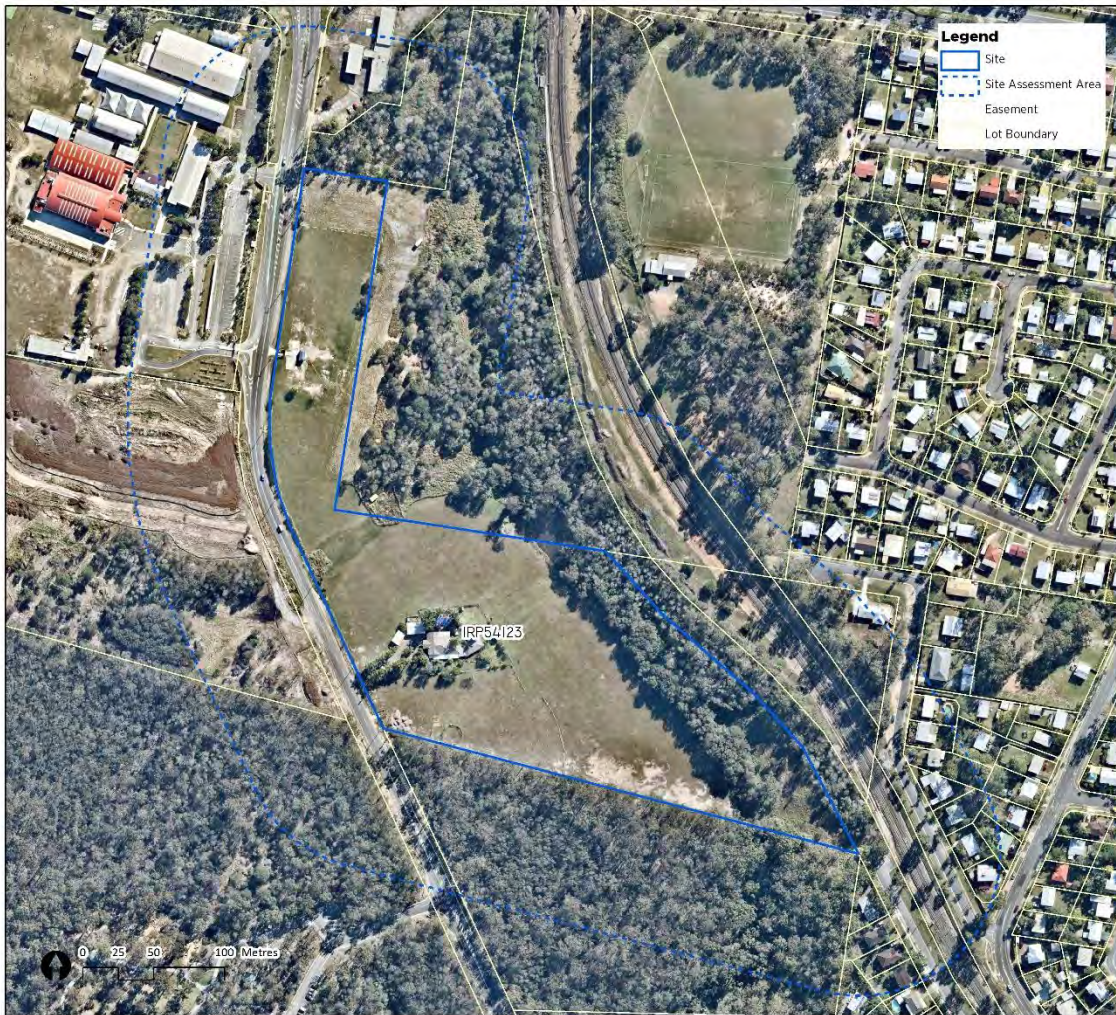


Figure 1: Rectified digital aerial photograph of the site (Source: NearMap 2017).

2 PROPOSED DEVELOPMENT

The proposed development is for a Reconfiguration of a Lot (1 into 79). The proposed development footprint includes 74 residential lots, 2 park lots and 3 drainage reserve lots. The plan of development is illustrated in Figure 2, with a copy of the proposed plan of development contained in Appendix 1.

The plan includes the proposed Rehabilitation Plan for the drainage reserve and waterway corridor to the east of the site (Litoria Consulting, 30/03/2017). A copy of the proposed Rehabilitation Plan is contained in Appendix 2.



Figure 2: Proposed development.

3 REGULATORY FRAMEWORK

Management of bushfire hazard in Queensland is considered an integral component of land use planning and development decisions given the potential significant impact on people, social wellbeing, property, the economy, the environment and infrastructure.

There are two (2) bushfire hazard planning instruments considered as part of this BHAMP that regulate development to avoid and mitigate potential impacts associated with bushfire hazard, namely:

- State Planning Policy (SPP) under the *Sustainable Planning Act 2009* (Qld); and,
- City Plan 2014.

Where planning requirements elicit a building requirement to mitigate risks, AS 3959-2009 is also referenced.

3.1 STATE PLANNING POLICY

The SPP came into effect in **December 2013** and identifies the Queensland Government's policies about matters of state interest in land use planning and development (Department of Infrastructure Local Government and Planning 2016). The SPP is a broad and comprehensive statutory planning instrument which sits above regional plans, standard planning scheme provisions and local government planning schemes within the hierarchy of planning instruments outlined in the *Sustainable Planning Act 2009* (Qld).

The SPP identifies the State interest in relation to bushfire hazard planning and management outcomes for development in bushfire prone areas. It sets out, *inter alia*, development assessment requirements for certain applications where a local planning scheme has not yet appropriately integrated the SPP and includes a State-wide map of bushfire prone areas. The State-wide map of bushfire prone areas (SPP map) is based on modelled potential fire line intensity according to the method described by Leonard *et al.* (2014). The SPP identifies land that could support a significant bushfire or be subject to significant bushfire attack. It includes areas of hazardous vegetation with a Very High, High or Medium Potential Bushfire Intensity, together with land within 100m of Bushfire prone areas as a Potential Bushfire Impact Buffer. The potential impact buffer identifies land that may be subject to significant flame attack, radiant heat or ember attack. Research indicates that not only does a very high intensity bushfire have the potential to cause injury from radiant heat exposure up to 100m away, but over 80% of housing loss and human life loss occurs within 100m of bushland (Leonard et al. 2014). Figure 3 (Map 2) indicates the State-wide map of bushfire prone areas (SPP map) for the site (Public Safety Business Agency 2015).

The SPP is supported by the State Planning Policy - state interest guideline - Natural hazards, risk and resilience (SPP Guidance Material) (Department of Infrastructure Local Government and Planning 2016) and a State Planning Policy - State interest technical manual - Natural hazards, risk and resilience (SPP Natural Hazards Technical Manual)

(Department of Infrastructure Local Government and Planning 2016) which provides an overview the method for undertaking bushfire hazard assessment as per Leonard et al. (2014).

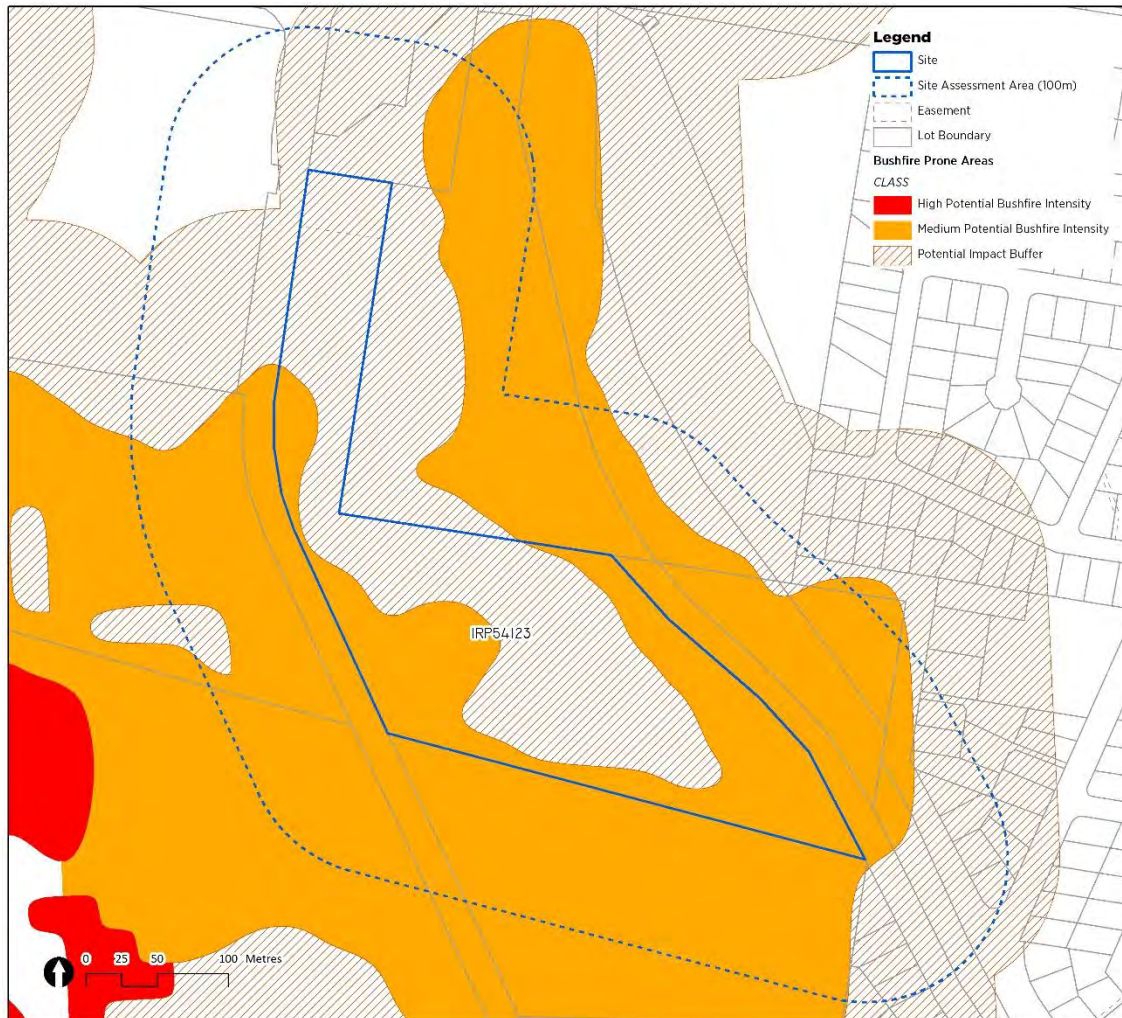


Figure 3: Excerpt from State Planning Policy State-wide map of bushfire prone areas (Source: Public Safety Business Agency 2014).

3.2 CITY PLAN 2014

City Plan 2014 identifies areas subject to bushfire hazard on the Bushfire overlay. An extract from the Bushfire overlay map for the site is indicated in Figure 4.

Certain assessable development in areas subject to the Bushfire overlay requires assessment against the Bushfire overlay code. The purpose of the Bushfire overlay code is to, *inter alia*, provide for the assessment of the suitability of development in the Bushfire Overlay. The purpose is achieved by ensuring that development does not expose people and property to an unacceptable risk of bushfire attack and, where applicable, provide treatments which reduce bushfire risk and provide for a safe environment for emergency services. Amongst other things, the Bushfire overlay code requires the preparation of a site-specific bushfire hazard assessment and management plan, prepared in accordance with the Bushfire Planning Scheme Policy (PSP) (SC6.4). The PSP identifies the methodology for undertaking bushfire hazard assessment using the qualitative methodology prescribed in the superseded SPP 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide.

Although the City Plan 2014 was gazetted following the SPP and Part 2.1 of City Plan 2014 indicates the relevant State interest in relation to planning for bushfire hazards is appropriately reflected in the scheme; the City Plan 2014 bushfire overlay map and associated planning provisions were prepared under the superseded State Planning Policy 1/03 and Superseded State Planning Policy 1/03 Guideline: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (Department of Local Government and Planning 2003) (SPP 1/03). Differences between the level and extent of hazard indicated on the SPP map and the Bushfire overlay map are a consequence of the different methods used to assess bushfire hazard (c.f. Figure 3 and Figure 4). The current SPP utilises a quantitative method as per Leonard *et al.* (2014) which predicts actual fire behaviour including calculation of **predicted fire intensity and rate of spread using a modified version of McArthur's equation**. The quantitative approach is also consistent with AS 3959, which regulates the construction of buildings in 'designated bushfire prone areas' pursuant to s. 12 of the *Building Regulation 2006* (Qld). The *City Plan 2014* Bushfire overlay map is derived from a qualitative approach based on the sum of weighted hazard 'factors', **with scores for vegetation, slope and aspect**.

Notwithstanding the methodology espoused by the PSP, the quantitative "fit for purpose" approach¹ is preferred, particularly in circumstances where the level or extent of hazard differs between the Bushfire overlay and the SPP map (c.f. Figure 3 and Figure 4). The SPP approach is preferred because it provides an actual estimate of fire behaviour, rather than a qualitative estimate of potential hazard; providing a basis for improved decision-making regarding the likelihood and severity of bushfire attack (i.e. risk assessment).

The following section of the report provides an overview of the methodology used to assess bushfire hazard, including quantitative measurement of fire intensity, rate of spread, flame length and radiant heat flux.

¹ [Leonard et al. 2014](#)

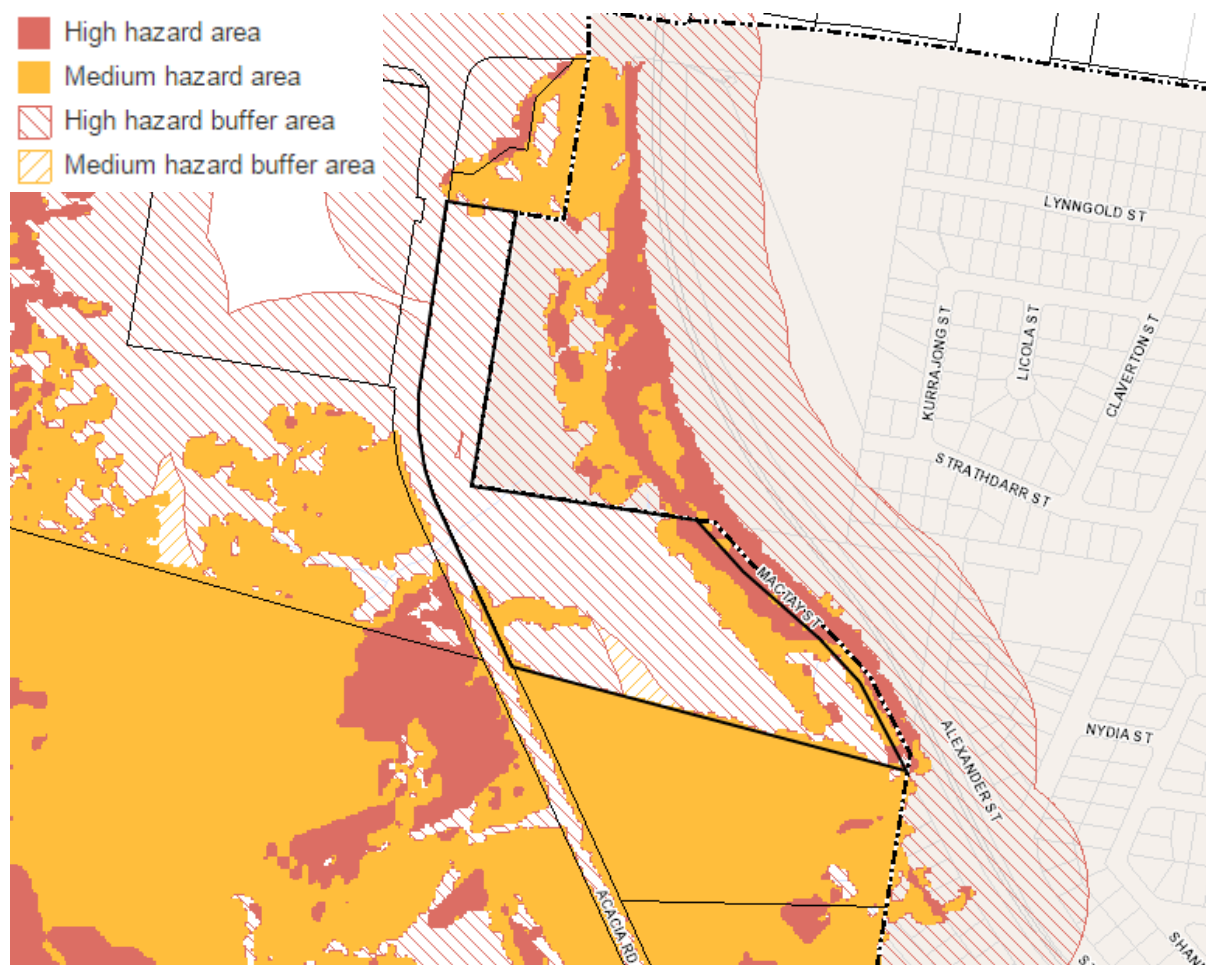


Figure 4: *City Plan 2014* Bushfire overlay showing areas of medium and high bushfire hazard and associated buffers (Brisbane City Council 2014).

4 METHODS

Bushfire hazard for the study area was modelled according to the methods described in the SPP Natural Hazards Technical Manual and the quantitative methods described by Leonard *et al.* (2014).

The SPP Natural Hazards Technical Manual identifies a quantitative method for preparing local-scale maps of bushfire hazard, based on modelling of factors which contribute to bushfire intensity: fuel load, slope and fire weather severity (or forest fire danger index) (Department of Infrastructure Local Government and Planning 2016). The method is described by Leonard *et al.* (2014) and utilises a modified version of the McArthur Equation (McArthur 1967; Noble *et al.* 1980):



Figure 5: SPP Method for calculation of potential fire line intensity (PFI) (Leonard *et al.* 2014).

Although the PSP identifies that a site-specific assessment of bushfire hazard is to be carried out according to a scoring approach described in the superseded SPP1/03, the BHAMP adopts the “fit for purpose” approach consistent with both the SPP Natural Hazards Technical Manual (Department of Infrastructure Local Government and Planning 2016) described by Leonard *et al.* (2014) and AS 3959-2009. The latter approach is not inconsistent with Council’s PSP since the code requires consideration of bushfire attack risk and, in certain cases, radiant heat flux (and Bushfire Attack Level as per AS 3959-2009).

The modelling included the following measures of fire behaviour:

- (i) Potential bushfire fire line intensity (PFI, kW/m);
- (ii) Potential rate of fire spread (metres/second);
- (iii) Potential flame lengths (m); and,
- (iv) Radiant heat flux/Bushfire Attack Level (kW/m², BAL) according to the View Factor Method described in AS 3959-2009.

The fire behaviour modelling was carried out via GIS spatial modelling using rasterised inputs² described by Leonard *et al.* (2014):

- i. Fuel load based on site-specific assessment of vegetation hazard class;
- ii. Maximum landscape slope; and,
- iii. Fire weather severity/Forest Fire Danger Index (FFDI).

² VHC/fuel load, maximum landscape slope and fire weather severity input rasters can be accessed via the Queensland Government Information Service (<http://dds.information.qld.gov.au/dds/>).

Fuel load is derived from an estimate of potential fuel load (tonnes/ha) for 25 grouped *vegetation hazard classes* (VHC). VHCs have been categorised from a combination of regional ecosystem maps, pre-clearing regional ecosystem maps (where no remnant vegetation is mapped), foliage projection cover maps, land use maps, water body maps, air photo interpretation (API) and tree plantation maps (Leonard *et al.* 2014). Figure 6 (Map 3, attached) and Figure 7 (Map 5, attached) show the SPP VHCs and SPP potential fuel loads for the site, respectively.

