



PLANS AND DOCUMENTS
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DEVELOPMENT APPROVAL

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BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

Flagstone City Stages 2-5

PREPARED FOR
PEET LIMITED

November 2018

AMENDED IN RED

By: Brandon Bouda
Date: 19 August 2019



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It is acknowledged and agreed that the site may be subject to a degree of bushfire hazard. The client acknowledges and agrees that Meridian Urban has not created or contributed to the creation or existence of this hazard and the Client indemnifies Meridian Urban for claims arising out of or resulting from a bushfire event except to the extent attributable to the negligence of Meridian Urban.

The Client agrees that the Consultant shall have no liability in respect of any damage or loss incurred as a result of bushfire. Compliance with this report shall be the responsibility of the Client and/or land owners.

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REVISION SCHEDULE

REV NO.	DATE	DESCRIPTION	SIGNATURE OR TYPED NAME (DOCUMENTATION ON FILE)			
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PEET Limited

Bushfire Hazard Assessment and Management Plan for Flagstone Stages 2-5

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1 Introduction

This report is commissioned by PEET Flagstone City Pty Ltd for the purposes of a site-based Bushfire Hazard Assessment and Management Plan in support of a development application for the extension of an existing residential community at Flagstone. The nature of this assessment focuses on the reconfiguration of a lot (RoL) application for Stages 2-5 of the Plan of Development (POD) previously assessed by Economic Development Queensland (EDQ). This report is prepared pursuant to the provisions of the Development Scheme for Greater Flagstone as the relevant planning instrument, noting the site is located within an identified Priority Development Area. This report is also prepared having regard to other instruments including the current State Planning Policy and AS3959-2009 – Construction of Buildings in Bushfire Prone Areas which outlines the national building construction specifications for land situated within bushfire prone areas.

The focus of this assessment report remains two-fold, both with respect to the statutory planning and building requirements as they plan apply in this case pursuant to all relevant policies, standards and regulation, and also end-user consideration. In addition, this report seeks to ensure fire risk and evacuation for adjoining and nearby properties is not advertently adversely impacted.

Flagstone West is located within the Greater Flagstone Priority Development Area (PDA) which is projected to eventually encompass a population of over 100,000, west of the Brisbane-Sydney railway line. The area is identified as being susceptible to bushfire hazard under the PDA Development Scheme and the Logan City Planning Scheme which would otherwise be in place. In addition, the site is identified on the State Planning Policy (SPP) bushfire prone area mapping.

This assessment report aims to mitigate the risk to life and property from bushfire threat and the impact of bushfire attack which includes:

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

Building loss is typically associated with one or more forms of bushfire attack, the most common being the combined effects of radiant heat and ember attack. Danger to human life is also associated with these forms of bushfire attack in addition to smoke emission.

This assessment does not seek to remove the threat of any bushfire risk, but provide detailed sitting, layout, building and / or servicing information to assist the ability of the owner(s) to manage the potential threat of this risk. This assessment report is prepared in accordance with best practice industry standards as applicable in Queensland and pursuant to both State and local government bushfire hazard policies and guidelines.

1.1 Impetus for Bushfire Hazard Assessment

It is noted a development application has been submitted to EDQ seeking an ROL for the proposed development as outlined at Section 3 of this report.

This report has been prepared to address the relevant provisions of the Natural Environment Site Strategy (NESS) Version 1.2 dated April 2014 and as endorsed by EDQ, specifically with regard to bushfire management and protection of biodiversity values across the site.

1.2 Site Details

Site Address	Flagstonian Drive, UNDULLAH
RP Description	Lot 2 on RP47120 Lot 907 on SP281066 Lot 908 on SP300625 Lot 910 on RP857850 Lot 911 on RP857870
Site Area	160ha approx.
Local Government	Economic Development Queensland (Greater Flagstone PDA)
Tenure	Freehold
Current Land Use	Vacant (managed)
Proposed Land Use	Urban residential subdivision
Fire Authority	RFSQ Jimboomba, Greenbank and Logan Village

2 Site and Locality Context

The subject site is located within the suburb of Undullah to the west of the Brisbane - Sydney Railway Line which traverses the centre of the Greater Flagstone PDA, with land adjacent to Stage 2-5 to the south that is currently being developed for urban purposes (approved Stage 1). Surrounding land to the north and west is also held in PEET ownership.

The majority of the area forming Stage 2 -5 has been historically cleared and comprises an expansive grassland area incorporating emergent regrowth vegetation. Existing vegetation in the outer periphery of the Stage and of the subject area has been retained along the waterway corridors as observed at Figure 1.

A similar clearing approach has been conducted for the remainder of Structure Plan area, in particular land located to the immediate west of Stages 2-5.

To the west and north-west of the Greater Flagstone PDA, there is steeper terrain in the immediate proximity of Flinders Peak and within the Flinders – Karawatha Bioregional Corridor. Development in this area is unlikely to occur due to ecological and scenic amenity values associated with the Corridor. However, land to the immediate west of the site and Structure Plan area is intended to be developed for urban residential purposes in the future.

Homestead Drive is a two-lane carriageway which has expanded across the railway line to provide access to Flagstonian Drive when enters Stage 1, south of Sandy Creek. Stage 1 comprises approximately 800 residential allotments which is currently in the final sub-stages of completion.

The Greater Flagstone PDA borders on the established area of Spring Mountain in the north and the Bromelton State Development Area to the south. There is a Council-managed sewerage effluent discharge area that is linked to an established sewerage treatment facility. This discharge area is situated on the eastern side of the Brisbane – Sydney Railway Corridor which is immediately south of Stage 1.

An established fire trail network throughout the Structure Plan area and surrounds also exists.



Figure 1 - PEET Flagstone Structure Plan area and location of Context Plan Area 1 and Stages 2-5
(Source: aerial imagery derived from Queensland Government, 2014)

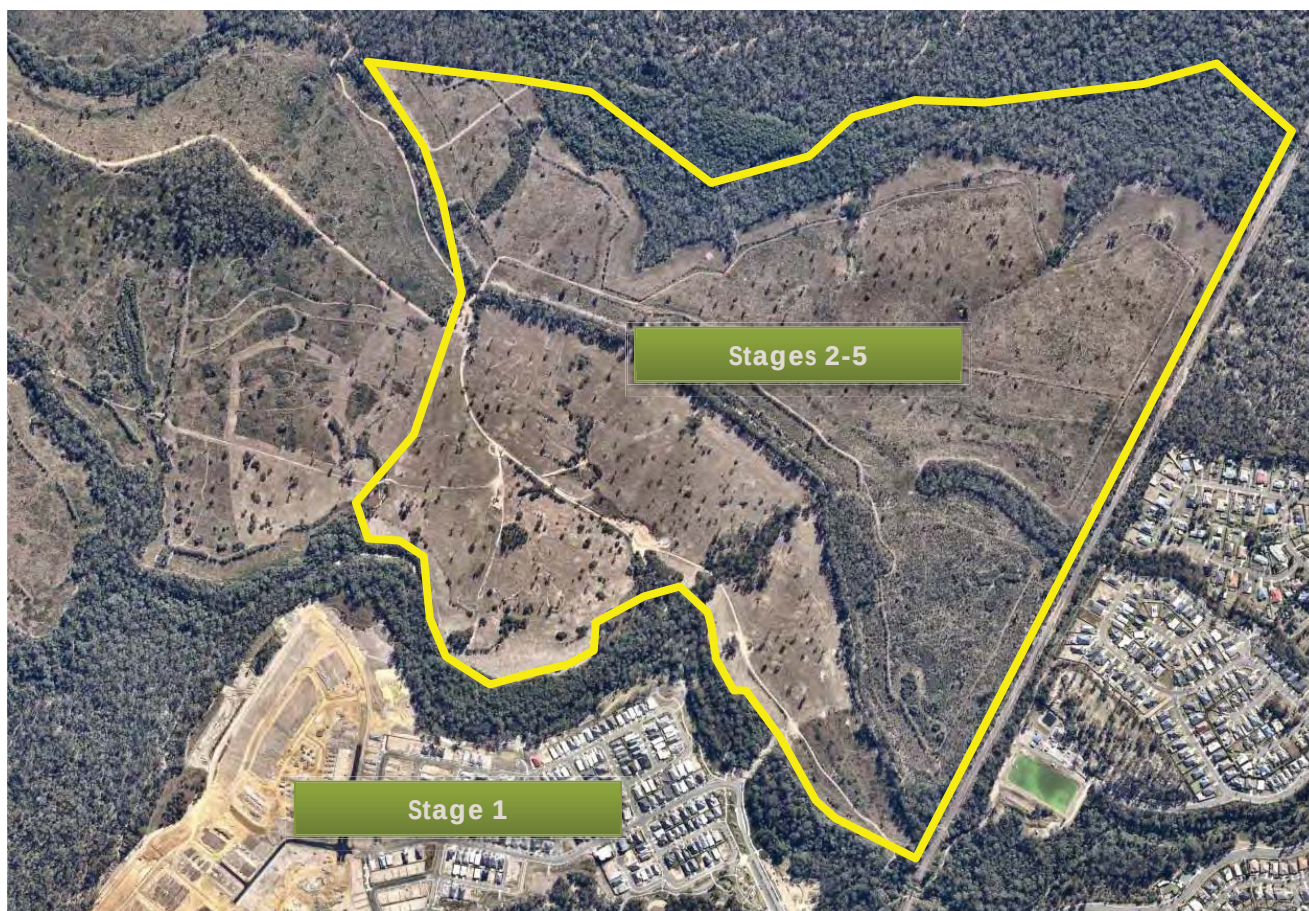


Figure 2 – Current aerial view of Stages 2-5 (Source: NearMap, 2018)

3 Proposed Development

3.1 Context Plan Area 1

Context Plan Area 1 encompasses the first of five Context Areas within the broader PEET Flagstone Structure Plan area. Context Plan Area 1 incorporates seven stages, including Stage 1 which is nearing completion as well as proposed Stages 2-5 and the local centre and an area to the south of the centre, refer to Figure 1 and Figure 3.

As identified by the Context Plan Area 1 Report prepared by RPS, Context Plan Area 1:

'encompasses the first of four residential "villages" within the Flagstone master planned community and the adjoining Town Centre. Each of the villages within will be distinct areas within Flagstone and will be supported by the town centre which will provide services and employment opportunities to Flagstone and the wider regional area.'

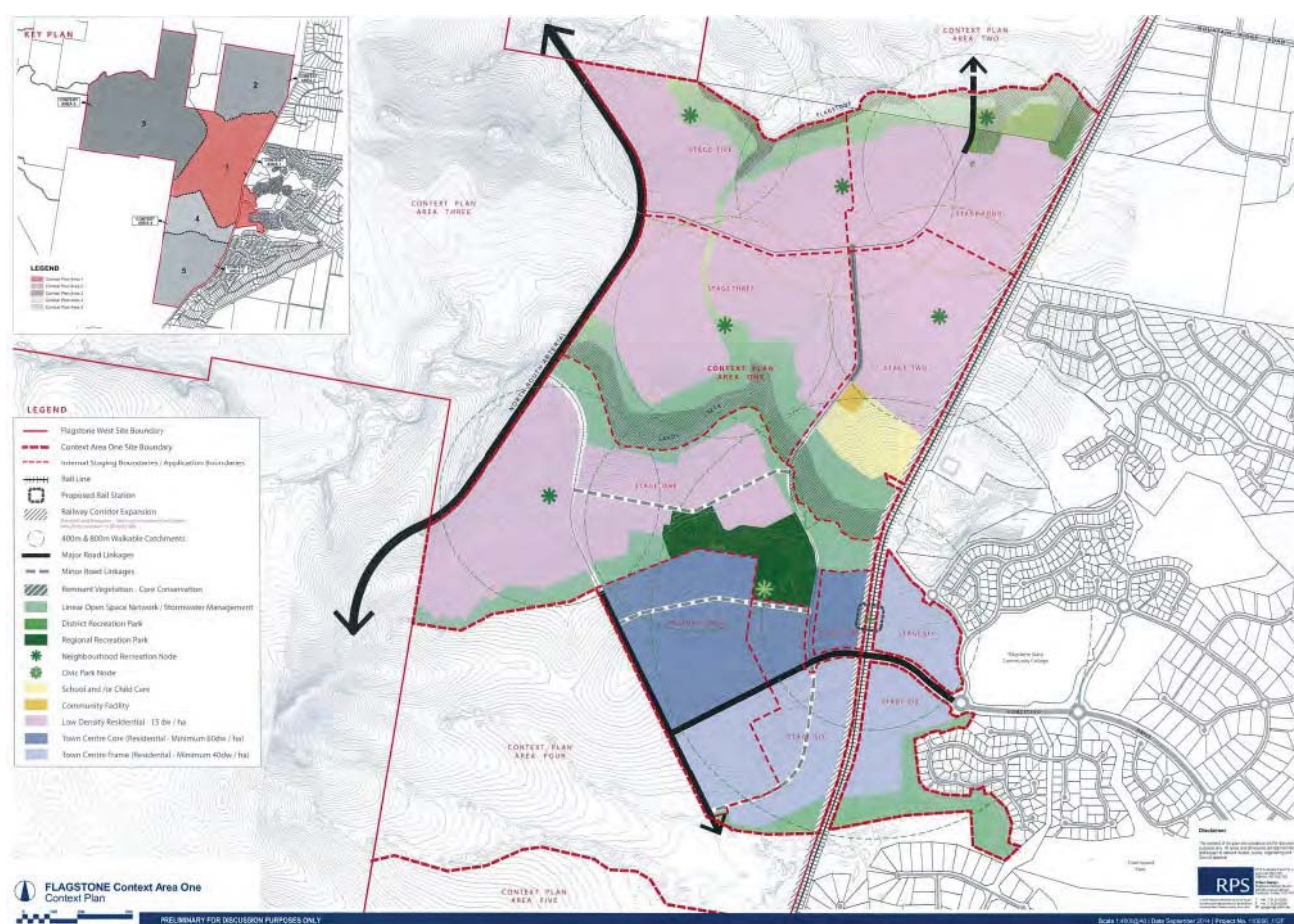


Figure 3 - Context Plan Area 1 (Source: RPS, 2014)

3.2 Stages 2-5

Stages 2 -5 of Context Plan Area 1 includes approximately 1,800 allotments as well as a new school site (subject to a separate RoL approval), punctuated by a range of parkland and recreational facilities. Stages 2-5 are situated to the north of the near-completed Stage 1. The subject area is bound by the Sandy Creek corridor in the south and the Flagstone Creek corridor to north. Both corridors encompass a core corridor with an average width of 100m and a buffer corridor area of 50m either side for an average overall width of 200m. Land to the north of Flagstone Creek is eventually envisaged to be cleared to accommodate urban residential development.

