Travers

bushfire & ecology

bushfire protection assessment

Planning Proposal
(Modification 5 of the Masterplan)
Edmondson Park South

Lot 8 DP 1200987, Lot 135 DP 1209717,
Lot 215 DP 1186108, Lot 375 DP 1191360,
Lot 459 DP 1191361 & Part Lot 7 DP 1220978
Edmondson Park

Under Section 117(2) Direction No 4.4 of the *EP&A Act*

August 2018
(REF: 18LAND06)

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Edmondson Park

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Date:	15 August 2018
File:	18LAND06

Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person including the client then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be relied upon as meaning it reflects any advice by this firm. The report does not suggest or guarantee that a bush or grass fire will not occur and or impact the development. This report advises on matters published by the *NSW Rural Fire Service* in their guideline *Planning for Bush Fire Protection 2006* and other advice available from that organisation.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

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EXECUTIVE SUMMARY

A bushfire protection assessment was prepared by this firm for the Edmondson Park Town Centre in March 2018. This amended report has been prepared to address the amended Secretary's Environmental Assessment Requirements (SEAR's) which states:

'Provide an assessment of the proposed modification against the current version of Planning for Bush Fire Protection 2006, including the proposed location of, and ongoing management arrangements for Asset Protection Zones'.

The revised proposal includes a modification to the boundary of the concept plan as well as development modifications relating to floor area, school zone, road layout, dwelling yield and building height. The key changes are outlined in Section 1.2 of this report.

This report identifies matters for consideration for the planning proposal and highlights the required bushfire protection measures, including asset protection zones (APZs), for future development under the *Environmental Planning and Assessment Act 1979 (EP&A Act), Section 117 Direction 4.4 and* in accordance *Planning for Bush Fire Protection 2006* (*PBP*) and *Community Resilience Practice Note 2/12 Planning Instruments and Policies*.

The key principle for the proposal is to ensure that future development is capable of complying with *PBP*. Planning principles for the proposal include the provision of adequate access including perimeter roads, establishment of adequate APZs for future housing, specifying minimum lot depths to accommodate APZs and the introduction of controls which avoid placing inappropriate developments in hazardous areas and placement of combustible material in APZs.

The assessment found that bushfire can potentially affect the site from the woodland and forested wetland vegetation adjoining the site resulting in possible ember attack, radiant heat and potentially flame attack.

The bushfire risk posed to the planning proposal however can be mitigated if appropriate bushfire protection measures (including APZs) are put in place and managed in perpetuity.

The assessment has concluded that development on site has the capacity to provide compliance with the planning principles of *PBP*, *Community Resilience Practice Note 2/12 – Planning Instruments and Policies* and therefore comply with the SEARs.

GLOSSARY OF TERMS

AHIMS	Aboriginal Heritage Information System
APZ	Asset protection zone
AS1596	*Australian Standard – The storage and handling of LP Gas*
AS2419	*Australian Standard – Fire hydrant installations*
AS3745	*Australian Standard – Planning for emergencies in facilities*
AS3959	*Australian Standard – Construction of buildings in bushfire-prone areas 2009*
BAL	*Bushfire attack level*
BCA	*Building Code of Australia*
BSA	Bushfire safety authority
EEC	Endangered ecological community
FDI	Fire danger index
IPA	Inner protection area
LEP	*Local environmental plan*
OPA	Outer protection area
PBP	*Planning for bush fire protection 2006*
RFS	NSW Rural Fire Service
SEARs	Secretary's environmental assessment requirements
SFPP	Special fire protection purpose

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Introduction 1

Travers bushfire & ecology have been engaged by *Landcom* to undertake a revised bushfire protection assessment for the planning proposal to amend the current Edmondson Park South – Town Centre North Masterplan.

The proposal is located on land mapped by *Liverpool City Council* as being bushfire prone. *Direction 4.4, Planning for Bush Fire Protection 2006 (PBP)* identifies matters for consideration for planning proposals that will affect, or are in proximity to land mapped as bushfire prone.

As such, the proposal is subject to the requirements of Section 117(2) of *the Environmental Planning and Assessment Act 1979 (EP&A Act)* which requires Council to consult with the Commissioner of the NSW Rural Fire Service (RFS) and to take into account any comments by the Commissioner.

1.1 Aims of the assessment

The aims of the bushfire protection assessment are to:

- Address the requirements of the SEARs
- Review the bushfire threat to the landscape
- Undertake a bushfire attack assessment in accordance with *PBP*
- Provide advice on planning principles, including the provision of perimeter roads, asset protection zones (APZs) and other specific fire management issues
- Review the potential to carry out hazard management over the landscape, taking into consideration the proposed retention of trees within the final development plans.

1.2 Project synopsis

The key changes as part of the Modification 5 (application no: MP10_0118 MOD 5) as it relates to bushfire assessment, are as follows:

- Increase the residential yield within the Landcom Town Centre North site from what was previously proposed under MOD 5, from 2,235 dwellings to 3,286 dwellings (depending on the area of land required by Department of Education and Training (DET) for the school site);
- Proposed height increases across Landcom Town Centre North as follows:
    - Station Precinct (allowing heights up to 50m and heights of up to 67m for a landmark building);
    - Maxwells Precinct (allowing for heights up to 28m);
    - Parkland Precinct (allowing heights up to 21m); and
    - School Site (allowing heights up to 21m);
- Proposed residential mix at Landcom Town Centre North to primarily comprise of residential flat buildings, multi-dwelling housing and secondary dwellings, including studio dwellings (i.e. Fonzie flats) introducing a diverse housing mix and range of dwelling sizes; and

- A revised road layout (to be confirmed after consultation with relevant stakeholders).

Based on the proposed modification to the concept plan (refer Figure 1.1 & 1.2) bushfire constraints have been highlighted and minimum APZs have been recommended. Recommendations have also been made for future road design, building construction, water supply and utilities.

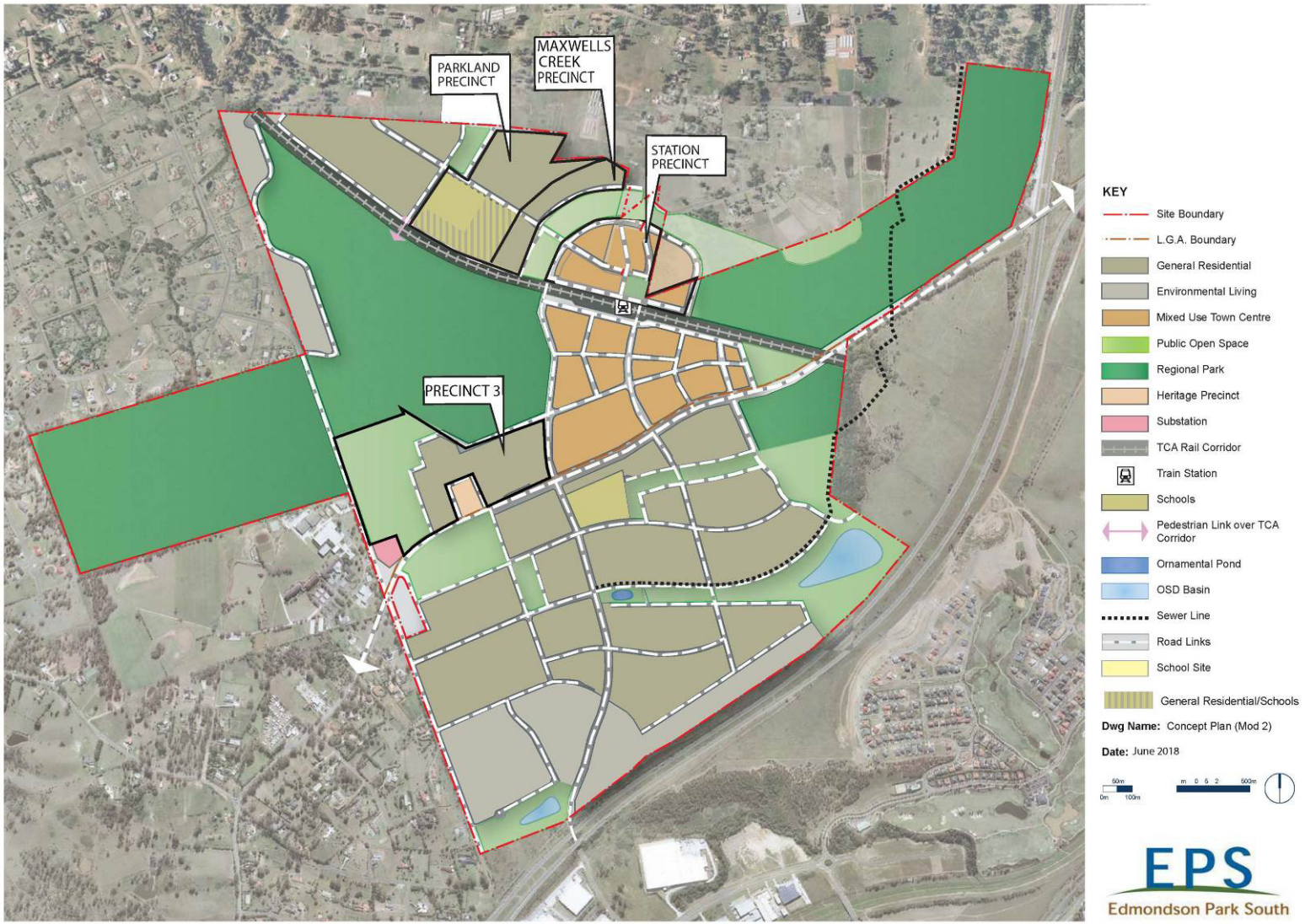


Figure 1.1 – Proposed modification to concept plan

Figure 1.2 – Proposed town centre north masterplan

1.3 Information collation

To achieve the aims of this report, a review of the information relevant to the property was undertaken. Information sources reviewed include the following:

- Edmondson Park Town Centre North - Masterplan prepared by Roberts Day, dated July 2018
- Amended Secretary's Environmental Assessment Requirements (Application no: MP10_0118 MOD 5), dated 6 July 2018
- Liverpool Local Environmental Policy (LLEP) 2008
- State Environmental Planning Policy (State Significant Precincts) 2005
- Edmondson Park South Development Control Plan (DCP), 2012
- *Google* aerial photography
- Topographical maps *DLPI of NSW* 1:25,000
- *Australian Standard 3959 Construction of buildings in bushfire-prone areas*
- *Planning for Bush Fire Protection 2006 (PBP)*
- *Community Resilience Practice Notes 2/12 Planning Instruments and Policies.*

An inspection of the proposed development site and surrounds was undertaken by Nicole van Dorst Travers on 13 September 2017 to assess the topography, slopes, aspect, drainage, vegetation and adjoining land use. The identification of existing bushfire measures and a visual appraisal of bushfire hazard and risk were also undertaken.