VHCs were assessed for the site and locations within 100m ('site assessment area'). The modelled VHCs for the site reflect the proposed development (i.e. ultimate land use) and include VHCs associated with any proposed vegetation retention or revegetation, where applicable. In this case, the modelled VHCs incorporated the proposed Rehabilitation Plan for the parkland and waterway corridor to the east of the site (Litoria Consulting, 30/03/2017, Appendix 2). This included three treatments:

- Zone A: Revegetation consistent with the mapped preclearing regional ecosystems for the waterway corridor of RE 12.3.11. RE 12.3.11 is classified as *VHC 16.1 Eucalyptus dominated closed to open forest on drainage lines and alluvial plains* and has a potential fuel load of 15.9 tonnes per hectare (Public Safety Business Agency 2014).
- Zone B: Weed management treatment and rehabilitation to RE 12.3.11. RE12.3.11 is classified as *VHC 16.1 Eucalyptus dominated closed to open forest on drainage lines and alluvial plains* and has a potential fuel load of 15.9 tonnes per hectare (Public Safety Business Agency 2014).
- 10m wide formed fire trail in accordance with Council's Bushfire overlay code requirements (a fuel free zone).

VHCs within the site assessment area were determined from a combination of:

- i. Quaternary botanical survey according to Neldner *et al.* (2012);
- ii. Current regional ecosystem mapping³; and,
- iii. API using current⁴, high-resolution⁵, rectified aerial photography.

Where observations indicated that the observed VHC differed from the mapped VHC, the classification or extent of VHC was altered to reflect the observed vegetation community and the potential fuel load which corresponded with that VHC (c.f. Figure 6 and Figure 7). The main differences between observed and modelled VHCs were:

- Areas containing existing and proposed development were re-mapped to *VHC 41.4 Low grass or tree cover in built-up areas* consistent with urban residential areas of similar density.
- The extent of *VHC 9.2 Moist to dry eucalypt woodland to open woodlands usually on coastal lowlands and ranges* was less than indicated by the current State Government VHC mapping, including:
 - Areas to the west of Acacia Road which have recently been cleared for urban development were mapped as *VHC 41.4 Low grass or tree cover in built-up areas* (3 tonnes per hectare);

³ Department of Natural Resources and Mines (2013). Vegetation management regional ecosystem and remnant map - version 8.0 coastal (GIS dataset). State of Queensland (Department of Natural Resources and Mines). Brisbane.

⁴ 2014.

⁵ Greater than 1:10,000 resolution.

- Areas to the east of the subject site contained linear infrastructure (railway) which was re-mapped as *VHC 42.6 Nil to very low vegetation cover* (2 tonnes per hectare);
- Land to the north of the site (Lot 2 on RP818511) was mapped as *VHC 9.1 Moist to dry eucalypt open forests on coastal lowlands and ranges* based on the preclearing regional ecosystem for the lot (RE 12.9-10.17) and the assumption that the vegetation in that area would ultimately reach its mature state⁶.
- Vegetation on adjacent land to the north of the site (Lot 4 on SP107509, Logan City Council) was highly disturbed and contained a mixture of VHCs. This included VHC 16.1 / 22.1 (Zone B rehabilitation treatment, Appendix 2) and areas which were periodically slashed and grazed (goats) which were consistent with *VHC 39.2 Low to moderate tree cover in built-up areas* (8 tonnes per hectare). The proportion of VHCs was VHC 16.1 (40%) / 22.1 (20%) / 39.2 (40%), incorporating both existing vegetation and the ultimate revegetation outcomes envisaged by the proposed Rehabilitation Plan (Appendix 2).

Non-forest vegetation hazard classes associated with rural and urban areas were separated or categorised according to a combination of foliage projection cover maps, land use maps and air photo interpretation (API), with supplementary site-based assessment to confirm desktop mapping.

The results of the site assessment of VHCs are contained in Appendix 3.

As per Leonard *et al.* (2014), the *Potential Fuel Load assigned to each Vegetation Hazard Class is generally representative of the higher fuel load expected for the typical vegetation types, landscape and site conditions within each Vegetation Hazard Class. This Potential Fuel Load of each Vegetation Hazard Class would approximate the 80th percentile fuel load of the "long unburnt condition" for the class (generally greater than 10 years without burning)*. Modelled fuel loads for each of the amended VHCs were unchanged from the loads recommended by PSBA (Public Safety Business Agency 2014). Fuel loads for modelled VHCs were as per the Updated Vegetation Hazard Classes and Potential Fuel Loads to support State-wide mapping of Bushfire Prone Areas in Queensland (Public Safety Business Agency 2014); with hybrid or complex communities receiving the sum of the proportional fuel load of each constituent VHC (e.g. remnant vegetation containing a mix of regional ecosystems such as 50%/50%). In the case of VHC 16.1 (40%) / 22.1 (20%) / 39.2 (40%), the resulting fuel load was 15.24 tonnes per hectare, which was not significantly different to the current State Government fuel load (15.24 *c.f.* 15.9 tonnes/ha). Where VHC patches were less than 1000m² in size, they were merged with an adjacent VHC comprising the greatest boundary. In addition, small patches or corridors of higher fuel load VHCs (8 tonnes/ha or more) less than 100m wide were merged with surrounding lower fuel load VHC classes where they were isolated from other patches of high fuel load VHCs by more than 100m. The modelled fuel loads are indicated in Figure 9 (Map 6, attached).

Landscape slope was created from a 25m resolution digital terrain model (DTM) by calculating the maximum slope (in degrees) from the central pixel in a group of 3 x 3 cells to the eight (8) adjoining cells in that group. Maximum landscape slope inputs varied from one (1) to 10 degrees (Refer to Figure 10, Map 7, attached).

⁶ SC6.4 Bushfire planning scheme policy, Item 6.

In addition to vegetation fuel loads and slope, fire behaviour is influenced by a range of weather variables including precipitation, wind speed, relative humidity and temperature. Due to the complexity of these influences, they are commonly combined into a single index variable of fire weather severity or forest fire danger index (FFDI) (McArthur 1967). The fire weather severity used for the purpose of calculating fire line intensity was based on 1 in 20 year weather conditions (i.e. 5% annual exceedance probability) to reflect the severity of fires and events suited to mitigation through land used planning in Queensland and was based on advice from the Queensland Fire and Emergency Services. An FFDI of 54 was adopted based on the 5% AEP event as per Leonard *et al.* (2014) (Refer to Figure 11 (Map 8, attached)).

Fuel load, VHC, landscape slope and FFDI were represented spatially in 10m resolution input rasters. The input rasters were modelled using GIS software to generate a model of potential fire behaviour for the 5% AEP event. Figure 9 to Figure 11 indicate the model site-based inputs for potential fuel load (Figure 9), maximum landscape slope (Figure 10) and fire weather severity/FFDI (Figure 11), respectively.

PFI was calculated in accordance with Leonard *et al.* (2014a):

$$PFI = 0.62 W^2 FFDI e^{(0.069\theta)} \quad (\text{Equation 1})$$

Where: **PFI** = Potential Fire line Intensity (kW/m);
W = Potential fuel load (tonnes/ha);
FFDI = Fire weather severity/FFDI; and,
θ = Maximum slope (degrees).

Resulting PFI was then classified into one of three (3) *potential bushfire hazard classes*, as outlined in Table 1.

Table 1: Potential Bushfire Intensity Classes (Source: Leonard *et al.* 2014).

Potential Bushfire Intensity	Potential Fire line Intensity
i. Very High	40,000+ kW/m
ii. High	20,000 – 40,000 kW/m
iii. Medium	4,000 – 20,000 kW/m

In addition to PFI, supplementary calculations of potential flame length (Figure 14) and rate of spread (Figure 13) were derived from AS 3959-2009 (Standards Australia 2009) and Leonard *et al.* (2014) according to Equations 2 and 3, respectively:

$$L_f = \frac{13R_\theta + 0.24W}{2} \quad (\text{Equation 2})$$

$$R_\theta = 0.0012 FFDI W e^{(0.069\theta)} \quad (\text{Equation 3})$$

Where: **L_f** = Potential flame length (m);
R_θ = Rate of fire spread (km/hr);
W = Potential fuel load (tonnes/ha);
FFDI = Fire weather severity/FFDI; and,
θ = Maximum slope (degrees).

Where modelling results indicated that the subject site or proposed buildings were located within a bushfire prone area (bushfire hazard area) and/or potential impact buffer,

radiant heat flux and associated Bushfire Attack Level (BAL) was calculated according to the View Factor Method described in AS 3959-2009 (Standards Australia 2009). Separation distances for achieving the various BAL levels were calculated according to methods generally in accordance with Method 2 (Appendix B) of AS 3959-2009, including inputs based on:

- Distance(s) between the closest edge of proposed lots and adjacent hazardous vegetation were measured via spatial analysis in GIS to ensure a high level of precision, with radiant heat flux calculated according to the maximum view factor for all vector combinations.
- An FFDI of 54 based on the 5% AEP event as per Leonard *et al.* (2014).
- Effective slope under the classified vegetation and site slope was calculated using the maximum landscape slope (Figure 10, Map 7).
- Fuel loads derived from site-specific assessment of vegetation hazard classes (Figure 9).

Bushfire Hazard Assessment and Management Plan
72 Acacia Rd, Karawatha

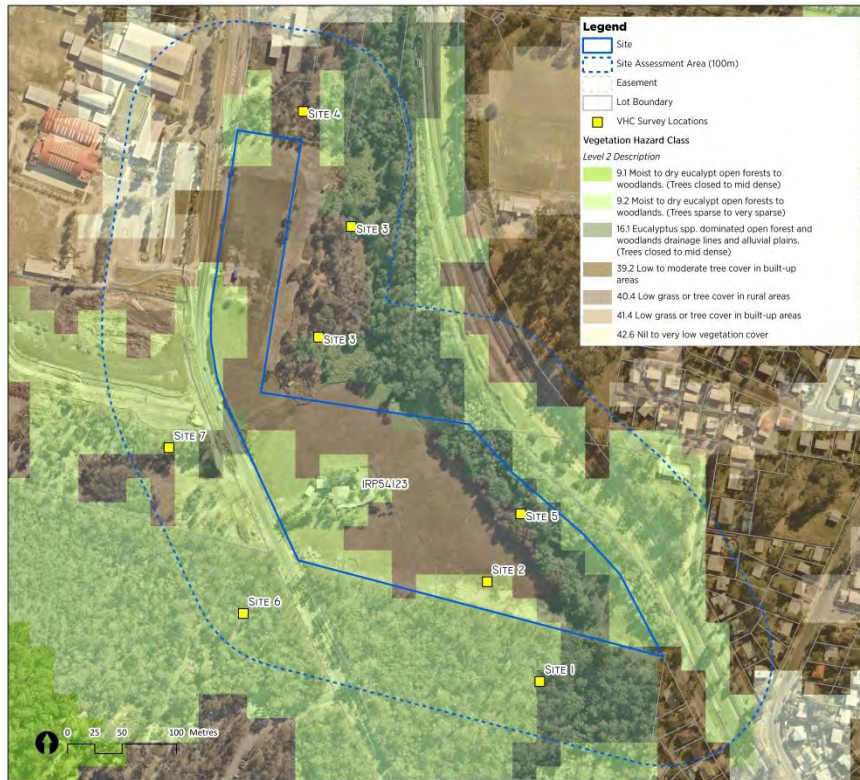


Figure 6: Extract from State-wide Map of Bushfire prone areas (bushfire prone areas): Vegetation Hazard Classes (Source: Public Safety Business Agency 2014).

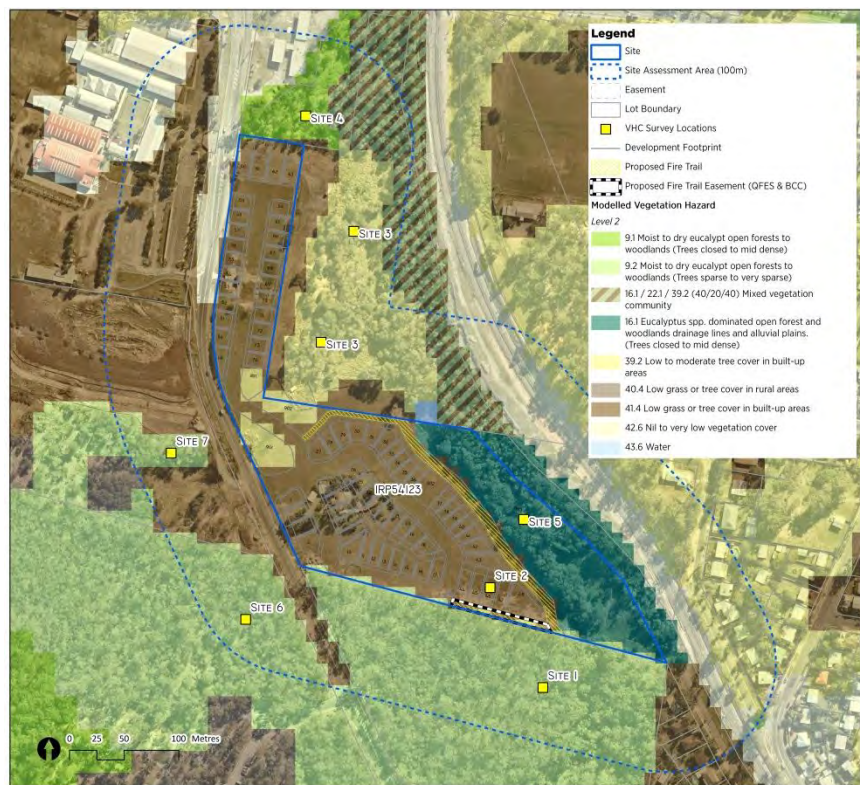


Figure 7: Modelled Vegetation Hazard Classes based on observed vegetation and API (NearMap 2017).

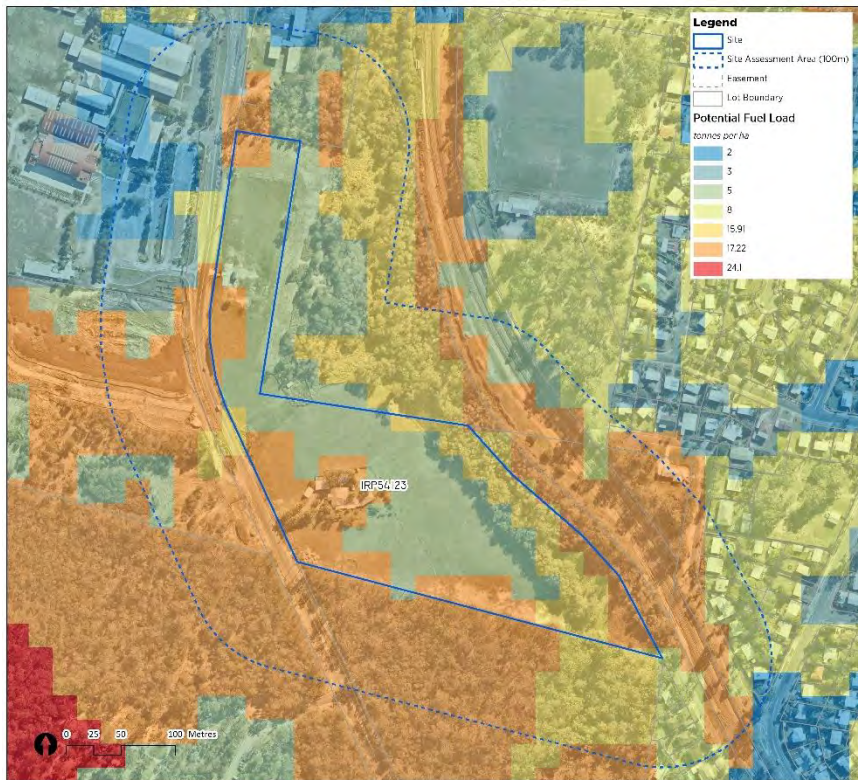


Figure 8: Extract from State-wide Map of Bushfire prone areas (bushfire prone areas): Potential fuel load (Source: Public Safety Business Agency 2014).

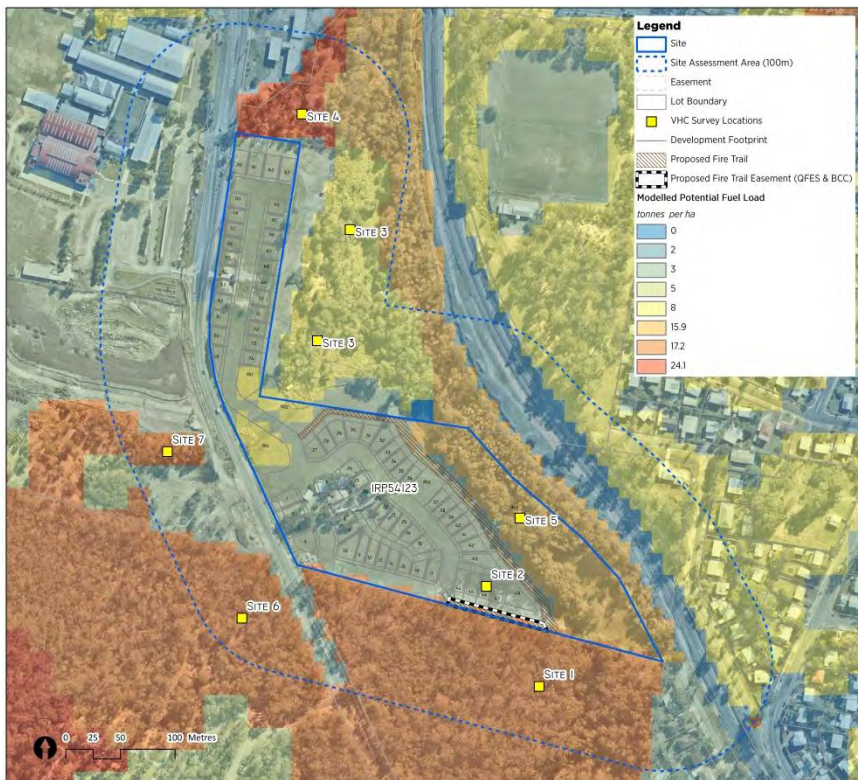


Figure 9: Modelled potential fuel loads.

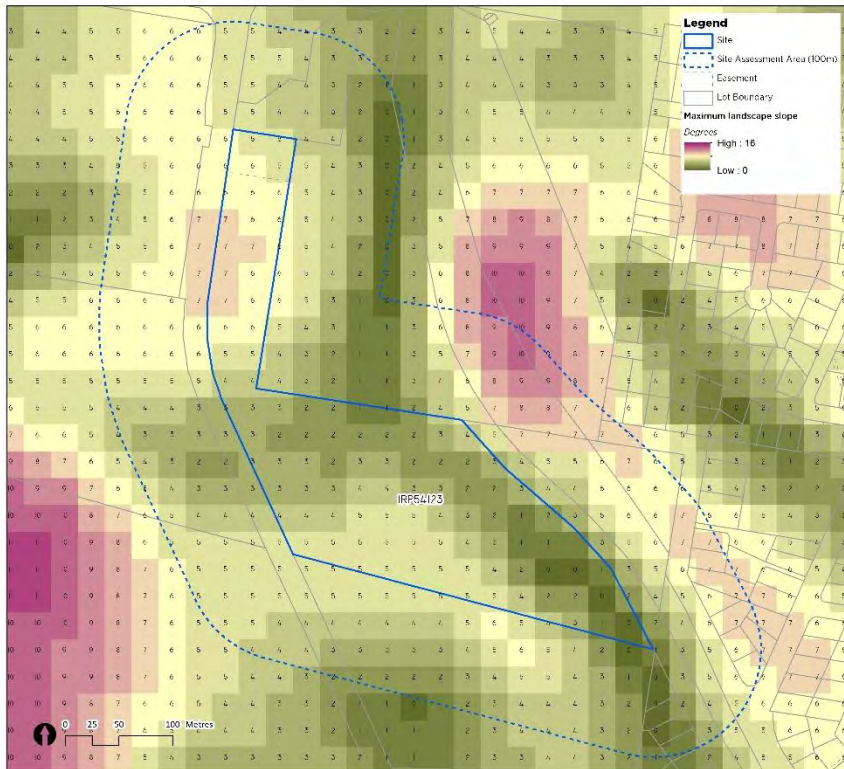


Figure 10: Extract from State-wide Map of Bushfire prone areas (bushfire prone areas): Maximum landscape slope (Public Safety Business Agency 2014).