Flagstonian Drive is the central spine of Stages 2-5 which links to Homestead Drive across the Brisbane – Sydney railway line and through Stage 1. Flagstonian Drive is a part of the primary road network for Stages 2-5 which will eventually link to the North-South Arterial Road (New Beith Road) which bounds the subject site to the west. A lower order collector road stems from Flagstonian Drive to the northern quadrant of the site and is proposed to eventually extend through the Flagstone Creek corridor to provide access to the northern area of the Structure Plan. A considerable pedestrian and cycle network is also proposed which extends along primary and secondary road networks as well as recreational and open space areas between the two vegetated corridors of Sandy Creek and Flagstone Creek, and adjacent areas of development.

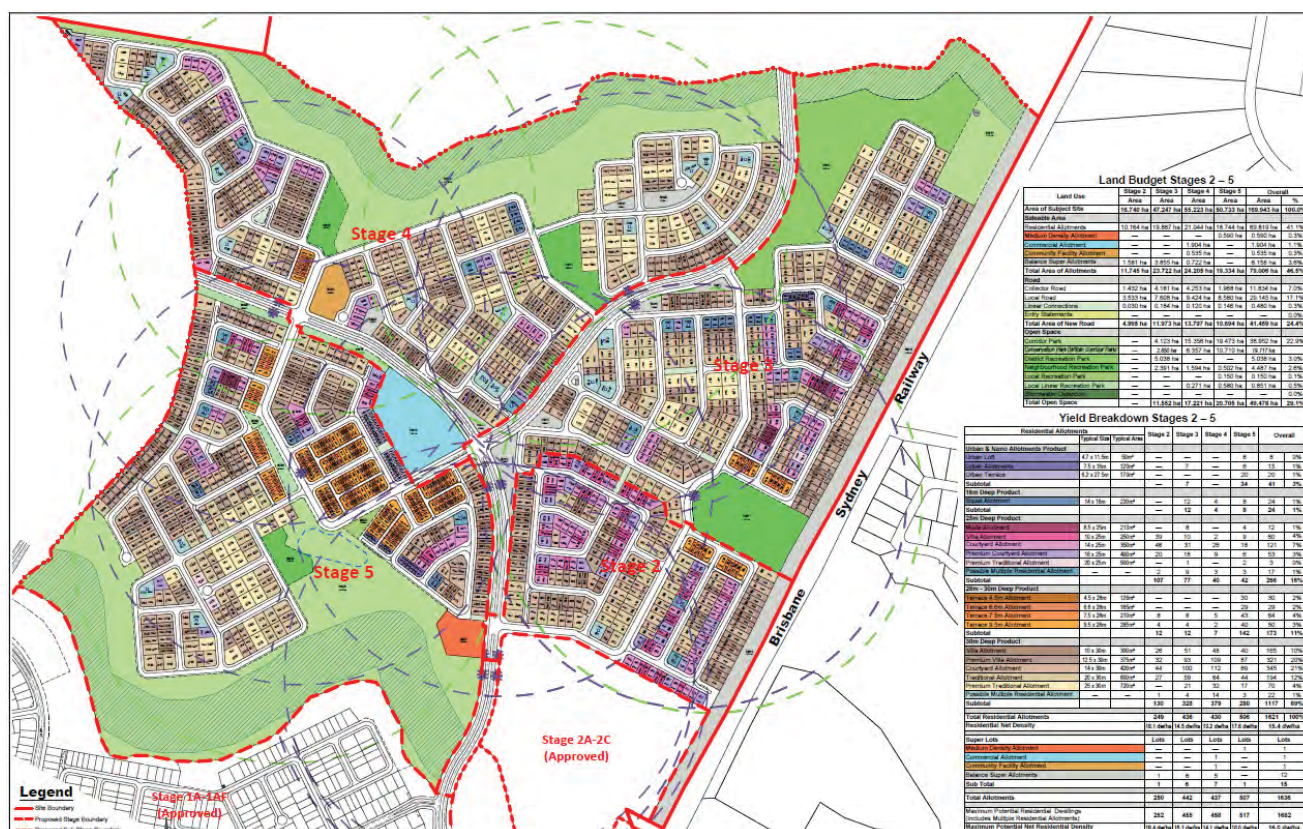


Figure 4 - Extract of proposal plans for Stages 2-5 (Source: RPS, 2018)

Proposed development plans are included at **Appendix A**.

4 Understanding Bushfire Hazard

Bushfires have long remained a fundamental characteristic of the Australian bush landscape, and likewise Australians have long retained a strong affinity with bush environments. There remains a number of common factors which are associated with bushfire events and these include the incidence of fire weather, availability of fuel along with its type, structure and continuity or fragmentation, and development at urban / bushland interface.

4.1 Bushfire Attack

Bushfire attack refers to the various methods in which bushfire may impact upon life and property and principally encompasses:

- Direct flame contact
- Ember and firebrand attack
- Radiant heat flux
- Fire-driven wind
- Smoke

During the progression of a bushfire event, these methods interact either exclusively or in concert. It is estimated that approximately 80 to 90 per cent of buildings located within 100m of the bushland interface are lost to bushfire, hence the relevance of statutory provisions and recommendations implemented across Australia which respond to various types of buildings within 100m of adjacent classifiable vegetation.

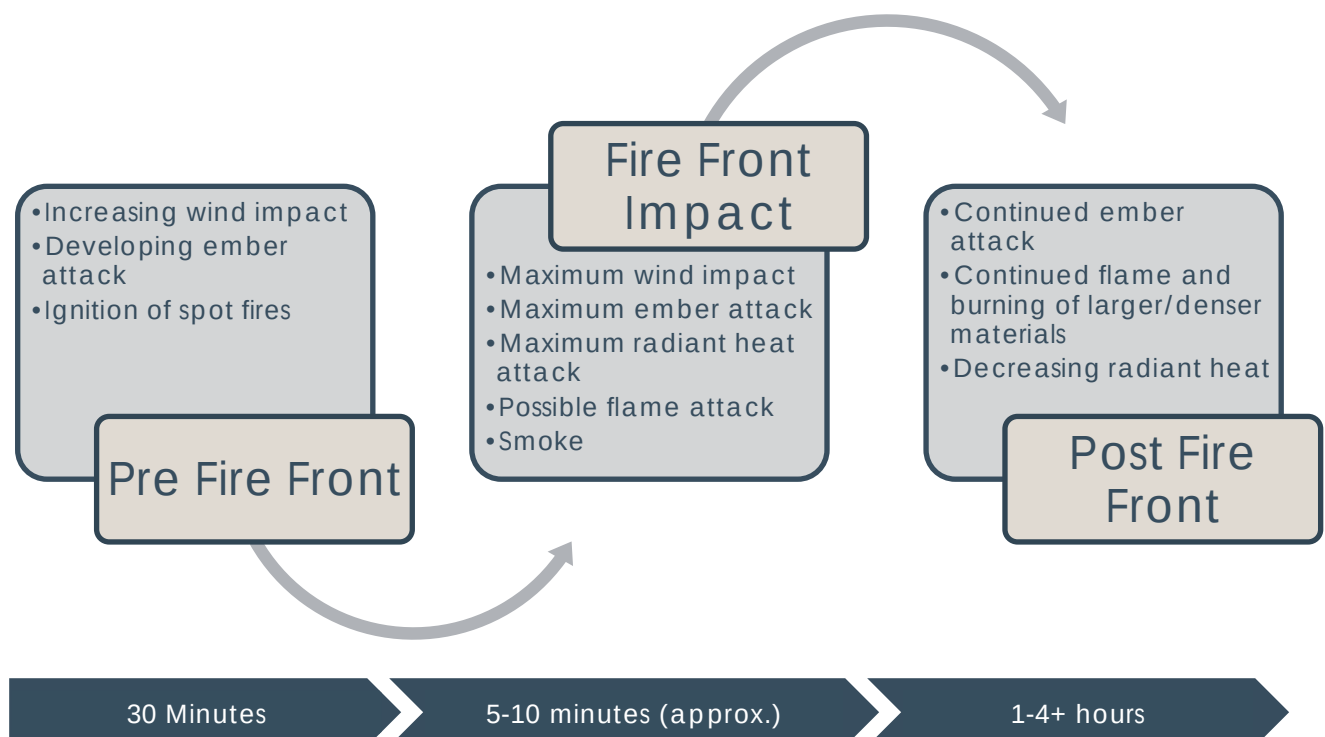


Figure 5 - The typical phases of bushfire attack (derived from Ramsay & Rudolph, 2003)

4.1.1 Direct Flame Contact

Direct flame attack refers to flame contact from the main fire front, where the flame which engulfs burning vegetation is one and the same as that which assumes contact with the building. It is estimated that only 10 to 20 per cent of buildings lost to bushfire occur as a direct result of flame attack.

4.1.2 Ember and Firebrand Attack

The convective forces of bushfire raise burning embers into the atmosphere on prevailing winds and deposit them to the ground ahead of the fire front. Typically, ember attack occurs approximately 30 minutes prior to the arrival of the fire front and continues during the impact of the fire front and for several hours afterwards, thus it is the longest lasting impact of bushfire attack. Firebrands occur in a very similar manner but relate to larger items of debris that may still be carried by the wind when alight, such as candle and ribbon barks.

In essence, building loss via ember attack relates largely to the vulnerabilities and peculiarities of each building, its distance from the classifiable vegetation and whether an occupant (or the like) is present to actively defend it. It is estimated by the CSIRO that approximately 80 to 90 per cent of buildings lost by bushfire are lost as a result of ember attack either in isolation or in combination with radiant heat impact.

4.1.3 Radiant Heat Flux

Exposure to radiant heat remains one of the leading causes of fatalities associated with bushfire events. Measured in kilowatts per m², radiant heat is the heat energy released from the fire front which radiates to the surrounding environment, deteriorating rapidly over distance. In terms of impacts on buildings, radiant heat can pre-heat materials making them more susceptible to ignition, or can cause non-piloted ignition of certain materials if the energy transmitted reaches a threshold level. Radiant heat can also damage building materials such as window glazing, allowing openings into a building through which embers may enter. Radiant heat impact is an especially important factor in building-to-building ignition.

In terms of radiant heat exposure for humans, it can cause pain to unprotected skin in milder situations or life threatening and fatal injury in higher exposure thresholds.

Radiant heat flux kW/m ²	Observed effect
1	Maximum for indefinite skin exposure
3	Hazardous conditions, firefighters expected to operate for a short period (10 minutes)
4.7	Extreme conditions, firefighters in protective clothing will feel pain after 60 seconds of exposure
6.4	Pain after 8 seconds of skin exposure
7	Likely to be fatal to unprotected person after exposure for several minutes
10	Critical conditions, firefighters not expected to operate in these conditions although they may be encountered. Considered to be life threatening in less than 60 seconds in protective equipment. Fabrics inside a building could ignite spontaneously with long exposure.
12.5 (BAL-12.5)	Volatiles from wood may be ignited by pilot after prolonged exposure. Standard float glass could fail during the passage of a bushfire.
16	Blistering of skin after 5 seconds
19 (BAL-19)	Screened float glass could fail during the passage of a bushfire.
29 (BAL-29)	Ignition of most timbers without piloted ignition (3 minutes of exposure) during the passage of a bushfire. Toughened glass could fail.
40+	Flame zone – exposure to direct flame contact from fire front

Figure 6 - The effects of radiant heat (NSWRFS, 2006; Drysdale, 1999, CFA, 2012)

4.1.4 Fire Driven Wind

The convective forces of bushfire typically result in strong to gale force fire-driven winds which in itself, can lead to building damage. The typical effects of fire driven wind include the conveyance of embers, damage from branches and debris hitting the building, as well as direct damage to vulnerable building components such as lifting roofs or roof materials and the damage / breakage of windows.

4.1.5 Smoke

Smoke emission remains a secondary effect of bushfire and is one which is typically not addressed by bushfire hazard assessment. Irrespective, it is important to note the potentially severe impact of smoke emission on the human respiratory system. It can lead to difficulties in breathing, severe coughing, blurred or otherwise compromised vision, and can prove fatal. It is also important to note that toxic smoke can occur during bushfire, particularly where buildings or materials are ignited. With regard to evacuation, it can reduce visibility and create difficulties for particularly vulnerable persons.