1.4 Site description

The proposed development forms part of the larger Edmondson Park Release Area within the South West Growth Centre of the Liverpool local government area (LGA). It is located to the north-west of Edmondson Park railway station and situated approximately 40km to the south west of Sydney CBD.

The site is bound by Edmondson Park Railway to the south and to the north and west by residential development (refer Figure 1.3). Maxwell's Creek North Riparian Park is located within the centre of the site with conservation areas Maxwell Creek South located to the east and Ingleburn Conservation area located beyond the railway line to the south-west.

Figure 1.3 – Aerial appraisal

1.5 Legislation and planning instruments

1.5.1 Environmental Planning and Assessment Act 1979 (EP&A Act) and bushfire prone land

The *EP&A Act* governs environmental and land use planning and assessment within New South Wales. It provides for the establishment of environmental planning instruments, development controls and the operation of construction controls through the *Building Code of Australia (BCA).* The identification of bushfire prone land is required under Section 146 of the *EP&A Act*.

Bushfire prone land maps provide a trigger for the development assessment provisions. Although only a portion of the property is mapped by *Liverpool City Council* as being bushfire prone (refer Figure 1.4) Maxwell Creek Reserve within the centre of the site and Ingleburn Conservation Area to the south-west also pose a bushfire risk to the site.

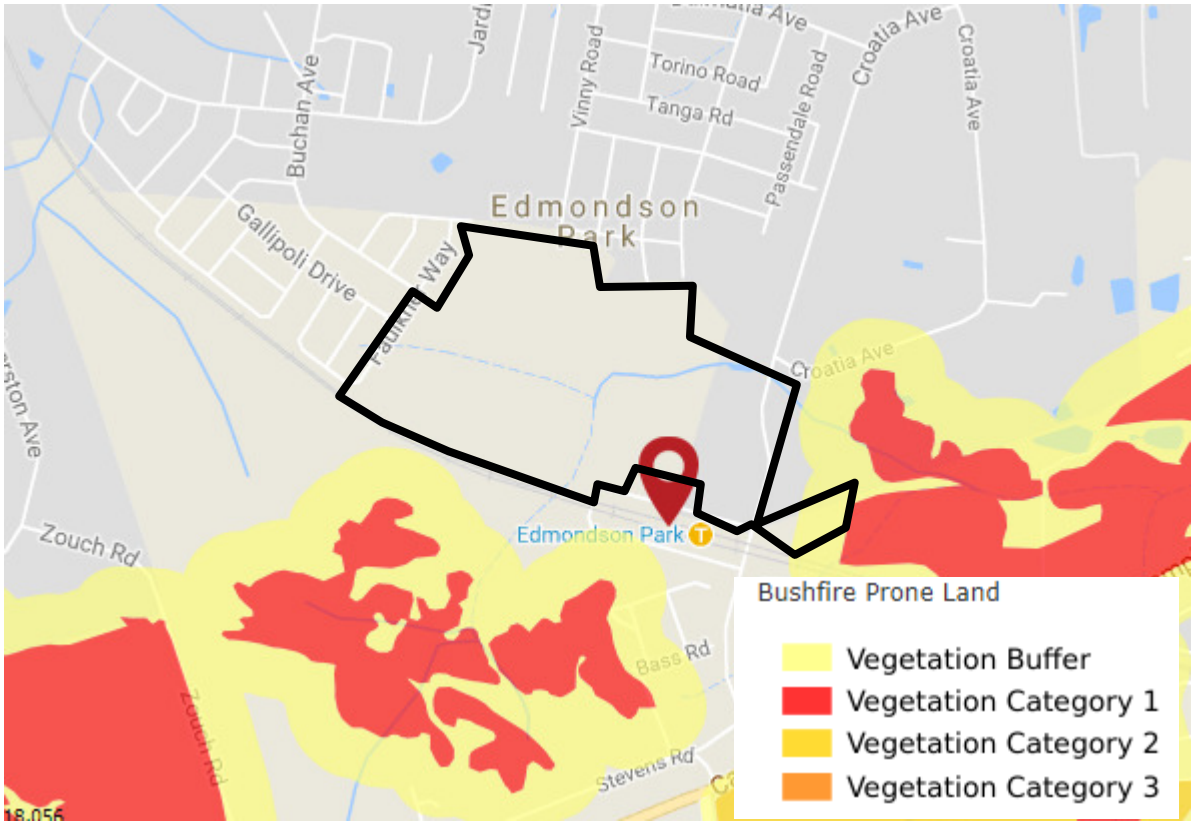


Figure 1.4 – Bushfire prone land map
(Source: Liverpool City Council)

PBP (pg 4) stipulates that if a proposed amendment to land use zoning or land use affects a designated bushfire prone area then the Section 117(2) Direction No 4.4 of the *EP&A Act* must be applied. This requires Council to consult with the Commissioner of the RFS and to take into account any comments by the Commissioner and to have regard to the planning principles of *PBP* (detailed within Section 1.5.3).

1.5.2 State Environmental Planning Policy (State Significant Precincts) 2005

A SEPP provides for a range of zonings which list development that is permissible or not permissible, as well as the objectives for development within a zone.

The site is zoned under the current *SEPP (2005)* as RE1 –Public Recreation, R1 – General Residential and B4 – Mixed Use (refer Figure 1.5). The proposed planning amendment, to restrict residential flat buildings and allow for the subdivision of studio dwellings is depicted within Figure 1.6.

Figure 1.5 – Current SEPP (2005) zoning

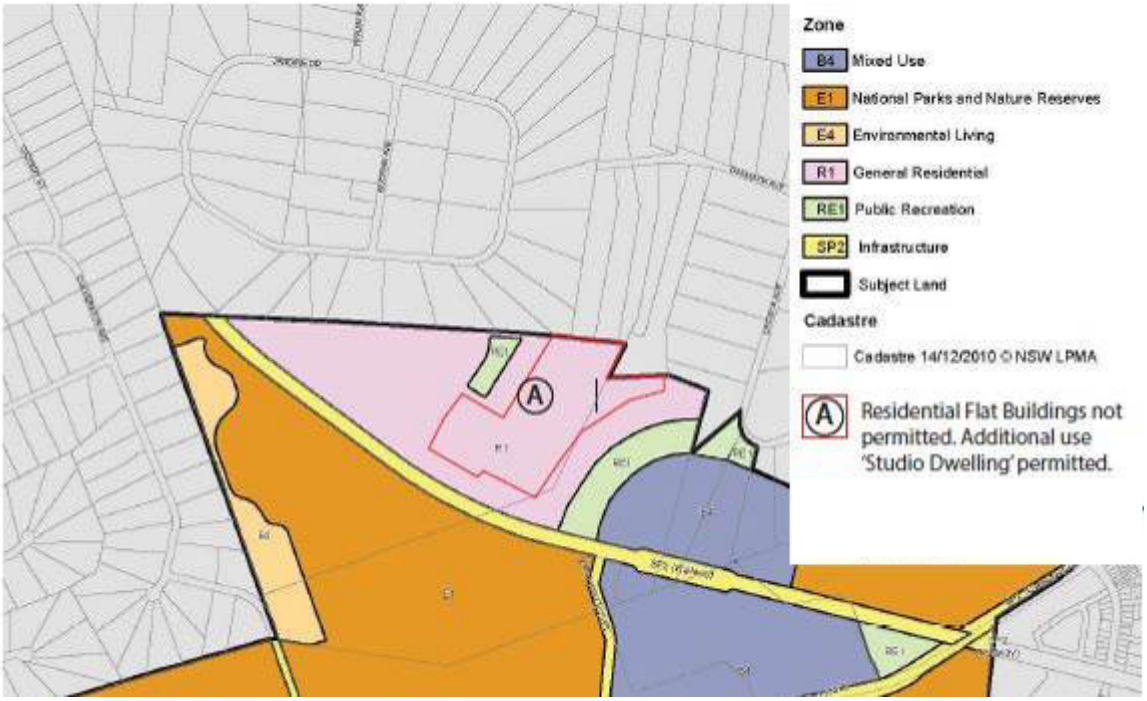


Figure 1.6 – Proposed planning amendment

The proposal, including the provision of APZs, would seek to comply with the objectives of the zoning.

1.5.3 Planning for Bush Fire Protection 2006 (PBP)

Bushfire protection planning requires the consideration of the RFS planning document entitled *PBP. PBP* provides planning principles for residential land as well as guidance on effective bushfire protection measures.