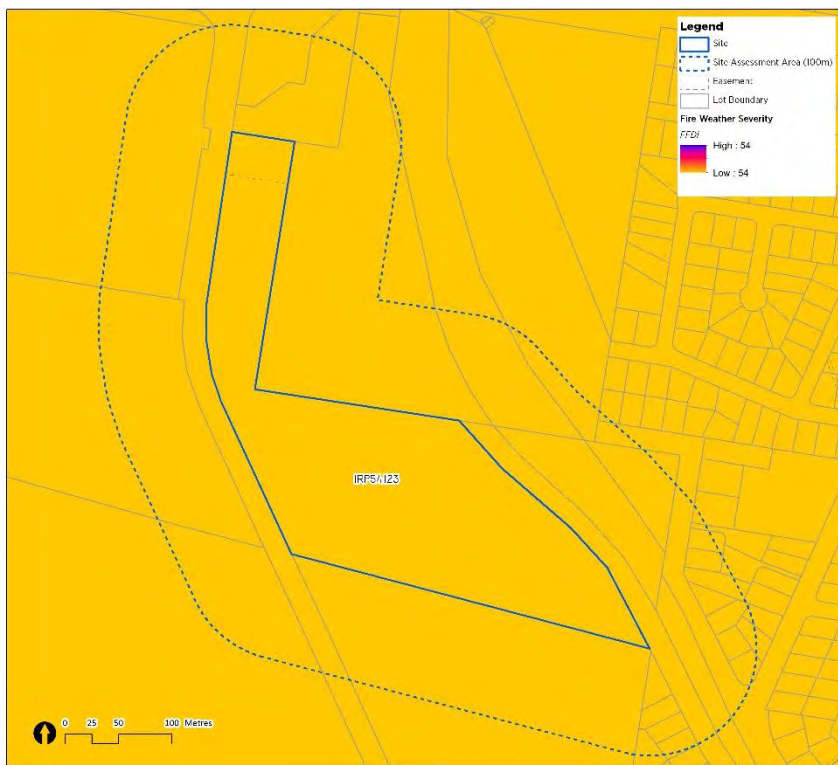


Figure 11: Extract from State-wide Map of Bushfire prone areas (bushfire prone areas): Fire weather severity (Forest Fire Danger Index) (AEP 5%) (Source: Public Safety Business Agency 2014).

5 RESULTS

5.1 BUSHFIRE BEHAVIOUR

The results of the assessments are described in terms of the extent and category of bushfire prone areas, potential fire line intensity, rate of fire spread, potential flame length and radiant heat flux levels.

Modelling results based on the AEP 5% FFDI indicated that the site contained medium potential bushfire intensity areas and several of the proposed lots were located within potential impact buffer (bushfire prone areas). Development within the potential impact buffer is at risk from the main mechanisms of bushfire attack, particularly ember attack; flame exposure and radiant heat (Refer to Figure 12 and Map 9, attached).

Modelled bushfire prone areas differed from the extent and classification of bushfire prone areas indicated by the SPP map (c.f. Figure 3 and Figure 12). This difference could be attributed solely to the precision of the observed distribution of vegetation hazard classes adopted in the modelling and the patch filtering rules used to generate the SPP map. Similarly, the modelled bushfire prone areas also differed from the extent indicated by the Bushfire overlay (c.f. Figure 4 and Figure 12). The latter difference could be attributed to:

- Methodological differences in the prediction of hazard areas, with the Bushfire overlay based on a qualitative assessment using categorical estimates of bushfire hazard; and,
- Vegetation inputs based on pre-development and pre-2014 vegetation cover.

Modelling of potential rate of bushfire spread for the AEP 5% fire weather severity event suggested potential rates of spread ranged from 0.3 to 0.5 metres per second (low) in bushfire prone areas to the east, south and west of the site and up to 1 metre per second in areas of modelled VHC 9.1 to the north of the site (Lot 2 on RP818511) (Refer to Figure 13 and Map 10, attached).

Supplementary modelling of potential flame length indicated that parts of the site were likely to be at risk of direct flame exposure, with potential flame lengths/heights of up to 12.5m possible within the Karawatha Forest Park to the south of the site and up to 16m in areas of modelled VHC 9.1 to the north of the site (Lot 2 on RP818511) (Refer to Figure 14 and Map 11, attached).

Modelling results within the narrow and smaller patches of vegetation, such as those in the proposed park to the east of the site, are considered conservative. Based on the configuration of retained vegetation on the site, fragmentation of hazardous vegetation within the landscape and smaller patch sizes; modelled fire line intensity, flame length and rate of spread are **unlikely to reach the 'potential' values identified** by the modelling, except in exceptional circumstances (i.e. actual fire weather severity >> AEP 5%). Although such patches are a **potential source of bushfire attack**, the **'potential' values identified by the modelling are unlikely to be encountered** in areas where the width of vegetation is less than 50m as per Catchpole *et al.* (1982).

Overall, results demonstrated that the proposed development could be at risk of bushfire attack and that planning and management to reduce bushfire attack risk is required.

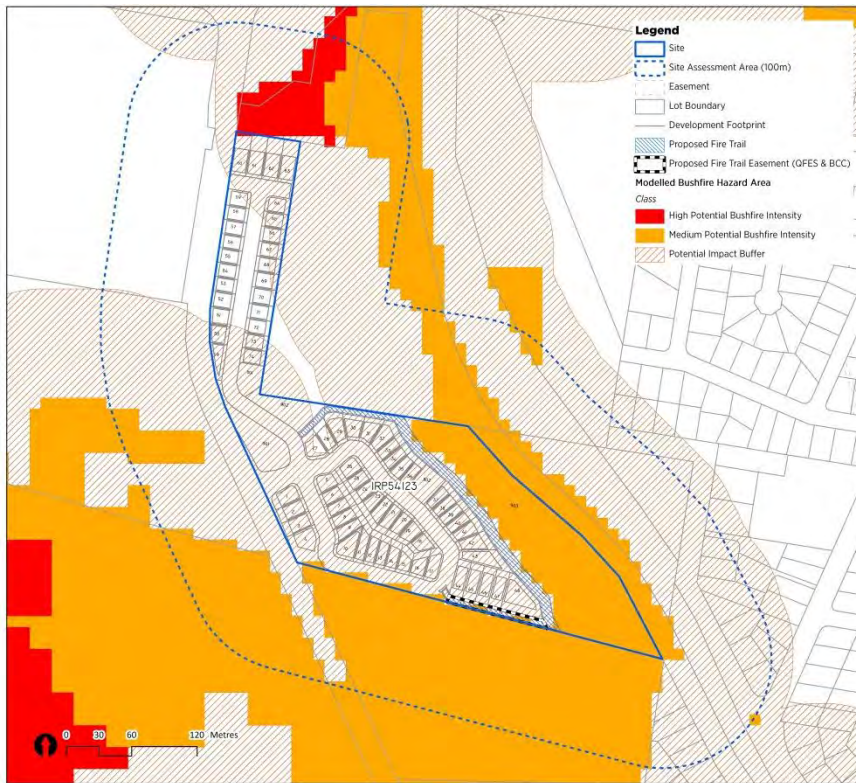


Figure 12: Modelled bushfire prone areas (bushfire prone areas).

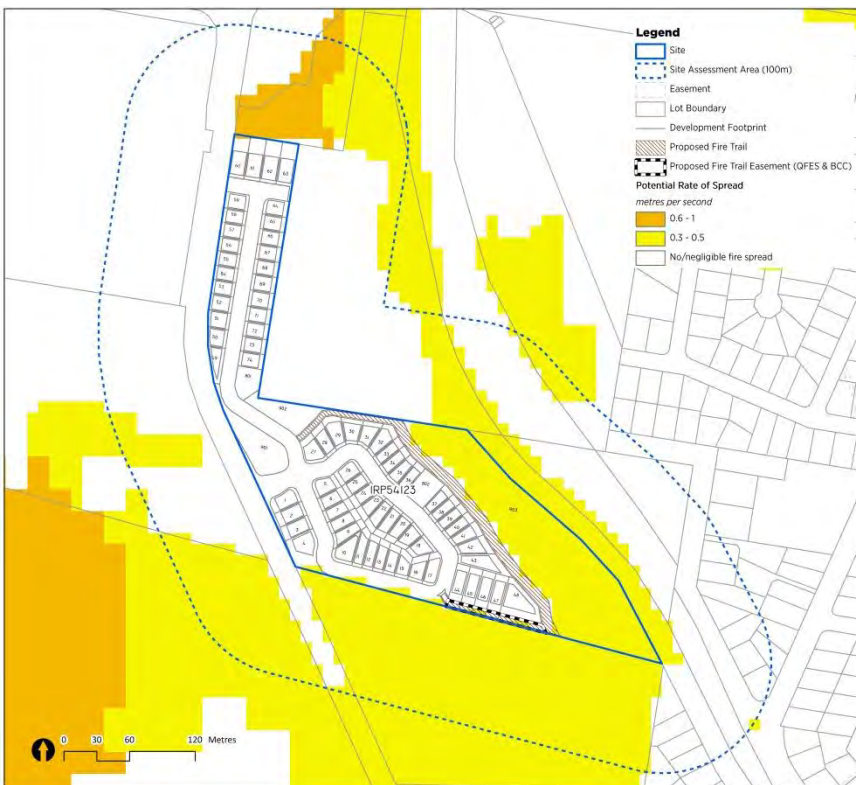


Figure 13: Modelled potential rate of fire spread.

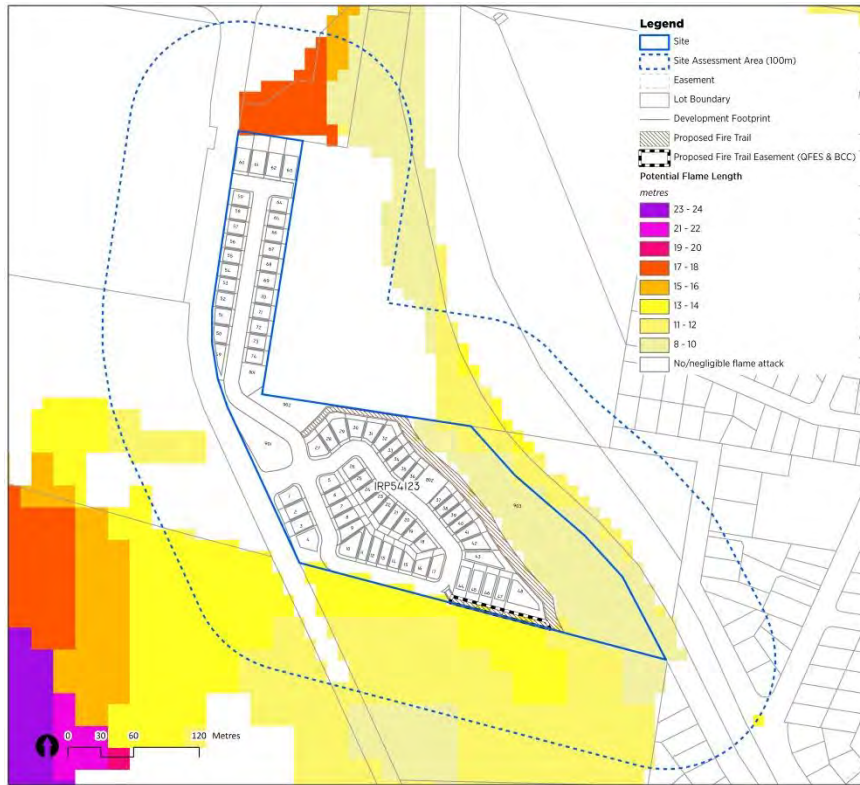


Figure 14: Modelled potential flame length.

5.2 RADIANT HEAT FLUX

Radiant heat flux was calculated for the proposed development footprint to support assessment requirements set out in the *Building Regulation 2006* (Qld) and AO 17.2 of the Bushfire overlay code. Buildings should be re-assessed at the building application stage.

Radiant heat flux was calculated based on the distance between the closest edge of the development to adjacent hazardous vegetation in accordance with Method 2 of AS 3959-2009 (View Factor Method), utilising the input data described in Section 4. For each lot, the maximum view factor and radiant heat exposure was calculated i.e. the combination of fuel, FFDI and site and effective slopes which maximise radiant heat flux. The model input data and results of the calculations are indicated in Table 2.

Results of the calculations indicated that:

- Proposed lots 4 and 44-48 adjoined bushfire prone areas within the Karawatha Forest Reserve and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to 19 kW/m^2 and still achieve viable building envelopes.
- Proposed lots 60-63 adjoined bushfire prone areas within the Lot 2 on RP818511 and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to 19 kW/m^2 and still achieve viable building envelopes.
- Proposed lots 10-17 were separated from the Karawatha Forest Reserve by a proposed public road (14m) and achieved a radiant heat flux less than or equal to 19 kW/m^2 at the closest point on boundary of any lot. Additional separation within the lots of at least 7m, for example via a front boundary setback, would allow for a building envelope which achieved a radiant heat flux less than or equal to 12.5 kW/m^2 .
- Several of the proposed lots which adjoin the proposed eastern park area were subject to moderate levels of radiant heat exposure, in particular lots 31-48. In each case, additional separation within the lots, for example via a rear boundary setback, would allow for a building envelope which achieved a radiant heat flux of less than or equal to 12.5 kW/m^2 or 19 kW/m^2 .
- With the exception of Lots 52-55 and 70-71 (BAL-LOW), the balance of the lots on the site achieve a radiant heat flux less than or equal to 12.5 kW/m^2 (BAL 12.5) at any point on the lot boundary.

Assessment results are preliminary only and subject to Council approval of the development application and subsequent building approval. Changes to aspects of the development may result in changes to radiant heat flux and associated Bushfire Attack Levels.

Table 2: Radiant heat flux calculations for the proposed development adjacent to hazardous vegetation

Lot No.	VHC	Total Fuel (tonnes/ha)	Surface Fuel (tonnes/ha)	Upslope/Downslope	Effective Slope (degrees)	Site Slope (degrees)	Separation Distance (m)	Fireline Intensity (kW/m)	Radiant Heat Flux (kW/m ²)	BAL	Separation Distance ⁷		
											BAL 29 (m)	BAL 19 (m)	BAL 12.5 (m)
1	9.2	17.2	14.9	U	5	3	43	9905	4.9	12.5			
2	9.2	17.2	14.9	U	5	4	32	9905	7.3	12.5			
3	9.2	17.2	14.9	U	5	4	24	9905	10.4	12.5			
4 (Western)	9.2	17.2	14.9	U	5	5	21	9905	12.1	12.5			
4 (Southern)	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
5-9 ⁸	9.2	17.2	14.9	-	-	-	-	-	-	12.5			
10	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
11	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
12	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
13	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
14	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
15	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
16	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
17	9.2	17.2	14.9	U	5	5	14	9905	18.8	19			21
18-26 ⁹	9.2	17.2	14.9	-	-	-	-	-	-	12.5			
27	9.2	17.2	14.9	U	3	2	87		1.6	12.5			
28 ¹⁰	9.2	17.2	14.9	-	-	-	-	-	-	12.5			
29	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	4	2	86	4724	1.8	12.5			
30	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	4	2	62	4724	2.8	12.5			
31	16.1	15.9	13.8	U	4	1	15	9717	18.2	19			22

⁷ From closest edge of hazardous vegetation.

⁸ Shielded from exposure to radiant heat/flame attack in accordance with Clause 3.5, AS 3959-2009.

⁹ Shielded from exposure to radiant heat/flame attack in accordance with Clause 3.5, AS 3959-2009.

¹⁰ Shielded from exposure to radiant heat/flame attack in accordance with Clause 3.5, AS 3959-2009.

Bushfire Hazard Assessment and Management Plan
72 Acacia Rd, Karawatha

Lot No.	VHC	Total Fuel (tonnes/ha)	Surface Fuel (tonnes/ha)	Upslope/Downslope	Effective Slope (degrees)	Site Slope (degrees)	Separation Distance (m)	Fireline Intensity (kW/m)	Radiant Heat Flux (kW/m ²)	BAL	Separation Distance ⁷		
											BAL 29 (m)	BAL 19 (m)	BAL 12.5 (m)
32	16.1	15.9	13.8	D	4	1	10	9717	28.0	29		15	22
33	16.1	15.9	13.8	D	4	2	10	9717	28.0	29		15	22
34	16.1	15.9	13.8	D	4	2	10	9717	28.0	29		15	22
35	16.1	15.9	13.8	D	4	2	10	9717	28.0	29		15	22
36	16.1	15.9	13.8	D	4	2	10	9717	28.0	29		15	22
37	16.1	15.9	13.8	D	2	2	10	9717	28.0	29		15	22
38	16.1	15.9	13.8	D	2	2	10	9717	28.0	29		15	22
39	16.1	15.9	13.8	D	2	2	10	9717	28.0	29		15	22
40	16.1	15.9	13.8	D	2	2	10	9717	28.0	29		15	22
41	16.1	15.9	13.8	D	2	3	10	9717	27.8	29		15	22
42	16.1	15.9	13.8	D	1	3	10	9069	26.3	29		14	20
43	16.1	15.9	13.8	D	1	3	10	9069	26.3	29		14	20
44	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
45	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
46 (Southern)	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
46 (Eastern)	16.1	15.9	13.8	D	1	4	20	9069	12.5	12.5			
47 (Southern)	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
47 (Eastern)	16.1	15.9	13.8	D	1	4	12	9069	21.7	29		14	20
48 (Southern)	9.2	17.2	14.9	U	5	5	0	9905	76.0	FZ	10	14	21
48 (Eastern)	16.1	15.9	13.8	D	0	2	10	9069	26.5	29		14	21
49	9.2	17.2	14.9	D	3	3	48	12183	5.0	12.5			
50	9.2	17.2	14.9	D	3	5	81	12183	2.2	12.5			
51	9.2	17.2	14.9	D	3	5	97	12183	1.6	12.5			
56-59 ¹¹	9.1	24.1	21	-	-	-	-	-	-	12.5			

¹¹ Shielded from exposure to radiant heat/flame attack in accordance with Clause 3.5, AS 3959-2009.

Bushfire Hazard Assessment and Management Plan
72 Acacia Rd, Karawatha

Lot No.	VHC	Total Fuel (tonnes/ha)	Surface Fuel (tonnes/ha)	Upslope/Downslope	Effective Slope (degrees)	Site Slope (degrees)	Separation Distance (m)	Fireline Intensity (kW/m)	Radiant Heat Flux (kW/m ²)	BAL	Separation Distance ⁷		
											BAL 29 (m)	BAL 19 (m)	BAL 12.5 (m)
60	9.1	24.1	21	D	3	5	0	23918	76.0	FZ	15	22	32
61	9.1	24.1	21	D	3	5	0	23918	76.0	FZ	15	22	32
62	9.1	24.1	21	D	3	5	0	23918	76.0	FZ	15	22	32
63	9.1	24.1	21	D	3	5	0	23918	76.0	FZ	15	22	32
64	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	83	6025	2.1	12.5			
65	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	84	6025	2.1	12.5			
66	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	86	6025	2.0	12.5			
67	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	87	6025	2.0	12.5			
68	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	90	6025	1.9	12.5			
69	16.1 / 22.1 / 39.2 (40/20/40)	15.24	12.2	U	0	4	95	6025	1.8	12.5			
72-74 ¹²	9.2	17.2	14.9	-	-	-	-	-	-	12.5			

¹² Shielded from exposure to radiant heat/flame attack in accordance with Clause 3.5, AS 3959-2009.

6 BUSHFIRE MANAGEMENT AND PLANNING

The outcomes of the bushfire hazard assessment indicated that parts of the proposed development were at risk of bushfire attack and that planning and design measures to reduce bushfire attack risk is required.

Planning and design measures to reduce the risk of bushfire attack can be categorised as:

- i. Urban design
- ii. Separation
- iii. Building
- iv. Access
- v. Water supply
- vi. Landscape and vegetation management

The following sections assess the proposed development against the applicable planning requirements including identification of planning and management measures to reduce the risk of bushfire attack and assessment of the development against the Bushfire overlay code.

6.1 URBAN DESIGN

Urban design is an integral part of bushfire risk management since it reduces *apriori* bushfire attack risk at the planning and construction stages of new development.