4.2 Vegetation Communities

Fuel load and arrangement represents a considerable component in dictating to a large degree the behaviour of fire in terms of intensity, rate of spread and flame height, and typically relates to dead plant material less than 6mm thick, and live plant material thinner than 3mm. On this basis, it stands to reason that different vegetation groups yield very different fire behaviour and intensity by virtue of their characteristics and fuel load output. The characteristics are not necessarily related to ecological values but remain a function of the propensity for certain groups of vegetation to ignite and sustain fire due to fuel load and arrangement, it can guide estimates on how quickly fire might spread and the likely fire behaviour and intensity which may occur.

Vegetation type, density and arrangement can further influence fire behaviour and intensity. Vertical and horizontal continuity is also a significant element. Thus, vegetation forms a critical element of analysis throughout this report.

4.3 Topography

Topography (effective slope) and to a lesser degree, aspect, are also factors which influence fire behaviour and intensity. Topography can have a drastic affect, with the rate of speed doubling for every 10 degrees of upslope and slowing by half for every 10 degrees of downslope, as a general rule. Aspect can also affect bushfire behaviour where areas with northerly and / or westerly aspects experience a higher level of solar access than those areas with a southern or eastern aspect. Notwithstanding, in times of drought and below average rainfall moisture levels in soil and vegetation in more sheltered areas with southerly and easterly aspects can also decrease substantially giving rise to significantly higher fuel abundance where the preceding fire regime has been less frequent or intense. Thus, aspect can be of less consequence.

4.4 Landscape and Localised Fire Hazard

Two types of risk are relevant in terms of bushfire hazard including:

- landscape risk – where large expanses of bushland over tens to hundreds of hectares are located in immediate proximity to, and may traverse, urban periphery suburbs/townships
- localised risk – which is most commonly presented by fragmented areas of vegetation larger than 1 hectare in size.

These two types of hazard present different types of fire behaviour, fire intensity and potential rate of spread characteristics.

4.5 Fire Weather

It remains important to understand the influence of fire weather with regard to how it can affect bushfire risk levels on a daily, weekly or seasonal basis.

In South East Queensland, hot-air fire wind is typically generated by west, north-west and south-westerlies and cool-air fire wind is generated by south-westerlies which are prevalent during Southern Queensland's fire season which extends from August to March, annually. In some situations however, south-easterlies can also drive bushfire behaviour on occasion.

Notwithstanding the above, it is noted bushfires do not always conform to widely-accepted characteristics. Other fire weather conditions must also be contemplated such as preceding weather conditions (such as low rainfall or drought), air temperature and relative humidity. If the area has been subject to drought or low rainfall for a period of time, vegetation health tends to deteriorate with increased leaf drop, curing and drying. This contributes to increased ground fuel loads and general ignition susceptibility. Prolonged dry periods also reduce soil moisture content.

Air temperatures of above 30 degrees Celsius are typically conducive to increased fire weather, as are extended periods of higher than average air temperatures. In conjunction, low relative humidity (i.e. low air moisture content) is also a contributing factor to increased fire weather.

In concert, all of the above factors can impact on the ability for fire to propagate, and alter behaviour and intensity characteristics and as such, fire weather is a significant component of bushfire hazard. Whilst an assessment of vegetation types, fuel loads, effective slope and other factors can be readily undertaken, fire weather can fluctuate across days, weeks and seasons and can have a significant impact on the potential for bushfire threat as well as influence bushfire behaviour and intensity.

The Forest Fire Danger Index (FFDI) is a commonly used method to readily advise the community of the likely ability of fire suppression based on fire weather, which is used to inform the Fire Danger Rating (FDR) System at Figure 7. It is important to maintain awareness as to the level of local fire danger during the fire season.

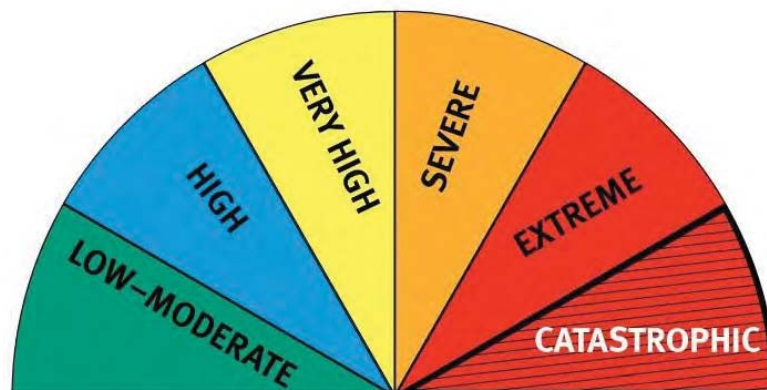


Figure 7 - Fire danger ratings (Source: RFSQ, 2013)

5 Regulatory Bushfire Assessment

5.1 Designated Bushfire Prone Area

Pursuant to Section 1.6 of the current Logan City Plan, it is noted the bushfire hazard overlay which forms part of the planning scheme designates bushfire prone areas across Logan for the purposes of the Building Code of Australia (BCA). As per Figure 6 below, the subject site is identified within the Designated Bushfire Prone Area. The above remains the case irrespective of the applicability of the Development Scheme for Greater Flagstone.

Further, it is noted the BCA triggers bushfire assessment (via AS3959-2009 – Construction of Buildings in Bushfire Prone Areas) for building classes 1, 2, 3 and selected 10a structures which do not include industrial and associated buildings. This being the case, the BCA (and AS3959-2009) is not relevant to this bushfire hazard assessment.

5.1.1 Greater Flagstone PDA Development Scheme

The Greater Flagstone PDA Development Scheme was approved by the State Government in 2011 and assists in planning, carrying out, promoting, coordinating and controlling the development of land in the Greater Flagstone PDA. The Development Scheme seeks to facilitate development design which effectively mitigates bushfire hazard however, it does not provide any specific guidelines or criteria with respect to any particular requirements or mandates in this regard. Rather, the Development Scheme defers to the guidelines and assessment criteria for bushfire hazard outlined in the SPP 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide which has since been replaced by the current single State Planning Policy (SPP). A map outlining the development constraints in the development scheme identifies areas of bushfire hazard as provided in Figure 8 which appears to relate to ultimate potential hazard as opposed to interim hazard, as is the current case.

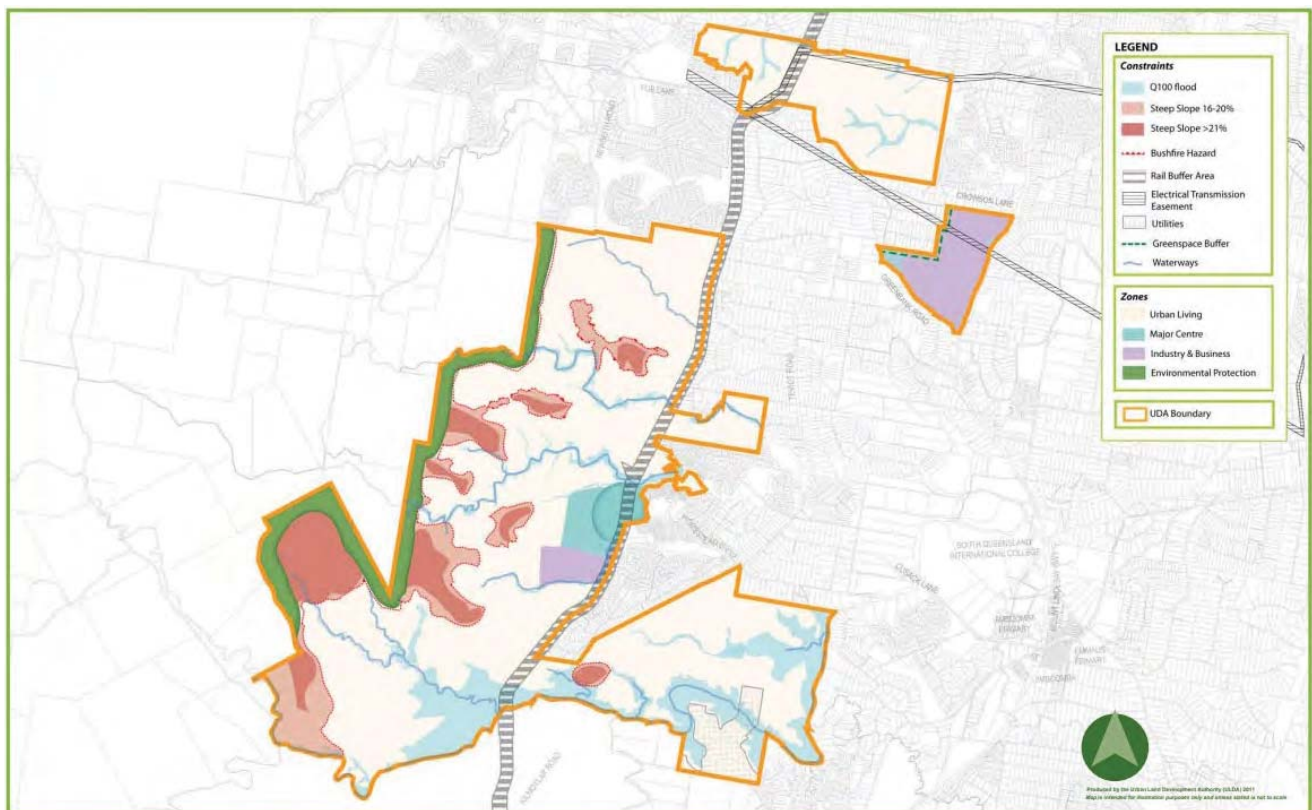


Figure 8: Excerpt of constraints mapping contained within the Greater Flagstone PDA Development Scheme (Source: Queensland Government, 2011)

5.1.2 Logan City Plan Bushfire Hazard Overlay

The Logan City Plan remains the applicable local planning instrument however, as the site remains within a declared PDA, the provisions of the local government planning scheme are not relevant.

Notwithstanding, the Bushfire Hazard Overlay mapping under the Logan City Planning Scheme remains relevant pursuant to the provisions of the Building Code of Australia (BCA). The BCA nominates local government planning scheme hazard overlay mapping as the relevant trigger for the applicability of AS3959-2009 – Construction of Buildings in Bushfire Prone Areas. On this basis, the overlay mapping continues to remain relevant in terms of dwelling construction.

Figure 8 provides an excerpt of the current Bushfire Hazard Overlay map under the Logan City Plan. A significant portion of Stages 2-5 are observed to comprise areas of 'medium' to 'high' bushfire hazard potential as well as potential hazard exposure buffers which includes areas along Sandy and Flagstone Creeks, as well as other areas internal to the Stages.

It is noted this mapping does not reflect the extent of clearing which has been managed over the past several years, as presented at Figure 2. The Logan City Plan hazard overlay mapping adopts the SPP bushfire prone areas mapping prepared by QFES – noting that mapping is updated every six months whereas the Logan City Plan mapping has not been updated since the planning scheme was adopted by Council in 2015.

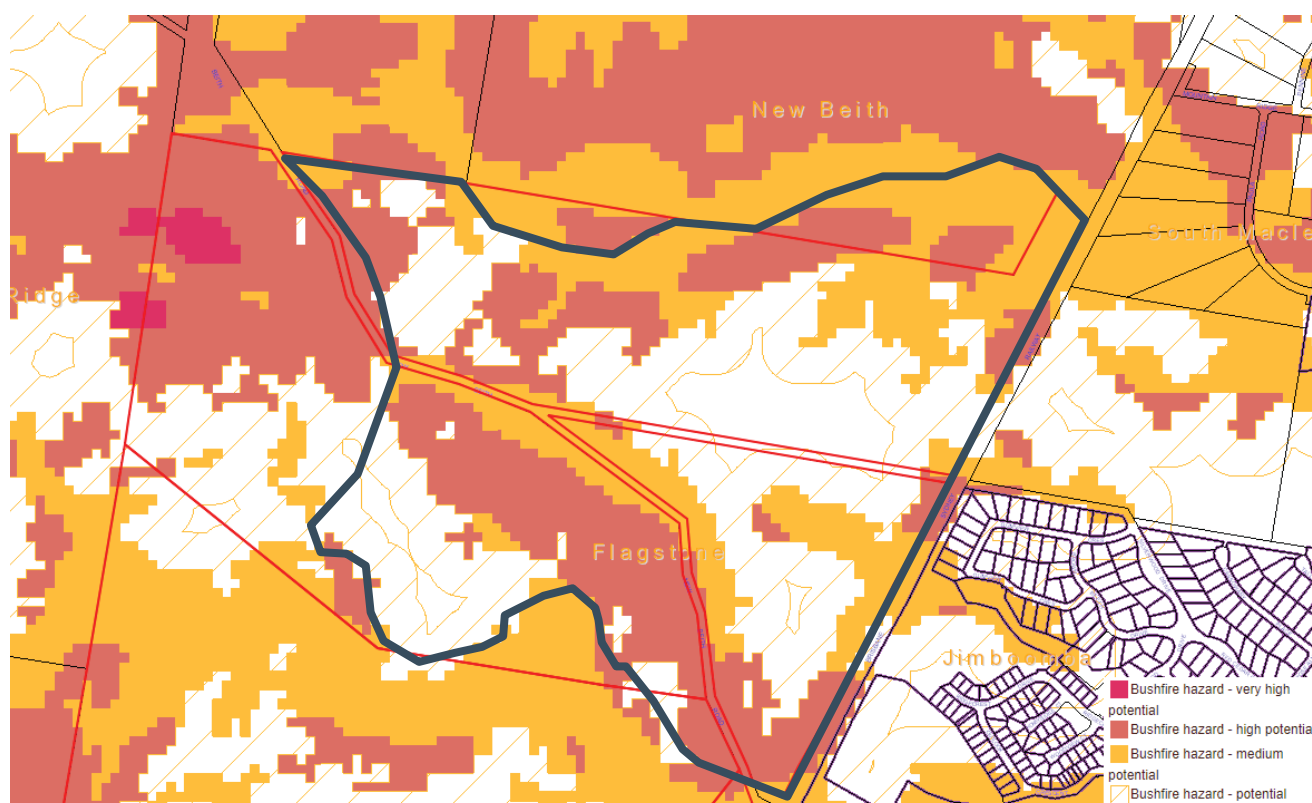


Figure 9: Excerpt from Logan City Plan Bushfire Hazard Overlay (Source: Logan City Council, 2015)

5.2 State Planning Policy

5.2.1 State-wide Bushfire Prone Area Mapping

The current State-wide bushfire prone areas mapping which underpins the SPP identifies part of the subject area as subject to a mix of 'Medium' and 'High' as well as potential hazard buffers. Areas of 'High' potential hazard buffers exist in the west and south-east quadrant of the subject area. It is noted that several vegetated areas identified as potential hazard in the subject area are intended to be removed in entirety as part of the proposed development. External potential hazard areas

are intended to be developed as part of the Greater Flagstone PDA however, future clearing not related to this particular development application is not taken into consideration on balance of the small potential that future development may not occur.