The policy aims to provide for the protection of human life (including fire fighters) and to minimise impacts on property and the environment from the threat of bushfire, while having due regard to development potential, on site amenity and protection of the environment.

PBP outlines the following planning principles that must be achieved for all planning proposals:

1. Provision of a perimeter road with two way access which delineates the extent of the intended development.

2. Provision, at the urban interface, for the establishment of adequate APZs for future housing.

3. Specifying minimum residential lot depths to accommodate APZs for lots on perimeter roads.

4. Minimising the perimeter of the area of land interfacing the hazard, which may be developed.
5. Introduction of controls which avoid placing inappropriate developments in hazardous areas, and

6. Introduction of controls on the placement of combustible materials in APZs.

In addition to the above, *PBP* outlines the bushfire protection measures required to be assessed for new development in bushfire prone areas.

The planning proposal has been assessed in compliance with the following measures to ensure that future development is capable of complying with *PBP*:

- asset protection zones
- building construction and design
- access arrangements
- water supply and utilities
- landscaping
- emergency arrangements

1.5.4 Draft Planning for Bush Fire Protection 2017 (PBP)

The draft PBP (2017) was placed on public exhibition between 15th May 2017 and 14th July 2017 and is currently with the NSW RFS to review submissions and make any required amendments before it is approved and released. It has been anticipated that the release of final publication will be this year.

There will be transition period before the new version of PBP takes effect in legislation. This transition period has not been confirmed, however all development applications which are lodged following the date at which the legislation takes effect will be determined under the new document.

The main changes within the draft document are summarised below, with details of the changes and the impacts on the proposed development site provided under the following headings, asset protection zones, construction standards, access, water and gas supply.

- introduction of grassland hazard and requirements for APZ determination

- amended fuel loadings for vegetation communities which will result in changes to APZ setbacks
- simplified access requirements
- greater emphasis on strategic planning, which considers state, regional and local level plan

1.5.5 Building Code of Australia (BCA) and the Australian Standard AS3959 Construction in bushfire-prone areas 2009 (AS3959)

The *BCA* is given effect through the *EP&A Act* and forms part of the regulatory environment of construction standards and building controls. The *BCA* outlines objectives, functional statements, performance requirements and deemed to satisfy provisions. For residential dwellings these include Classes 1, 2 and 3 buildings. The construction manual for the deemed to satisfy requirements is *AS3959.*

Although consideration of *AS3959* is not specifically required in a planning proposal, this report (Section 3.2) provides the indicative setbacks for each dwelling construction level and can be used in future planning for master plans and / or subdivision proposals.

1.6 Environmental and cultural constraints

1.6.1 Environmental constraints

Ecological Australia have undertaken previous studies and have identified the following ecological features:

The presence of two (2) endangered ecological communities:

- Cumberland Plan Woodland (Coastal Valley Grassy Woodland)
- Alluvial Woodland (Coastal Floodplain Wetland)

Presence of the five (5) threatened fauna species:

- Cumberland Plain Land Snail *(Meridolum corneovirens)*
- Eastern Bentwing-bat *(Miniopterus schreibersii oceanensis)*
- Eastern False Pipistrelle *(Falsistrellus tasmaniensis)*
- Eastern Freetail-bat *(Mormopterus norfolkensis)*
- Greater Broad-nosed Bat *(Scoteanax rueppellii)*

1.6.2 Cultural constraints

A review of the Edmondson Park South Development Control Plan has revealed that the site supports five (5) heritage artefacts (refer to Figure 1.7).

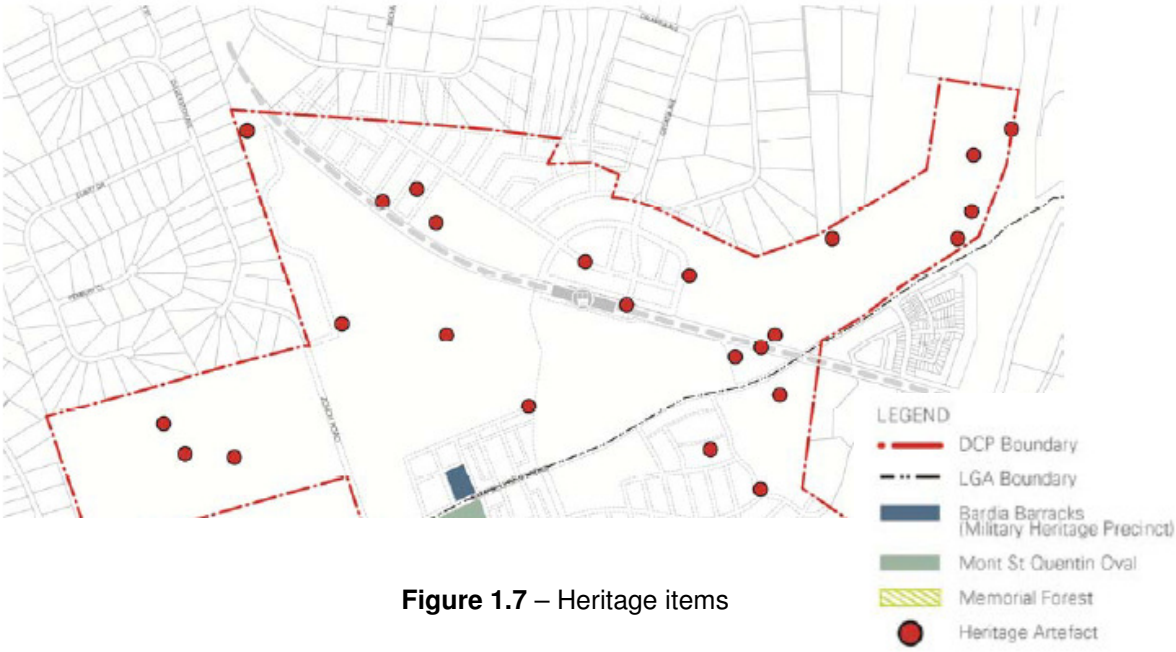


Figure 1.7 – Heritage items

Bushfire Threat Assessment 2

To assess the bushfire threat and to determine the required width of an APZ for a development, a review of the elements that comprise the overall threat needs to be completed.

PBP provides a methodology to determine the size of any APZ that may be required to offset possible bushfire attack. These elements include the potential hazardous landscape that may affect the site and the effective slope within that hazardous vegetation.

2.1 Hazardous fuels

PBP guidelines require the identification of the predominant vegetation formation in accordance with David Keith (2004) to determine APZ distances for residential developments. However, when determining construction standards in accordance with *AS3959,* AUSLIG Pictorial Analysis is used to determine the vegetation and hence APZ setbacks and building construction standards (refer Section 3.2 of this report).

The hazardous vegetation is calculated for a distance of at least 140m from a proposed site boundary and can be summarised as:

- Woodland vegetation (Coastal Valley Grassy Woodland) located beyond Croatia Avenue (within Maxwell Creek South Conservation Area) to the east as well as internally from Maxwells Creek North Riparian Park.

- Woodland vegetation (Coastal Valley Grassy Woodland) located beyond the railway line to the south, within Ingleburn Conservation Area.

- Forested wetland vegetation (Coastal Floodplain Wetland) within small sections of Maxwells Creek North Riparian Park.

- Unmanaged grassland vegetation to the north as well as to the east of Croatia Avenue. Please note that *AS3959* states that managed grassland in a minimal fuel condition is regarded as low threat vegetation. Managed grass does not require APZ or BAL construction standards. Minimal fuel condition is recognised as short-cropped grass (i.e. nominal height of 100mm). It is recommended that the future use and management of the land to the east should be explored at development application stage to determine if APZs are required.

  It is noted that the land to the north of the Town Centre North site is now largely developed or under construction. Unmanaged grassland will not be a long term hazard and is unlikely to be retained or remain at the time of construction / development of this site.

The following photographs depict the hazardous vegetation surrounding the site:

Photo 1 – Woodland vegetation to the east beyond Croatia Avenue

Photo 2 – Woodland vegetation within Maxwells Creek North Riparian Park.

Photo 3 – Unmanaged grassland to the north

The remaining land within 140 metres of the development is managed and does not pose a bushfire threat to the site.

Remnant woodland vegetation (0.54ha in size) is located within Clermont Park (in the north-west). The approved landscape plan for this park is provided below and includes playgrounds, shade structures, pavement surfaces and kick around areas, with the bushland area confined to the central portion of the park. Clermont Park is currently under construction and due for completion in late 2018.