Examples of urban design management measures include:

- Requirements for perimeter roads between lots and hazardous vegetation in urban areas and fire trails between development and hazardous vegetation in rural areas.
- Minimising corridors of hazardous vegetation within the development.
- Avoidance of layouts with **high perimeter to area ratios and 'hourglass' shapes**, which maximise perimeters and create bottlenecks.
- Requirements for the undergrounding of critical or hazardous infrastructure such as electricity, gas, telecommunications and water supply.
- Tenure/use requirements for ongoing maintenance of separation distances and managed fuel zones.

In this instance:

- The layout achieves a compact urban form, avoiding 'hourglass' shapes, which otherwise maximise perimeters and create bottlenecks.
- The layout includes a mixture of fire trails, driveways and public roads between proposed lots and immediately adjacent hazardous vegetation.
- The approved layout does not include any corridors of hazardous vegetation within the development.
- Electricity, gas, telecommunications and water supply infrastructure will be located underground as part of the development.

- Conditions can be imposed to ensure that separation distances and fuel management zones are maintained in accordance with the proposed Rehabilitation Plan (Appendix 2).

6.2 SEPARATION

Empirical studies of bushfire-related loss of dwellings and other buildings in Australia have demonstrated a negative relationship between proximity to hazardous vegetation and house loss (Chen and McAneney 2004; Bianchi *et al.* 2014). Evidence demonstrates that increasing the distance that buildings are separated from hazardous vegetation and the presence of fuels is critical to reducing bushfire risks associated with direct flame contact, radiant heat exposure and ember attack (Bianchi *et al.* 2014). Provision of separation between hazardous vegetation and the development also reduces the design and construction costs to owners of lots adjacent to bushland by reducing the BAL to their lot boundary (Leonard and Bianchi 2012).

Separation areas should only include measures or uses which assist in reducing bushfire attack risks such as fire trails or perimeter roads and fuel management zones (e.g. maintained lawns or fire-retardant landscaping). In terms of separation distances, PO17 of the Bushfire overlay code requires that '*development is designed to:*

- (a) mitigate the risk of bushfire hazard to each lot;*
- (b) limit the spread of bushfire within the reconfiguration;*
- (c) achieve and maintain sufficient separation distance between development and hazardous vegetation to minimise bushfire hazard to future buildings during a bushfire;*
- (d) allow for emergency services access.*
- (e) locate buildings within a building protection zone.'*

Modelling results indicated that:

- Separation between the majority of proposed lots and adjacent hazardous vegetation achieved a radiant heat flux level of less than 12.5kW/m², which complies with the acceptable outcomes set out in the Bushfire overlay code (equivalent to Bushfire Attack Level BAL 12.5).
- Lots which exceeded the acceptable solution at the lot boundary were able to accommodate a building envelope which achieved a radiant heat flux of less than or equal to 29kW/m² (equivalent to Bushfire Attack Level BAL 29).

Measured separation distances between proposed lots and adjacent hazardous vegetation are indicated in Figure 15¹³.

Although BAL 29 lots do not comply with the acceptable solution (AO17.2) set out in the Bushfire overlay code, the proposed solution meets the performance outcome (PO17) as:

¹³ Distances measured from observed, closest edge of 'hazardous vegetation' community, rather than rasterised, input data. Rasterised input data shown for information and assessment purposes.

- Other than proposed Lots 4 and 60-63, all lots adjacent to hazard are otherwise separated from the hazard by an all-weather, public road or a fire trail, and serviced by an urban brigade, with access to reticulated water supply (Figure 17).
- BAL 12.5, 19 and 29 are all designed to protect from the same bushfire attack vector i.e. ember attack only.
- For the lots (31-48) which back onto hazardous vegetation within the drainage reserve rehabilitation area (Lot 903), the size, dimensions and configuration of the vegetation means that bushfire will never reach the fire line intensities predicted by Leonard et al. (2014) or the radiant heat levels predicted by AS 3959-2009, except in exceptional circumstances i.e. actual fire weather severity >> AEP 5%. Whilst some level of attack cannot be ruled out, it is likely that 'nuisance fires' will be readily controlled or burn out before significant damage property could eventuate.
- Fuel loads within the Karawatha Forest Reserve are actively managed by Brisbane City Council.



Figure 15: Separation between proposed lots and hazardous vegetation.

6.3 BUILDING

Improving the design and construction of buildings to withstand bushfire attack is one of the most significant management measures to reduce the likelihood of property loss or loss of life (Blanchi *et al.* 2014).

Certain new buildings within *designated bushfire prone areas* require assessment are assessed against the National Construction Code (NCC). The NCC performance requirement is deemed to have been met where the building complies with either AS3959-2009 or the NASH Standard - Steel Framed Construction in Bushfire Areas¹⁴ (National Association of Steel Framed Housing 2014). Both AS3959-2009 and the NASH Standard contain provisions which can be used for construction to resist bushfires in order to reduce the risk of bushfire attack. These provisions include requirements for burning debris and ember protection, controls on the combustibility of exterior materials, and the protection of openings, such as windows and doors. The NCC requirements do not apply to non-residential buildings (Class 4-9) such as offices, shops, hospitals and schools.

Both AS 3959-2009 and the NASH Standard are concerned with improving the ability of buildings in designated bushfire-prone areas to better withstand attack from bushfire, thus giving a measure of protection to the building occupants (until the fire front passes) as well as to the building itself. Table 3 outlines current Bushfire Attack Levels, radiant heat flux thresholds and relevant sections of AS 3959-2009 which specifies building design and construction features.

Table 3: BALs and representative heat flux thresholds, levels of exposure and relevant sections of AS 3959-2009 outlining relevant construction requirements (Standards Australia 2009).

Bushfire Attack Level (BAL)	Heat flux exposure thresholds	Relevant sections of AS 3959-2009
BAL 12.5	< 12.5kW/ m ²	3 and 5
BAL 19	>12.5 kW/m ² to 19 kW/m ²	3 and 6
BAL 29	>19 kW/m ² to 29 kW/m ²	3 and 7
BAL 40	>29 kW/m ² to 40 kW/m ²	3 and 8
BAL FZ	>40 kW/m ²	3 and 9

Results of the radiant heat flux calculations according to Method 2 of AS3959-2009 indicated that:

- Proposed lots 4 and 44-48 adjoined bushfire prone areas within the Karawatha Forest Reserve and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to BAL 19 and still achieve viable building envelopes.
- Proposed lots 60-63 adjoined bushfire prone areas within the Lot 2 on RP818511 and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to BAL 19 and still achieve viable building envelopes.

¹⁴ Applies to steel-framed construction only.

- Proposed lots 10-17 were separated from the Karawatha Forest Reserve by a proposed public road (14m) and achieved a radiant heat flux less than or equal to BAL 19 at the closest point on boundary of any lot. Additional separation within the lots of at least 7m, for example via a front boundary setback, would allow for a building envelope which achieved a radiant heat flux less than or equal to BAL 12.5.
- Several of the proposed lots which adjoin the proposed eastern park area were subject to moderate levels of radiant heat exposure, in particular lots 31-48. In each case, additional separation within the lots, for example via a rear boundary setback, would allow for a building envelope which achieved a radiant heat flux of less than or equal to BAL 12.5 and BAL 19.
- With the exception of Lots 52-55 and 70-71 (BAL-LOW), the balance of the lots on the site achieve a radiant heat flux less than or equal to BAL 12.5 at any point on the lot boundary.

Assessment results are preliminary only and subject to Council approval of the development application and subsequent building approval. Changes to aspects of the development may result in changes to radiant heat flux and associated Bushfire Attack Levels.

Figure 16 illustrates the relationship between BAL, radiant heat and bushfire attack mechanisms. Figure 17 (Map 12) indicates the BAL 'contours' for all of the proposed allotments, including internal boundary setbacks necessary to reduce construction requirements to a lower BAL.

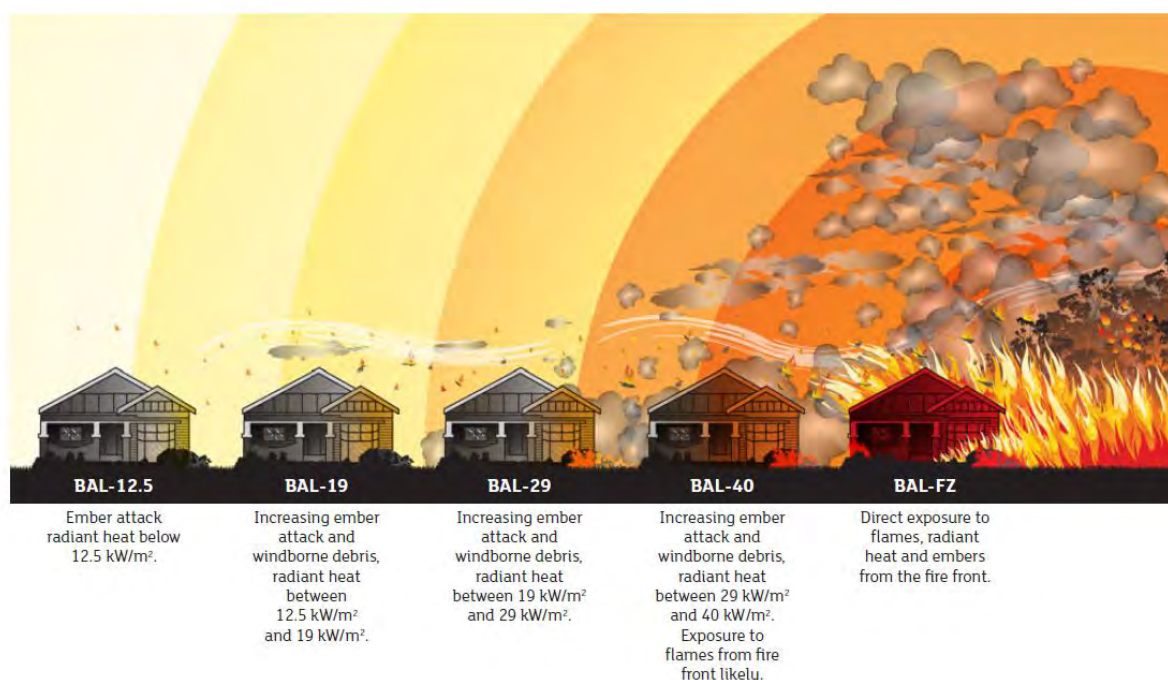


Figure 16: BAL/radiant heat levels and bushfire attack mechanisms (Source: Country Fire Authority 2012).



Figure 17: Bushfire Management Plan including Bushfire Attack Levels (AS 3959-2009).

6.4 ACCESS

Access to and from sites reduces the risk of bushfire attack by:

- Providing easy and safe movement away from any encroaching fire;
- Providing easy and safe access for firefighting and other emergency vehicles; and
- Allowing for alternative safe access and evacuation routes should access in one direction be blocked in the event of a fire.

In the case of the approved development:

- All lots have direct access the internal road network.
- The internal road network links to Acacia Road, providing for easy and safe movement away from any encroaching fire from the west, south or east.
- The layout has been redesigned to incorporate a perimeter fire trail within the proposed parkland which provides operational space for emergency services for

firefighting or maintenance purposes. fire trail is located in the proposed drainage reserve (Lot 903), between Lots 27 and 48 and proposed rehabilitation zones and achieves the following parameters:

- A minimum clearance width of 6m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
- A minimum formed width of 4m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
- A minimum vertical clearance of 4m to any overhanging obstructions including tree branches and 6m clearance to adjacent vegetation.
- At least 5m clearance to all power lines.
- A gradient of less than 12.5% with adequate drainage to prevent soil erosion and minimise ongoing trail maintenance.
- Vehicular access at each end.
- Is located on public land, other than the section within proposed Lots 44-48 which will be located within an access easement that is granted in favour of Brisbane City Council and Queensland Fire and Rescue Service. The section of the trail adjacent to Lots 44-48 will also serve as driveway access to each of the lots and will be designed to comply with the 'private access roads or driveway' requirements set out in *Table 8.2.5.3.C—Road design requirements for emergency vehicle access* of the Bushfire overlay code.

Detailed design of the access/trail can be conditioned and assessed as part of a subsequent operational works application.

6.5 WATER SUPPLY

Access to an adequate reticulated or dedicated, static water supply for firefighting purposes is an essential element of bushfire safety planning. The development has access to reticulated water supply.

Given the level of bushfire attack and proximity to hazardous vegetation, it is recommended that the development also includes the following measures:

- Fire hydrants are designed and installed in accordance with AS2419.1 2005, unless otherwise specified by Queensland Urban Utilities;
- Internal road access includes geometry and turning radii in accordance with Old Fire and Emergency Services' Fire Hydrant and Vehicle Access Guidelines;
- Internal roads achieve a minimum of 4.8m vertical clearance above the road; and,
- Hydrants and water access points are not located within parking bay allocations.

The proposed measures can be conditioned as part of any development permit.

6.6 LANDSCAPE AND VEGETATION MANAGEMENT

Proximity to hazardous vegetation and bushfire fuel sources increased the likelihood and risk of bushfire attack. In addition to maximising the distance between buildings / structures and hazardous vegetation, fuel load management via landscape design and vegetation management is integral to reducing bushfire attack risk (e.g. controlled burning, mowing/slashing etc.).

In the case of the approved development, landscaping within the separation distances should be designed and managed to minimise flame contact and radiant heat exposure to buildings, and the potential for ignition from ember attack. Examples of landscape design and vegetation (fuel load) management measures include:

- Selection of low-flammability trees and shrubs with good barrier-forming attributes e.g. rainforest species.
- Fencing using treated hardwood or non-combustible materials.
- Planting or maintaining plant species which minimise leaf litter drop and minimise contribution to the accumulation surface fuel i.e. persistent leaf litter.
- Planting or maintaining low-flammability species.
- Planting or maintaining species with attributes which:
 - Reduce the ease of combustion;
 - Minimise contribution to potential fuel load; or,
 - Act as a potential barrier, reducing the rate of fire spread.
- Landscape maintenance, including the maintenance of separation distances and fuel loads.

In the case of the proposed development:

- Boundary fences for Lots 4, 32-48 and 60-63 shall have fencing constructed from non-combustible materials (e.g. sheet metal or masonry).
- Boundary fences for the remaining lots (other than Lots 52-55 and 70-71, BAL-LOW) shall have fencing constructed from:
 - Non-combustible materials (e.g. sheet metal or masonry); or
 - Treated hardwood, where the timber fence does not connect to a dwelling and has a minimum of 1 metre separation from the dwelling. Where a fence connects directly to or has less than 1 metre separation from a dwelling it should be constructed from non-combustible materials only.
- Public streetscapes, detention basins (Lots 801, 802), proposed parks (Lots 901, 902) and landscaping within private lots should be designed and maintained to achieve a total fuel load not exceeding 8 tonnes per hectare. A total fuel load of 8 tonnes per hectare is typically characterised by scattered canopy trees with a maintained grassy understorey and is consistent with expected fuel load for urban areas with a dwelling density of 10-15 dwellings per hectare.
- Vegetation within the proposed drainage reserve (Lot 903) is managed in accordance with the outcomes identified in the proposed Rehabilitation Plan (Litoria Consulting 30/03/2017; Appendix 2).

6.7 BUSHFIRE OVERLAY CODE

The proposed development involves assessable development identified as requiring assessment against the Bushfire overlay code by the tables of assessment in Part 5.10 (Tables of assessment - Overlays) of City Plan 2014.

The purpose of the Bushfire overlay code is achieved via the following outcomes:

- a) Development maintains the safety of people and property by not exposing them to an unacceptable risk from bushfire.
- b) Development does not increase the exposure of people and property to an unacceptable bushfire risk.
- c) Development involving new premises for vulnerable uses, difficult to evacuate uses and assembly uses is not located in an area of bushfire risk.
- d) Development which would increase the number of people living, working on or visiting the site is not exposed to an unacceptable risk from bushfire.
- e) Development incorporates appropriate siting, design and management measures to avoid areas at risk of bushfire and mitigate risk from bushfire.
- f) Development for essential community infrastructure and its function during a bushfire event is protected from bushfire risk.
- g) Development involving the storage and handling of hazardous chemicals in the Bushfire overlay does not pose an unacceptable risk to public safety or the environment.
- h) Development provides access and evacuation routes for both private and emergency service vehicles which are appropriate to the nature of the development and the level of bushfire risk.
- i) Development provides for fire-fighting requirements.
- j) Development is sited and includes design and building treatments to avoid impacts on biodiversity values, ecological features and ecological processes.
- k) Development for reconfiguring a lot does not result in an area of future bushfire hazard from revegetation or future vegetation corridors.

The proposed development was assessed against each of the applicable elements and performance criteria set out in the City Plan 2014 Bushfire overlay code. Results of the assessment indicated that the proposed development complied with the applicable performance outcomes sought by the Code, subject to the management measures outlined in Section 6 of the BHAMP. A copy of the code assessment is contained in Appendix 4.

Outcomes of the code assessment indicated that the proposed development complied or could be conditioned to comply with the Bushfire overlay code.

7 SUMMARY

The BHAMP was prepared by Litoria Consulting on behalf of Chris and Moira Smit to accompany a development application on land described as 72 Acacia Rd, Karawatha (Lot 1 on RP 54123).

The purpose of the BHAMP was to:

- i. Identify and measure site-specific factors which contribute to bushfire hazard.
- ii. Assess the extent of bushfire prone areas and calculate:
 - a. Potential fire intensity (PFI, kW/m),
 - b. Potential flame length (m),
 - c. Potential rate of fire spread (metres/second).
- iii. For development within bushfire prone areas or potential impact buffer (100m), assess Bushfire Attack Level (BAL) in accordance with Australian Standard 3959-2009 Construction of buildings in bushfire-prone areas (AS 3959-2009).
- iv. Where applicable, identify management measures to achieve compliance with the hazard and risk outcomes sought by:
 - a. State Planning Policy (SPP);
 - b. City Plan 2014 Bushfire overlay code; and,
 - c. AS 3959-2009.

Bushfire hazard for the study area was modelled according to the methods described in the SPP Natural Hazards Technical Manual (August 2014) and Leonard *et al.* (2014), including the creation of a quantitative model of the following measures of fire behaviour:

- i. Potential bushfire fire line intensity (PFI, kW/m);
- ii. Potential rate of fire spread (metres/second); and,
- iii. Potential flame lengths (m).

The fire behaviour modelling was carried out via GIS spatial modelling using rasterised inputs¹⁵ described by Leonard *et al.* (2014):

- i. Fuel load based on site-specific assessment of vegetation hazard class;
- ii. Maximum landscape slope; and,
- iii. Fire weather severity/FFDI.

Modelling results based on the AEP 5% FFDI indicated that:

- i. The site contained medium potential bushfire intensity hazard areas and several of the proposed lots were located within potential impact buffer.
- ii. Potential rates of spread ranged from 0.3 to 0.5 metres per second (low) in bushfire prone areas to the east, south and west of the site and up to 1 metre per second in areas of modelled VHC 9.1 to the north of the site (Lot 2 on RP818511) (Refer to Figure 13 and Map 10, attached).
- iii. Supplementary modelling of potential flame length indicated that parts of the site were likely to be at risk of direct flame exposure, with potential flame lengths/heights of up to 12.5m possible within the Karawatha Forest Park to the

¹⁵ VHC/fuel load, maximum landscape slope and fire weather severity input rasters can be accessed via the Queensland Government Information Service (<http://dds.information.qld.gov.au/dds/>).

south of the site and up to 16m in areas of modelled VHC 9.1 to the north of the site (Lot 2 on RP818511) (Refer to Figure 14 and Map 11, attached).

- iv. Calculation of radiant heat flux indicated that:
- a. Proposed lots 4 and 44-48 adjoined bushfire prone areas within the Karawatha Forest Reserve and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to 19 kW/m² and still achieve viable building envelopes.
 - b. Proposed lots 60-63 adjoined bushfire prone areas within the Lot 2 on RP818511 and were subject to direct flame exposure and high levels of radiant heat; however were of sufficient depth to enable adequate separation to achieve radiant heat flux of less than or equal to 19 kW/m² and still achieve viable building envelopes.
 - c. Proposed lots 10-17 were separated from the Karawatha Forest Reserve by a proposed public road (14m) and achieved a radiant heat flux less than or equal to 19 kW/m² at the closest point on boundary of any lot. Additional separation within the lots of at least 7m, for example via a front boundary setback, would allow for a building envelope which achieved a radiant heat flux less than or equal to 12.5kW/m².
 - d. Several of the proposed lots which adjoin the proposed eastern park area were subject to moderate levels of radiant heat exposure, in particular lots 31-48. In each case, additional separation within the lots, for example via a rear boundary setback, would allow for a building envelope which achieved a radiant heat flux of less than or equal to 12.5kW/m² or 19 kW/m².
 - e. With the exception of Lots 52-55 and 70-71 (BAL-LOW), the balance of the lots on the site achieve a radiant heat flux less than or equal to 12.5kW/m² (BAL 12.5) at any point on the lot boundary.