It is noted the hazard mapping below is not consistent with the Bushfire Hazard Overlay mapping contained within the Logan City Plan but is more closely aligned (but not completely representative of) the current state of the subject areas as per Figure 2.

The mapping supports the implementation of the SPP only and is not triggered for AS3959-2009 – Construction of Buildings on Bushfire Prone Areas pursuant to the Building Code of Australia.



Figure 10: Excerpt of SPP Bushfire Prone Areas mapping (Source: Queensland Government, 2018)

5.2.2 State Planning Policy Assessment

The single State Planning Policy (SPP) was released by the State Government in December 2013 and amended in July 2017. This policy details a range of State-interest requirements for planning scheme preparation and interim development assessment provisions.

As the Greater Flagstone PDA Development Scheme does not incorporate specific provisions relating to bushfire protection, assessment is deferred to the State Planning Policy as the primary assessment instrument.

As identified at Part E of the SPP, the following requirements relate to all types of development subject to natural hazards, assessed pursuant to the SPP:

Table 1 - State Interest Policy and Assessment Benchmarks for Planning for Safety and Resilience to Natural Hazards

For all natural hazards, development	Assessment
1. Avoids natural hazard areas or mitigates the risks of the natural hazard to an acceptable or tolerable level; and	The provisions of this report seek to appropriately mitigate the risk of potential bushfire attack via a range of methodologies including: - Settlement pattern and urban design - Asset protection zones and defensible space - Building construction provisions - landscaping, rehabilitation and vegetation management approaches for fuel management - the use of firebreaks - access and egress - fencing and retaining provisions - water supply and firefighting infrastructure - bushfire awareness.
2. Supports, and does not unduly burden, disaster management response or recovery capacity and capabilities; and	In this case, it is considered that matters with regard to disaster management response and recovery were reasonably considered at the time the Greater Flagstone PDA was declared by the Minister and the Development Scheme was prepared, taking into consideration the extent of population growth proposed in this location. Irrespective of the above, the mitigation methodologies identified by this report seek to provide for increased community resilience and emergency response if required in addressing matters such as vegetation management, property maintenance, access and egress and built form. It is recommended a copy of this report is provided to the local Rural Fire Brigade for their information purposes.
3. Directly, indirectly and cumulatively avoids an increase in the severity of the natural hazard and the potential for damage on the site or to other properties; and	A range of mitigation measures are recommended by this report to reduce the potential for damage caused by possible bushfire attack whilst maintaining a focus on end-user safety.
4. Avoids risks to public safety and the environment from the location of hazardous materials and the release of these materials as a result of the natural hazard; and	Not applicable.

5. Maintains or enhances natural processes and the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard	The proposed development of Stage 2 - 5, the subject area and wider PEET Flagstone Structure Plan Area is subject to a range of land management, vegetation management, ecological assessment and landscape concept plans which combined, seek to effectively balance the natural features and processes associated with the subject land and hazard mitigation approaches. The measures and methodologies outlined in this report remain cognisant of this strategic balance.
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Additional SPP bushfire-related guidance material is anticipated to be released by the Department of State Development, Manufacturing, Infrastructure and Planning for public consultation in the near future however, at the time of writing the material was not publicly available.

5.3 AS 3959 – Construction of Buildings in Bushfire Prone Areas

The AS3959 – Construction of Buildings in Bushfire Prone Areas specifies requirements and measures for residential buildings constructed in bushfire prone areas. Bushfire attack levels (BALs), which form the foundation upon which AS3959-2009 is applied, distinguish the level of attack buildings (and occupants) may experience based on a range of factors which are analysed at Section 6 below.

A BAL is defined as ‘a means of measuring the severity of a buildings potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared, and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire’ (Standards Australia, 2011).

The level of attack buildings may experience is based on a range of factors including vegetation typologies (fuel load), effective slope and separation distance, each of which has a significant bearing on the likely behaviour and intensity of a bushfire and how these factors can combine to impact upon nearby buildings.

The Australian Standard adopts six distinct BAL categories including a ‘low’ category for areas where bushfire risk is limited, these categories are outlined at Figure 10. The categories are based upon the level of radiant heat flux which may be experienced during a bushfire event measured at the building façade and generally relates to how close or far a building is from classifiable vegetation. These BAL classifications translate to specific building construction requirements to enhance the ability of building occupants and the building itself to withstand bushfire attack.

It is noted a draft revised version of the Standard was released for public comment in late 2017 and is expected to be implemented in the first quarter of 2019. As the document remains draft in its current context and has since been amended, this assessment does not provide any assessment against the draft version of the Standard released in 2017 however, it is acknowledged dwellings constructed in Stages 2-5 will likely be subject to the newer version of the Standard, upon its introduction.

BUSHFIRE ATTACK LEVELS AND CORRESPONDING SECTIONS FOR SPECIFIC CONSTRUCTION REQUIREMENTS

Bushfire Attack Level (BAL)	Classified vegetation within 100 m of the site and heat flux exposure thresholds	Description of predicted bushfire attack and levels of exposure
BAL—LOW	See Clause 2.2.3.2	There is insufficient risk to warrant specific construction requirements
BAL—12.5	$\leq 12.5 \text{ kW/m}^2$	Ember attack
BAL—19	$> 12.5 \text{ kW/m}^2$ $\leq 19 \text{ kW/m}^2$	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL—29	$> 19 \text{ kW/m}^2$ $\leq 29 \text{ kW/m}^2$	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux
BAL—40	$> 29 \text{ kW/m}^2$ $\leq 40 \text{ kW/m}^2$	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames
BAL—FZ	$> 40 \text{ kW/m}^2$	Direct exposure to flames from fire front in addition to heat flux and ember attack

Figure 11: Excerpt from AS3959-2009 (Source: Standards Australia, 2011)

6 Site-based Bushfire Hazard Assessment

6.1 Methodology

The following assessment was carried out in accordance with the broad methodology underpinning AS 3959 – Construction of Buildings in Bushfire Prone Areas, in the absence of any State-based or locally-applicable site assessment guidelines.

A range of instruments have been utilised to perform a desktop analysis to complement available site data. These instruments include:

- Local and State bushfire hazard mapping;
- Ecological data provided by Saunders Havill group and State-based vegetation (RE) mapping;
- Proposal plans and supporting documentation including the OSS, etc.;
- Vegetation management and landscaping plans;
- Aerial imagery;
- QFES RediPortal Mapping Platform;
- State Planning Policy - Fit-For-Purpose Approach to Undertaking Natural Hazard Studies and Risk Assessments Technical Manual; and
- AS3959-2009 – Construction of Buildings in Bushfire Prone Areas.

A site inspection was undertaken on Monday 4 June 2018 under fine, low season weather conditions. At the time of this site inspection, preceding rainfall had been low to moderate with temperatures not dissimilar to typical early winter averages.

It is noted the inspection included a number of areas across Stages 2-5, focussing principally on the vegetated corridors of Sandy Creek to the south and Flagstone Creek to the north.

6.2 Fire Weather

In terms of assessment methodology, it is noted the Forest Fire Danger Index (FFDI) adopted by AS3959-2009 for Queensland is 40 with a flame temperature of 1,090k. However, recent research has determined the fire weather in South East Queensland is higher than that identified under AS3959-2009. The State Planning Policy mapping methodology developed by CSIRO identifies this area of South East Queensland as subject to an FFDI ranging between 50 and 60. The QFES RediPortal indicates an estimated FFDI for this area of South East Queensland at approximately 56. To this end, an FFDI of 60 is assumed on a conservative basis for the purposes of this assessment. This remains higher than the FFDI adopted by both the current and draft version of AS 3959.

In considering the above, it is important to understand the frequency of more extreme fire weather days in South East Queensland. The number of days per decade on which an FFDI of 50 (Severe) is exceeded is 11.7 days, and an FDI of 75 (Extreme to Catastrophic) is exceeded only 0.9 days of each decade (Lucas, 2007). The influence of climate change may alter these statistics into the future however at present, this data accurately indicates the current risk profile posed by such fire weather conditions.

6.3 Vegetation Communities

Vegetation classification is important for a number of reasons, namely it indicates the level of fire intensity and fire behaviour associated with specific stands of vegetation and it also indicates the fuel loads which may exist in certain locations.

The following sections discuss the vegetation communities associated with both the Sandy Creek corridor and the Flagstone Creek corridor, as well as the implications of interim classified vegetation within Stages 2-5 which will eventually be removed as development progresses.

It is noted a Property Map of Assessable Vegetation (PMAV) exists for the subject site which identifies the specific Regional Ecosystems (REs) relevant to both the Sandy Creek and Flagstone Creek corridors. It is these REs which are adopted for the purpose of this assessment. It is noted the PMAV REs differ to that provided by the Queensland Herbarium, hence the need for the accuracy of the PMAV.

In addition to the above, it is noted It is noted the '*vast majority of areas encompassing Context Plan Area 1 were cleared in 2008 and 2009*' (Sanders Havill Group, 2012, p.35). Thus, despite the nature of the SPP bushfire prone areas mapping, the majority of existing hazard internal to the Stages either has or is intended to be removed to site development thus, the focus of this assessment remains the Sandy and Flagstone Creek corridors. Notwithstanding this, regard is had to the nature of potential interim hazard, located internal to the site, until such a time as Stages 2-5 is completed. Additional land management provisions are also identified later in this report.

6.3.1 Sandy Creek Corridor

The fuel composition within the Sandy Creek corridor is generally continuous at present, with both horizontal and vertical connectivity remaining in situ and connected to a wider area of vegetation to the west. This area to the west also forms part of the Greater Flagstone PDA and may be developed into the future however at this stage, must be considered in its current form. Further to the west and north-west, the PDA adjoins the Flinders Peak – Karawatha Bioregional Corridor noting this area is unlikely to accommodate any potential future development.

Sandy Creek will also be dissected by the connection of Flagstonian Drive which requires initial clearing of approximately 100m of the corridor, with revegetation likely to occur to the toe of proposed road batters (refer to Detail Sheet 22 of the current Vegetation Management Plan for Flagstone City prepared by Saunders Havill Group). The existing cleared area within the corridor buffer on the northern side of Sandy Creek will be maintained in perpetuity, landscaped with fire-wise species.

The PMAV assessment conducted by Saunders Havill identifies the vegetation communities of the Sandy Creek corridor to be a mix of RE 12.3.6 and RE 12.3.11.

In terms of associated fuel load, the April 2016 'SPP Technical Manual - A 'fit for purpose' approach in undertaking natural hazard studies and risk assessments' incorporates a potential fuel load guide which links to a range of 'Vegetation Hazard Classes' (VHCs), converted from REs. The VHCs and corresponding potential fuel loads are identified below.

Table 2 - Vegetation communities of the Sandy Creek corridor

RE	RE Description	VHC	VHC Description	Potential Fuel Load
12.3.6	Melaleuca quinquenervia +/- Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia open forest	22.1	Melaleuca open forests on seasonally inundated lowland coastal swamps	28.4t/ha
12.3.11	Eucalyptus tereticornis +/- Eucalyptus siderophloia, Corymbia intermedia open forest	16.1	Eucalyptus dominated forest on drainage lines and alluvial plains	15.9t/ha

The vegetation within the Sandy Creek corridor is dominated (in terms of fuel structure, but not necessarily species prevalence) by tall eucalypt specimens, with a shrub understorey and ground cover fuel layer. Melaleuca specimens are also prevalent, along with lantana weed infestation. Weed treatment has been conducted within the Sandy Creek corridor in recent time.

Having regard to the above and in accordance with Table 2.3 of AS3959-2009, the vegetation communities within the Sandy Creek corridor are classified as Open Forest.