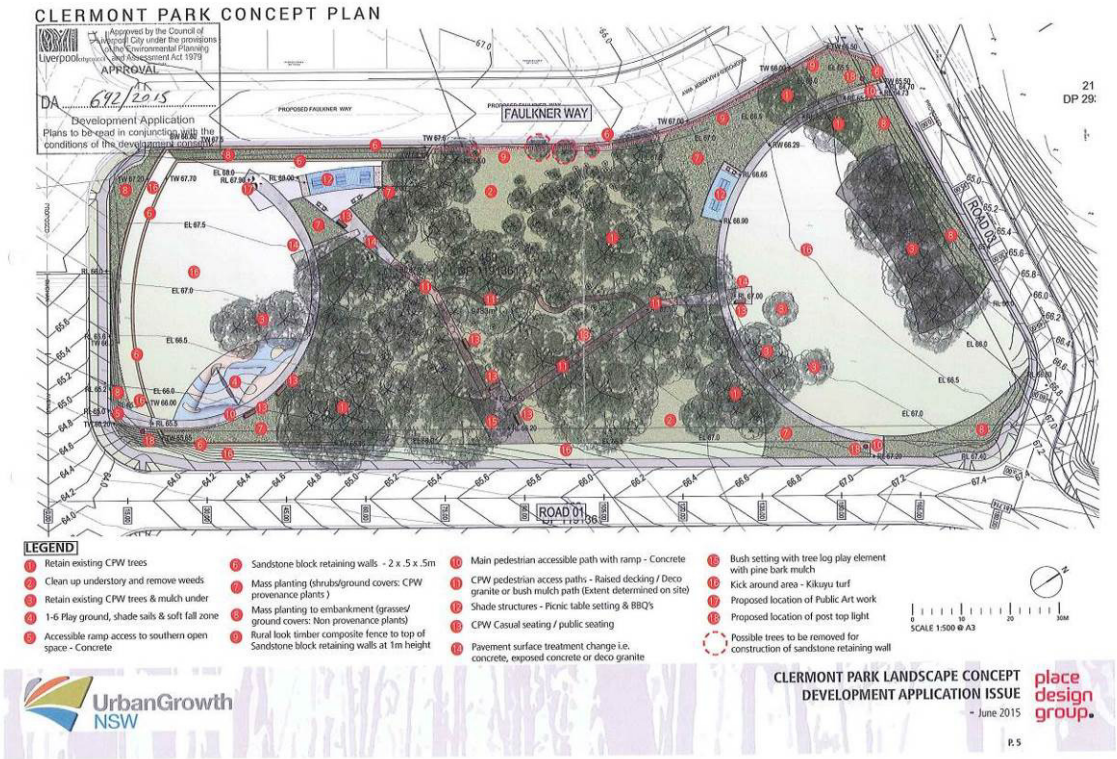


Figure 2.1 – Clermont Park Landscape Plan

The vegetation within the park is less than 1ha in size and is separated from the development via proposed perimeter roads. This vegetation is excluded from being classified within AS3959 (2009) as it is not within 100m of other areas of vegetation. As a result BAL levels may not apply to dwellings adjacent to Clermont Park.

However in accordance with the *NSW RFS Fast Fact 03/16 – Remnant Vegetation* an appropriate APZ is required in compliance with *Planning for Bushfire Protection 2006* for development assessment purposes.

2.2 Effective slope

The effective slope is determined by reviewing the slopes within 100m of the development boundary. Effective slope refers to that slope which provides the most effect upon likely fire behaviour. A mean average slope may not in all cases provide sufficient information such that an appropriate assessment can be determined.

The effective slope within the hazardous vegetation is:

- 2^{0D} slope within the woodland beyond the Station Precinct to the east
- 1-1.5^{0D} within the grassland to the east of Croatia Avenue
- Level within the forested wetland associated with the eastern portion of Maxwells Creek North Riparian Park.
- 2-3^{0D} within the woodland associated with the central and southern portion of Maxwells Creek North Riparian Park
- Level to upslope within the woodland beyond the railway line to the south
- Level to upslope within Clemont Park to the west.

2.3 Bushfire attack assessment

It is important that the developer understands that there are different methods in determining APZ and BAL levels to ensure that there is a clear understanding of the implications for future dwelling construction (i.e. costs and processes associated with dwelling approval).

Subdivision Approval – PBP 2006 Appendix 2 is used to determine APZ distances to achieve approval for subdivision development applications. This approach does not conform to the construction code AS3959 *Construction of buildings in bushfire prone areas* in all cases and therefore can pose significant implications for future dwelling approval.

In order to avoid potential future complications the assessment in the following Table 2.1 has been undertaken using a deemed to satisfy and alternate solution approach which provides the following two (2) different results in terms of APZ and BAL level outcomes. Either of these methods can be used to achieve dwelling approval following subdivision.

- ***Deemed to satisfy approach*** (DS) – The deemed to satisfy approach is undertaken in compliance with AS3959 and is used by future lots owners to obtain approval for a construction certificate under complying development.

  The assessment uses Method 1 Table 2.4.2 of AS3959. This will allow future purchasers of each allotment to submit their application for building construction in accordance with the Code's SEPP (i.e. complying development). This is a simplified process and results in a cheaper bushfire assessment at building construction stage (refer Column 7 of Table 2.1). However it is often not the cheapest approach as BAL levels can be higher.

- ***Alternate solution approach*** (AS) – The alternative solution approach is undertaken in compliance with AS3959 Appendix B Method 2 to obtain an accurate BAL rating approval using reduced fuel loads and accurate slopes.

  This method maximises the developable area and can provide future lots owners with the best way to achieve cheaper building construction costs. However future purchasers will be required to lodge their dwelling application under Section 79BA of the *EP&A Act,* which will require a further bushfire protection assessment report (i.e. increased cost for report) to support the lower BAL level. Referral of the report to the RFS is also required from when using an alternative solution.

Please note that the APZs (based on a BAL 29 construction) depicted in Schedule 1 attached are based on an alternative solution approach as detailed in Column 6 (Table 2.1).

A fire danger index (FDI) of 100 has been used to calculate bushfire behaviour on the site based on its location within the Greater Sydney region. Table 2.1 provides a summary of the bushfire attack assessment using each of the above methods.

Table 2.1 – Bushfire attack assessment

Aspect	Vegetation formation within 140m of development (refer Note 1)	Effective slope of land	Minimum APZ required (alternative solution approach)	APZ provided	Building construction standards (Alternative solution approach) (refer Note 2)	Building construction standards (Deemed to satisfy approach) (refer Note 3)
North	Managed land	N/A	N/A	>100	N/A	N/A
	Grassland (north-east of Maxwells Creek Precinct	Level / upslope	N/A	9m required (refer Note 4)	N/A	BAL 19 (9 - <13) BAL 19 (13 - <19) BAL 12.5 (19-<50)
	Forested wetland (AS - 15/20t) (DS - 25/35t for forest)	3^{0D}	19	30-37	BAL 19 (30 - <37) BAL 12.5 (37-<100)	BAL 40 (24-<32) BAL 29 (32-<43) BAL 19 (43 - <57) BAL 12.5 (57-<100)
	Grassland (north of Station Precinct)	1.5^{0D}	10	10	BAL 29 (10-<14) BAL 19 (14 - <20) BAL 12.5 (20-<50)	BAL 29 (10-<15) BAL 19 (15 - <22) BAL 12.5 (22-<50)
East	Grassland	1^{0D}	9	9m required (refer Note 4)	BAL 29 (9-<14) BAL 19 (14 - <20) BAL 12.5 (20-<50)	BAL 40 (7-<10) BAL 29 (10-<15) BAL 19 (15 - <22) BAL 12.5 (22-<50)
	Woodland (east of Station Precinct)	2^{0D}	19	30	BAL 29 (19-<27) BAL 19 (27 - <37) BAL 12.5 (37-<100)	BAL 19 (29 - <41) BAL 12.5 (41-<100)
Central (Maxwells Creek North)	Woodland	$2\text{-}3^{0D}$	20	20-30	BAL 29 (20-<28) BAL 19 (28 - <38) BAL 12.5 (38-<100)	BAL 29 (21-<29) BAL 19 (29 - <41) BAL 12.5 (41-<100)
South	Woodland	Level / upslope	N/A	60 (includes railway)	N/A	BAL 12.5 (33-<100)
West	Managed land	N/A	N/A	>100	N/A	N/A
	Remnant forest (Clermont Park)	Level to upslope	N/A	24	N/A	N/A

Aspect	Vegetation formation within 140m of development (refer Note 1)	Effective slope of land	Minimum APZ required (alternative solution approach)	APZ provided	Building construction standards (Alternative solution approach) (refer Note 2)	Building construction standards (Deemed to satisfy approach) (refer Note 3)
Proposed school site						
North, east and west	Managed land	N/A	N/A	>100	N/A	N/A
South	Woodland	Level to upslope	N/A	>100	N/A	N/A

*Notes: * Slope is either 'U' meaning up slope or 'C' meaning cross slope or 'D' meaning down slope*

Note 1: Fuel loads utilised for each method is provided in brackets. AS – Alternate solution, DS – Deemed to satisfy.

Note 2: A performance based assessment using Appendix B of *AS3959* was undertaken to determine the required BAL level based on accurate slope calculations as well as PBP fuel loads for 'forested wetland' vegetation. The results of the assessment, provided within Appendix 2, were prepared using the bushfire attack assessor (BFAA) developed by *Newcastle Bushfire Consulting*

It is worth noting that the Draft PBP 2017 document provides varying fuel loads for vegetation communities. The draft document identifies Coastal Valley Grassy Woodland as having a fuel load of 10/18.07 and Coastal Floodplain Wetland as having a fuel load of 8.2/15.1. Whilst the Draft PBP cannot be used for current development applications, the fuel loadings for woodland and forested wetland in that document are significantly less than those used in AS3959 therefore future applications for dwelling construction may result in a lesser BAL rating once the Draft PBP is adopted.

Note 3: Under clauses 3.36B and 3A.37 of the Codes SEPP the construction of dwellings on some bush fire prone land may be considered as complying development. For complying development to occur on future allotments, the land must be certified as being below a BAL 29 risk rating and be provided a minimum setback as outlined in Column 6. A BAL Certificate must be obtained from the council or a person who is recognised by the RFS as a suitably qualified consultant in bush fire risk assessment prior to lodging an application for a CDC. Buildings assessed as BAL 40 or BAL FZ are not considered complying and must lodge their application under section 79BA and a full bushfire protection assessment must be prepared for submission to NSW RFS.

BAL levels are indicative only and should be reassessed at building construction stage. BAL levels may not apply once the adjoining land is developed and the hazard is removed.