Modelling results within the narrow and smaller patches of vegetation, such as those in the proposed park to the east of the site, are considered conservative. Based on the configuration of retained vegetation on the site, fragmentation of hazardous vegetation within the landscape and smaller patch sizes; modelled fire line intensity, flame length and rate of spread are unlikely to reach the 'potential' values identified by the modelling, except in exceptional circumstances (i.e. actual fire weather severity >> AEP 5%). Although such patches are a potential source of bushfire attack, the 'potential' values identified by the modelling are unlikely to be encountered in areas where the width of vegetation is less than 50m as per Catchpole *et al.* (1982).

Overall, results demonstrated that the proposed development is at risk of bushfire attack and that planning and management to reduce bushfire attack risk was required.

An assessment of management responses was carried out and the following recommendations should be adopted and conditioned by Council as part of a development permit:

- Electricity, gas, telecommunications and water supply infrastructure will be located underground as part of the development.
- The approved plans include requirements for building envelopes for all lots to achieve radiant heat flux of less than or equal to 29 kW/m² or BAL 29. The building envelopes are indicated on the Bushfire Management Plan (Figure 17, Map 12).

- A fire trail is located in the proposed drainage reserve (Lot 903), between Lots 27 and 48 and proposed rehabilitation zones and achieves the following parameters:
 - A minimum clearance width of 6m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
 - A minimum formed width of 4m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
 - A minimum vertical clearance of 4m to any overhanging obstructions including tree branches and 6m clearance to adjacent vegetation.
 - At least 5m clearance to all powerlines.
 - A gradient of less than 12.5% with adequate drainage to prevent soil erosion and minimise ongoing trail maintenance.
 - Vehicular access at each end.
 - Is located on public land, other than the section within proposed Lots 44-48 which will be located within an access easement that is granted in favour of Brisbane City Council and Queensland Fire and Rescue Service. The section of the trail adjacent to Lots 44-48 will also serve as driveway access to each of the lots and will be designed to comply with the 'private access roads or driveway' requirements set out in *Table 8.2.5.3.C—Road design requirements for emergency vehicle access* of the Bushfire overlay code.
 - Detailed design of the access/trail can be conditioned and assessed as part of a subsequent operational works application.
- The development shall ensure that the following water supply and access requirements are provided:
 - Fire hydrants are designed and installed in accordance with AS2419.1 2005, unless otherwise specified by Unity Water;
 - Internal road access includes geometry and turning radii in accordance with Qld Fire and Emergency Services' Fire Hydrant and Vehicle Access Guidelines;
 - Internal roads achieve a minimum of 4.8m vertical clearance above the road; and,
 - Hydrants and water access points are not located within parking bay allocations.
- Boundary fences for Lots 4, 32-48 and 60-63 shall have fencing constructed from non-combustible materials (e.g. sheet metal or masonry).
- Boundary fences for the remaining lots (other than Lots 52-55 and 70-71, BAL-LOW) shall have fencing constructed from:
 - Non-combustible materials (e.g. sheet metal or masonry); or
 - Treated hardwood, where the timber fence does not connect to a dwelling and has a minimum of 1 metre separation from the dwelling. Where a fence connects directly to or has less than 1 metre separation from a dwelling it should be constructed from non-combustible materials only.
- Public streetscapes, detention basins (Lots 801, 802), proposed parks (Lots 901, 902) and landscaping within private lots should be designed and maintained to achieve a total fuel load not exceeding 8 tonnes per hectare. A total fuel load of 8 tonnes per hectare is typically characterised by scattered canopy trees with a maintained grassy understorey and is consistent with expected fuel load for urban areas with a dwelling density of 10-15 dwellings per hectare.
- Vegetation within the proposed drainage reserve (Lot 903) is managed in accordance with the outcomes identified in the proposed Rehabilitation Plan (Litoria Consulting 30/03/2017; Appendix 2).

The proposed development was assessed against each of the applicable elements and performance criteria set out in the Bushfire overlay code. Results of the assessment indicated that the proposed development complied with, or could be conditioned to comply with, the applicable performance outcomes sought by the Code.

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72 Acacia Rd, Karawatha

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Map 1: Aerial photograph of site (2 July 2016)



Legend

- Site
- Site Assessment Area
- Easement
- Lot Boundary

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




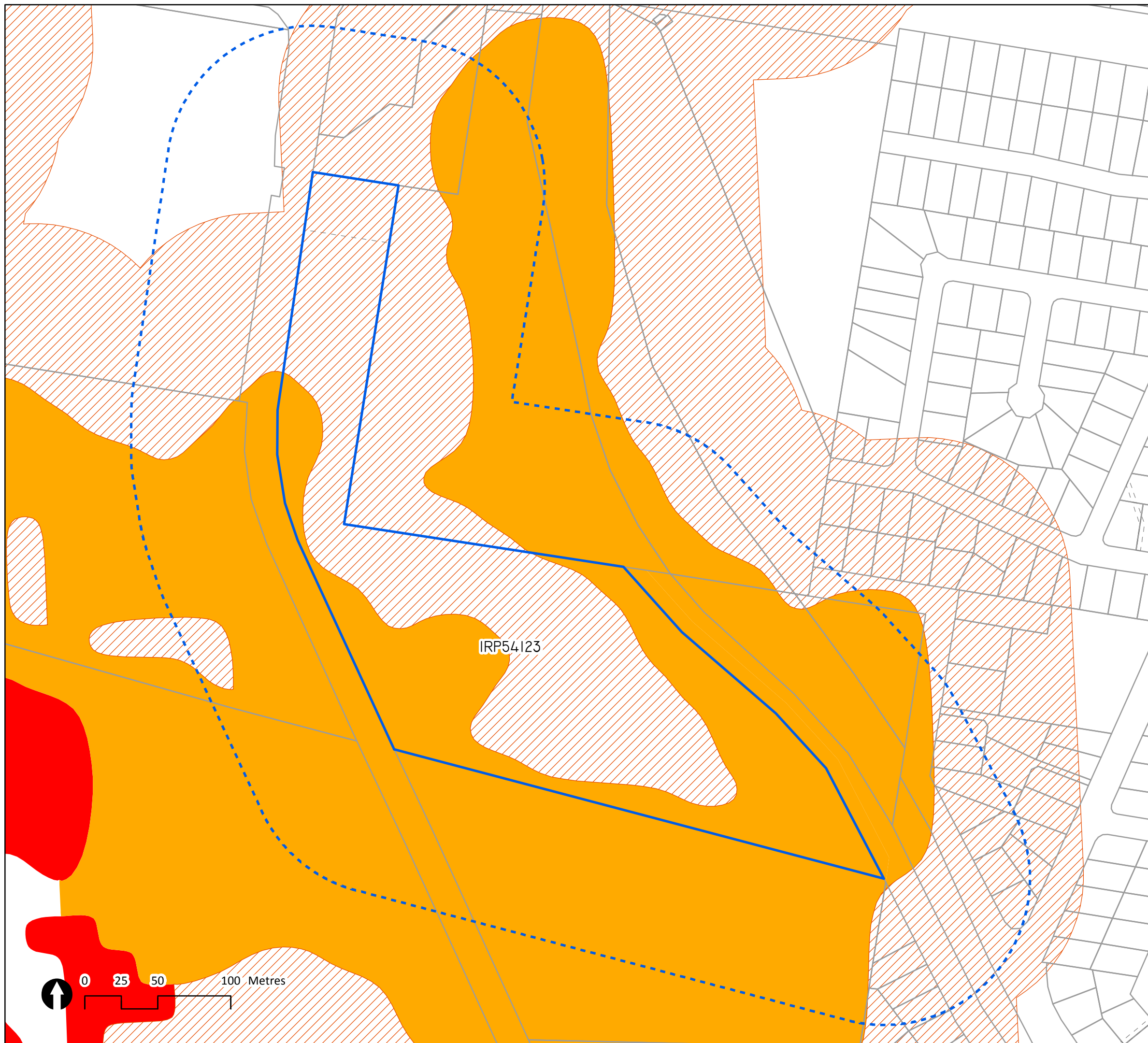
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0 25 50 100 Metres

Map 2: State-wide Map of Bushfire Hazard Areas

Legend

-  Site
 -  Site Assessment Area (100m)
 -  Easement
 -  Lot Boundary
- Bushfire Prone Areas
- CLASS
-  High Potential Bushfire Intensity
 -  Medium Potential Bushfire Intensity
 -  Potential Impact Buffer



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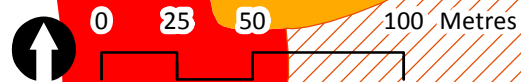
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





Map 3: State-wide Map of Bushfire Hazard Areas: Vegetation Hazard Class

Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary
-  VHC Survey Locations

Vegetation Hazard Class

Level 2

-  9.1 Moist to dry eucalypt open forests to woodlands. (Trees closed to mid dense)
-  9.2 Moist to dry eucalypt open forests to woodlands. (Trees sparse to very sparse)
-  16.1 Eucalyptus spp. dominated open forest and woodlands drainage lines and alluvial plains. (Trees closed to mid dense)
-  39.2 Low to moderate tree cover in built-up areas
-  40.4 Low grass or tree cover in rural areas
-  41.4 Low grass or tree cover in built-up areas
-  42.6 Nil to very low vegetation cover

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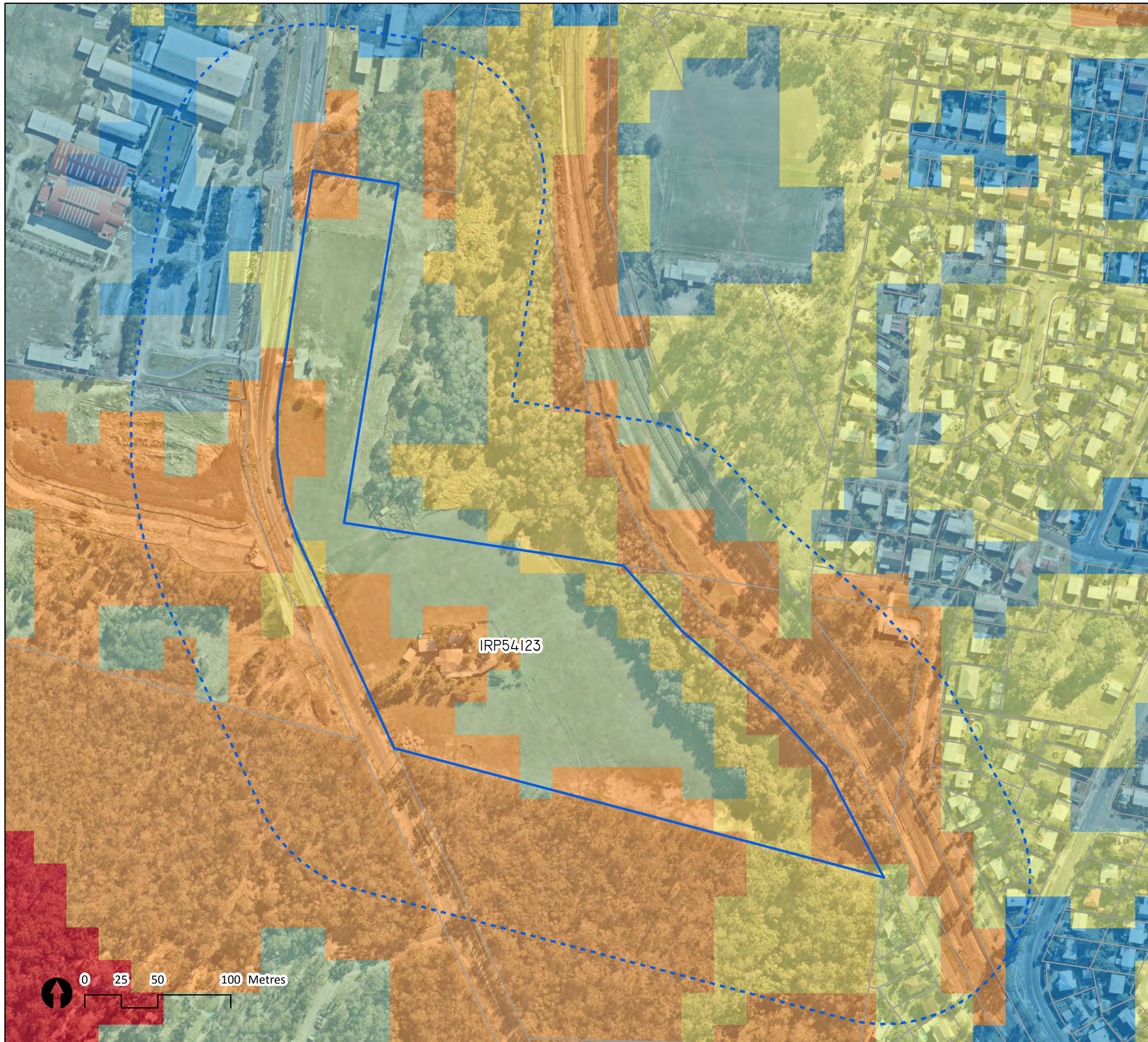
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Map 4: State-wide Map of Bushfire Hazard Areas: Potential Fuel Load










Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary

Potential Fuel Load

tonnes per ha

-  2
-  3
-  5
-  8
-  15.91
-  17.22
-  24.1

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Map 5: Modelled Vegetation Hazard Class

Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary
-  VHC Survey Locations
-  Development Footprint
-  Proposed Fire Trail
-  Proposed Fire Trail Easement (QFES & BCC)

Modelled Vegetation Hazard

Level 2

-  9.1 Moist to dry eucalypt open forests to woodlands (Trees closed to mid dense)
-  9.2 Moist to dry eucalypt open forests to woodlands (Trees sparse to very sparse)
-  16.1 / 22.1 / 39.2 (40/20/40) Mixed vegetation community
-  16.1 Eucalyptus spp. dominated open forest and woodlands drainage lines and alluvial plains. (Trees closed to mid dense)
-  39.2 Low to moderate tree cover in built-up areas
-  40.4 Low grass or tree cover in rural areas
-  41.4 Low grass or tree cover in built-up areas
-  42.6 Nil to very low vegetation cover
-  43.6 Water

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







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



Map 6: Modelled Potential Fuel Load

Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary
-  VHC Survey Locations
-  Development Footprint
-  Proposed Fire Trail
-  Proposed Fire Trail Easement (QFES & BCC)

Modelled Potential Fuel Load

tonnes per ha

-  0
-  2
-  3
-  5
-  8
-  15.9
-  17.2
-  24.1

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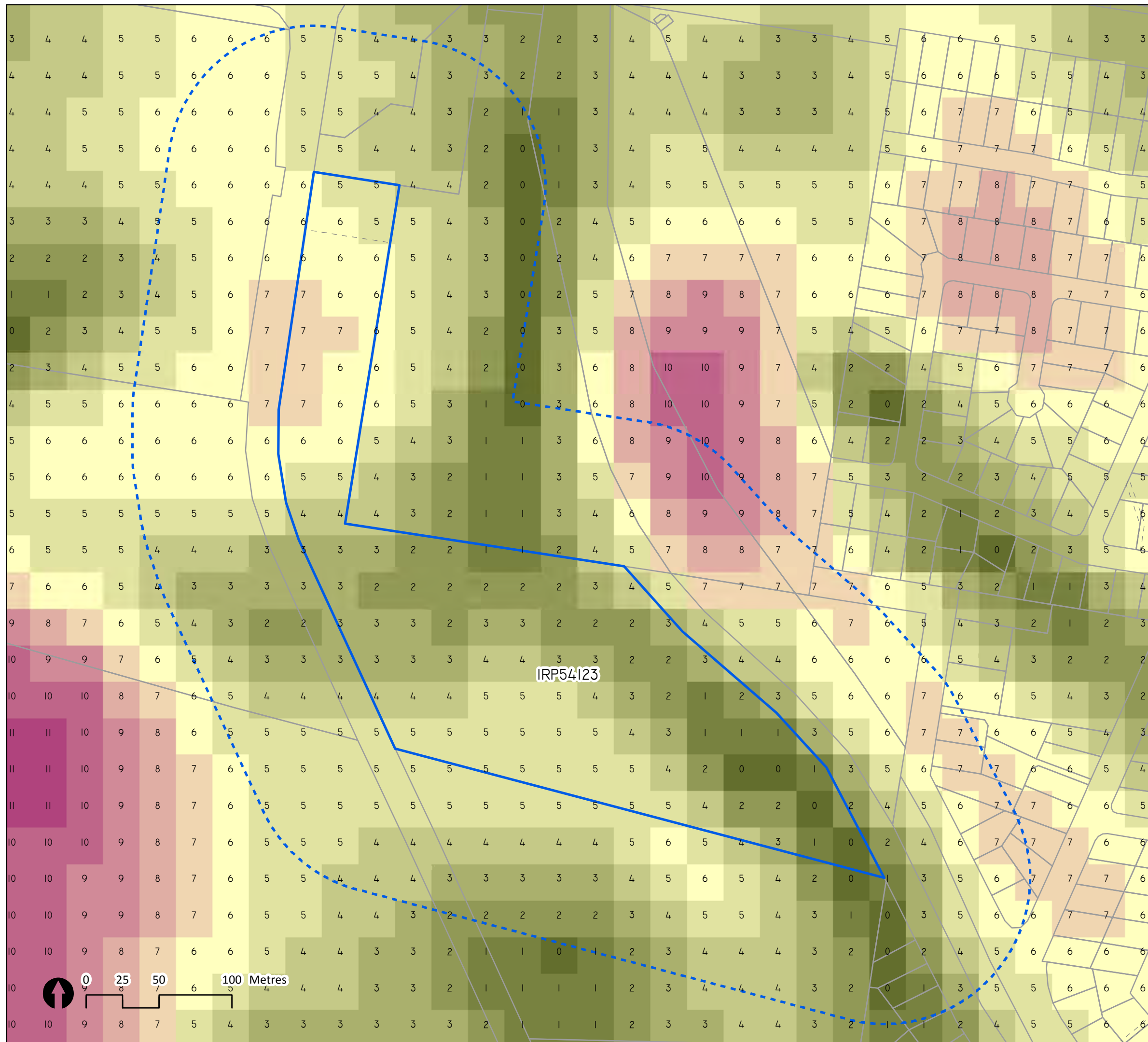
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Map 7: State-wide Map of Bushfire Hazard Areas: Maximum landscape slope