6.3.2 Flagstone Creek Corridor

Similar to the Sandy Creek corridor, the vegetation along the Flagstone Creek corridor is largely continuous in nature and forms the southern-most extent of Context Plan Area 2 which is not yet cleared. Thus, the landscape extent of hazard which exists to the north of Stages 2-5 is broader than just the Flagstone Creek corridor.

Within 100m of the extent of Stages 2-5, the vegetation communities are largely consistent with that of the Sandy Creek Corridor, namely comprising RE 12.3.7 and RE 12.3.11. This varies further to the north (beyond the 100m assessment extent) to incorporate RE 12.9-10.2, RE 12.9-10.12 and RE 12.9-10.7 comprising areas of endangered regional ecosystems.

Within the Flagstone Creek corridor to the north-west of Stages 2-5, RE 12.9-10.2 and RE 12.9-10.7 communities are also present.

Table 3 - Vegetation communities of the Flagstone Creek corridor

RE	RE Description	VHC	VHC Description	Potential Fuel Load
12.3.6	Melaleuca quinquenervia +/- Eucalyptus tereticornis, Lophostemon suaveolens, Corymbia intermedia open forest	22.1	Melaleuca open forests on seasonally inundated lowland coastal swamps	28.4t/ha
12.3.11	Eucalyptus tereticornis +/- Eucalyptus siderophloia, Corymbia intermedia open forest	16.1	Eucalyptus dominated forest on drainage lines and alluvial plains	15.9t/ha
12.9-10.2	Corymbia citriodora subsp. variegata +/- Eucalyptus crebra open forest	10.1	Spotted gum dominated open forests	20.8t/ha
12.9-10.7	Eucalyptus crebra +/- E. tereticornis, Corymbia tessellaris, Angophora spp., E. melanophloia woodland	13.2	Dry to moist eucalypt woodlands on undulating metamorphics and granite	14.4t/ha

Adopting a conservative approach, the higher overall fuel load of those vegetation communities identified within each corridor is adopted for the purposes of this assessment, at 28.4t/ha.

Likewise for the Sandy Creek corridor, in accordance with Table 2.3 of AS3959-2009, the vegetation communities within the Flagstone Creek corridor are classified as Open Forest.



Figure 12 – Flagstone Creek corridor (north-western area of Stages 2-5)

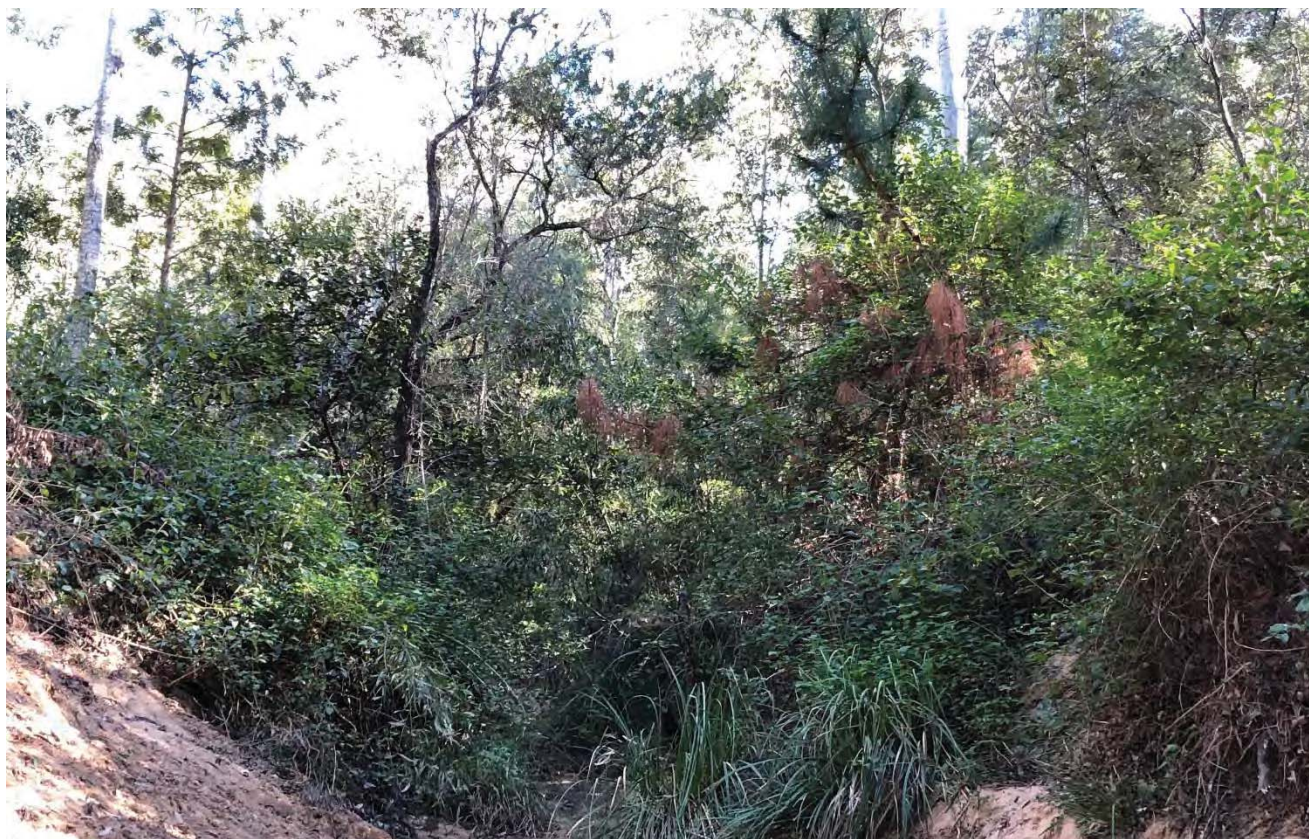


Figure 13 - Flagstone Creek corridor

The staging of development across Stages 2-5 will result in the incremental advancement of residential activity across the subject area which will include potential exposure to grassfire and small stands of vegetation which will eventually be cleared in later stages. In order to avoid interim potential hazard exposure beyond that identified by Figure 14 below, areas surrounding interim stages will require to be managed in a low fuel state to an extent not less than 100m until such a time as later stages are constructed.

Figure 14 below demonstrates the extent of hazard relating to Stages 2-5. Refer to the proposed Landscape Concept Plans prepared by Urbis and proposed earthworks, trunk sewer and detention basin plans prepared by Bradlees Meinhardt for proposed location of corridor works.

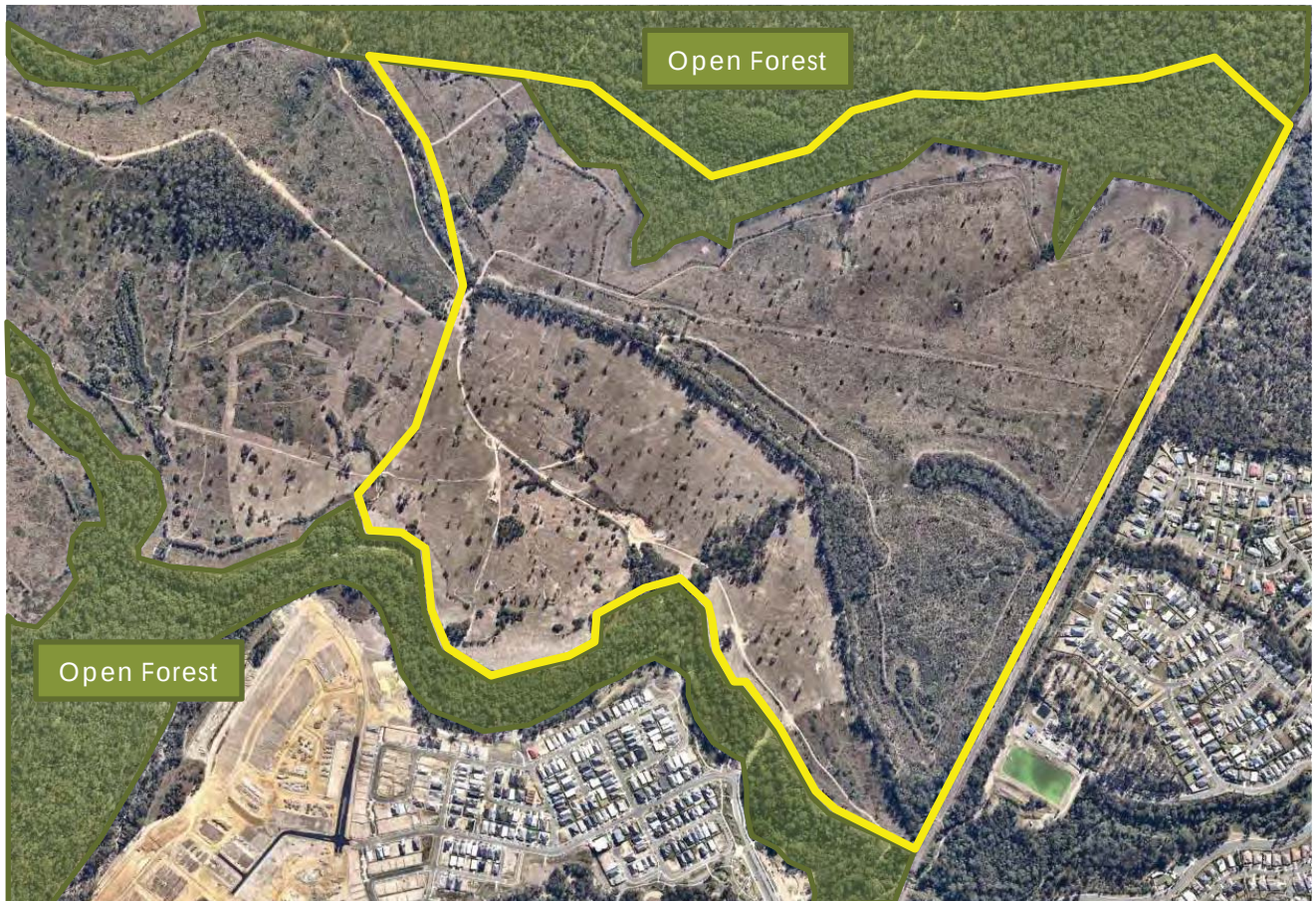


Figure 14 - Vegetation classifications relevant to Stages 2-5 (Source: Base image derived from NearMap, 2018)

6.4 Effective Slope

Effective slope relates to the topography of vegetation beneath classified vegetation, as this influences fire speed and rate of spread - namely, that the speed of fire doubles for every 10 degrees incline. An on-site effective slope assessment has been conducted via detail survey, Council and DNRM contour data and verified via site inspection.

As the extent of classifiable vegetation is associated with both the Flagstone and Sandy Creek corridors, this effective slope assessment focuses on these two locations.

6.4.1 Sandy Creek Corridor

The effective slope relating to Sandy Creek corridor is entirely downslope from the extent of proposed development however, the extent of slope does vary across the corridor. The relevant downslopes (measured in degrees of slope) are illustrated at the figure below. This assessment focuses on that area of the Sandy Creek corridor within 100m of the extent of development to the

north. This largely incorporates the northern creek bank, but not the southern bank. Adopting a conservative approach, the parallel downslope and upslope which is likely to mitigate the effect bushfire behaviour and intensity (likely reducing it from the slopes identified below) has been factored out.

To the west, the northern creek bank is steeper than in other areas, with small pockets of steep topography occurring to the east and west of the proposed Flagstonian Drive connection through the corridor, which will be cleared to a width of approximately 100m.