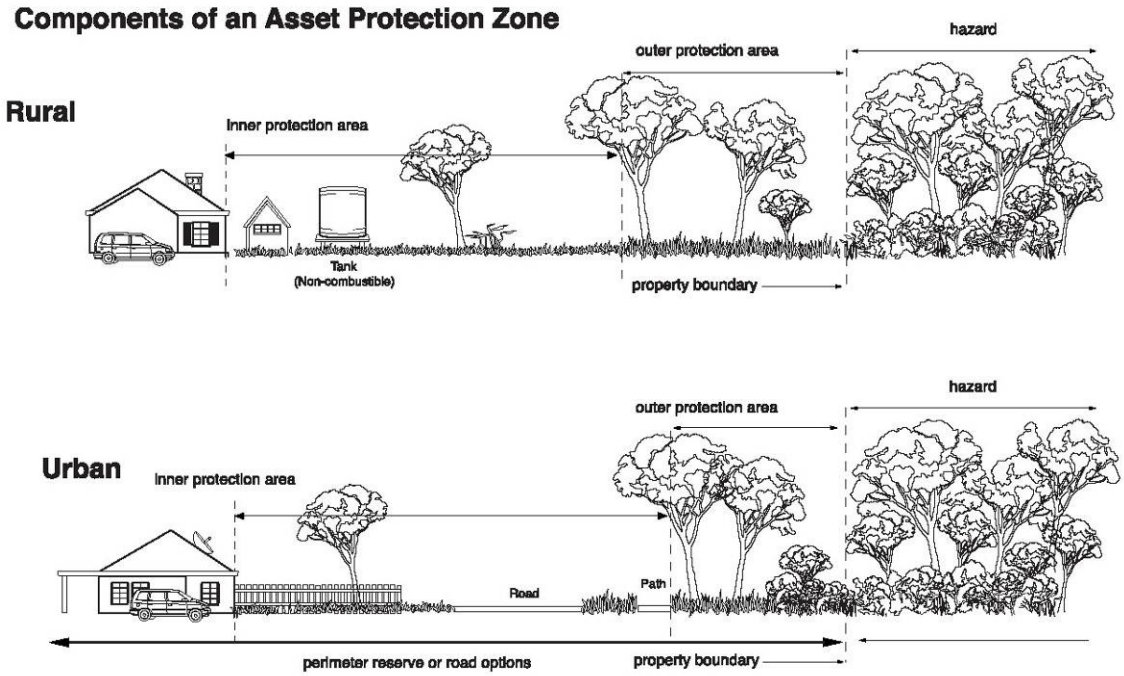
Note 4: The current masterplan does not provide for the minimum APZ's required adjacent to unmanaged grassland areas. It is recommended that these areas are assessed further prior to DA and dwelling construction approval. Unmanaged grassland will not be a long term hazard and is unlikely to be retained or remain at the time of construction / development of this site. For example there is a current DA being assessed by Council for the development of the adjoining land to the north. Once approved the grassland will be cleared for the construction of apartment buildings.

Specific Protection Issues

3

3.1 Asset protection zones (APZs)

APZs are areas of defendable space separating hazardous vegetation from buildings. The APZ generally consists of two subordinate areas, an inner protection area (IPA) and an outer protection area (OPA). The OPA is closest to the bush and the IPA is closest to the dwellings. The IPA cannot be used for habitable dwellings but can be used for all external non-habitable structures such as pools, sheds, non-attached garages, cabanas, etc. A typical APZ and therefore defendable space is graphically represented below:



APZs and progressive reduction in fuel loads (Source: RFS, 2006)

Note: Vegetation management as shown is for illustrative purposes only. Specific advice is to be sought in regard to vegetation removal and retention from a qualified and experienced expert to ensure APZs comply with the *RFS* performance criteria.

PBP dictates that the subsequent extent of bushfire attack that can potentially emanate from a bushfire must not exceed a radiant heat flux of 29*kW/m*^{2} for residential developments and 10kW/m^2 for special fire protection purpose developments (i.e. school). This rating assists in determining the size of the APZ in compliance with *PBP* to provide the necessary defendable space between hazardous vegetation and a building. Table 3.1 & 3.2 outlines the proposals compliance with the performance criteria for APZs for both residential development and SFPP (proposed school).

Table 3.1 – Performance criteria for asset protection zones (*residential development*)

Performance criteria	Acceptable solutions	Statement of compliance with acceptable solutions.
Radiant heat levels at any point on a proposed building will not exceed 29kW/m^2.	APZs are provided in accordance with Appendix 2. APZs are wholly within the boundary of the development site.	Complies for the most - refer Table 2.1. Minimum asset protection zones will be required adjacent to grassland areas. This may involve a redesign of the concept plan or alternatively liaison with the adjoining landholder may be required to seek an 88B easement agreement. This agreement will allow for the implementation of APZ's on adjoining land.
APZs are managed and maintained to prevent the spread of fire towards the building.	In accordance with the requirements of *Standards for Asset Protection Zones* (*NSW RFS* 2005).	Complies - to be made a condition of consent.
APZ maintenance is practical , soil stability is not compromised and the potential for crown fires is negated.	The APZ is located on lands with a slope of less than 18^o.	Complies - Slopes are less than 18^o.

Table 3.2 – Performance criteria for asset protection zones (*SFPP – School site*)

Performance criteria	Acceptable solutions	Statement of compliance with acceptable solutions.
Radiant heat levels of greater than 10kW/m^2 will not be experience by occupants or emergency services workers entering or exiting a building.	An APZ is provided in accordance with the relevant tables and figures in Appendix 2 of *PBP.* Exits are located away from the hazard side of the building. The APZ is wholly within the boundaries of the development.	Complies.
Applicant demonstrates that issues relating to slope are addressed: maintenance is practical, soil stability is not compromised and the potential for crown fire is negated.	Mechanisms are in place to provide for the maintenance of the APZ over the life of the development. The APZ is not located on land with a slope exceeding 18^o.	Complies - to be made a condition of consent.
APZs are managed and maintained to prevent the spread of a fire towards the building.	In accordance with the requirements of *Standards for Asset Protection Zones* (*RFS* 2005).	Complies - to be made a condition of consent.

The Draft PBP 2017 document provides varying fuel loads for vegetation communities. The draft document identifies Coastal Valley Grassy Woodland as having a fuel load of 10/18.07

and Coastal Floodplain Wetland as having a fuel load of 8.2/15.1. These fuel loadings are less than that used in AS3959 and Appendix 2 of PBP and therefore minimum APZ distances are reduced under the draft document.

3.2 Building protection

The construction of buildings in bushfire prone areas is subject to stringent rules pertinent to the building envelope being located on the non-hazardous side of the APZ. The role of the APZ is to provide a safe space to separate the hazard from the building.

In terms of future subdivision approval, the minimum APZ must be provided in accordance with Appendix 2 of *PBP.* The APZs provided in Table 2.1 (Section 2.3) of this report comply with these requirements, whilst also considering the final building setbacks as per *AS3959*.

Although not required in terms of the planning proposal, Table 2.1 and Schedule 1 attached provide advice in relation to building construction levels and can be used for future planning and subdivision design.

3.3 Hazard management

In terms of implementing and / or maintaining APZs, there is no physical reason that would constrain hazard management from being successfully carried out by normal means (e.g. mowing / slashing).

The APZs are to be managed in accordance with the RFS guidelines *Standards for Asset Protection Zones (RFS, 2005),* with landscaping to comply with Appendix 5 of *PBP* and include perimeter roads and dwelling setbacks.

A summary of the guidelines for managing APZs is attached as Appendix 1 to this report.

3.4 Access for fire fighting operations

Future access within the site will be provided via a road network as illustrated in Figure 3.1.

Table 3.3 outlines the performance criteria and acceptable solutions for future public roads. Perimeter roads have been provided adjacent to Maxwells Creek North and Maxwells Creek South and should have a minimum carriageway width of 8m. All other roads are to have a carriageway width of 6.5m.

It is noted that the Draft PBP 2017 maintains the recommendation for 8m wide perimeter roads, however allows for a reduction of road widths to 5.5m for other internal roads (excluding parking).