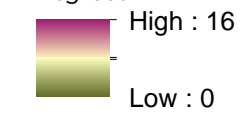


Legend

- Site
- Site Assessment Area (100m)
- Easement
- Lot Boundary

Maximum landscape slope

Degrees



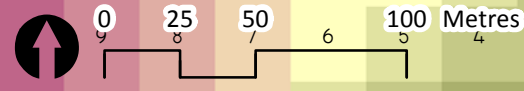
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
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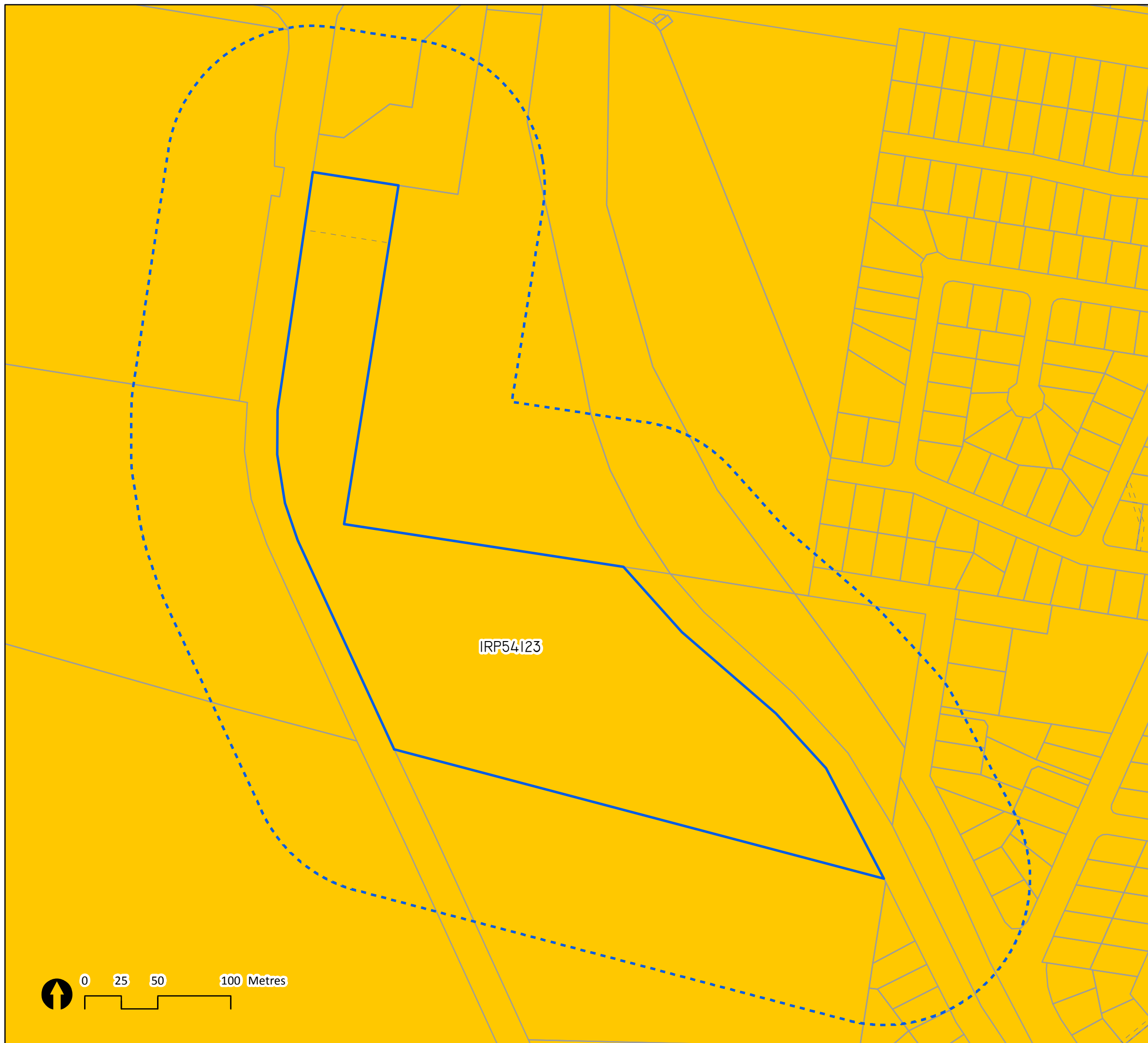


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Map 8: State-wide Map of Bushfire Hazard Areas: Fire Weather Severity

Legend

-  Site
 -  Site Assessment Area (100m)
 -  Easement
 -  Lot Boundary
- Fire Weather Severity
- FFDI*
-  High : 54
 - Low : 54



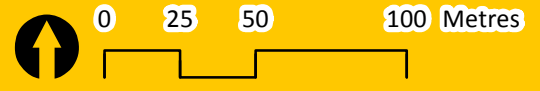
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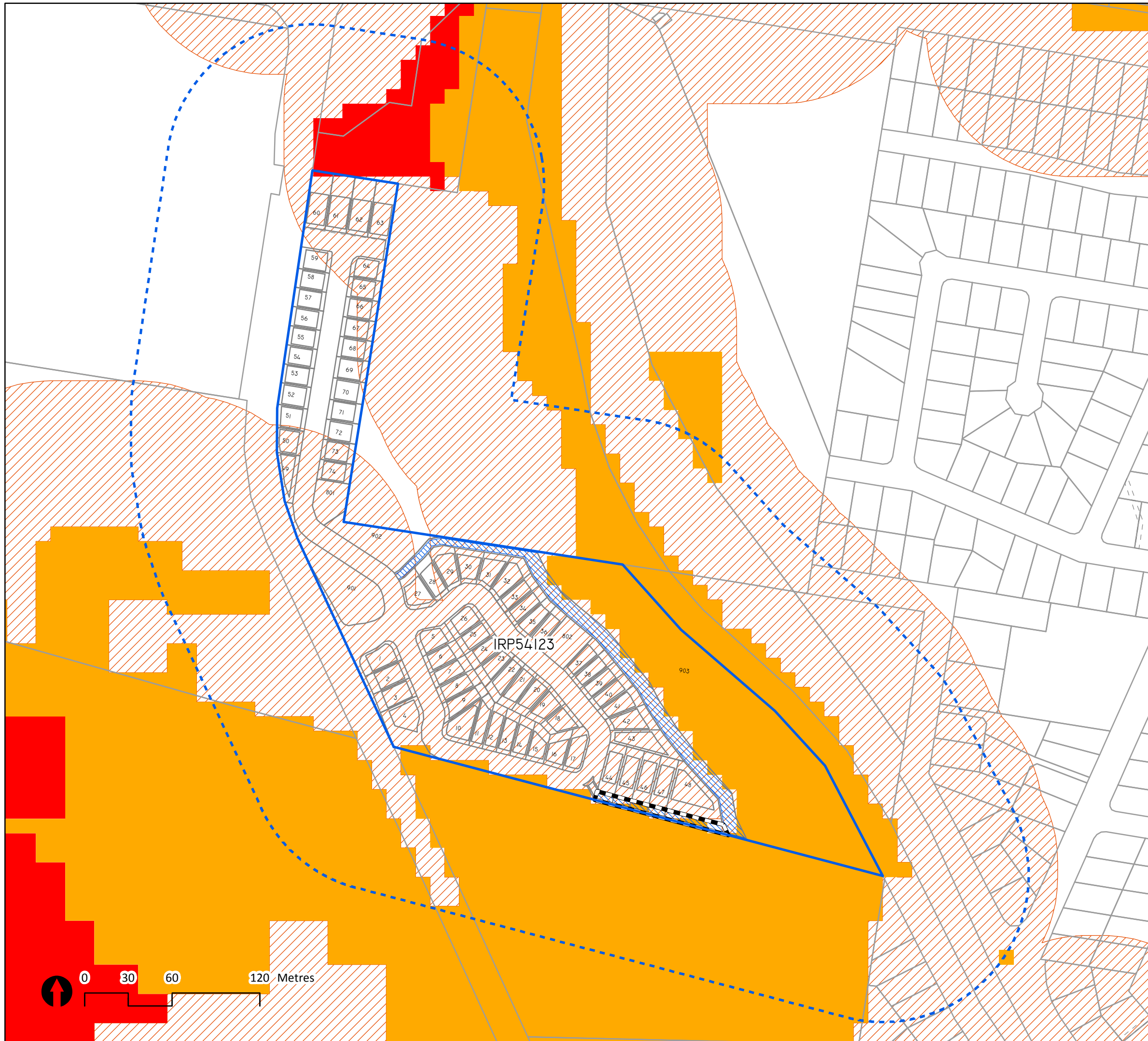


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Map 9: Modelled Bushfire Hazard Areas

Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary
-  Development Footprint
-  Proposed Fire Trail
-  Proposed Fire Trail Easement (QFES & BCC)
- Modelled Bushfire Hazard Area
- Class**
-  High Potential Bushfire Intensity
-  Medium Potential Bushfire Intensity
-  Potential Impact Buffer



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Date Created: 13/04/2017

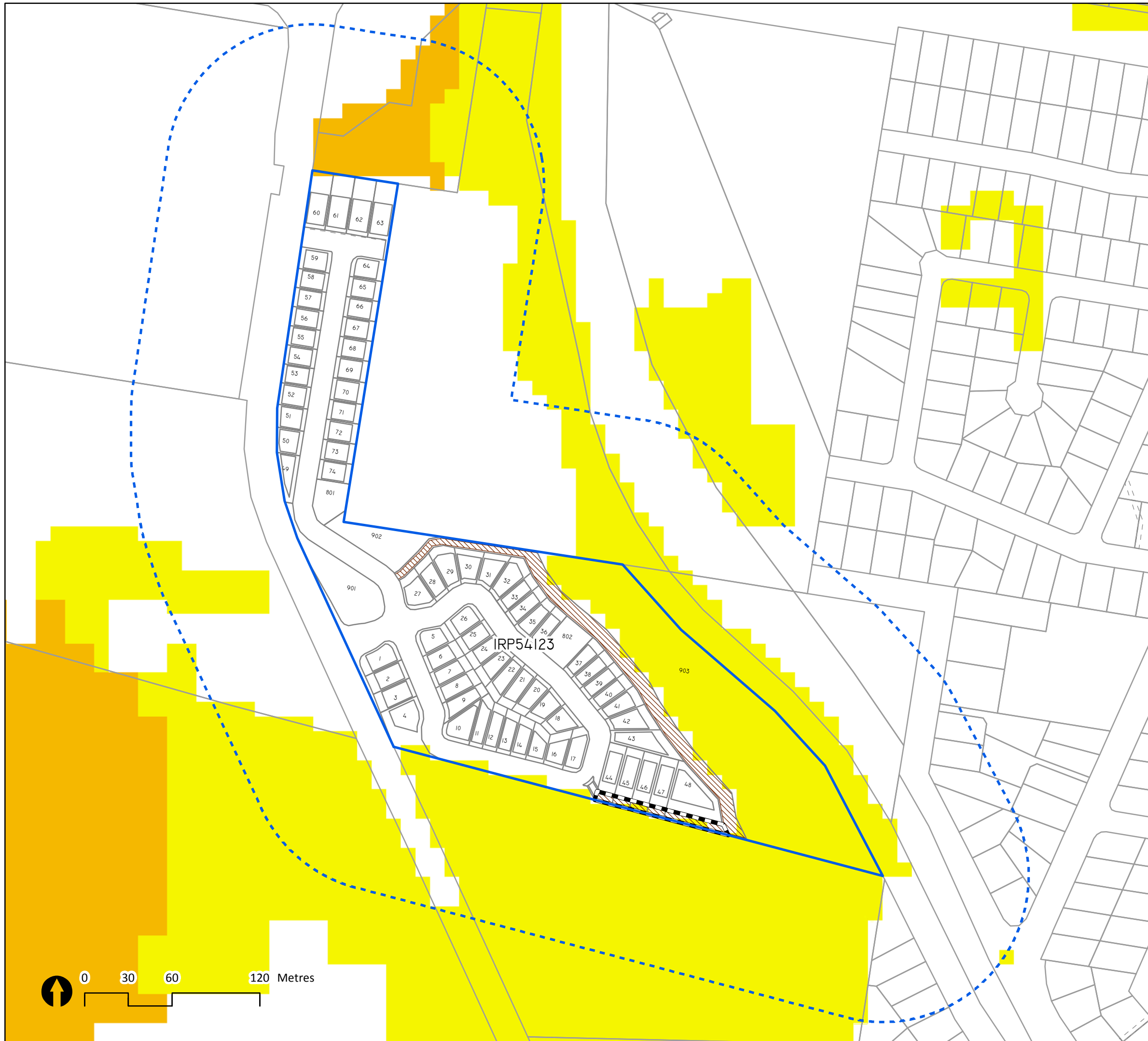


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Map 10: Modelled Potential Rate of Spread

Legend

-  Site
 -  Site Assessment Area (100m)
 -  Easement
 -  Lot Boundary
 -  Development Footprint
 -  Proposed Fire Trail
 -  Proposed Fire Trail Easement (QFES & BCC)
- Potential Rate of Spread
metres per second
-  0.6 - 1
 -  0.3 - 0.5
 -  No/negligible fire spread



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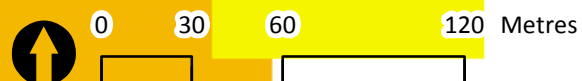
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


Map 11: Modelled Potential Flame Length

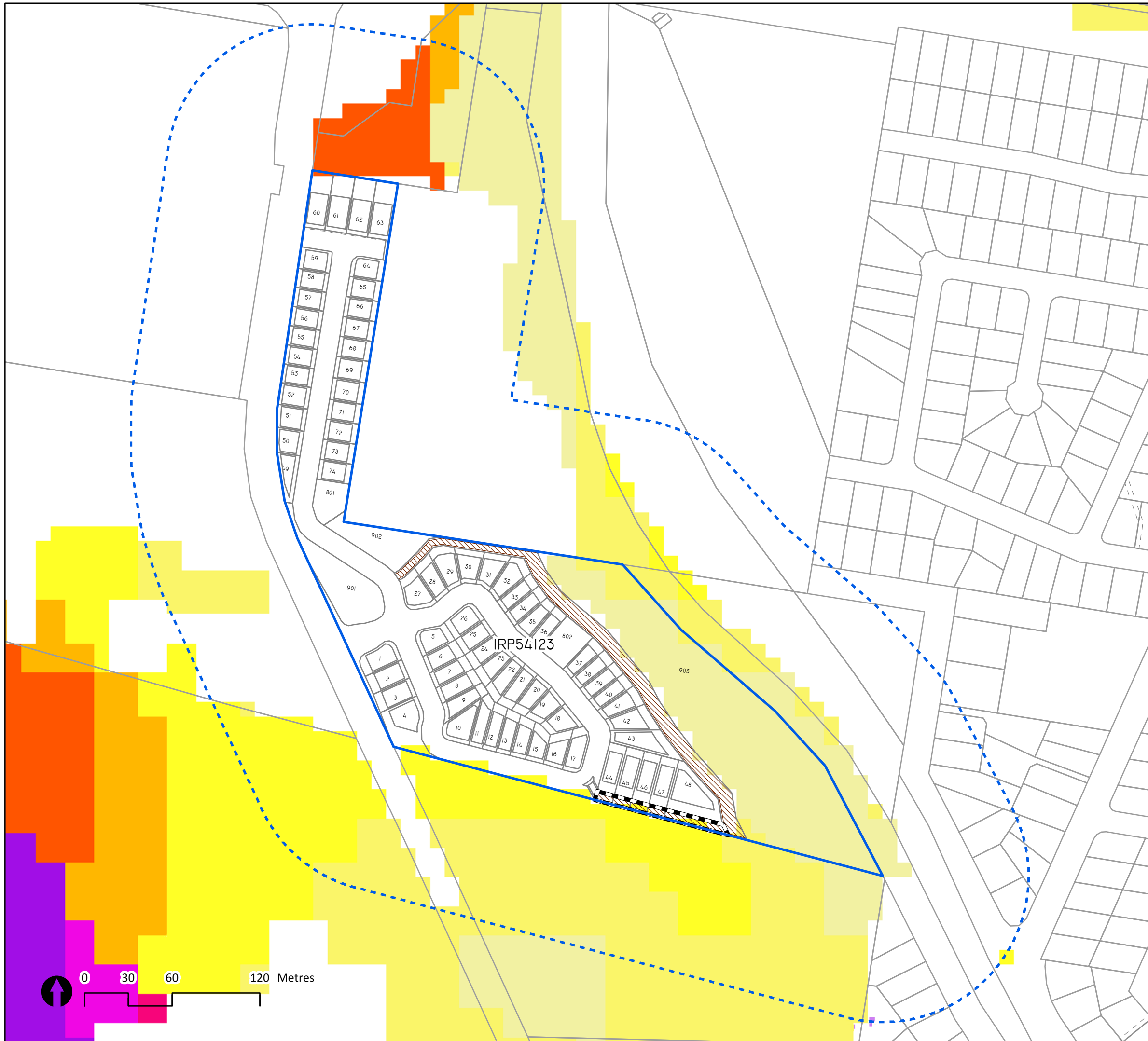
Legend

-  Site
-  Site Assessment Area (100m)
-  Easement
-  Lot Boundary
-  Development Footprint
-  Proposed Fire Trail
-  Proposed Fire Trail Easement (QFES & BCC)

Potential Flame Length

metres

-  23 - 24
-  21 - 22
-  19 - 20
-  17 - 18
-  15 - 16
-  13 - 14
-  11 - 12
-  8 - 10
-  No/negligible flame attack



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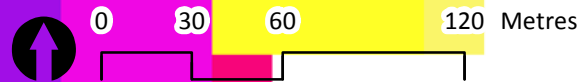
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Map 12: Bushfire Management Plan

- Notes:
- 1) Building faces which are not in a direct line of sight to hazardous vegetation can otherwise be constructed to BAL 12.5 in accordance with Clause 3.5 of AS 3959-2009.
 - 2) Bushfire Attack Levels are preliminary only and subject to Council approval of the development application and subsequent building approval. Changes to aspects of the development may result in changes to radiant heat flux and associated Bushfire Attack Levels.
 - 3) Electricity, gas, telecommunications and water supply infrastructure will be located underground as part of the development.
 - 4) The approved plans include requirements for building envelopes for all lots to achieve radiant heat flux of less than or equal to 29 kW/m² or BAL 29. The building envelopes are indicated on the Bushfire Management Plan (Error! Reference source not found., Map 12).
 - 5) A fire trail is located in the proposed drainage reserve (Lot 903), between Lots 27 and 48 and proposed rehabilitation zones and achieves the following parameters:
 - a) A minimum clearance width of 6m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
 - b) A minimum formed width of 4m and increasing to 10m along the eastern boundary of Lots 32-43 & Lot 48.
 - c) A minimum vertical clearance of 4m to any overhanging obstructions including tree branches and 6m clearance to adjacent vegetation.
 - d) At least 5m clearance to all powerlines.
 - e) A gradient of less than 12.5% with adequate drainage to prevent soil erosion and minimise ongoing trail maintenance.
 - f) Vehicular access at each end.
 - g) Is located on public land, other than the section within proposed Lots 44-48 which will be located within an access easement that is granted in favour of Brisbane City Council and Queensland Fire and Rescue Service. The section of the trail adjacent to Lots 44-48 will also serve as driveway access to each of the lots and will be designed to comply with the 'private access roads or driveway' requirements set out in *Table 8.2.5.3.C—Road design requirements for emergency vehicle access* of the Bushfire overlay code.
 - h) Detailed design of the access/trail can be conditioned and assessed as part of a subsequent operational works application.
 - 6) The development shall ensure that the following water supply and access requirements are provided:
 - a) Fire hydrants are designed and installed in accordance with AS2419.1 2005, unless otherwise specified by Unity Water;
 - b) Internal road access includes geometry and turning radii in accordance with Qld Fire and Emergency Services' Fire Hydrant and Vehicle Access Guidelines;
 - c) Internal roads achieve a minimum of 4.8m vertical clearance above the road; and,
 - d) Hydrants and water access points are not located within parking bay allocations.
 - 7) Boundary fences for Lots 4, 32-48 and 60-63 shall have fencing constructed from non-combustible materials (e.g. sheet metal or masonry).
 - 8) Boundary fences for the remaining lots (other than Lots 52-55 and 70-71, BAL-LOW) shall have fencing constructed from:
 - a) Non-combustible materials (e.g. sheet metal or masonry); or
 - b) Treated hardwood, where the timber fence does not connect to a dwelling and has a minimum of 1 metre separation from the dwelling. Where a fence connects directly to or has less than 1 metre separation from a dwelling it should be constructed from non-combustible materials only.
 - 9) Public streetscapes, detention basins (Lots 801, 802), proposed parks (Lots 901, 902) and landscaping within private lots should be designed and maintained to achieve a total fuel load not exceeding 8 tonnes per hectare. A total fuel load of 8 tonnes per hectare is typically characterised by scattered canopy trees with a maintained grassy understorey and is consistent with expected fuel load for urban areas with a dwelling density of 10-15 dwellings per hectare.
 - 10) Vegetation within the proposed drainage reserve (Lot 903) is managed in accordance with the outcomes identified in the proposed Rehabilitation Plan (Litoria Consulting 27/03/2017; Appendix 2).