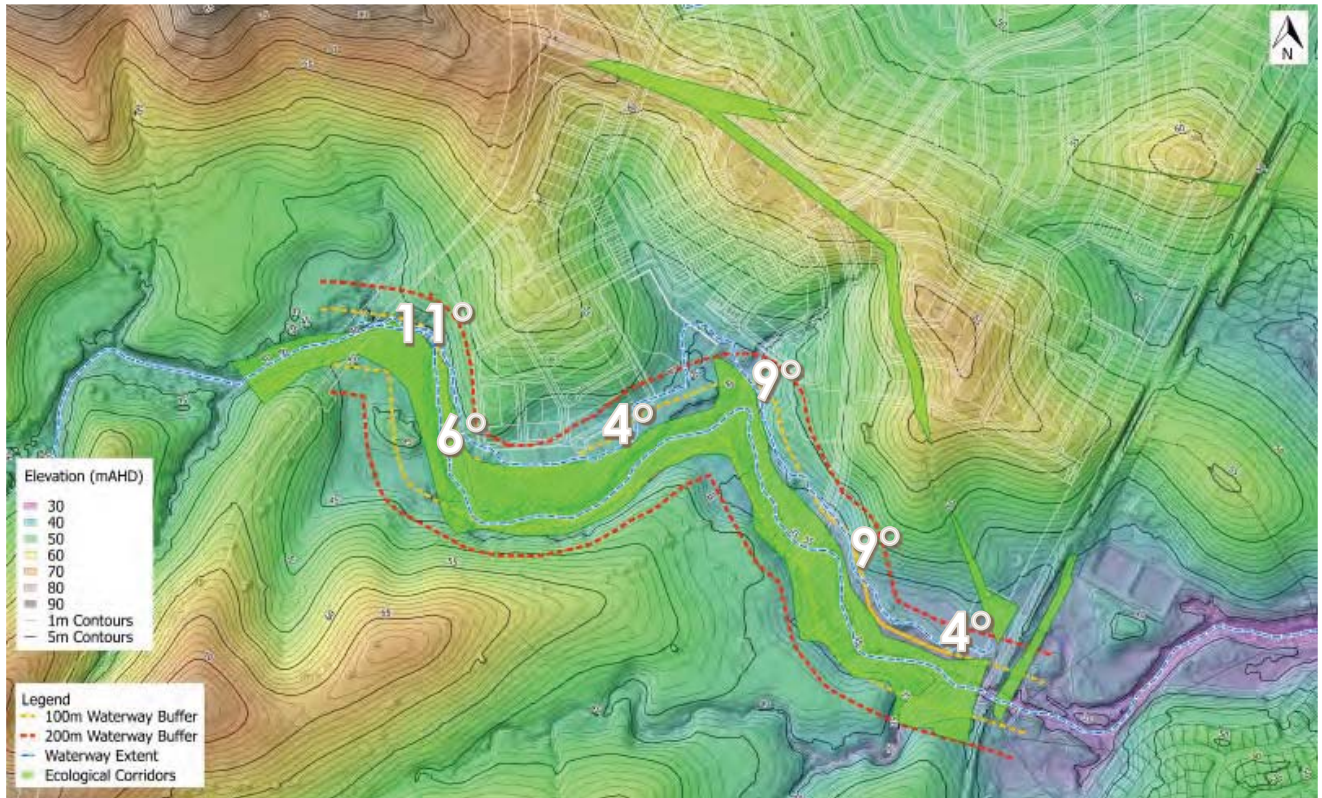


Figure 15 - Effective slope assessment across the northern bank of Sandy Creek

6.4.2 Flagstone Creek Corridor

Similar to the Sandy Creek corridor, the topography of Flagstone Creek is entirely downslope from the extent of proposed development however, the extent of slope does vary across the corridor. The relevant downslopes (measured in degrees of slope) are illustrated at the figure below. This assessment focuses on that area of the Flagstone Creek corridor within 100m of the extent of development to the south. This largely incorporates the southern creek bank, but not the northern bank. Adopting a conservative approach, the parallel downslope and upslope which is likely to mitigate the effect bushfire behaviour and intensity (likely reducing it from the slopes identified below) has been factored out.

For Flagstone Creek, terrain increases in steepness toward the centre of the adjacent Stages 2-5 where a drainage path from the south flows into Flagstone Creek. The area to the west of this drainage path is proposed to be buffered by parkland however, development to the east of this area is subject to steeper effective downslopes as a result of corridor terrain.

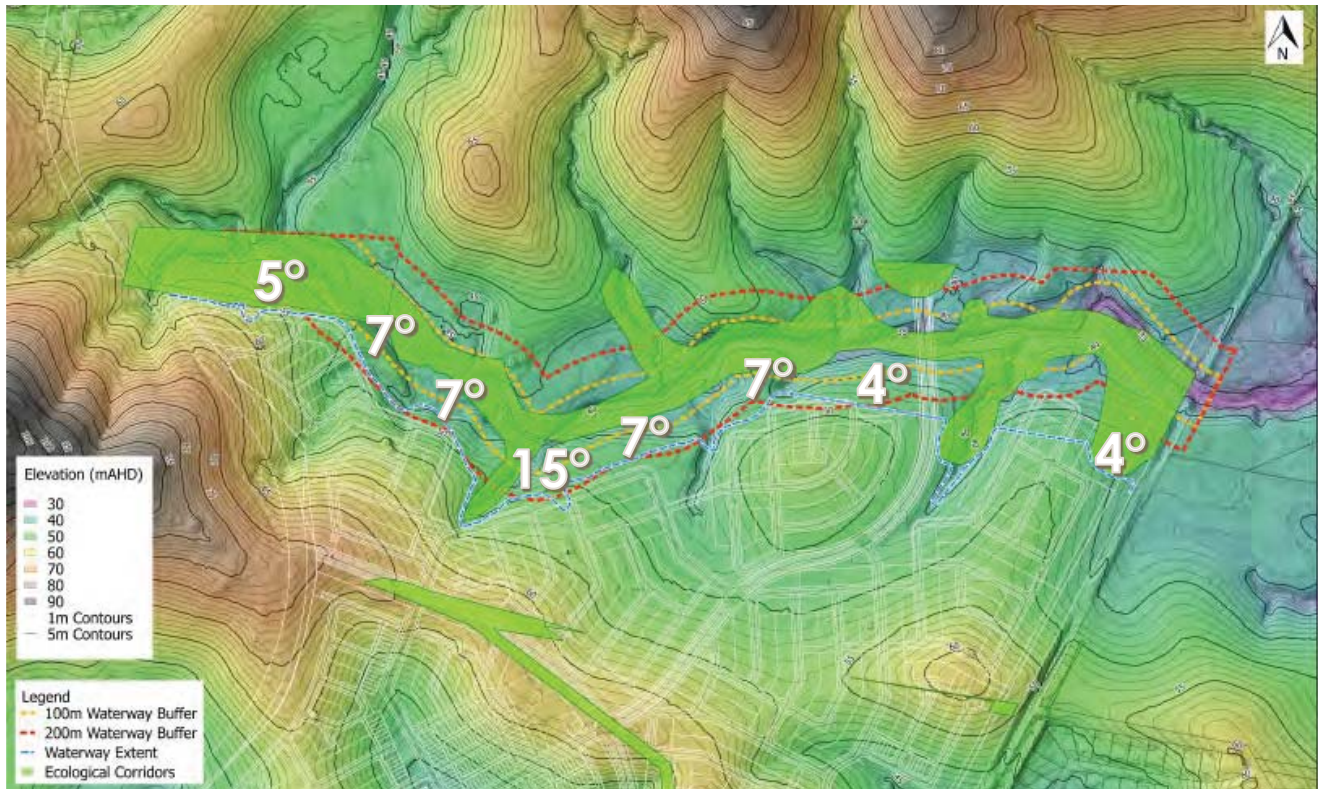


Figure 16 - Effective slope assessment across the southern bank of Flagstone Creek

6.5 Aspect

Aspect can affect bushfire behaviour where slopes with northerly and/or westerly aspects experience a higher level of solar access than those areas with a southern or eastern aspect. This generally translates to drier fuels with lower moisture content and increased dead/drying/curing material. Notwithstanding, in times of drought and below average rainfall, moisture levels in soil and vegetation in more sheltered areas with southerly and easterly aspects can also decrease substantially giving rise to significantly higher fuel abundance where the preceding fire regime has been less frequent or intense. Thus, aspect is of only partial consequence in this respect and this is reflected by the current SPP mapping methodology and information made publicly available by QFES.

Insofar as slope aspect relevant to the subject area, both Sandy Creek and Flagstone Creek corridors include northern and southern banks, conveying water flow from the west to the east, toward Logan River which is situated to the west of Flagstone. As aspect in this case relates to waterway corridors of varying orientation, it is not considered to maintain any significant influence on bushfire intensity within either corridor, if fire were to occur.

6.6 Bushfire Behaviour Assessment and Extent of Hazard

Two types of risk are relevant to Stages 2-3 in terms of bushfire hazard including landscape hazard where large expanses of bushland remain proximate, and localised bushfire hazard which is most commonly presented by fragmented areas of vegetation larger than 1 hectare in size.

It is noted the Greater Flagstone PDA expands to the north, west and south surrounding the PEET Flagstone City Structure Plan Area such that the exposure to landscape fire risk over time will likely reduce as intervening development sites are cleared. Whilst in the medium term this expectation may translate to a lower level of risk exposure, in the interim the context of landscape fire risk associated with vegetation to the north and west of the site requires consideration. The mitigation measures and methodology set out in Section 7 of this report seek to respond to the risk profile of

the site taking into consideration the context of surrounding vegetation and other influential hazard characteristics such as fire weather, separation distance, orientation and effective slope.

An ignition to the north, north-west or south-west could emanate in a fire run toward Stages 2-5. To the west, the development site is buffered by cleared land directly adjoining Stages 2-5. These areas remain largely upslope from Stages 2-5, thus the immediate area of fire advancement would slow in rate of spread and likely intensity, but could be of higher intensity beyond these locations.

A range of fire trails traverse the area to the north and west of the site which provide opportunities for ongoing vegetation and land management, emergency services access and construction of firebreaks, control lines for back burning and defensive firefighting tactics activities should they be required. A number of minor, moderate and larger-scale water stores (such as the Bromelton off-line water storage facility which is in the ownership of the Coordinator-General) are situated in the wider area which may be useful for suppression activities.

Sandy Creek, as a remnant corridor, is more localised in its hazard context. A fire occurring in this location is more likely associated with point ignition (i.e. via ember) rather than an intensive fire run / front by virtue of location, orientation with regard to the subject site and constrained size / width which, for the most part, would combine to limit any potential fire activity from reaching maximum rate of spread. Having regard to these factors, the entirety of both sides of Sandy Creek corridor are accessible by vehicle for the purposes of ongoing land management as well as emergency access.

The proposed combination of landscaping, vegetation management, rehabilitation as well as earthworks, essential works and stormwater detention activities which are required as part of Stages 2-5 influence the overall bushfire protection outcomes. This outcome is further guided by the Natural Environment Site Strategy (land management strategy) prepared for the Structure Plan area; the Context Plan Area 1 Community Green Space Plan, prepared by RPS; and the Stages 2-5 Landscape Concept Plan, prepared by Urbis. The excerpt below from the Landscape Concept Plan demonstrates the intended landscape and vegetation outcome for both Sandy Creek and Flagstone Creek.



Figure 17 - Indicative landscape master plan (Source: Urbis, 2018)

6.6.1 Fire History

It is noted a number of smaller scale ignitions have occurred in the general region over recent years, largely as a result of human activity (i.e. dumping of vehicles in isolated areas of bushland, which are set alight). The QFES Redi-Portal does not identify any significant burn polygons in the general area, noting that several have occurred further to the north within the Spring Mountain Park area however, it is unknown at this time whether these ignitions were the result of hazard reduction or bushland.

7 Bushfire Management and Mitigation

The bushfire risk and hazard context associated with the subject site requires a number of management provisions.

The site allows for the management and mitigation of risk in accordance with national approaches to planning and building in bushfire prone areas. The below provisions should be read in conjunction with the Stages 2-5 Master Bushfire Management Plan provided at **Appendix B**.

7.1 Urban Design (Structure and Settlement Pattern)

The structure and settlement pattern of proposed Stages 2-5 responds to the localised nature of bushfire hazard (existing within the Sandy Creek and Flagstone Creek corridors) it adjoins in the following ways:

- Perimeter roads are provided for the majority of interface areas, providing defensible space 'in perpetuity' i.e. guaranteed separation which is incapable of inadvertently transitioning to a fuel-laden area;
- Multi-optioned movement network which is capable of facilitating emergency egress (and emergency services access) with limited bottlenecks. Importantly, the ultimate signalised intersection at Stage 1 means inadvertent impacts on others also potentially experiencing evacuation is not endured;
- Limited cul-de-sac outcomes. Where these cannot be avoided (due to topography, stormwater requirements, etc.), traversable bollards can be considered which allow for traffic movements to adjacent streets in case of emergency;
- Emergency egress which can be facilitated via the approved ARTC level rail crossing, should access across the bridge to Homestead Drive become compromised;
- A density which is commensurate with the nature of hazard and risk, including a mix of lot sizes with direct street access; and
- Access continues to be facilitated to land to the west and north via a series of existing fire trails for land and fire management purposes. QFES has recently traversed these trails to confirm their ability to convey fire appliance access.

Over time, the broader Flagstone PDA is likely to be developed which extends further to the west. This will dramatically reduce the extent of actual bushfire hazard exposure relevant to Stages 2-5. In the interim, the built form solution provided by the proposal is entirely commensurate with the extent of hazard which currently exists.

7.2 Access and Egress

Access and egress is significant in terms of a range of aspects of bushfire prevention and ability for firefighting. It must cater for emergency access and egress in times of potential bushfire events. Road layout is significant in terms of a range of aspects of bushfire prevention, emergency evacuation and ability for bushfire fighting.

The site's primary access to the established road network is provided via Flagstonian Drive which skirts Stage 1 of Flagstone City to connect with Homestead Drive across the Brisbane-Sydney railway line. Homestead Drive is the central road access connector for the Flagstone Estate. Homestead Drive is a dual carriageway road with a 70km/hour speed limit. Established areas of the Flagstone Estate convey traffic onto Homestead Drive which provides connections to surrounding areas, including Jimboomba.

With the future development of the PEET Flagstone Structure Plan, alternate road access to the north and south will also eventually be provided however, in the interim Flagstonian Drive/Homestead Drive will remain the primary source of access and egress for Stages 2-5.

The proposed Stages 2-5 road network incorporates a primary collector which enters the site from the south across Sandy Creek, which will be cleared to an approximate width of 100m to allow for the construction of this road crossing. This collector, being Flagstonian Drive, then bends to the west where it will eventually connect to New Beith Road, upon its extension. Local connection streets emanate from Flagstonian Drive to connect with local streets. Cul-de-sacs are avoided where possible however, a small number are required, particularly at the south-western area of the site. In these locations and where permitting, plastic emergency-friendly bollards which are easily removed or collapsible to provide an informal access / egress opportunities should the need arise, could be considered.

The proposed and existing road networks are of a design which seeks to facilitate ease of access and egress for Stages 2-5 without compromising the ability of Stage 1 residents to also evacuate. The existing Stage 1 intersection to Flagstonian Drive will eventually be signalised, a preferred arrangement which means evacuation from either stage is unlikely to adversely affect egress from the other.