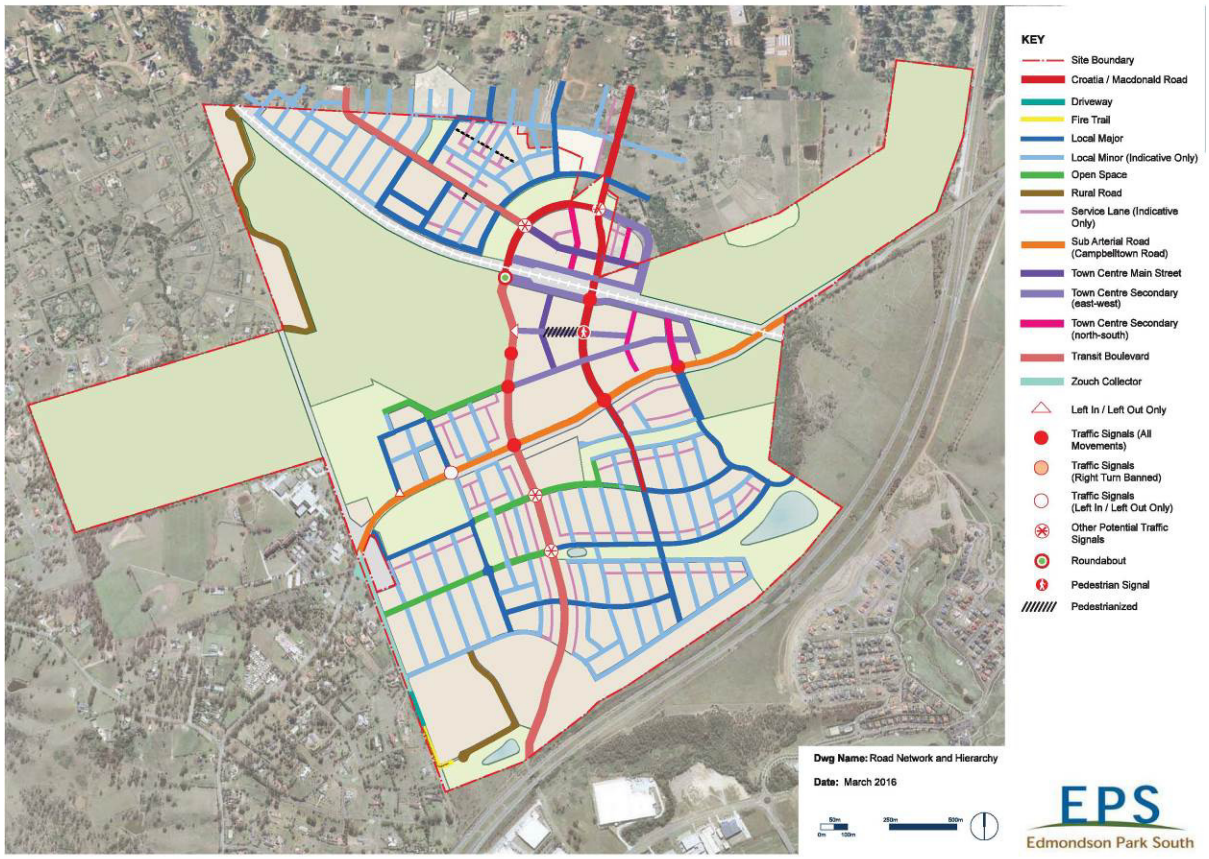


Figure 3.1 – Proposed road layout

Table 3.3 – Performance criteria for public roads (*PBP* guidelines pg. 20)

Performance criteria	Acceptable solutions
Fire fighters are provided with safe all weather access to structures (thus allowing more efficient use of fire fighting resources).	Public roads are two-wheel drive, all weather roads.
Public road widths and design that allow safe access for fire fighters while residents are evacuating an area.	Urban perimeter roads are two way, that is, at least two traffic lane widths (carriageway 8m minimum kerb to kerb) allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 3.4 below. Perimeter road is linked with the internal road system at an interval of no greater than 500m in urban areas. Traffic management devices are constructed to facilitate access by emergency services. Public roads have a cross fall not exceeding 3°. All roads are through roads. If unavoidable, dead end roads are not more than 200m in length, incorporate a minimum 12m outer radius turning circle, sign posted dead end and direct traffic away from the hazard.

Performance criteria	Acceptable solutions
	Curves of roads (other than perimeter) have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress. The minimum distance between inner and outer curves is 6m. Maximum grades for sealed roads do not exceed 15^{o} and an average grade of not more than 10^{o}. Minimum vertical clearance of 4m above the road at all times.
The capacity of road surfaces and bridges is sufficient to carry fully loaded fire fighting vehicles	The capacity of road surfaces and bridges is sufficient to carry fully loaded fire fighting vehicles (15 tonnes for reticulated water and 28 tonnes for all other areas). Bridges clearly indicate load rating.
Roads that are clearly sign posted (with easily distinguishable names) and buildings / properties that are clearly numbered.	Public roads >6.5m wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water. Public roads 6.5-8m wide are No Parking on one side with the hydrant located on this side to ensure accessibility to reticulated water. Public roads <6.5m wide provide parking within parking bays and locate services outside of parking bays to ensure accessibility to reticulated water. One way only public access are no less than 3.5m wide and provide parking within parking bays and locate services outside of parking bays to ensure accessibility to reticulated water.
There is clear access to reticulated water supply. Parking does not obstruct the minimum paved width	Parking bays are a minimum of 2.6m wide from kerb edge to road pavement. No services or hydrants are located within parking bays. Public roads directly interfacing the bushfire hazard are to provide roll top kerbing to the hazard side of the road.

Table 3.4 – Minimum widths for public roads that are not perimeter roads

Curve radius (inside edge) (metres width)	Swept path (metres width)	Single lane (metres width)	Two way (metres width)
<40	3.5	4.5	8.0
40-69	3.0	3.9	7.5
70-100	2.7	3.6	6.9
>100	2.5	3.5	6.5

3.5 Water supplies

Town reticulated water supply is available to the property in the form of an underground reticulated water system.

Table 3.5 outlines the performance criteria and acceptable solutions for reticulated water supply.

Table 3.5 – Performance criteria for reticulated water supplies (*PBP* guidelines pg. 27)

Performance criteria	Acceptable solutions
Water supplies are easily accessible and located at regular intervals.	Reticulated water supply to urban subdivision uses a ring main system for areas with perimeter roads. Fire hydrant spacing, sizing and pressures comply with AS2419.1 - 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles. Hydrants are not placed within any road carriageway. All above ground water and gas pipes external to the building are metal, including and up to taps. The provisions of parking on public roads are met.

3.6 Gas

Table 3.6 outlines the required performance criteria for the gas supply.

Table 3.6 – Performance criteria for gas supplies (*PBP* guidelines pg. 27)

Performance criteria	Acceptable solutions
Location of gas services will not lead to the ignition of surrounding bushland land or the fabric of buildings	Reticulated or bottled gas bottles are to be installed and maintained in accordance with AS1596 (2002) and the requirements of relevant authorities. Metal piping is to be used. All fixed gas cylinders are to be kept clear of flammable materials to a distance of 10m and shielded on the hazard side of the installation. If gas cylinders are to be kept close to the building the release valves must be directed away from the building and at least 2m away from any combustible material, so that they do not act as a catalyst to combustion. Connections to and from gas cylinders are metal. Polymer sheathed flexible gas supply lines to gas meters adjacent to buildings are not to be used.

3.7 Electricity

Table 3.7 outlines the required performance criteria for electricity supply.

Table 3.7 – Performance criteria for electricity services (*PBP* guidelines pg. 27)

Performance criteria	Acceptable solutions
Location of electricity services limit the possibility of ignition of surrounding bushland or the fabric of buildings Regular inspection of lines in undertaken to ensure they are not fouled by branches.	Where practicable, electrical transmission lines are underground Where overhead electrical transmission lines are proposed: • Lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas: and • No part of a tree is closer to a power line than the distance set out in accordance with the specification in *Vegetation Safety Clearances* issued by *Energy Australia* (NS179, April 2002).

Conclusion & Recommendations

4

4.1 Conclusion

A bushfire protection assessment has been undertaken for the proposed amendments to the Edmondson Park Concept Plan (MP10_0118 MOD5), which forms part of the South West Priority Land Release Area. The planning proposal involves the redesign of the Town Centre North which incorporates the Parkland, Maxwells Creek and Station Precincts. The key changes are outlined in Section 1.2 of this report.

The assessment found that bushfire can potentially affect the site from the woodland and forested wetland vegetation located adjacent to the site resulting in possible ember attack, radiant heat and potentially flame attack.

Whilst the current masterplan does not provide for the minimum APZ's required adjacent to unmanaged grassland areas. It has been recommended that these areas are assessed further prior to DA and dwelling construction approval. Unmanaged grassland will not be a long term hazard to the site and is unlikely to be retained or remain at the time of construction / development.

The bushfire risk posed to the planning proposal has the potential to be successfully mitigated if the proposed bushfire protection measures (including APZs) are put in place and managed in perpetuity.

Table 4.1 – Planning principles

Planning principles	Recommendations
Provision of a perimeter road with two way access which delineates the extent of the intended development.	Perimeter roads have been provided adjacent to Maxwells Creek North and to the west of Parcel 25 (Maxwells Creek South).
Provision, at the urban interface, for the establishment of adequate APZs for future housing.	APZs have been provided in compliance with PBP and AS3959 (2009) for the majority of the site. Further consideration of APZ's adjacent to unmanaged grassland areas is required.
Specifying minimum residential lot depths to accommodate APZs for lots on perimeter roads.	Future subdivision design is to allow for the minimum APZs as recommended within Table 2.1 and as depicted within Schedule 1 attached.
Minimising the perimeter of the area of land interfacing the hazard, which may be developed.	Compliant.
Introduction of controls which avoid placing inappropriate developments in hazardous areas.	Future development consists of residential dwellings and a primary school and is appropriate for the level of bushfire risk.
Introduction of controls on the placement of combustible materials in APZs.	Compliant – can be made a condition of consent.

REFERENCES

Australian Building Codes Board (2010) – *Building Code of Australia*, Class 1 and Class 10 Buildings Housing Provisions Volume 2.

Chan, K.W. (2001) – *The suitability of the use of various treated timbers for building constructions in bushfire prone areas*. Warrington Fire Research.

Councils of Standards Australia AS3959 (2009) – *Australian Standard Construction of buildings in bush fire-prone areas.*

Hon Brad Hazzard (7 June 2012) – *Planning proposal to rezone land at Boundary Road, Medowie from 1 (c1) Rural Small Holdings Zone to 1(c5) Rural Small Holdings, 1(c4) Rural Small Holdings and 7(a) Environmental Protection.*

Keith, David (2004) – *Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT*. The Department of Environment and Climate Change.

Rural Fire Service (2006) - *Planning for bushfire protection– a guide for councils, planners, fire authorities and developers*. NSW Rural Fire Service.