Legend

-  Site
-  Easement
-  Lot Boundary
-  Development Footprint
-  Proposed Fire Trail
-  Proposed Fire Trail Easement (QFES & BCC)

Bushfire Attack Level

- BAL
-  Not Applicable (Park/Drainage Reserve)
 -  Low (No BAL requirements)
 -  12.5
 -  19; 19
 -  29; 29
 -  >29

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APPENDIX 1: PROPOSED PLAN OF DEVELOPMENT



LEGEND

- PROPOSED BUILDING ENVELOPE
- OPTIONAL BUILT TO BOUNDARY WALL
- BAL - NOT APPLICABLE
- BAL - LOW (NO BAL REQUIREMENTS)
- BAL - 12.5
- BAL - 19
- BAL - 29
- BAL - >29
- PROPOSED ACCESS TRAIL ADJACENT TO LOTS 32-43 AND LOT 48 ACCESS TRAIL TO BE FORMED 10m WIDTH TO WITHSTAND EROSION AS PER MEDIATION ITEM 1. (d). REFER CIVIL ENGINEERING DRAWINGS FOR DETAILS
- STAGE BOUNDARY (1:2500)
- STAGE BOUNDARY (1:1000)

NOTES

1. THIS DRAWING HAS BEEN PREPARED TO SHOW PROPOSED BUILDING ENVELOPE SETBACKS ONLY AND IS NOT TO BE USED FOR ANY OTHER PURPOSE OTHER THAN ORIGINALLY INTENDED.

2. SUBDIVISION LAYOUT AND LOT BOUNDARIES ARE AS PER DTS DRAWING B140342P1- REVISION H. BUSHFIRE ATTACK LEVEL (BAL) ZONES AND PROPOSED FIRE TRAIL EASEMENT ARE BASED ON BUSHFIRE MANAGEMENT PLAN INFORMATION PREPARED BY LITORIA - DATED 27/11/2016.

3. FOR ALL EASEMENT DETAILS REFER TO SURVEYORS PLAN OF SUBDIVISION.

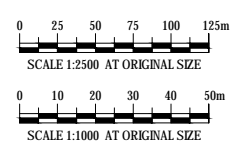
BUILDING ENVELOPE SETBACKS

ALL SETBACKS APPLIED ARE BASED ON DEVELOPMENT OF TWO-STORY DWELLINGS.

FOR SMALL LOTS (LESS THAN 450m²) WITH LESS THAN 25m AVG. DEPTH - BUILDING ENVELOPES ARE AS FOLLOWS:
 FRONT (PRIMARY): 3m
 FRONT (SECONDARY): 1.5m
 SIDE: 1m - OR BUILT TO BOUNDARY WHERE COMPLYING WITH REDUCED SIDE BOUNDARY SETBACK AND BOUNDARY WALL REQUIREMENTS OF DWELLING HOUSE (SMALL LOT) CODE - BCC CITYPLAN 2014
 REAR: 4.5m

FOR SMALL LOTS (LESS THAN 450m²) WITH GREATER THAN 25m AVG. DEPTH - BUILDING ENVELOPES ARE AS FOLLOWS:
 FRONT (PRIMARY): 3m
 FRONT (SECONDARY): 1.5m
 SIDE: 1m - OR BUILT TO BOUNDARY WHERE COMPLYING WITH REDUCED SIDE BOUNDARY SETBACK AND BOUNDARY WALL REQUIREMENTS OF DWELLING HOUSE (SMALL LOT) CODE - BCC CITYPLAN 2014
 REAR: 6m

FOR LOTS (GREATER THAN 450m²) - BUILDING ENVELOPES TO BE IN ACCORDANCE WITH REQUIREMENTS OF QUEENSLAND DEVELOPMENT CODE.



FOR APPROVAL

F	ISSUE FOR APPROVAL	CP*	12.04.17
E	ISSUE FOR APPROVAL	CP*	31.03.17
rev	description	drawn	date

CHRISTOPHER AND MOIRA SMIT
 72 ACACIA ROAD, KARAWATHA
 BUILDING ENVELOPE INTENT PLAN
 BRISBANE CITY COUNCIL LOT RP54123



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scale | 1:1000 for A1 job no. | 1612-012
 date | APR 2017 rev no. | F

approved E.NICHOLAOU* SK001

PLAN
SCALE 1:1000

APPENDIX 2: REHABILITATION PLAN

APPENDIX 3: VEGETATION HAZARD CLASS SURVEY

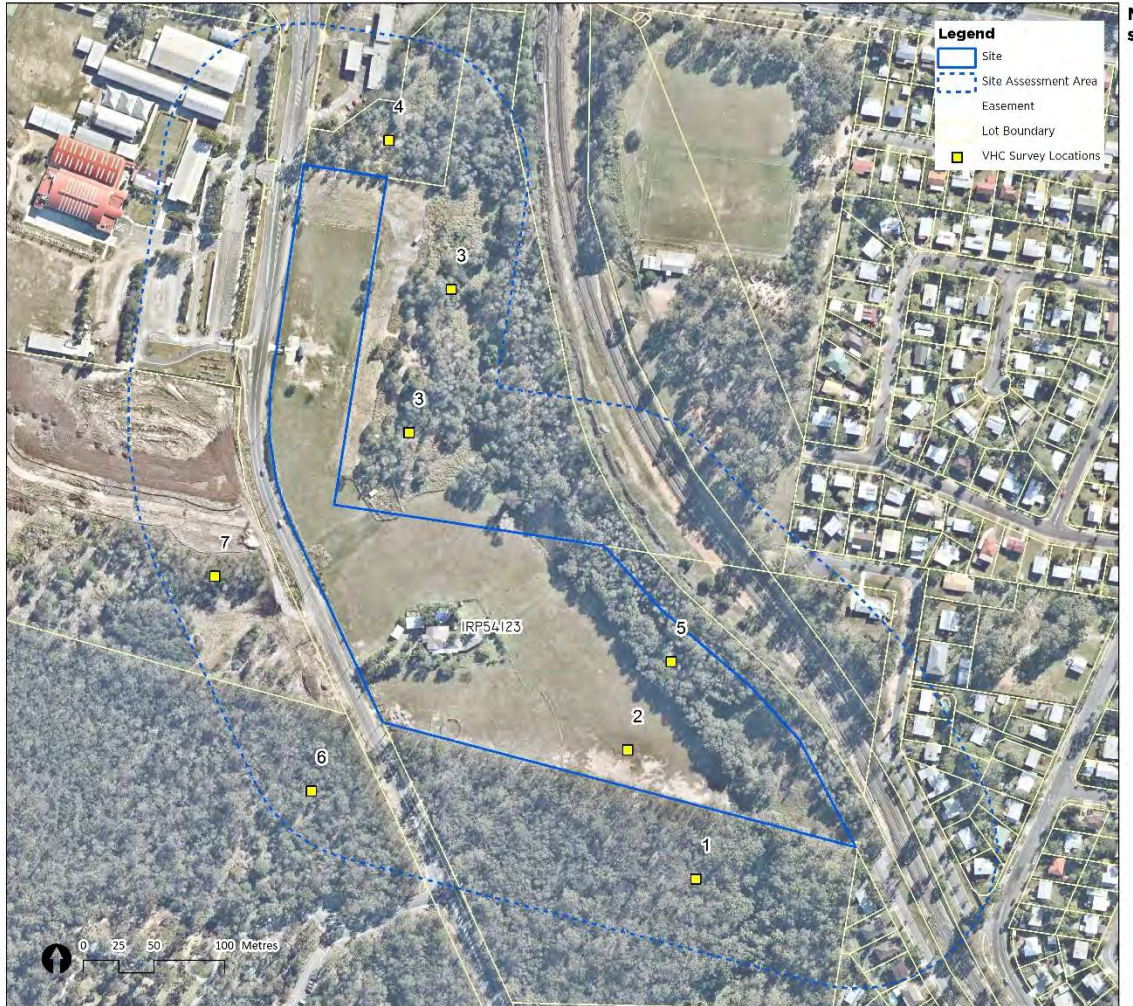


Figure 18: Rectified digital aerial photograph of the site and site assessment area (100m) (NearMap 2017, Image dated July 2016).



Site No.:	1
Site address/GPS location:	Lot 3 on RP203428 Karawatha Forest Reserve (BCC)
Mapped VHC (PSBA):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse).
Observed VHC (Litoria Consulting):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse). Canopy species include: <i>Eucalyptus fibrosa</i> subsp. <i>fibrosa</i> , <i>Corymbia intermedia</i> , <i>E. propinqua</i> , <i>E. seeana</i> , <i>E. tindaliae</i> and <i>Angophora leiocarpa</i> . <i>Lophostemon suaveolens</i> present in T2 and lower slopes.
Potential fuel load:	17.2 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • Native, sparse grassy understorey. • Leaf litter present: 2-5 cm settled depth; 100% cover. • Large wood debris as near surface fuel.




Site No.:	2
Site address/GPS location:	Lot 1 on RP 54123 72 Acacia Rd, Karawatha
Mapped VHC (PSBA):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse).
Observed VHC (Litoria Consulting):	Current Level 2: 41.4 Low grass or tree cover in built-up areas. Post-development Level 2: 41.4 Low grass or tree cover in built-up areas.
Potential fuel load:	2 tonnes/hectare
Notes:	<ul style="list-style-type: none"> Historically cleared and maintained/slashed areas. Very little surface or near-surface fuel.



Site No.:	3
Site address/GPS location:	Lot 4 on SP107509 (Logan City Council)
Mapped VHC (PSBA):	Level 2: 16.1 Eucalyptus spp. dominated open forest and woodlands drainage lines and alluvial plains. (Trees closed to mid dense)
Observed VHC (Litoria Consulting):	Level 2: 39.2 Low to moderate tree cover in built-up areas.
Potential fuel load:	8 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • Historically cleared and highly disturbed. • Scattered (v. sparse to isolated) shrubs to 8m including <i>Acacia disparimma</i>, <i>Melaleuca quiquenervia</i>, <i>Corymbia torelliana</i>, <i>Pinus elliotii</i>, <i>Lophostemon suaveolens</i>, <i>Cinnamomum camphora</i>, <i>M. linarifolia</i> and <i>Allocasuarina littoralis</i>. • Canopy and T2 vegetation absent, with limited recruitment due to grazing (goats) and slashing. • Surface fuel low and sparse. • Understorey vegetation and near-surface fuel dominated by dense, exotic grass cover, mostly <i>Setaria sphacelata</i>.



Site No.:	4
Site address/GPS location:	Lot 2 on RP818511
Mapped VHC (PSBA):	Level 2: 40.4 Low grass or tree cover in rural areas (5 tonnes/hectare)
Observed VHC (Litoria Consulting):	Level 2: 39.2 Low to moderate tree cover in built-up areas
Potential fuel load:	8 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • Scattered (sparse to isolated) canopy trees: <i>E. siderophloia</i> and <i>Corymbia torelliana</i>. • Sparse to isolated shrub layer present with species including, <i>inter alia</i>, <i>Acacia disparrima</i>, <i>Celtis sinensis</i>, <i>Corymbia torelliana</i>, <i>Lantana camara</i> and <i>Pinus elliotii</i>. • Minimal understorey layer, mostly consisting of exotic grasses. • Limited recruitment of native vegetation absent, due to grazing (goats) and slashing. • Surface fuel low and sparse. • Understorey vegetation and near-surface fuel dominated by dense, exotic grass cover, mostly <i>Setaria sphacelata</i>.

	
Site No.:	5
Site address/GPS location:	Lot 1 on RP 54123 72 Acacia Rd, Karawatha
Mapped VHC (PSBA):	Level 2: 16.1 Eucalyptus spp. dominated open forest and woodlands drainage lines and alluvial plains. (Trees closed to mid dense)
Observed VHC (Litoria Consulting):	Level 2: Mixed 16.1 / 22.1 / 39.2 (40/20/40)
Potential fuel load:	15.24 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • Highly disturbed vegetation community. • Heterogeneous with respect to composition and structure - inseparable at <1:5000. • Narrow fringing community of <i>Melaleuca quinquenervia</i>, <i>M. linarifolia</i> closed forest-tall shrubland (22.1, 20%) / <i>Eucalyptus tereticornis</i>, <i>E. microcorys</i>, <i>Lophostemon suaveolens</i>, <i>M. quinquenervia</i> and <i>Corymbia torelliana</i> open forest (16.1, 40%) / Scattered (sparse to isolated) canopy trees: <i>E. siderophloia</i>, <i>E. tereticornis</i>, <i>Corymbia torelliana</i> and <i>C. intermedia</i> with disturbed/grazed understorey (39.2, 40%). • Bark fuel in VHC 22.1 (paperbarks). • Leaf litter present within VHC 16.1 and 22.1 only. In VHC 39.2, understorey vegetation and near-surface fuel dominated by dense, exotic grass cover, mostly <i>Setaria sphacelata</i>.



Site No.:	6
Site address/GPS location:	Lot 2 on RP54123 Karawatha Forest Reserve (BCC)
Mapped VHC (PSBA):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse).
Observed VHC (Litoria Consulting):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse). Canopy species include: <i>Eucalyptus racemosa</i> , <i>E. siderophloia</i> , <i>E. fibrosa</i> subsp. <i>fibrosa</i> , <i>Corymbia intermedia</i> , <i>E. propinqua</i> , <i>E. seeana</i> , <i>E. tindaliae</i> , <i>C. trachyphloia</i> and <i>Angophora leiocarpa</i> .
Potential fuel load:	17.2 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • Evidence of maintenance including clearing and revegetation. • Native, sparse grassy understorey. • Leaf litter present: 2-4 cm settled depth; 100% cover. • Large wood debris as near surface fuel.



Site No.:	7
Site address/GPS location:	Lot 5 on SP163827
Mapped VHC (PSBA):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse).
Observed VHC (Litoria Consulting):	Level 2: 9.2 Moist to dry eucalypt forests to woodlands usually on coastal lowlands and ranges (trees sparse to very sparse).
Potential fuel load:	17.2 tonnes/hectare
Notes:	<ul style="list-style-type: none"> • <i>Allocasuarina littoralis</i> dominated regrowth. • Minimal understorey layer, mostly leaf litter. • Leaf litter present: 2-4 cm settled depth; 100% cover. • Absence of canopy trees suggests previous clearing.

APPENDIX 4: BUSHFIRE OVERLAY CODE

Table 8.2.5.3.A—Criteria for self-assessable and assessable development

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
Section A—If for self-assessable or assessable development other than for reconfiguring a lot		
<p>PO1</p> <p>Development addresses the bushfire hazard determined by a site-specific bushfire hazard assessment.</p> <p>Note—Bushfire hazard is assessed based on the vegetation existing on site, adjacent and nearby to the site at the time of application, except where reconfiguring a lot, when the level of bushfire hazard posed by any areas subject to revegetation is assessed as if that area had reached its mature state.</p>	<p>AO1</p> <p>Development is designed and sited in compliance with:</p> <ul style="list-style-type: none"> (a) a current approved bushfire management plan relevant to the full nature of the uses, which identifies the level of bushfire hazard and the location of hazardous vegetation affecting the development; or (b) a building protection zone approved as part of the reconfiguring of a lot; or (c) for a lot less than or equal to 2,500m², a site-specific bushfire hazard assessment prepared in accordance with the <u>Bushfire planning scheme policy</u> which: <ul style="list-style-type: none"> (i) is undertaken by a person suitably qualified and experienced with technical expertise in the field of bushfire hazard identification and mitigation, including protection of biodiversity values; (ii) determines the relevant bushfire attack level for that part of the site in which development is proposed; (iii) identifies the location of hazardous vegetation that poses a bushfire risk to 	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>the development; or (d) for a lot greater than 2,500m², a site-specific bushfire hazard assessment prepared in accordance with the <u>Bushfire planning scheme policy</u> which:</p> <ul style="list-style-type: none"> (i) confirms the level of bushfire hazard for the part of the site which development is proposed; (ii) identifies the location of hazardous vegetation that poses a bushfire risk to the development. <p>Note—Where a bushfire hazard assessment determines that the bushfire hazard for the part of the site in which development is proposed is 'low', no further assessment against this code is required.</p>	
<p>PO2</p> <p>Development is sited, designed and maintained taking account of all relevant factors affecting the bushfire hazard on the site, including site topography, aspect, location and type and structure of vegetation to:</p> <ul style="list-style-type: none"> (a) minimise the number of buildings and people working, living or visiting a site exposed to bushfire risk; (b) protect life during bushfire; 	<p>AO2.1</p> <p>Development other than an extension to an existing building is:</p> <ul style="list-style-type: none"> (a) sited in a building protection zone where approved as part of reconfiguring a lot stage; or (b) sited in compliance with an approved bushfire management plan relevant to the full nature of the use; or (c) if there is no approved building protection zone and no approved bushfire management plan, where on a lot great 	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>(c) increase the survival of buildings and structures during a bushfire; (d) minimise bushfire risk from build-up of fuels around buildings and structures.</p> <p>Note—A bushfire management plan prepared in accordance with the <u>Bushfire planning scheme policy</u> can assist in demonstrating achievement of this performance outcome.</p>	<p>than 10ha, located in the area of lowest risk from bushfire on the site; and</p> <p>(d) if there is no approved building protection zone and no approved bushfire management plan, where on a lot greater than 2,500m²:</p> <p>(i) located away from ridgelines in compliance with <u>Figure a</u>;</p> <p>(ii) located on land with a gradient less than 15%;</p> <p>(iii) preferably located on east- to south-facing slopes and avoiding north- to west-facing slopes unless the slope is clear of vegetation and is not located in the High hazard buffer area sub-category or the Medium hazard buffer area sub-category;</p> <p>(iv) with setbacks to hazardous vegetation 1.5 times the predominant mature canopy height, or 20m whichever is greater so that vegetation does not overhang a building.</p>	
	<p>AO2.2</p> <p>Development other than an extension to an existing building is sited within a building protection zone extending a minimum of 20m from the outermost projection of the main building or any habitable structure or to the maximum extent possible on sites less than 2500m² where a building protection zone would</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>extend into neighbouring properties; and</p> <p>(a) clusters buildings and structures in the building protection zone;</p> <p>(b) designs the inner 10m of the building protection zone to maintain a very low fuel state in the first 10m, and a fuel-reduced state to the extent of the building protection zone, in compliance with Figure b and Figure c.</p> <p>Note—The building protection zone includes the dwelling and all ancillary structures and may extend to a road or a building protection zone in an adjoining site.</p>	
<p>PO3</p> <p>Development utilises fencing that:</p> <p>(a) does not contribute to the spread of bushfire;</p> <p>(b) in an urban area or in proximity to accommodation uses, contributes to reducing bushfire hazard to a building;</p> <p>(c) facilitates the safe movement of fauna.</p>	<p>AO3.1</p> <p>Development for a fence within 20m of any building used for accommodation comprises non-combustible or fire retardant materials.</p>	<p>Not applicable.</p>
	<p>AO3.2</p> <p>Development for a fence:</p> <p>(a) incorporates gaps and spacing to allow the safe movement of fauna; or</p> <p>(b) is designed to enable fauna to climb the fence.</p>	<p>Not applicable.</p>
<p>PO4</p>	<p>AO4</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>Development ensures that the location, siting, and design of development and associated driveways and access routes:</p> <ul style="list-style-type: none"> (a) avoid potential for entrapment during a bushfire; (b) facilitate safe and efficient emergency services to access and egress the site during a bushfire; (c) enables safe evacuation of the site during a bushfire for site occupants. <p>Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.</p>	<p>Development ensures that:</p> <ul style="list-style-type: none"> (a) the length of driveways or access routes does not exceed 70m between the most distant part of any occupied building and the nearest part of the public road; or (b) where the length of the driveway or access route exceeds 70m: <ul style="list-style-type: none"> (i) the driveway or private access route design meets the requirements of emergency vehicles in compliance with Table 8.2.5.3.C; (ii) the driveway or access route provides all weather access for two-wheel-drive vehicles; (iii) where relying on a private access route or driveway longer than 200m to reach a public road, a safe alternative access and egress route is provided. 	
<p>PO5</p> <p>Development has adequate road access to the site for emergency vehicles and safe evacuation in a bushfire.</p>	<p>AO5</p> <p>Development has frontage to a constructed, all-weather public road capable of carrying emergency service vehicles.</p>	<p>Not applicable.</p>
<p>PO6</p> <p>Development makes adequate provision for fire-fighting requirements, including water supply.</p>	<p>AO6</p> <p>Development ensures that:</p> <ul style="list-style-type: none"> (a) a reliable reticulated water supply and water pressure is available for fire-fighting 	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>requirements with water supply and pressure, which is in compliance with the standards specified by the relevant utilities provider; or:</p> <p>(b) where sufficient reticulated water supply is not available for:</p> <p>(i) residential lots, there is a minimum water supply available and retained for fire-fighting purposes in compliance with Table 8.2.5.3.B, which may be in the form of a separate tank or a reserve section as part of a main water supply tank; or</p> <p>(ii) development other than for residential lots involving new premises or an existing premises with a <u>gross floor area</u> greater than 50m², on-site water storage is provided which is appropriate to the use, according to the standards specified by the relevant emergency services agency and is not less than 5,000L.</p> <p>Note—Water supply for fire fighting is in addition to water supply for household use. Where a non-reticulated supply of water is required, swimming pools, creeks and dams should not be used as a substitute for a dedicated static supply as these sources of water are not reliable during drought conditions.</p>	