7.2.1 Fire Trails and Fire Breaks

Stages 2-5 is of a design which largely negates the need for any specific fire trail or fire break network to be established above and beyond that required to manage the overall Structure Plan Area which includes a network which is already in place. However, there do remain two areas which attract specific requirements. In the first instance, an interim fire break is required immediately adjoining the western boundary of Stages 2-5. A future major road connection (New Beith Road) is identified in this location. It is required to clear this area between the rear property boundary of allotments in Stages 2-5 and the western alignment of this future road reserve. This fire break will assist in moderating any potential impact of landscape fire to the west of the site, on an interim basis. This same treatment was applied for Stage 1.

7.2.2 Evacuation

In the event of emergency, the existing football field constructed adjacent to the regional park in Stage 1 could operate a potential 'Neighbourhood Safer Place' (pending QFES advice), though early evacuation of the area would be preferential.

Should evacuation via either Flagstonian Drive or Homestead Drive become problematic, it is noted an approved ARTC level crossing across the Brisbane-Sydney railway line already exists, adjacent to the school site within Stages 2-5. A fire trail easement could be established to facilitate enduring emergency access to this crossing in the event of emergency.

Notwithstanding the above, network demand in the event of emergency can be considerable. Residents are encouraged to consider their evacuation route and evacuation destination prior to any specific bushfire event and at what stage they will evacuate ensuring it is early enough to ensure safe evacuation. Residents are strongly discouraged from adopting a 'wait and see' approach and should prepare a personal / household bushfire survival plan and ideally, speak with officers of the local rural fire brigade for advice in advance of any particular bushfire event.

7.3 Land and Vegetation Management

The proposed development comprises a number of parkland and retained vegetation areas. The bushland areas and corridors which adjoin the development site must be managed so as to reduce the build-up of unacceptable fuel loads. It is understood the Flagstone Creek and Sandy Creek corridors will remain intact, subject to weed management activities. Into the future, regular inspections by the developer, Council and local rural fire brigade will be required to limit the opportunity for increased fire intensity by virtue of ground fuel load build-up and the propagation of weeds or swathes of long grass where in proximity to the site.

Management processes should ideally be undertaken prior to and during summer. Prescribed burning should only occur during winter months when the FFDI is low and weather conditions permit.

The management of bushland surrounding the site should be included in Council's bushfire management plan and undertaken in accordance with Council policy.

The master bushfire management plan contained at **Appendix B** reflects the nature of the proposed vegetation management plan for the site, prepared by Saunders Havill Group.

7.4 Landscaping

A landscape master plan has been prepared for the site by Urbis. This master plan, read in conjunction with the VMP, outlines the conceptual nature of both Sandy Creek and Flagstone Creek corridors. The northern side of Sandy Creek may be used for passive recreational activities and any landscaping / revegetation intent for this area will incorporate fire wise species, ensuring that plantings in this location do not inadvertently extend the existing fire hazard.

Based upon the above, the landscaping approaches for the retained corridors are subject to the following rationale:

- limiting potential for fuel accumulation on the site
- breaking opportunities for propagation of fire
- implementing fuel / fire breaks
- ensuring inner and outer defendable space zones are implemented and maintained in perpetuity
- landscape design which does not inadvertently increase bushfire attack risk.

The corridors are both punctuated by a series of stormwater detention basins, parkland areas, walking and cycle paths. A possible lake is identified adjacent to the Sandy Creek corridor, whilst a district size recreation park adjoins the Flagstone Creek corridor in the north east.

The landscaping intent within the buffer areas of the corridors, must not inadvertently allow for fire propagation. Landscaping of the corridor is to be undertaken in accordance with the following:

- any further tree planting is to be undertaken as isolated specimens and not in groups
- shrub planting within the corridor is avoided where possible and if required, are not located within the drip zone of any tree canopy and may only form small groupings where entirely isolated from tree species, avoid shrubs and tree planting within 5m of any residential property boundary
- any ground cover plantings must not exceed 1m in height, or 500mm where within the drip zone of any tree specimen
- shrub and tree planting is not undertaken within 10m of any residential property boundary
- avoid the use of organic garden mulch where possible and instead replace with alternatives such as stones, gravel, scoria, pebbles, shells or the like with a low level of flammability
- all plantings are selected in accordance with the CFA's 'Landscaping for Bushfire' Plant Selection Key which identifies essential characteristics for 'fire-wise' species – being those species which are less likely to propagate flame (available online).

Collectively with the clearing guidelines above, the landscaping provisions identified here seek to ensure the corridors provide defendable space for adjoining residential areas which does not contribute to bushfire hazard.

Notwithstanding the above and irrespective of the characteristics of such species, certain weather conditions can impact upon the propensity for ignition and propagation of fire within any vegetation. It must be noted that no vegetation can be considered 'fire proof'.

It is noted the easiest and most effective way of managing bushfire threat is to monitor and reduce ground fuel loads and regrowth. Year-round maintenance is required to ensure excess or build-up of ground fuels (dead plant material) is removed prior to and during each annual fire season.

7.4.1 Landscaping for residential allotments

The landscaping rationale for private residential allotments plays a significant role in enhancing the ability of dwellings to withstand bushfire attack. Landscape design and plant selection is a critical element.

As identified above, the CFA's Plant Selection Key and 'Landscaping for Bushfire' Guideline provide a range of helpful tips for purchasers to consider when landscaping their properties. For example, it is recommended that purchasers:

- do not provide garden beds immediately adjoining a house or garage, but instead provide a gravel or concrete path at least 500mm in width
- select plants which accord with the characteristics outlined in the CFA's Plant Selection Key
- ensure vegetation layers avoid providing horizontal and / or vertical fuel continuity by separating out plant types by height and groupings
- consider the type of plants located near any windows or doors which may apply heat to glazing
- consider plantings which help to filter possible embers and wind but are of a nature which complies with the CFA's Plant Selection Key.

7.4.2 Fencing and Retaining

Fencing materials can have a considerable impact on the propagation of fire. Likewise, some fencing materials can alleviate exposure to radiant heat which can assist life and property survival. Timber fencing material is the most common form of fencing in urban residential areas. However, fire resistant and fire retardant materials are considered more appropriate than timber. For those allotments sharing a boundary with either the Sandy Creek or Flagstone Creek corridors, it is recommended that open style metal (pool), Colorbond or masonry fencing is utilised in lieu of timber fencing to provide an additional level of protection. Specific provisions for fencing in some locations are illustrated at Attachment B. Traditional timber paling fences (including side returns) are not recommended in these locations.

In addition, any retaining walls required in the area of dwelling units requiring BAL-12.5 or above should be constructed of fire resistant or fire retardant material such as concrete, stone, masonry or the like and not constructed from timber.

7.5 Strategic Asset Protection Zones

The master bushfire management plan included at **Appendix B** identifies the strategic approach to asset protection, separation and defensible space across Stages 2-5. Relevant to both the Sandy Creek and Flagstone Creek corridors, strategic-level separation is provided by way of:

- Perimeter roads;
- Parkland and open space;
- Stormwater detention basins;
- Bulk earthworks and batters; and
- Trunk infrastructure corridors.

The strategic asset protection zones do not require any clearing specifically to meet bushfire protection objectives and thus, complies entirely with the provisions of the OESS and VMP for the Context Plan Area.

7.5.1 Allotment Asset Protection Zones

Each individual allotment is taken to an asset protection zone in and of itself, providing a managed environment for each dwelling and that of adjoining dwellings. In addition is the asset protection zone provided between allotments and nearby vegetation as identified above. Refer to the master bushfire management plan at **Appendix B** for further detail.

7.6 Water Supply and Firefighting Infrastructure

It is understood the site is to be connected to reticulated water supply. As per any new urban development the reticulated water network must comply with Council requirements and BCA standards, which includes specific provisions for firefighting requirements. It is understood the site will also be serviced with fire hydrants.

Reticulated water (pressure or supply) may not be guaranteed in the event of bushfire. This can be for a number of reasons including power outages to pump stations, damage to pump stations via bushfire or large amounts of water being drawn from the mains by fire services and the wider community. On this basis, the provision of a static water supply for individual allotments may be a measure to be considered, but is not specifically mandated by this report.

Should water tanks be provided on site, they are not to be constructed of any material which may fail when exposed to excessive heat and must be located on that side of the building which is furthest away from adjacent bushland vegetation. Access around the entire perimeter of each building should be maintained and any hoses and equipment should likewise be capable of reaching all external areas of the buildings.

Should water tanks for static supply be considered, water tanks should also include a 50mm male camlock fitting for emergency fire service use (or as otherwise instructed by QFES). External hose connections both to reticulated water supplies and directly to the storage tank are recommended.

Plastic gas fittings at the external façade of any building are not acceptable.

7.7 Fire Trails and Fire Breaks

Stages 2-5 are of a design which largely negates the need for any specific fire trail or fire break network to be established above and beyond that required to manage the overall Structure Plan Area. However, there does remain one area which attracts specific requirements. An interim fire break is required immediately adjoining the western boundary of Stages 2-5, refer to **Appendix B**. A future major road connection is identified in this location. It is required to clear this area between the rear property boundary of allotments in Stages 2-5 and the western alignment of this future road reserve. This fire break will assist in moderating any potential impact of landscape fire to the west of the site, on an interim basis.

Continued access to the broader landholding fire trail network will also be maintained.

7.8 Building Construction

The Master Bushfire Management Plan provided at **Appendix B** includes radiant heat contours which equate with a devised FFDI 60 table for Bushfire Attack Level (BAL) classifications which, at this strategic planning phase are intended to guide the future development of Stages 2-5. This takes account of a higher FFDI than the current AS3959-2009 (noting a revision is poised to take effect in 2019), and continues to allow Method 2 assessments to be conducted for sub-stages or individual allotments.

This approach demonstrates the proposed Stages 2-5 layout is more than capable of meeting the required building construction provisions, and includes a level of redundancy should minor alternations to earthworks etc. occur throughout construction. This approach allows for internal allotment alternations to occur throughout construction without necessitating a change to the BMP, unless such changes impact upon the outer extent of development or vegetation / management regime of adjoining corridors. A site-wide or sub-stage BAL plan will be prepared at a later date, in accordance with the provisions of the Master Bushfire Management Plan at **Appendix B**.

7.8.1 Building Design to Reduce BAL Construction Costs

For potential purchasers and builders, it should be noted certain building design approaches can effectively decrease construction costs associated with meeting the provisions of AS3959-2009. Some of these approaches include:

- consider on-site setbacks which may decrease BAL classes, the further a dwelling is from nearby vegetation the lower the building specifications
- slab on ground construction
- brick / masonry / concrete veneer as opposed to timber cladding
- consideration of the location of windows and window design, avoiding floor-to-ceiling glazing and raising windows at least 400mm off the ground and away from any adjoining timber structures such as decking
- consideration of more simple designs which avoid numerous roof valleys and avoiding re-entrant corners around the building
- consideration of door locations and door types, some types more affordably meet AS3959-2009 than others (i.e. consider avoiding bi-fold doors)
- stainless steel security screening to doors and windows and aluminium roller shutters (shutters may not be essential but may be more affordable than specified glazing requirements)
- avoid timber framing to windows and doors where applicable, which require selected timbers to a bushfire resistant density
- avoid entry sidelights
- avoid unnecessary skylights and certain roof ventilation systems (i.e. whirlybirds) to avoid additional need for ember guarding
- select non-combustible material for garage doors and frames as opposed to timber materials which must be of bushfire-resisting density
- consider the need for timber decking and / or other timber structures which may be located adjoining or affixed to the main dwelling and which would require bushfire resisting timber for construction.

Informed building design can substantially decrease costs associated with ember and radiant heat protection construction methodologies. Purchasers are strongly recommended to consult their builder and private certifier with respect to these opportunities in advance of dwelling design selection to maximise the opportunity for construction savings.

7.8.2 Limitations of Building Construction Provisions

The Australian Standard provides that although its provisions are:

‘designed to improve the performance of buildings when subjected to bushfire attack in designated bushfire-prone areas there can be no guarantee that a building will survive a bushfire event on every occasion. This is substantially due to the unpredictable nature and behaviour of fire and extreme weather conditions.’

It is significant to also understand the objective of AS3959-2009, which is to

‘prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire, appropriate to the:

- potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire; and
- intensity of the bushfire attack on the building.’

Further and as set out previously in this report, the FFDI provisions pursuant to AS3959-2009 adopted for Queensland is 40 and as such the design parameters in this context are designed to a maximum of Very High (FDI 25-49). Thus, fire days in excess of this (Severe, Extreme and Catastrophic days) are not accommodated by existing statutory building instruments and is beyond design parameters. As advised by the Rural Fire Service, early evacuation on fire danger days above Very High is recommended, even if properties are well-prepared and no immediate fire threat exists.

Importantly, the enhancement of survival of life and property relies upon a range of mitigation measures, including regular and on-going property and vegetation management as well as BAL construction requirements. Again, whilst all reasonable care and diligence has been applied throughout the preparation of this assessment and the identification of BAL provisions, these provisions in no way form a guarantee against the loss of life or property as a result of bushfire and it remains the responsibility of property owners to investigate, self-educate and understand how best to protect their property and lives in the event of bushfire.