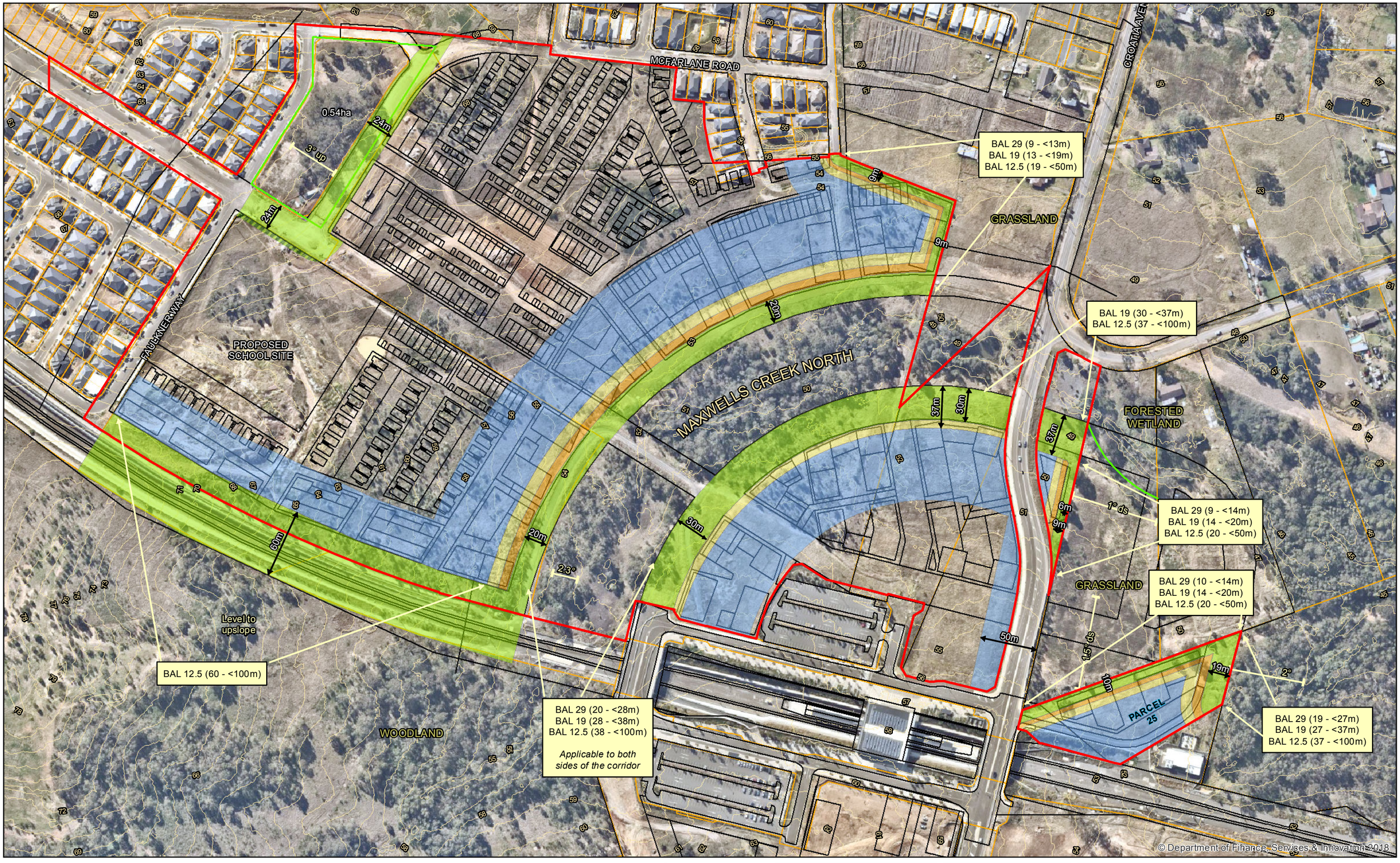
Rural Fire Service (2006) - Bushfire Attack Software on RFS Web site.

Tan, B., Midgley, S., Douglas, G. and Short (2004) - *A methodology for assessing bushfire attack.* RFS Development Control Service.

Travers, J. (2003) *The Ecological Management of Asset Protection Zones at Wallarah Peninsula – A Case Study*.

Plan of Bushfire Protection Measures

S1



Legend

- Site boundary (source: CAD - 34.88ha)
- Contours - 1m (source: LiDAR)
- Edge of vegetation

Asset Protection Zone (APZ)

- APZ for residential development
- Minimum APZ for SFPP (School)

Bushfire Construction Standards AS3959 (2009)*

- BAL 29
- BAL 19
- BAL 12.5

* Please refer to additional construction requirements for BAL levels which are contained in Addendum Appendix 3 of *'Planning for Bushfire Protection'* (2006).

Aerial source: Nearmap

0 50 100 m

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

PROJECT & MXD REFERENCE	DATE & ISSUE NUMBER	SCALE & COORDINATE SYSTEM
Edmondson Park 18LAND06_BF001	19/07/2018 Issue 1	1:3,000 @A3 GDA 1994 MGA Zone 56

TITLE

Schedule 1 - Bushfire Protection Measures

Document Path: N:\GIS STORAGE\N Drive\A17147_Edmondson_Park\MXDs\18LAND06_BF001.mxd

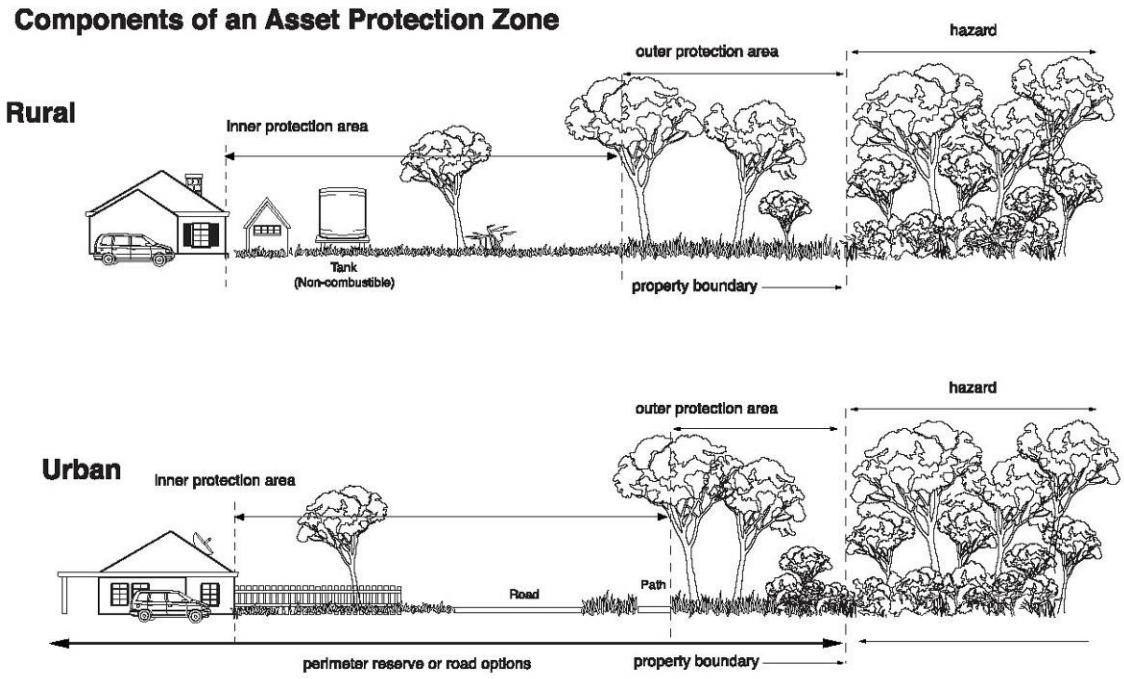
Travers bushfire & ecology
www.traversecology.com.au

Management of Asset Protection Zones

A1

The RFS provides basic advice in respect of managing APZs through documents such as, *Standards for Asset Protection Zones* (RFS, 2005), with landscaping to comply with Appendix 5 of *PBP*.

The APZ generally consists of two subordinate areas, an inner protection area (IPA) and an outer protection area (OPA). The OPA is closest to the bush and the IPA is closest to the dwellings. The property is to be managed to IPA standards only. A typical APZ is graphically represented below:



APZs and progressive reduction in fuel loads (Source: RFS, 2006)

Note: Vegetation management as shown is for illustrative purposes only. Specific advice is to be sought in regard to vegetation removal and retention from a qualified and experienced expert to ensure APZs comply with the RFS performance criteria.

The following provides maintenance advice for vegetation within the IPA.

Inner Protection Area (IPA)
Fuel loads within the IPA are to be maintained so it does not exceed 4t/ha.

Trees are to be maintained to ensure;

- Canopy cover does not exceed 15% (at maturity)
- Trees (at maturity) do not touch or overhang the building

- Tree canopies (at maturity) should be well spread out and not form a continuous canopy
- Lower limbs should be removed up to a height of 2m above ground
- Preference should be given to smooth barked and evergreen trees

Shrubs are to be maintained to ensure;

- Large discontinuities or gaps in vegetation
- Shrubs should not be located under trees
- Shrubs should be in clumps no greater than $5m^2$
- Shrubs should not form more than 10% of ground cover
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.

Grass is to be maintained to ensure:

- A height of 10cm or less
- Leaves and debris is removed.

Landscaping to the site is to comply with the principles of Appendix 5 of PBP. In this regard the following landscaping principles are to be incorporated into the development:

- Suitable impervious areas being provided immediately surrounding the building such as courtyards, paths and driveways;
- Restrict planting in the immediate vicinity of the building which may over time and if not properly maintained come in contact with the building;
- When considering landscape species consideration needs to be given to estimated size of the plant at maturity;
- Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies;
- Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown;
- Avoid planting of deciduous species that may increase fuel at surface/ ground level (i.e. leaf litter);
- Avoid climbing species to walls and pergolas;
- Locate combustible materials such as woodchips/mulch, flammable fuel stores away from the building;
- Locate combustible structures such as garden sheds, pergolas and materials such timber garden furniture way from the building; and
- Use of low flammability vegetation species.