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>PO7</p> <p>Development ensures that the water supply provided for fire-fighting is safely located and freely accessible for fire-fighting purposes at all times.</p>	<p>AO7</p> <p>Development, for which sufficient reticulated water supply is not available, provides:</p> <ul style="list-style-type: none"> (a) a water supply outlet located away from any potential fire hazards, such as gas bottles; (b) a hardstand area of 11m by 3.5m for fire-fighting vehicles within 2m of the water supply outlet; (c) tanks on the bushfire hazard side of the buildings with adequate shielding for the protection of fire fighters; (d) pumps which are shielded from bushfire hazard; (e) an outlet pipe which is 50mm in diameter and fitted with a 50mm male camlock (standard rural fire brigade fitting); (f) that any underground tank for fire-fighting purposes has an access hole of 200mm to allow a tanker to refill direct from the tank; (g) that any above-ground water tank is made of concrete or metal and its stand is protected from bushfire hazard; (h) that all above-ground water pipes external to the building are metal, including and up to any taps. <p>Note—Plastic tanks are not to be used.</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
Additional criteria for all development in the Biodiversity areas overlay if on a site larger than 2,500m ²		
<p>PO8</p> <p>Development through the siting, design, and construction of buildings, access routes and fire maintenance trails, and ongoing site management:</p> <ul style="list-style-type: none"> (a) provides effective separation from sources of bushfire risk; (b) responds to the bushfire risk in that location; (c) maintains the safety and protection of people and property over time; (d) maximises the protection of vegetation in areas of high biodiversity value. <p>Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome that ensures:</p> <ul style="list-style-type: none"> • ongoing site management, such as the bushfire risk to buildings, does not increase beyond the standard to which they have been designed and constructed; • appropriate design and 	<p>AO8</p> <p>Development locates building protection zones as shown on Figure b and Figure c, driveways and access routes and any fire maintenance trails:</p> <ul style="list-style-type: none"> (a) outside of the Biodiversity areas overlay; or (b) within the existing disturbed, degraded or cleared areas, using natural fire breaks to avoid vegetation clearing and to avoid or otherwise minimise fragmentation or incursions into a habitat area, fauna movement corridor or remnant vegetation. 	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>maintenance of the site, and access routes and driveways.</p>		
<p>Section B—If for assessable development other than reconfiguring a lot</p>		
<p>PO9</p> <p>Development ensures that the following uses avoid being located in the bushfire overlay area and otherwise support safe and efficient evacuation and emergency services access to the site during a bushfire:</p> <ul style="list-style-type: none"> (a) the introduction of significant worker or resident populations in a bushfire hazard area; (b) the location of vulnerable uses; (c) the introduction or expansion of difficult to evacuate uses; (d) the congregation of large numbers of people in a bushfire hazard area including assembly uses. <p>Note—This includes consideration of appropriate alternative shelter for vulnerable uses, management of health and wellbeing requirements during evacuation, safe site operation, and access and egress arrangements in bushfire</p>	<p>AO9.1</p> <p>Development:</p> <ul style="list-style-type: none"> (a) does not increase the number of people living, working on or visiting the site by more than 10%; or (b) increasing the number of people living, working on or visiting the site, or vulnerable, difficult to evacuate or assembly uses by more than 10%, implements the recommendations of an approved bushfire management plan, which identifies measures that address the identified bushfire risk relevant to the development. 	<p>Not applicable.</p>
	<p>AO9.2</p> <p>Development provides alternative access routes that meet the road design requirements of items 1–7 in Table 8.2.5.3.C, for the following:</p> <ul style="list-style-type: none"> (a) an extension to existing premises which increases the number of people living, 	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>events.</p> <p>Note—A bushfire management plan prepared in accordance with the <u>Bushfire planning scheme policy</u> can assist in demonstrating compliance with this performance outcome.</p>	<p>working on or visiting the site by more than 10%;</p> <p>(b) the introduction of vulnerable, difficult to evacuate or assembly uses.</p>	
<p>Additional criteria if involving storage or handling on site of hazardous chemicals in quantities that would be equivalent to or exceed the threshold quantities set out in <u>Table 8.2.5.3.D</u></p>		
<p>PO10</p> <p>Development does not cause:</p> <p>(a) <u>unacceptable risk</u> to people, property and the environment due to the impact of bushfire on the storage or handling on site of hazardous chemicals;</p> <p>(b) (b) excessive danger or difficulty to emergency services for emergency response or evacuation.</p>	<p>AO10</p> <p>Development for storage or handling of hazardous chemicals:</p> <p>(a) is not located within the bushfire overlay; or</p> <p>(b) complies with an approved bushfire management plan prepared in accordance with the <u>Bushfire planning scheme policy</u> which identifies measures that ensure the development:</p> <p>(i) mitigates the bushfire risk relevant to the development;</p> <p>(ii) does not pose an <u>unacceptable risk</u> to people, public health and safety or risk environmental harm;</p> <p>(iii) does not present significant difficulties to emergency services for emergency response or evacuation.</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>Note—Bushfire management plans and site-based risk assessments are prepared in accordance with the Bushfire planning scheme policy. Guidance on the preparation of a hazard and risk analysis is provided in the Industrial hazard and risk assessment planning scheme policy.</p> <p>Note—Any risk mitigation measures, including construction of underground tanks or fire-protected above-ground tanks or package stores, are in compliance with AS 1940-2004 The storage and handling of flammable and combustible liquids.</p>	
Additional criteria for essential community infrastructure		
<p>PO11</p> <p>Development for essential community infrastructure is located, designed and sited to:</p> <p>(a) protect the safety of people during a bushfire;</p> <p>(b) not create or increase the exposure of people to an unacceptable risk from a bushfire;</p> <p>(c) minimise the risk to vulnerable populations from a bushfire;</p>	<p>AO11</p> <p>Development for essential community infrastructure:</p> <p>(a) is ancillary to and not relied on for the provision of the essential service during a bushfire; or</p> <p>(b) implements an approved bushfire management plan prepared in accordance with the Bushfire planning scheme policy which identifies measures that:</p> <p>(i) ensure the development allows for safe and efficient emergency access and site evacuation during a bushfire;</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>(d) mitigate the impacts on the community and environment from the effects of a bushfire on the development.</p>	<p>(ii) do not pose an unacceptable risk to people on a premises during a bushfire;</p> <p>(iii) ensure the development is not at risk of failure during a bushfire which results in health or safety risks or adverse environmental impacts;</p> <p>(iv) (iv) enable people and property to be defended safely and effectively from a bushfire.</p>	
<p>PO12</p> <p>Development for essential community infrastructure is able to function effectively during and immediately after bushfire events.</p>	<p>AO12</p> <p>Development for essential community infrastructure:</p> <p>(a) is ancillary to and not relied upon for the provision of the essential service during a bushfire; or</p> <p>(b) containing elements vital to the function of the essential service during a bushfire is not located in the Bushfire overlay area; or</p> <p>(c) implements an approved bushfire management plan prepared in accordance with the <u>Bushfire planning scheme policy</u> which identifies measures that ensure that:</p> <p>(i) essential community infrastructure is able to function during bushfire events;</p> <p>(ii) access necessary to maintain safety or</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>function of the development is not compromised by a bushfire;</p> <p>(iii) mitigation measures are not unduly reliant on human activation to respond to a bushfire;</p> <p>(iv) the safe storage of valuable records or items of cultural or historical significance, including storage of public records under the <i>Public Records Act 2002</i>, is able to be maintained during a bushfire event.</p>	
Additional criteria if for landscaping or a park landscape plan is a requirement for development		
<p>PO13</p> <p>Development provides landscaping that does not create an unacceptable risk to people or property and provides for ongoing management of risk to the development and people from a bushfire.</p>	<p>AO13</p> <p>Development is in compliance with a landscaping plan which:</p> <ul style="list-style-type: none"> (a) is prepared in compliance with an approved bushfire management plan; (b) preserves the requirements of any building protection zone; (c) does not increase the exposure of a habitable building not located in a building protection zone to a bushfire hazard. <p>Note—The requirements of a building protection zone are shown in Figure b and Figure c.</p>	<p>Not applicable.</p>
<p>PO14</p>	<p>AO14</p>	<p>Not applicable.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>Development for a park is designed so that the park:</p> <ul style="list-style-type: none"> (a) is practical to maintain and requires minimal resources to be restored to its designed function and condition after a bushfire; (b) provides for safe and efficient site evacuation and efficient emergency services access avoiding potential for entrapment during a bushfire; (c) does not place unacceptable bushfire risk on an adjoining or nearby site, people and assets; (d) provides efficient access for fire fighting; (e) provides ongoing protection from bushfire for major park assets and buildings. <p>Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.</p>	<p>Development provides a park landscape plan that complies with a bushfire management plan prepared in accordance with the Bushfire planning scheme policy.</p>	
<p>Section C—If for reconfiguring a lot</p> <p>Note—The following performance outcomes and acceptable outcomes only apply to the following categories of reconfiguring a lot:</p> <ul style="list-style-type: none"> • Rural: Reconfiguring a lot in a non-urban setting. 		

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<ul style="list-style-type: none"> Urban (7 or more lots): Reconfiguring a lot in an urban or emerging community area which creates 7 or more lots, or involves the opening of a new road. Urban (fewer than 7 lots): Reconfiguring a lot in urban areas which creates 6 or fewer new lots and does not involve the opening of a new road. 		
<p>PO15</p> <p>Development addresses the bushfire hazard determined by a site-specific bushfire hazard assessment.</p> <p>Note—Bushfire hazard is assessed based on the vegetation existing on site, adjacent and nearby to the site at the time of application, except where reconfiguring a lot, when the level of bushfire hazard posed by any areas subject to revegetation is assessed as if that area had reached its mature state.</p>	<p>AO15</p> <p>Development addresses the level of bushfire hazard identified in a site-specific bushfire hazard assessment undertaken in accordance with the <u>Bushfire planning scheme policy</u>, which confirms the level of bushfire hazard for the part of the site in which development is proposed, and the location of hazardous vegetation posing a risk to the development in a bushfire.</p> <p>Note—Where a bushfire hazard assessment determines that the bushfire hazard for the part of the site in which development is proposed is 'low', no further assessment against this code is required.</p>	<p>Complies. The results of a site-specific bushfire hazard assessment, including assessment of hazardous vegetation, fuel loads and fire behaviour, indicated that the proposed development was located within the potential impact buffer of 100m. The site specific bushfire hazard assessment:</p> <ul style="list-style-type: none"> (i) confirms the level of bushfire hazard for the part of the site which development is proposed; (ii) identifies the location of hazardous vegetation that poses a bushfire risk to the development. <p>Map 12 identifies the relevant bushfire management measures.</p>
<p>PO16</p> <p>Development does not materially increase the number of premises exposed to unacceptable risk during bushfire events.</p>	<p>AO16</p> <p>Development does not materially increase the number of people living or working in the Bushfire overlay area.</p>	<p>Proposed solution. The development achieves an acceptable/tolerable level of bushfire attack risks through a number of management measures which reduce vulnerability to bushfire attack. Management measures are summarised in</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
		Section 7 of the BHAMP and Map 12 and should be conditioned by Council as part of a development permit.
<p>PO17</p> <p>Development is designed to:</p> <ul style="list-style-type: none"> (a) mitigate the risk of bushfire hazard to each lot; (b) limit the spread of bushfire within the reconfiguration; (c) achieve and maintain sufficient separation distance between development and hazardous vegetation to minimise bushfire hazard to future buildings during a bushfire; (d) allow for emergency services access. (e) locate buildings within a building protection zone <p>Note—Lot size, location, configuration, dimensions and building measures are balanced to achieve an acceptable level of risk to future occupants.</p> <p>Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this</p>	<p>AO17.1</p> <p>Development requires that lot number, size, shape and layout allow for the siting of future buildings within the lowest hazard locations on the site being located:</p> <ul style="list-style-type: none"> (a) within a building protection zone in accordance with Figure b and Figure c; (b) to achieve separation distances between the development and hazardous vegetation of at least 1.5 times the predominant mature tree canopy height; (c) away from ridgelines and hilltop sites in compliance with Figure a; (d) on land with a gradient less than 15%; (e) preferably on east to south facing slopes and avoiding north to west facing slopes unless the slope is clear of vegetation and is not located in the High hazard buffers sub-category or Medium hazard sub-category. 	<p>Complies. The proposed development balances lot size, location, configuration, dimensions and building measures to achieve an acceptable level of risk to future occupants. The proposed development:</p> <ul style="list-style-type: none"> a) Achieves an acceptable level of bushfire attack risk to each lot through a combination of management measures including separation, provision of operational space for firefighters, access to evacuation routes, vegetation management and access to reticulated water supply. b) Includes BAL zones/envelopes for all allotments which do not exceed BAL 29 (calculated in accordance with AS 3959-2009 Construction of buildings in bushfire-prone areas). c) Is located away from ridgelines and hilltop sites. d) Is located on land with a gradient less than 15%. e) Is located on east to south facing slopes.
	<p>AO17.2</p>	<p>Complies. Refer to response to AO 17.1.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>performance outcome.</p>	<p>Development ensures that the bushfire attack level of the nominated <u>development footprint plan</u> does not exceed:</p> <p>(a) in a rural category, bushfire attack level 19 (calculated in accordance with <u>AS 3959-2009 Construction of buildings in bushfire-prone areas</u>);</p> <p>(b) in an urban category, bushfire attack level 12.5 (calculated in accordance with <u>AS 3959-2009 Construction of buildings in bushfire-prone areas</u>).</p>	
<p>PO18</p> <p>Development promotes safe site access, avoids creating a potential entrapment situation and supports accessibility and manoeuvring for fire fighting during bushfires.</p> <p>Note—This includes easements and boundary realignments.</p> <p>Note—A bushfire management plan prepared in accordance with the <u>Bushfire planning scheme policy</u> can assist in demonstrating compliance with this performance outcome.</p>	<p>AO18</p> <p>Development provides a lot layout which:</p> <p>(a) provides direct road access and egress for new lots to public roads, rather than the creation of easements;</p> <p>(b) in an urban category, avoids creating a new lot less than or equal to 2,500m² which directly adjoins hazardous vegetation;</p> <p>(c) in an urban category, locates a future building protection zone to avoid a driveway of longer than 70m from the road frontage to a habitable building;</p> <p>(d) in a rural category, provides for an alternative access where the private access roads or driveways are longer than 200m to reach a public road.</p>	<p>Complies. Development:</p> <ul style="list-style-type: none"> • Provides direct road access and egress for new lots to public roads. • Only 9 allotments (4, 44-48, 60-63) directly adjoin hazardous vegetation; however, each allotment has direct access to a public road or is serviced by a driveway which is less than 70m from a public road.

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
<p>PO19</p> <p>Development ensures that the road layout and design provides:</p> <p>(a) efficient emergency services access to sites and manoeuvring within the subdivision;</p> <p>(b) safe and efficient movement of residents, workers and visitors out of the subdivision and away from an approaching bushfire;</p> <p>(c) safe and efficient movement of emergency services into the subdivision;</p> <p>(d) alternative egress routes considering the most likely bushfire scenarios;</p> <p>(e) ongoing availability and maintenance of access and egress routes for the purposes of evacuation and emergency services access.</p> <p>Note—A bushfire management plan prepared in accordance with the Bushfire planning scheme policy can assist in demonstrating compliance with this performance outcome.</p>	<p>AO19.1</p> <p>Development involving a new road or fire maintenance trail is designed and constructed in compliance with:</p> <p>(a) Table 8.2.5.3.C; or</p> <p>(b) an approved bushfire management plan.</p> <p>AO19.2</p> <p>Development has a road layout and design which:</p> <p>(a) provides for alternative access routes to the subdivision, by public roads that meet the requirements in Table 8.2.5.3.C and are able to access the arterial road network;</p> <p>(b) excludes cul-de-sacs, except where a perimeter road with a cleared width of 20m isolates the development from hazardous vegetation;</p> <p>(c) does not include dead-end roads or if a dead-end road is unavoidable, it is a maximum of 60m long, or 200m where located in the Environmental management zone, Conservation zone, Rural zone, or Rural residential zone, and an alternative emergency evacuation and egress route away from the most likely source of bushfire risk is provided for lots where multiple road access or exit points are not possible;</p>	<p>Complies. Proposed road and proposed fire trail dimensions have been dimensioned to comply with Table 8.2.5.3.C.</p> <p>Complies. Proposed road and proposed fire trail layout provides:</p> <p>a) efficient emergency services access to sites and manoeuvring within the subdivision;</p> <p>b) safe and efficient movement of residents, workers and visitors out of the subdivision and away from an approaching bushfire;</p> <p>c) safe and efficient movement of emergency services into the subdivision;</p> <p>d) alternative egress routes considering the most likely bushfire scenarios;</p> <p>e) ongoing availability and maintenance of access and egress routes for the purposes of evacuation and emergency services access.</p>

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>(d) links road within the subdivision to, or provides for future links to roads in adjacent subdivisions.</p> <p>Note—Where staged development occurs or development is in accordance with an approved master plan, a temporary perimeter road may be considered, subject to availability of reticulated water supply.</p>	
<p>PO20</p> <p>Development involving new premises provides adequate infrastructure to support fire fighting.</p>	<p>AO20.1</p> <p>Development involving new premises ensures that:</p> <p>(a) lots have access to reticulated water supply and water pressure available for fire-fighting requirements with water supply and pressure that accord with the standards specified by the relevant utilities provider; or</p> <p>(b) where reticulated water supply is not available for:</p> <p>(i) residential lots, there is a minimum water supply available and retained for fire-fighting purposes in compliance with Table 8.2.5.3.B, which may be in the form of a separate tank or a reserve section as part of a main water supply tank;</p> <p>(ii) development other than residential lots, onsite water storage is provided</p>	<p>Complies. The proposed development has access to reliable reticulated water supply and water pressure is available for fire-fighting requirements with water supply and pressure, which is in compliance with the standards specified by the relevant utilities provider. It is recommended that the development also includes the following measures, which can be conditioned by Council as part of a development permit:</p> <ul style="list-style-type: none"> • Fire hydrants are designed and installed in accordance with AS 2419.1 2005, unless otherwise specified by the relevant utilities provider; • Internal road access includes geometry and turning radii in accordance with Qld Fire and Emergency Services' Fire Hydrant and Vehicle Access Guidelines; • Internal roads achieve a minimum of 4.8m vertical clearance above the road; and, • Hydrants and water access points are not located within parking bay

Performance outcomes	Acceptable outcomes	Compliance/proposed solution
	<p>which is appropriate to the proposed future use according to the standards specified by the relevant emergency services agency and is not less than 5,000L.</p> <p>Note—Water supply for fire-fighting is in addition to water supply for household use. Where a non-reticulated supply of water is required, swimming pools, creeks and dams should not be used as a substitute for a dedicated static supply as these sources of water are not reliable during drought conditions.</p>	<p>allocations.</p>
	<p>AO20.2</p> <p>Development provides fire hydrants in accordance with Central SEQ Distributor-Retailer Authority, Queensland Urban Utilities (incorporating Water Services Association of Australia) Standards.</p>	<p>Complies. Refer response to AO20.1.</p>