7.9 Community Awareness and Education

Landowners are responsible for developing their own knowledge and understanding of the level of bushfire risk specific to their respective property and the wider landscape within which one chooses to live. A household bushfire plan is strongly recommended and must take account of matters such as where occupants are during the day (at home, work or school), if any occupants require special assistance (i.e. infants, the elderly or the ill), evacuation routes available, evacuation destinations, property maintenance and preparation and arrangements for pets. Planning ahead of any perceived bushfire event is essential.

Understanding what to do in the event of bushfire emergency is critical, residents may not always receive an extended warning or warning to evacuate and fire appliances may not always be available to render assistance. Thus, prior knowledge as to the steps to take during the lead up to a fire event, during the passage of bushfire and what to do immediately after the fire front has passed is critical.

The RFSQ’s ‘Bushfire Survival Plan’ provides detailed information on how to prepare for the bushfire season and how to take action to survive in the event of bushfire. A copy of this publication is available at <https://www.ruralfire.qld.gov.au/Pages/Home.aspx>.

8 Interim Construction Land Management

The staging of development across Stages 2-5 will result in the incremental advancement of residential activity across the subject area which will include potential exposure to grassfire and small stands of vegetation which will eventually be cleared in later stages. In order to avoid interim potential hazard exposure beyond that identified by Figure 14, areas surrounding interim stages will require to be managed in a low fuel state to an extent not less than 100m until such a time as later stages are constructed.

9 Conclusions

This report considers the bushfire mitigation measures required for Stages 2-5 of Context Plan Area 1 as part of the PEET Flagstone City Structure Plan Area. Based upon on-site inspections and analysis, a range of mitigation measures are identified to aid in the defence against bushfire with respect to areas of classifiable vegetation which surround the development site.

Based on this assessment, a range of recommendations has been derived. In addition, it is significant to note that bushfire remains a natural process which is endemic to the Australian bush and is subject to a range of contributing factors which are variable almost on a daily basis. As such, it is extremely difficult to predict the behaviour and intensity of a fire event at any given time. On this basis it remains of the upmost importance that residents within identified bushfire prone areas obtain knowledge and remain aware of their options in the event of a bushfire to ensure the preservation of both life and property.

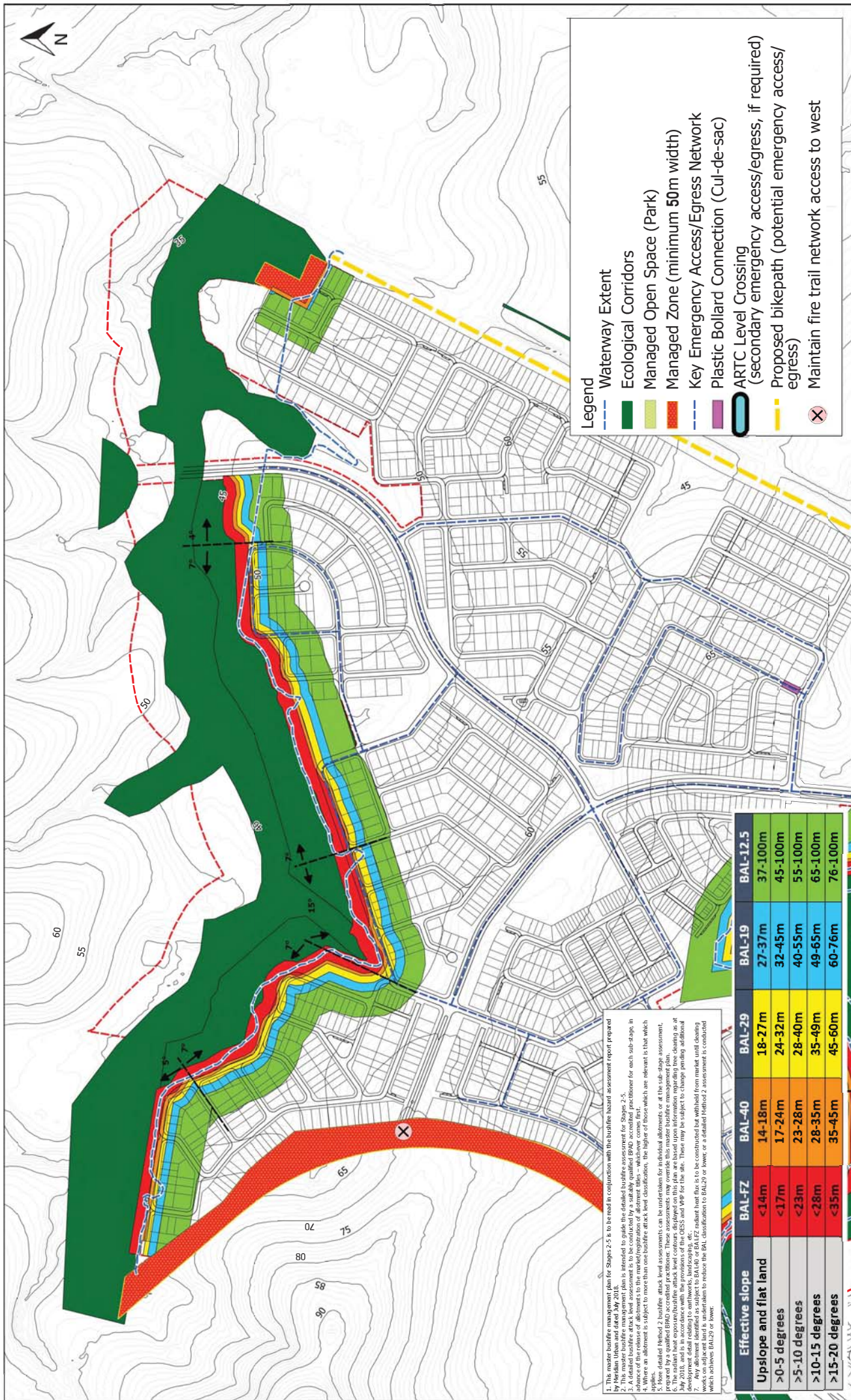


APPENDICES

Appendix A Proposal Plan

Refer current approved subdivision plan

Appendix B Stages 2-5 Master Bushfire Management Plan



- Legend**
- Waterway Extent
 - Ecological Corridors
 - Managed Open Space (Park)
 - Managed Zone (minimum 50m width)
 - Key Emergency Access/Egress Network
 - Plastic Bollard Connection (Cul-de-sac)
 - ARTC Level Crossing (secondary emergency access/egress, if required)
 - Proposed bikepath (potential emergency access/egress)
 - Maintain fire trail network access to west

1. This master bushfire management plan for Stages 2-5 is to be read in conjunction with the bushfire hazard assessment report prepared by Meridian Urban and dated July 2018.

2. It is intended to guide the detailed bushfire assessment for Stages 2-5.

3. A detailed bushfire attack level assessment is to be conducted by a suitably qualified BPAO accredited practitioner for each sub-stage, in advance of the release of allotments to the market (registration of allotment titles - whichever comes first).

4. Where an allotment is subject to more than one bushfire attack level classification, the higher of those which are relevant is that which is to be used.

5. From detailed Method 2 bushfire attack level assessments can be undertaken for individual allotments or at the sub-stage assessment, prepared by a qualified BPAO accredited practitioner. These assessments may override this master bushfire management plan.

6. The master bushfire management plan is to be updated in accordance with the provisions of the CSES and WPR for the site. These may be subject to change pending additional development detail relating to allotments, landscaping, etc.

7. The master bushfire management plan is to be constructed by a suitably qualified practitioner from Meridian Urban, ensuring works on different land is undertaken to reduce the BAL classification to BAL-29 or lower or a detailed Method 2 assessment is conducted which achieves BAL-29 or lower.

Effective slope	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL-12.5
Upslope and flat land	<14m	14-18m	18-27m	27-37m	37-100m
>0-5 degrees	<17m	17-24m	24-32m	32-45m	45-100m
>5-10 degrees	<23m	23-28m	28-40m	40-55m	55-100m
>10-15 degrees	<28m	28-35m	35-49m	49-65m	65-100m
>15-20 degrees	<35m	35-45m	45-60m	60-76m	76-100m

Radiant Heat (BAL Exposure) Contours

- 12.5 kW/m² Maximum
- 19 kW/m² Maximum
- 29 kW/m² Maximum
- 40 kW/m² Maximum
- Exclusion Zone

BUSHFIRE MANAGEMENT PLAN

PROJECT: Flagstone Stages 2-5		Scale: 1:3,000 @ A1		Sheet: 2 of 2	
LOCATION: New Bath Road		Drawing No: FLS2018E (1/area)		Revision:	
CLIENT:		Drawn: SRC		Surveyed:	
Rev:		Date		Corr. Interval: 10A	
Description		Drawn		Checked	
A		BAL V1		23/7/2018	
B		Flagstone BAL Stages 2-5 V2		23/7/2018	
C		Flagstone BAL Stages 2-5 V3		23/7/2018	

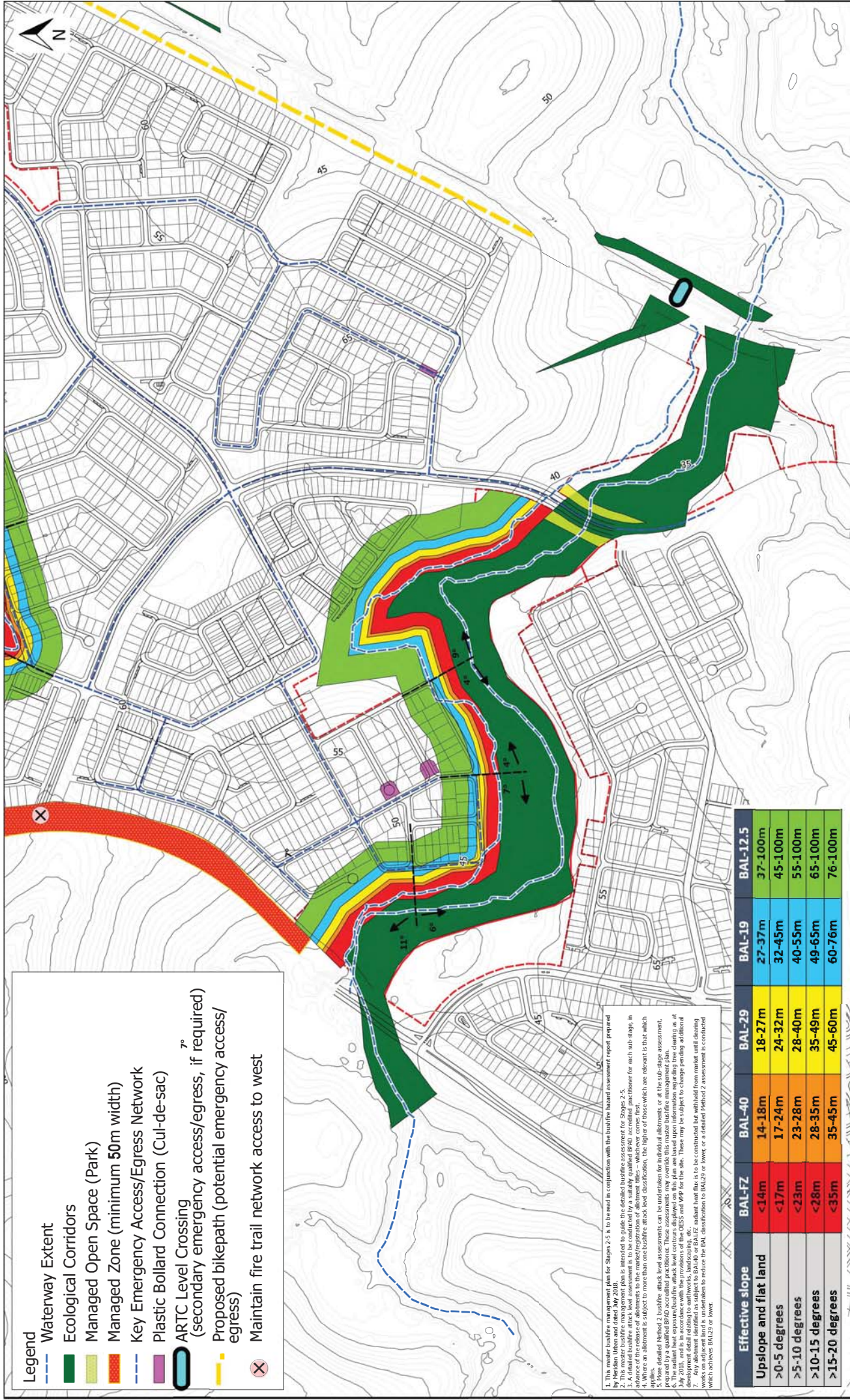


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Scale 1:3,000 - Lengths are in Meters

500 m

0 100 200 300 400 500 m



Radiant Heat (BAL Exposure) Contours									
12.5 kW/m² Maximum 19 kW/m² Maximum 29 kW/m² Maximum 40 kW/m² Maximum Exclusion Zone									
0 100 200 300 400 500 m									
Scale: 1:3,000 - Lengths are in Meters									
ORIGINAL SIZE A1									
BUSHFIRE MANAGEMENT PLAN									
PROJECT: Flagstone Stages 2-5									
LOCATION: New Blith Road									
CLIENT:									
Date:									
Drawn: SBC									
Checked: SBC									
Date: 20/07/2018									
Rev:									
Description:									
Horizontal Datum: N/A									
Vertical Datum: N/A									
Surveyed: N/A									
Contract Interval: N/A									
Local Authority: Logan City Council									
Sheet: 1 of 2									
Revision:									
Drawing no.: FLAGSTONE 1 (South)									
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