Performance based assessment

A2

NBC Bushfire Attack Assessment Report V2.1

AS3959 (2009) Appendix B - Detailed Method 2

Printed: 24/01/2018 **Assessment Date:** 31/10/2017

Site Street Address: Edmondson Park, Edmondson Park

Assessor: Mr Admin; admin

Local Government Area: Liverpool **Alpine Area:** No

Equations Used

Transmissivity: Fuss and Hammins, 2002
Flame Length: RFS PBP, 2001
Rate of Fire Spread: Noble et al., 1980
Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005
Peak Elevation of Receiver: Tan et al., 2005
Peak Flame Angle: Tan et al., 2005

Run Description: A North-east (BAL 19)

Vegetation Information

Vegetation Type:	Forest	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	3 Degrees	**Vegetation Slope Type:**	Level
Surface Fuel Load(t/ha):	15	**Overall Fuel Load(t/ha):**	20

Site Information

Site Slope	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m)	Default	**APZ/Separation(m):**	20

Fire Inputs

Veg./Flame Width(m):	100	**Flame Temp(K)**	1090

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	100

Program Outputs

Category of Attack:	MODERATE	**Peak Elevation of Receiver(m):**	5.66
Level of Construction:	BAL 19	**Fire Intensity(kW/m):**	15122
Radiant Heat(kW/m2):	18.6	**Flame Angle (degrees):**	72
Flame Length(m):	11.91	**Maximum View Factor:**	0.292
Rate Of Spread (km/h):	1.46	**Inner Protection Area(m):**	20
Transmissivity:	0.837	**Outer Protection Area(m):**	0

Run Description:	B North-east (BAL 12.5)		
Vegetation Information			
Vegetation Type:	Forest	Vegetation Group:	Forest and Woodland
Vegetation Slope:	3 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	20
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Level
Elevation of Receiver(m)	Default	APZ/Separation(m):	37
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	LOW	Peak Elevation of Receiver(m):	8.07
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	22878
Radiant Heat(kW/m2):	12.46	Flame Angle (degrees):	74
Flame Length(m):	16.79	Maximum View Factor:	0.206
Rate Of Spread (km/h):	2.21	Inner Protection Area(m):	37
Transmissivity:	0.795	Outer Protection Area(m):	0

Run Description:	C North (BAL 29)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1.5 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	10
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	HIGH	Peak Elevation of Receiver(m):	3.62
Level of Construction:	BAL 29	Fire Intensity(kW/m):	43577
Radiant Heat(kW/m2):	25.96	Flame Angle (degrees):	67
Flame Length(m):	7.87	Maximum View Factor:	0.393
Rate Of Spread (km/h):	18.74	Inner Protection Area(m):	10
Transmissivity:	0.87	Outer Protection Area(m):	0

Run Description:	D North (BAL 19)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1.5 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	14
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	MODERATE	Peak Elevation of Receiver(m):	3.76
Level of Construction:	BAL 19	Fire Intensity(kW/m):	43577
Radiant Heat(kW/m2):	18.12	Flame Angle (degrees):	73
Flame Length(m):	7.87	Maximum View Factor:	0.279
Rate Of Spread (km/h):	18.74	Inner Protection Area(m):	14
Transmissivity:	0.854	Outer Protection Area(m):	0

Run Description:	E North (BAL 12.5)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1.5 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	20
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	LOW	Peak Elevation of Receiver(m):	3.85
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	43577
Radiant Heat(kW/m2):	12.21	Flame Angle (degrees):	78
Flame Length(m):	7.87	Maximum View Factor:	0.193
Rate Of Spread (km/h):	18.74	Inner Protection Area(m):	20
Transmissivity:	0.833	Outer Protection Area(m):	0

Run Description:	F East (BAL 29)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	9
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	HIGH	Peak Elevation of Receiver(m):	3.48
Level of Construction:	BAL 29	Fire Intensity(kW/m):	42099
Radiant Heat(kW/m2):	28.52	Flame Angle (degrees):	64
Flame Length(m):	7.73	Maximum View Factor:	0.429
Rate Of Spread (km/h):	18.11	Inner Protection Area(m):	9
Transmissivity:	0.874	Outer Protection Area(m):	0

Run Description:	G East (BAL 19)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Level
Elevation of Receiver(m)	Default	APZ/Separation(m):	14
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	MODERATE	Peak Elevation of Receiver(m):	3.72
Level of Construction:	BAL 19	Fire Intensity(kW/m):	42099
Radiant Heat(kW/m2):	17.8	Flame Angle (degrees):	74
Flame Length(m):	7.73	Maximum View Factor:	0.274
Rate Of Spread (km/h):	18.11	Inner Protection Area(m):	14
Transmissivity:	0.854	Outer Protection Area(m):	0

Run Description:	H East (BAL 12.5)		
Vegetation Information			
Vegetation Type:	Grassland	Vegetation Group:	Grassland
Vegetation Slope:	1 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	4.5	Overall Fuel Load(t/ha):	4.5
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	20
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	130
Program Outputs			
Category of Attack:	LOW	Peak Elevation of Receiver(m):	3.78
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	42099
Radiant Heat(kW/m2):	12	Flame Angle (degrees):	78
Flame Length(m):	7.73	Maximum View Factor:	0.189
Rate Of Spread (km/h):	18.11	Inner Protection Area(m):	20
Transmissivity:	0.833	Outer Protection Area(m):	0

Run Description:	II East (BAL 29)		
Vegetation Information			
Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	2 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	19
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	HIGH	Peak Elevation of Receiver(m):	7.32
Level of Construction:	BAL 29	Fire Intensity(kW/m):	26690
Radiant Heat(kW/m2):	27.46	Flame Angle (degrees):	63
Flame Length(m):	16.43	Maximum View Factor:	0.427
Rate Of Spread (km/h):	2.07	Inner Protection Area(m):	19
Transmissivity:	0.846	Outer Protection Area(m):	0

Run Description:	I East (BAL 19)		
Vegetation Information			
Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	2 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	27
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	MODERATE	Peak Elevation of Receiver(m):	7.72
Level of Construction:	BAL 19	Fire Intensity(kW/m):	26690
Radiant Heat(kW/m2):	18.2	Flame Angle (degrees):	70
Flame Length(m):	16.43	Maximum View Factor:	0.292
Rate Of Spread (km/h):	2.07	Inner Protection Area(m):	27
Transmissivity:	0.819	Outer Protection Area(m):	0

Run Description:	J East (BAL 12.5)		
Vegetation Information			
Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	2 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	37
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	LOW	Peak Elevation of Receiver(m):	7.9
Level of Construction:	BAL 12.5	Fire Intensity(kW/m):	26690
Radiant Heat(kW/m2):	12.19	Flame Angle (degrees):	74
Flame Length(m):	16.43	Maximum View Factor:	0.202
Rate Of Spread (km/h):	2.07	Inner Protection Area(m):	37
Transmissivity:	0.794	Outer Protection Area(m):	0

Run Description:	K Central Corridor (BAL 29)		
Vegetation Information			
Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	3 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Level
Elevation of Receiver(m)	Default	APZ/Separation(m):	20
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	HIGH	Peak Elevation of Receiver(m):	7.75
Level of Construction:	BAL 29	Fire Intensity(kW/m):	28597
Radiant Heat(kW/m2):	27.48	Flame Angle (degrees):	63
Flame Length(m):	17.39	Maximum View Factor:	0.429
Rate Of Spread (km/h):	2.21	Inner Protection Area(m):	20
Transmissivity:	0.843	Outer Protection Area(m):	0

Run Description:	L Central Corridor (BAL 19)		
Vegetation Information			
Vegetation Type:	Woodland	Vegetation Group:	Forest and Woodland
Vegetation Slope:	3 Degrees	Vegetation Slope Type:	Downslope
Surface Fuel Load(t/ha):	15	Overall Fuel Load(t/ha):	25
Site Information			
Site Slope	0 Degrees	Site Slope Type:	Downslope
Elevation of Receiver(m)	Default	APZ/Separation(m):	28
Fire Inputs			
Veg./Flame Width(m):	100	Flame Temp(K)	1090
Calculation Parameters			
Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	308
Moisture Factor:	5	FDI:	100
Program Outputs			
Category of Attack:	MODERATE	Peak Elevation of Receiver(m):	8.17
Level of Construction:	BAL 19	Fire Intensity(kW/m):	28597
Radiant Heat(kW/m2):	18.47	Flame Angle (degrees):	70
Flame Length(m):	17.39	Maximum View Factor:	0.297
Rate Of Spread (km/h):	2.21	Inner Protection Area(m):	28
Transmissivity:	0.817	Outer Protection Area(m):	0

Run Description:	M Central Corridor (BAL 12.5)		
Vegetation Information			
Vegetation Type:	Woodland	**Vegetation Group:**	Forest and Woodland
Vegetation Slope:	3 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	15	**Overall Fuel Load(t/ha):**	25
Site Information			
Site Slope	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m)	Default	**APZ/Separation(m):**	38
Fire Inputs			
Veg./Flame Width(m):	100	**Flame Temp(K)**	1090
Calculation Parameters			
Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	100
Program Outputs			
Category of Attack:	LOW	**Peak Elevation of Receiver(m):**	8.36
Level of Construction:	BAL 12.5	**Fire Intensity(kW/m):**	28597
Radiant Heat(kW/m2):	12.47	**Flame Angle (degrees):**	74
Flame Length(m):	17.39	**Maximum View Factor:**	0.207
Rate Of Spread (km/h):	2.21	**Inner Protection Area(m):**	38
Transmissivity:	0.793	**Outer Protection Area(m):**	0